Enquiries and formal applications for admissions should be directed to the Registrar.
University of Waterloo, Waterloo, Ontario.
Telephone 744-6111 (Area Code 519)

The Registrar's Office is located in Room 113 of the Dana Porter Arts Library. Office hours are from 9 a.m. to 5 p.m., Monday through Friday.
The office is not open on Saturdays.

The Senate and the Board of Governors of the University of Waterloo reserve the right to make changes in this calendar without prior notice.
Contents

1 The University of Waterloo

1.1 History

1.2 Use of the calendar

2 The Faculty of Arts

2.1 Degrees

2.2 Admission Requirements

2.3 Examinations and Standings

2.4 Academic Programmes

2.5 The General Programme

2.6 Honours Programmes

2.6.1 Anthropology

2.6.2 Anthropology and Geography

2.6.3 Anthropology and Political Science

2.6.4 Canadian Studies

2.6.5 Economics

2.6.6 Economics and Geography

2.6.7 Economics and Political Science

2.6.8 Economics and Mathematics

2.6.9 English

2.6.10 English (Drama)

2.6.11 English and French

2.6.12 English and German

2.6.13 English and History

2.6.14 English and Latin

2.6.15 English and Philosophy

2.6.16 English and Political Science

2.6.17 English and Psychology

2.6.18 English and Sociology

2.6.19 English and Spanish

2.6.20 French

2.6.21 French and German

2.6.22 French and Latin

2.6.23 French and Political Science

2.6.24 French and Russian

2.6.25 French and Sociology

2.6.26 French and Spanish

2.6.27 Geography

2.6.28 Geography and Earth Sciences

2.6.29 Geography and History

2.6.30 Geography Political Science

2.6.31 German and Russian

2.6.32 German

2.6.33 History

2.6.34 History and Philosophy

2.6.35 History and Political Science

2.6.36 Latin

2.6.37 Philosophy

2.6.38 Philosophy and Literature

2.6.39 Philosophy and Mathematics

2.6.40 Philosophy and Political Science

2.6.41 Philosophy and Psychology

2.6.42 Philosophy and Sociology

2.6.43 Political Science

2.6.44 Political Science and Psychology

2.6.45 Political Science and Sociology
Psychology 39
Psychology and Mathematics 39
Psychology and Sociology 40
Religious Studies 41
Russian 41
Sociology 42
Sociology and Anthropology 42
Spanish 43
Social Science (Applied)—Renison College 43
Graduate Studies 44

3 The Faculty of Engineering Degrees 47
Admission Requirements 48
Examinations and Promotions 50
Academic Programmes 52
Chemical Engineering 54
Civil Engineering 57
Electrical Engineering 60
Mechanical Engineering 62
Systems Design 67
Solid Mechanics 70
Biomedical Research Group 72

4 Division of Environmental Studies Degrees 79
Admission Requirements 79
Examinations and Standings 82
Academic Programmes 85
Man-Environment Studies 85
Geography 87
School of Urban and Regional Planning 90
School of Architecture 92

5 Programme of Integrated Studies 98

6 Inter-Faculty Programme Mathematics The Faculty of Mathematics Degrees 100
Admission Requirements 102
Standings and Promotions 106
Academic Programmes 107
General Programme 108
Honours Programmes—Regular 109
Actuarial Science 109
Applied Mathematics 109
Computer Science 109
Combinatorics and Optimization 109
Pure Mathematics 110
Statistics 110
Teaching 109
Mathematics and Philosophy 111
Mathematics and Economics 111
Applied Mathematics with Physics 110
Statistics and Psychology 112
Honours Programmes—Co-operative 112
Chartered Accountancy 114
Examinations and Standings 123
Academic Programmes 129
Honours Programmes 132
  Biology 132
  Biology and Chemistry 133
  Chemistry 134
  Chemistry (Mathematics Option) 135
  Chemistry (Physics Option) 136
  Co-operative Applied Chemistry 137
  Earth Sciences (Geology Option) 138
  Earth Science and Geography 139
  Physics 140
  Theoretical Physics 141
  Co-operative Applied Physics 142
Optometry Programme 144
General Programme 146

9 The School of Physical Education and Recreation Degrees 154
  Admission Requirements 155
  Examinations and Promotions 158
  Academic Programmes 159
    Honours Kinesiology 159
    Honours Recreation 160

10 Graduate Studies Degree Requirements 164
  Admission Requirements 168
  Definitions 168

11 Course Descriptions
Undergraduate, Graduate
  Anthropology 335
  Applied Analysis and Computer Science 336
  Applied Mathematics 172
  Architecture 272
  Art—See Fine Arts 184
  Arts 187
  Biology 185
  Canadian Studies 194
  Chemical Engineering 204
  Chemistry 217
  Civil Engineering 229
  Classics 229
  Classics and Romance Languages 336
  Combinatorics and Optimization 239
  Earth Sciences 245
  Economics 251
  Electrical Engineering 263
  English 272
  Film—see Fine Arts 272
  Fine Arts 272
  French 224
  General Engineering 279
  Geography 281
  German and Slavic Languages and Literatures 283
  German 283
  Greek 231
  History 302
  Italian 235
  Kinesiology 317
Man-Environment Studies 327
Mathematics 335
Mathematical Research 339
Mechanical Engineering 362
Music—see Fine Arts 272
Optometry 379
Philosophy 387
Physics 397
Political Science 412
Psychology 420
Pure Mathematics 337
Recreation 445
Religious Studies 448
Romance Languages 232
Russian 297
Science 456
Sociology 458
Spanish 235
Statistics 338
Systems Design 473
Ukranian 300
Urban and Regional Planning 480

12 Student Services

University Counselling Service 488
Dean of Women 489
Campus Health Services 489
Student Health Insurance 489
Student Discipline 490
Foreign Student Office 490
Campus Centre 490
Federation of Students 491
Book Store 493
Office of Research Administration 493
Industrial Research Institute 493
Planning and Resources Institute 494
Regular Officers Training Plan (ROTP) 494
Off-Campus Housing Office 495
Residence Information 495
Conrad Grebel College 495
Renison College 495
St. Jerome's College 495
Notre Dame College 495
St. Paul's College 496
University of Waterloo Residence 496
Married Student Residences 497
Minota Hagey Residence 497
Continuing Education 498
University Extension 499
Centre for Continuing Studies in Marketing 499

13 Fees 502

14 The University Libraries 508

15 The Department of Co-ordination and Functions of the Department of Co-ordination and Placement 512
16 Scholarships, Bursaries
Prizes and Financial Aid

17 Governing Bodies
and Staff

18 Faculty

19 Academic Calendar
1 The University of Waterloo
The University of Waterloo

The University of Waterloo is incorporated as a non-denominational institution of higher learning offering courses both at the undergraduate and graduate level. Programmes are offered in Architecture, Arts, Engineering, Environmental Studies, Integrated Studies, Mathematics, Optometry, Physical Education and Recreation, and Science. Classes commenced in July 1957 with the introduction of the Co-operative Engineering Programme. In March 1959 a Private Bill was approved by the Legislative Assembly of the Province of Ontario incorporating the University of Waterloo as a degree-granting institution. The University is a member of The Association of Universities and Colleges of Canada and of the Association of Universities of the British Commonwealth.

The buildings of the University of Waterloo are situated on an attractive site of 1,000 acres in the northwest section of Waterloo. The first of the major teaching buildings on campus, the Chemistry-Chemical Engineering Building, was occupied in September, 1958. Since 1958 the teaching facilities have expanded to include two Engineering buildings and an Engineering lecture hall, the Physics building, the Mathematics and Computer Science building, the Chemistry-Biology building, and four arts buildings, including an Arts lecture hall, the Theatre of the Arts and the Humanities Building Theatre. Another Chemistry Building and an addition to the Engineering complex are presently under construction. The Physical Education and Recreation building has classrooms and laboratories as well as the normal facilities for intramural and intercollegiate athletic activities.

At the focal centre of the campus rises the ten storey Dana Porter Arts Library Building which was opened in 1965. It provides immediate accommodation for 322,000 volumes as well as seating space for 750 readers.

The general administrative offices are temporarily located in the Dana Porter Arts Library. The University Cafeteria and the office of the Department of University Extension and the Marketing Centre are located in the South Campus Hall. The Federation of Students and offices of the various student organizations are located in the Campus Centre building.

A Faculty Club, with membership open to all faculty and staff at the University, was completed early in 1970.

The University Health Services Building, houses the Health Services staff which serves the university community. A fully qualified medical staff including a medical doctor and registered nurses is available for regular service Monday through Friday from 8 a.m. to 8 p.m. Emergency Service is available at all times on a 24-hour basis.

Short term in-patient care is provided by the infirmary which is supervised by the medical staff. Further information about the Health Services may be obtained at the building which is located in the heart of the south campus between St. Jerome's College and the Campus Centre.

Residence accommodation for both men and women is provided on campus by the four Church Colleges, the non-denominational University Residence Villages and the Minota Hagey Residence. Residence accommodation for married students became available on campus in the Fall of 1970.

For students not admitted to residence, off-campus housing in private homes may be arranged, prior to registration, through the University Housing Service.
St. Jerome's College  A Roman Catholic church-related liberal arts college, which had been affiliated with the University of Ottawa since 1947, entered into federation with the University of Waterloo in July, 1960. It offers a basic undergraduate programme of Arts courses which can be supplemented by courses offered by the University. In September of 1962, St Jerome's College opened three new buildings on the University Campus: a teaching and administration building, a men's residence with accommodation for 100 students, and a women's residence with accommodation for 54 students under the supervision of the School Sisters of Notre Dame.

Renison College  Incorporated by Provincial Charter in 1959, Renison affiliated with the University of Waterloo in 1960. An undergraduate arts college, it offers credit courses with a special concentration on education in social work. The college also contributes to the University's inter-faculty studies programme. Renison courses, open to university and college students, include Arts (Chinese Culture), English, French, Geography (Human and Cultural), Contemporary History, International Politics, Social Psychology, Religious Studies (with emphasis on religion and culture), Sociology and Social Work. The college has residences for 100 men and 80 women. Priority in residence admission is given to arts students enrolling in college courses. A varying number of places are available each year for students in other faculties. For further information write to: The Principal, Renison College, Waterloo, Ontario. Area Code 519, Telephone No. 744-1191.

St. Paul's College  A residential self-governing community of students from all faculties, and many religious backgrounds, with different academic and personal interests. While it is affiliated to the University as a liberal arts college, the emphasis of the College is upon building a community of students who welcome opportunities for discussion, community, service and worship. Accommodation for 100 men and 50 women. Sponsored by the United Church.

Conrad Grebel College  A Mennonite church supported college which affiliated with the University in 1961. Courses are offered in Music, Religious Studies, and Sociology. In 1970 the first of a series of four general education courses was offered, especially for first and second year students.

The four areas are: Social Studies, Humanities, Communications and Natural Sciences.

University Colours and Coat of Arms

The official colours of the University of Waterloo are gold, black and white. The coat of arms for the University of Waterloo as adopted in October 1961, is:

Arms  Or, a chevron sable surmounted by a chevronell argent between three lions rampant gules.

Crest  Between two maple branches in saltire a trillium, displayed and leaved, all proper.

Supporters  Two laurel branches joined in saltire below the shield, proper.
Motto Concordia Cum Veritate—*in harmony with truth.*

**The University Mace**

The symbolic theme may be described as follows:

The fundamental concept is unity amid diversity and tension in the creative intellectual process that strives to bring forth a new individual.

The design of the mace interprets this theme in the idiom of the life process: From the seed at the base of the stave the mace grows in unity and strength until it differentiates by a four-fold separation into diverse elements.

This four-fold diversity is significant because of the four faculties existing at the time this Mace was presented to the University and as well, of the four church-related colleges federated and affiliated with the University. These diverse elements together form a crown, and the points of the crown, while tending toward a union do not quite touch but remain as individuals suspended in tension and yet engaged in a deep harmony. This creative process is focussed not on the traditional spherical orb of static perfection but rather on an elliptical silver ovum—the egg-shaped symbol of creativity—the marvellous potential of a new individual life.

**The Calendar**

This calendar is intended to portray the historical and philosophical tenets of the University of Waterloo and to serve as an explanatory guide to the programmes and courses offered at the University. Candidates for admission to the University as well as students currently enrolled are urged to study carefully the policies outlined in the calendar in order to ensure a successful and orderly approach to their University education. If there is any doubt as to the interpretation of the contents of the calendar, enquiries can be made to the Registrar or to the person directly concerned with the area in question.

The calendar is arranged in chapters which fall into three general divisions. The first division (Chapters 2 to 10) explains the policies and programmes of each individual faculty or school. The second division (Chapter 11) lists alphabetically by department all courses which have been approved by the University. Since all the courses listed may not be offered in the current sessions, students are advised to consult the University timetable prior to arranging their programmes. The third division (Chapters 12 to 19) contains information concerning fees, facilities, student services and the general administrative structure of the University. A more detailed table of contents is to be found at the beginning of this chapter.

The information in the calendar applies to the 1971-72 academic session which commences in September 1971. The Senate and the Board of Governors of the University of Waterloo reserve the right to make changes in the academic calendar without prior notice.
2 The Faculty of Arts
The Faculty of Arts

Technological skills and resources are needed to solve—at least manage—the myriad perplexing problems that face mankind during the closing years of the Twentieth Century. Equally necessary, perhaps more necessary, are the skills and resources provided by the traditional disciplines that study that curious creature man. It is precisely this curious creature that one studies in the humanities and social sciences comprising the various Arts curricula: man and his history and his art, literature, languages; man and his political and social institutions; man and his philosophical and theological and ethical systems; man and his cities, nations, wars; man as a consumer, buyer, seller, trader; man as a thinker, a creator, a destroyer; man as a hermit, man as a social creature; man and his behaviour.

In addition to the public role of the Arts is the private and inner dimension. University students come to university expecting that their main concern will be to prepare themselves to make a living. They should also concern themselves about the business of living. Unless there are some inner resources, some disciplined, creative and liberated imaginative faculties trained to go to work, a person is not going to explore fully the business of living.

The graduate in Arts has not earned a professional degree. He is generally and liberally educated and has not been trained for a specific task in a specific profession. The holder of the Honours B.A. is usually qualified to enter professional programmes to begin professional training. To be liberally educated is no mean accomplishment; the world has increasing need of men and women so educated. The goal of a liberal education—acquaintance with some of the major ideas and forces that shape our civilization and the ability to think clearly, critically, and creatively—is important and desirable in itself.

Degrees

The Degree of Bachelor of Arts (B.A.) is awarded by the University in the following undergraduate programmes:

Pass Programme (3 years) The General Programme in Arts

Honours Programmes (4 years)

Anthropology
Anthropology and Political Science
Science
Anthropology and Geography
Economics
Economics (Canadian Studies)
Economics and Geography
Economics and Mathematics
Economics and Political Science
Economics and Political Science (Canadian studies)

English
English (Drama)
English and French
English and German
English and History
English and Latin
English and Philosophy

French and German
French and Latin
French and Political Science
French and Russian
French and Sociology
French and Spanish
Geography
Geography and Geology
Geography and History
Geography and Political Science

German (with appropriate minor)
German and Russian
History
History (Canadian Studies)
History and Philosophy
History and Political Science
History and Political Science (Canadian Studies)
Admission Requirements

English and Psychology
English and Russian
English and Sociology
English and Spanish
French
Philosophy and Psychology
Philosophy and Sociology
Political Science
Political Science (Canadian studies)
Philosophy and Literature
Philosophy and Mathematics
Philosophy and Political Science
Psychology and Sociology
Russian and appropriate minor
Sociology
Sociology and Anthropology

Graduation from any of the following programmes with at least Second Class Honours standing qualifies a student for admission to the corresponding Type A course at one of the Ontario Colleges of Education:
Honours Economics and
Honours English
Honours French and German
Honours English and French
Honours English and History
Honours English and Latin
Honours French
Honours French and German
Honours French and Latin
Honours French and Russian
Honours Geography
Honours History
Honours History and Political Science
Honours Latin
Honours Spanish

Admission Requirements

General Application for admission to the Faculty of Arts should be made as early in the year as possible. Academic certificates (not diplomas) and other supporting documents should be forwarded as soon as they become available.

Admission cannot be granted until all the requirements have been met and all the required documents submitted. Applicants currently enrolled in Ontario Grade 13 who wish to be considered for Early Final Admission must apply before January 4, 1971. All other applicants must apply and have submitted all the necessary documents by July 1, 1971. Persons applying after these dates cannot be guaranteed consideration of their application.

Applicants should note that both Renison and St. Jerome's Colleges offer programmes leading toward the B.A. degree in conjunction with the University and that applicants may register for the programmes through either Renison or St. Jerome's College.

Since many of the programmes offered at the University have limited enrolment, the possession of the minimum requirements does not in itself guarantee admission to any of the programmes. If clarification is required on any of the admission requirements, applicants should contact the Office of the Registrar, University of Waterloo, Waterloo, Ontario.

The admission requirements listed in the calendar are applicable for admission in September 1971.
Admission Requirements

Admission Deposit Each applicant admitted to full time studies is required to submit a $50.00 admission deposit. The deposit will be refunded if notice of termination is received prior to August 1, 1971.

Application Documents All applicants must submit an application form, and certified transcripts of secondary or post-secondary education. Applicants enrolled in Ontario Grade 13 in the 1970-71 academic year must apply on the "General Application for Admission to University 1971" form which is available from the secondary school. Applications should be submitted prior to January 4, 1971.

Applicants not enrolled full time in Ontario Grade 13 must apply on forms from the Office of the Registrar. In addition at least two letters of reference are required. All educational institutions attended by the applicant must be accounted for on certified documents. Applicants from non-English speaking countries must arrange to submit certified English translations of their academic documents.

Ontario Grade 13 Applicants

Requirements For applicants currently enrolled full time in an Ontario Grade 13 programme of studies, the overall University requirement will be the assurance from the Secondary School that the prerequisites for the Secondary School Honour Graduation Diploma have been satisfied.

Applicants to the Faculty of Arts will normally be required to achieve a 60% overall average in their Grade 13 standings. No specific courses are required for admission, but students are strongly advised to have completed English, a language other than English, and additional courses in the Arts areas—particularly those areas in which they intend to take University work. It is expected that applicants will present a balanced selection of Grade 13 courses.

Basis of Admission Students enrolled full time in Ontario Grade 13 will be considered for Early Final Admission. The University expects to fill the majority of places available to Grade 13 applicants using the following criteria:

Grade 13 interim standing
Grade 12 final standing
Principal's recommendation
SACU aptitude and achievement tests results.

Applicants whose interim standings are not sufficient for Early Final Admission will be considered on the basis of Grade 13 final standings and qualified applicants will be admitted until the remaining places are filled.

Applicants who have spent more than the normal length of time in Secondary School to complete their University preparation may be required to present a higher admission average. Applicants who completed their Grade 13 studies in less than the normal period of time will be considered providing that the Grade 13 admission prerequisites are satisfied.

Successful applicants may expect to be notified after May 1, 1971 of their acceptance and will be allowed until June 1, 1971 to confirm the offer of admission.

The University reserves the right to withdraw the offer of admission if the applicant fails to complete his year satisfactorily.
Admission Requirements

Test (CSAT) and the Canadian English Language Achievement Test (CELAT) or the French equivalent.

Non-Ontario Grade 13 Applicants

Applicants who have taken their secondary school education in other than Ontario Grade 13 will be asked to submit the following certificates recognized as being equivalent to the Ontario Grade 13 certificate. These certificates may be accepted in so far as they meet the admission requirements of the University of Waterloo in subjects and percentages. Applicants from countries not mentioned in the following list can obtain detailed admission requirements from the Office of the Registrar.

Alberta
British Columbia
Manitoba
New Brunswick
Newfoundland
Nova Scotia
Prince Edward Island
Quebec
Saskatchewan
Scotland
United States of America

Senior Matriculation (Grade 12)
Senior Matriculation (Grade 13)
Senior Matriculation (Grade 12)
Senior Matriculation (Grade 13)
Year 1 Memorial University
Senior Matriculation (Grade 12)
Third Year Certificate from 1 year University of Prince Edward Island
First Year CEGEP programme
Senior High School Leaving Certificates
Senior Matriculation (Grade 12)
The General Certificate of Education with passes in at least five subjects, two of which must be at Advanced Level
The Scottish Certificate of Education
High School Graduation plus an additional year of formal study in subjects comparable to Ontario Grade 13 subjects.

Admission as an Adult Student

Any student of mature age who has been away from formal education for more than two years and who does not possess the minimum requirements for admission may apply to enter as an adult student. It is recommended that applicants attempt to obtain standing in at least one Ontario Grade 13 level subject or its equivalent. This subject should relate to the applicant’s proposed programme of study at University. Mature students who cannot meet the requirements for degree candidacy, or who are uninterested in pursuing a degree at this time, may apply on a non-degree basis. Such students may take as many as two courses per session for University credit up to a total of six. Courses taken under this provision will count toward a degree if the student is admitted later as a degree candidate. Each application will be considered on its merits by the Admissions Committee.

Admission as a Part-time Student

Any candidate wishing to enrol as a part-time student may be allowed to take a maximum of two courses per session. If he wishes to take courses toward a degree, he must meet the regular admission requirements (see above). If he wishes to take courses for University credit but does not wish to pursue a degree, he may be admitted as a non-degree student.

Admission to Advanced Years

An applicant for admission to advanced standing must submit an official transcript from the University or educational institution which he has attended showing his ability to pursue advanced standing at the University of Waterloo.
advanced standing may receive credit for courses taken elsewhere:
a) if the grade earned in such courses is at least C
b) if such courses are relevant to a student's proposed programme in the faculty of Arts
c) and if the appropriate Faculty of Arts department recommends that such courses be credited to a student's programme.

English Proficiency Students from areas where English is not the common language must provide certified translations of academic certificates. In addition, the applicant may be required to take either "The English Proficiency Tests" prepared by the English Language Institute of the University of Michigan, or the examinations for "The Certificate of Proficiency in English" of the University of Cambridge, in order to satisfy the Admissions Committee that the applicant's knowledge of the English language is adequate to pursue his studies successfully.

Re-Admission The University reserves the right to refuse admission to any candidate, and to refuse re-admission if, in the opinion of competent authority, a student is not profiting from University studies.

Registration September 7, 8, 9, 10, 1971.

Fees Refer to Section 13 page 502

Examinations and Standings

The following regulations govern final examinations, standing and make-up examinations in the Faculty of Arts. These regulations also apply to part-time students and special programmes.

Students should note that the Faculty of Arts operates under a course system in which student progress is measured by courses successfully completed rather than by years. Students who have passed fewer than five courses will be considered Year 1 students; those who have passed at least five courses but fewer than ten will be considered Year 2 students; those with at least ten but fewer than fifteen, Year 3, and those with fifteen or more, Year 4.

1 Final Examinations a) The Faculty constitutes the examining body for all examinations. Final written examinations are normally held at the end of a course in December or April; oral examinations may be required at the discretion of individual departments. The normal time for written examinations is three hours.
b) In all courses each student is required to submit, in such form and at such time as may be determined by the instructor, evidence of satisfactory participation in term work. The marks obtained for work during term may be used, in part or in whole, in determining grades. At the discretion of the chairman of the department concerned and of the Dean, a student may be barred from the final examination if the course requirements are not completed to the satisfaction of his instructor.
c) Failure to write an examination may be considered a failure to pass. A student who defaults a final examination, except for a properly certified reason, shall have no make-up examination privileges. If a student failed to write for medical reasons, a Doctor's certificate, covering the precise period of absence, must be filed in the Registrar's Office within a reasonable period of time after the examination should have been written.
2 Standing

a) Letter grades signify the following evaluations in individual courses:
   - A: Excellent
   - B: Good
   - C: Average
   - D: Poor but passing
   - F: Failure

Grades in individual subjects are determined by the instructor and normally constitute a combination of the marks assigned for term work and those obtained in the final examination.

b) For the purpose of striking averages, the following weights will be assigned to grades received in individual courses:

c) Overall standing is determined by the cumulative average of grades assigned for all courses taken at the University (at any time, whether passed or failed) while registered in the Faculty of Arts and is indicated by the following terms:

<table>
<thead>
<tr>
<th>Cumulative Average</th>
<th>Honours Programme</th>
<th>General Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-14</td>
<td>First Class Honours</td>
<td>A</td>
</tr>
<tr>
<td>9-11.9</td>
<td>Second Class Honours</td>
<td>B</td>
</tr>
<tr>
<td>6-8.9</td>
<td>Third Class Honours</td>
<td>C</td>
</tr>
<tr>
<td>3-5.9</td>
<td>Conditional</td>
<td></td>
</tr>
<tr>
<td>2.9 or below</td>
<td>Failure</td>
<td></td>
</tr>
</tbody>
</table>

Note: In cases where a failed course is repeated, both marks will be used in calculating the student's cumulative overall average or standing.

d) A regular (full-time) student in the General Arts Programme must, in each academic year, enrol in at least five courses, but in not more than six. A regular student in the Honours Arts Programme must each year enrol in at least five or six courses (see departmental Honours programmes for specifications and exceptions). Students in Honours programmes may not enrol in more than one course in excess of the number specified for their programme.

e) Students may be enrolled for reduced programmes with the approval of the Dean of Arts or of one of the departments (depending upon the status of the student), and of the Examinations and Standings Committee. The student will be expected to support his proposal with good reasons showing that his personal or academic interest will be best served by such a proposal. While such programmes are intended to provide greater flexibility in the General Arts Course, the only formal restriction imposed by the Faculty is that no Honours Degree shall be granted to a student who has not completed at least one year (other than year one) of his academic work as a full-time student in the Honours Arts courses.

f) To be considered in good standing in the General Arts programme, a student must maintain a cumulative overall average of at least 6 (C-) as well as an average of at least 7 (C) in his field of specialization. If at any time a student's overall average falls between 3 (D-) and 5.9 or his average in his field of specialization below 7 (C), he will be granted conditional status for one year, during which period he must make reasonable progress toward obtaining good standing or he will be asked to withdraw. A student whose cumulative overall average falls below 3 (F) is not eligible for conditional status but must withdraw.
g) To be considered in good standing in the Honours Arts programme, a student must maintain a cumulative overall average of at least 6 (C-) as well as an average of at least 10 (B) in his field of specialization (unless otherwise specified in a departmental Honours programme). If an Honours degree candidate's major average falls below the prescribed minimum, he will be considered for the General degree and the regulations in (f) above will apply. If, subsequently, he raises his average to the required level, he may, through his Department Chairman, petition the Examinations and Standings Committee to review his case. (See Note Below)

Note The requirements specified in (f) and (g) are minimum academic requirements and do not guarantee admission to all programmes. Individual departments may specify requirements beyond those listed here.

h) Even while otherwise in good standing, a student who fails more than two full courses in any academic year may be required to withdraw if the Faculty Council considers that he will not profit by further study.

1) A student who has been required to withdraw for academic reasons is eligible to apply for re-admission after one year's absence.

3 Make-up Examinations A student will be eligible to apply for make-up examinations only when failure to pass is attributable to extraordinary circumstances. In addition, he
a) must have attended a reasonable number of lectures in the course in which he proposes to write, and must have satisfied all term work requirements;
b) must have secured the permission of the professor concerned.

4 Appeals Appeals against faculty decisions (whether dealing with grades or with the application of any other Faculty rules) made under these regulations may be made in writing to the Examinations and Standings Committee of the Arts Faculty Council.

Academic Programmes

Group A and Group B Requirements In order to earn a B.A., a student must complete, with the necessary cumulative averages, the necessary number of prescribed and elective courses for either the General or the Honours Programme. All Arts students in all Arts Major and Honours Programmes must also meet the Faculty of Arts Group A and B requirements. Group A comprises courses in the humanities, and Group B comprises courses in the social sciences:

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
</table>
| (i) English, History, Philosophy
| (ii) French, German, Greek,
Italian, Latin, Russian,
Spanish, Ukrainian (see Note)
| Anthropology, Economics,
Geography, Political Science,
Psychology, Sociology

Before being admitted to the degree an Arts student must complete with passing marks a minimum of three courses from Group A and a minimum of two courses, one of which must be in Group B. The Group A courses must be in one of the three groups (i), (ii), (iii).
(i), Group A (ii) and Group A (iii). Of the three courses required of each student in Group A, a student must complete with passing marks.
- a minimum of one from Group A (i)
- a minimum of one from Group A (ii)

Special Note  Arts students should note that they may elect to meet the Group A (ii) requirement in their second or subsequent year by completing with passing marks one of the following five courses:
- German 271*/272*; Russian 271*/272*; Spanish 210; Classical Civilization 251*/252* or Italian 230J. These courses are not open to first year Arts students. These five courses are the only approved alternatives to the A (ii) requirements.

Selection of Year 1 Programmes  All Year 1 students are officially classified as being in the General Arts Programme. Students are not identified with a specific major or honours programme until their second year. The great majority of students are relieved to discover that they do not have to choose between a General or Honours Programme for the first year. The first year is a broad exploratory year, and the student should select a programme of courses that keeps as many options as possible open to him for advanced work.

Students thinking of an Honours Programme should generally follow the recommended first year programmes outlined in the Calendar beginning on page 16. These are recommendations only (which general students may also follow if they wish), but various substitutions and adjustments may be made to suit a student's special needs or interests.

A full time student must sign up for a minimum of five courses. However, a general student in the first year may sign up for a maximum of six courses. He should be careful to select introductory courses in subjects in which he thinks he might major or do an honours programme. A student is free to choose any course in the university for which he has the prerequisites. Students may choose courses from Groups A and B; courses in Mathematics, in Science, in Physical Education or in Environmental Studies.

Usually, a first year student is encouraged to take five or six courses in different fields so that he has a broad exploratory base from which to mount his second year programme. There is ample opportunity for specialization in subsequent years. Usually, if his marks meet the necessary minima, an Arts student can move into almost any second year programme in the Arts Faculty. Often he is able to transfer to second year programmes in other faculties. With the exception of certain advanced courses, in the first year a student is free to select almost any five or six courses he wishes. The Faculty of Arts has no required course in any particular subject in the first year.

A student who has not determined the field or subject in which he wishes to concentrate should study the Calendar carefully. After examining the suggested departmental programmes, he should read the descriptions of separate courses in order to have a more comprehensive idea of what the content of any programme would include. He should consult his School Guidance Officer, the chairman of any University department, or the office of the Dean of Arts by letter or in person for additional clarification or information.

Note 1  Space limitations may, from time to time, imply that students admitted to the University or otherwise in good standing, are not guaranteed course and programme selections of their choice. (page 13). (page 00).

Note 2  Each student’s programme must be approved on or before registration day
The General Programme

Note 3 In year 1, a student must normally complete the introductory course in the department in which he will major in his later years.

Note 4 "Courses" refers to courses which extend for one full academic year (September through April). Two half-year (term) courses are the equivalent of one full course; half (term) courses are marked with * in the course description section.

Course and Programme Changes

a) Students may add and drop half courses during the first three weeks of the Fall and Winter terms upon having the appropriate change form completed.
b) Students may add and drop full year courses during the first three weeks of the Fall term upon having the appropriate change form completed.
c) After these periods, students will be allowed to add courses only with the permission of the instructor and the appropriate undergraduate officer and upon completing the appropriate change form.
d) After these periods, students enrolled in more courses than their programmes require may, upon having the appropriate change form completed, with the initials of the instructor and appropriate undergraduate officer, drop courses to reduce their programmes to the specified minimum up to but not later than four weeks prior to the end of lectures in the courses being dropped.
e) Students may reduce their programmes below the specified minimum only under extraordinary circumstances and only with the approval of the Examinations and Standings Committee upon recommendation from the office of the Dean of Arts for first year students or, for advanced year students, their major department.
f) A course that has not been dropped officially (i.e. recorded in the Registrar's Office) prior to the last four weeks of lectures in that course will receive a grade and be counted in the student's average.

The General Programme

Year 1 Each student in Year 1 chooses at least five courses, usually two from Group A and two from Group B, with one or two more as electives. See Year One Programme, page 14. At the end of Year 1, each student in the General major Programme must choose one of the following subjects as his major field of study:

- Anthropology
- Economics
- English
- Fine Arts (Art)
- French
- Geography
- German
- Greek
- History
- Latin
- Philosophy
- Political Science
- Psychology
- Religious Studies
- Russian
- Sociology
- Spanish

There are no double majors or minors in the General Programme.

Year 2 Each student in Year 2 of the General Programme chooses at least five courses in consultation with his departmental adviser:
a) a minimum of two further courses in his major subject (see notes);
b) three other courses (see notes).

Year 3 Each student in Year 3 must choose five courses in consultation with his departmental adviser:
a) a minimum of two further courses in his major subject;
Honours Programmes

Note 1 The programme of every student in the General Programme must include either
a) a minimum of eight courses beyond the 100 level, or
b) courses from no more than seven subject fields.

Note 2 Before graduation each student in the General Programme must have completed a minimum of fifteen courses with passing mark in each and an overall cumulative average of at least 6 (C—), and a cumulative average in his major of 7 (C).

Non-Major General Arts Programme

a) A student in the Arts Faculty may graduate with a general Arts degree (non-major) upon completion of 15 courses with a passing mark in each, including:

- a minimum of 7.5 courses above the first year level;
- a minimum of 7.5 courses in the Faculty of Arts;
- a minimum of two courses, not both in the same subject, from among English, History, Philosophy, Fine Arts, Religious Studies, and languages other than English;
- a minimum of two courses, not both in the same subject, from among Anthropology, Economics, Geography, Political Science, Psychology, and Sociology.

b) A cumulative average of 7 (C) is required for graduation.

Note Any normal first year Arts programme will satisfy the needs for a student contemplating a General Arts (non-major) programme. The programmes of Non-Major General Arts students must be arranged through the office of the Associate Dean (Undergraduate Affairs).

Honours Programmes

In Year 1 a student must normally complete the introductory course in the subject in which he will major in later years. Before graduation each student must have completed twenty to twenty-four courses, (as specified in a Departmental Honours Programme) with a passing mark in each. Students are requested to refer to the detailed programmes following this page for other departmental requirements. Joint Honours Programmes not found in this section may be arranged by consultation between the student and the departments concerned.

Honours Anthropology

Year 1 Recommended Programme
Anthropology 101*/102*
Four electives

Year 2 A full course (or two half-courses) in ethnography (as Anthropology 234*, 235*, 227*, 228*).
A full course (or two half-courses) in prehistory (as Anthropology 218*, 219*, 220*, 221*).
A full course in physical Anthropology.
Two electives.
Honours Programmes

Year 3
Anthropology 320 or 322
Anthropology 350
One other advanced (200 or above) anthropology course
Two electives

Year 4
Anthropology 450
Two other advanced (200 or above) anthropology courses
Two electives

Honours Anthropology and Geography

Year 1 Recommended Programme:
Anthropology 101*/102*
Geography 101*/102*
Three other electives

Year 2 Two Anthropology electives (including one course in ethnography or prehistory)
Geography 200*/201*
Geography 202*/203*
Two other electives

Year 3 Two Anthropology electives (including a course in anthropological theory)
Geography 375
One Geography elective
Two other electives

Year 4 Two Geography electives
Two Anthropology electives
One other elective

Note 1 The degree requirements of the Faculty of Arts must be met for the B.A. Degree; the degree requirements of the Division of Environmental Studies for the B.E.S. Degree.

Note 2 Students intending to qualify for the Type A Certificate for teaching high school must elect a minimum of 9 courses in Geography.

Honours Anthropology and Political Science

Year 1 Recommended Programme
Anthropology 101*/102*
Either Political Science 105*/106* or 115*/116*
The equivalent of three other full courses

Year 2 The equivalent of two full courses in Anthropology (one of which must be a course in ethnography)
The equivalent of two full courses in Political Science (see note)
The equivalent of two other full courses

Year 3 The equivalent of two full courses in Anthropology (one of which must be a course in theory)
The equivalent of two full courses in Political Science (see note)
The equivalent of two full courses
Honours Programmes

Year 4  The equivalent of two full courses in Anthropology
The equivalent of two full courses in Political Science one of which must
be at the 400 or 500 level (see note)
* The equivalent of one other full course

Note  Political Science courses must be selected so as to satisfy the Department's
field requirements for Joint Honours programmes (see p. 16)

Honours Programmes in Canadian Studies

Recommended Programme

Year 1  French 100
The specified introductory course in the
student's proposed major subject (see note 1)
The equivalent of three other full courses
chosen from among those specifically
recommended for freshmen planning a
Canadian Studies programme (see note 2)

Year 2  Canadian Studies 200
The equivalent of three full courses in the
student's major subject, one of
which should specifically deal with
Canada (see note 3)
The equivalent of two other full courses
chosen from among those specifically
recommended for students concentrating
their programme in Canadian Studies (see note 4)

Year 3  Canadian Studies 300
The equivalent of three full courses in
the student's major subject, one of
which should specifically deal with
Canada (see note 3)
The equivalent of two other full courses chosen from
among those specifically
recommended for students concentrating
their programme in Canadian Studies (see note 4)

Year 4  Canadian Studies 400
The equivalent of three full courses in
the student's major subject, one of
which should specifically deal with
Canada (see note 3)
The equivalent of one other full course
chosen from among those specifically
recommended for students concentrating
their programme in Canadian Studies (see
Note 4)

Note 1  Students who wish to follow a programme in Canadian Studies do so by
selecting a major department in the usual fashion and fitting the above
recommendations to its requirements. Students proposing a double honours
programme with a concentration in Canadian Studies should complete
both the required introductory courses for their programme. (See page 16
for a further discussion of joint honours programmes).

Note 2  For descriptions of freshmen courses specifically recommended for students
planning a Canadian Studies major, see 400 of the Faculty of Arts

Note 3  For descriptions of courses specifically recommended for students
concentrating in Canadian Studies, see 400 of the Faculty of Arts
Honours Programmes

Note 3  Students following a double honours programme will normally take the equivalent of two full courses in each of their major departments, one of which in each case should be the principal Canadian course at the 200, 300, or 400 level.

Note 4  Each of the participating departments has designated its principal Canadian course at the 200, 300, and 400 levels but students may choose from among any of the Canadian content courses listed on pages 185-186 of the Calendar. Many 300 and 400 level courses have specific prerequisites and it is often desirable to use the electives to pursue work in a particular discipline. Students following double honours programmes should reduce the number of electives at each level by one.

Honours Economics

Prerequisites  It is desirable, but not mandatory, that students planning to enter Honours Economics should offer both Ontario Grade 13 credits in Mathematics or their equivalents.

Year 1  Recommended Programme:
- Economics 101*/102*
- One of Political Science 105*/106* or 115*/116*
- English 101
- History 100, or Philosophy 101 or equivalent
- One elective†

Year 2  Economics 201*/202*†
- Economics 231*/232††
- One of Economics 241*/242*, 256*/257*, 261*/262* or 320
- Two electives of which one must satisfy the Group A requirement†††.

Year 3  Economics 300
- Two of Economics 330, 340, 370, 380
- Two electives

Year 4  Economics 400
- One course in Mathematics
- Three electives†
  It is strongly recommended that students elect Mathematics 130 (Calculus).††
  Appropriate substitutions for these courses are possible with the approval of the department.†††
  If Mathematics 233 (Probability and Statistics) is chosen as the elective in Year 2 a second elective must be chosen in place of Economics 300 (Statistics) in Year 3.

Honours Economics and Geography

Recommended Programme:

Year 1  Geography 101*/102*
- Economics 101*/102*
- One of Political Science 105*/106* or 115*/116*
- Two other electives

Year 2  Geography 200*/201*
- Geography*203*
- Economics 201*/202*, 231*/232*
- Two other electives
Honours Programmes

**Year 3**  
Geography 310*/311*  
Geography 375 or Economics 300  
One of Economics 330, 340, 370, 380  
Three other electives

**Year 4**  
Two Geography electives  
Two Economics electives  
One other elective

**Note 1** *The degree requirements of the Faculty of Arts must be met for the B.A. Degree and of the Division of Environmental Studies for the B.E.S. Degree.*

**Note 2** *Students intending to qualify for the Type A Certificate for teaching high school must elect a minimum of courses in either Geography or Economics.*

**Honours Economics and Political Science**  
**Recommended Programme:**

**Year 1**  
Economics 101*/102*  
Either Political Science 105*/106* or 115*/116*  
The equivalent of three other full courses

**Year 2**  
Economics 201*/202*  
Economics 231*/232*  
Economics 241*/242*  
The equivalent of two full courses in Political Science *(see note)*  
The equivalent of one other full course

**Year 3**  
Economics 300  
One of Economics 330, 340, 370, or 380  
The equivalent of three full courses in Political Science *(see note)*  
The equivalent of one other full course

**Year 4**  
The equivalent of at least one further full course in Economics  
The equivalent of at least one further full course in Political Science which must be at the 400 or 500 level *(see note)*  
The equivalent of three other full courses

**Note** *Political Science courses must be selected so as to satisfy the Department's field requirements for Joint Honours programmes (see p. 000)*

**Honours Economics and Mathematics**  
**Choice of Degree**  
Students in Years 1 and 2 may take this programme in either faculty, but at the end of the second year, they will decide whether to continue toward a degree in Arts or a degree in Mathematics. The programme must then be approved by the Economics Department or by an appropriate department of the Faculty of Mathematics.

**Requirements for all students**  
(Other requirements will depend on which degree is taken; the student will have to add to these to meet the requirements of his faculty.)
Honours Programmes

Economics
101/102, 201/202 or 203/204, 231/232 or 205/206, and 460. Three others, one of which must be Econ. 300 if Math. 233 is not selected.

Mathematics
129, 130, 229, 232, or 237 and one of 233, 234, 239, 240
Two others

Further requirements for the degree B.Math. (Mathematics and Economics) see entry under Mathematics Faculty, page 108

Further requirements for the degree B.A. (Economics and Mathematics)
Group A and B requirements for an Arts Degree.

Honours English

English Requirements
English 101 or approved equivalent
English 251
English 261, 270 (See Note 3)
One full course equivalent from English 361*, 362*, 363*
Two full course equivalents from English 281*, 282*, 290*, 296, 350, 370
One full course equivalent from English 380, 451, 456, 341*, 342*
One full course equivalent from English 460, 465, 385R, 343*, 344*, 314*, 315*
Three approved English full course equivalents (See Note 4)

Other Requirements
One full course equivalent in a foreign language
Two full course equivalents from Group B
Eight other full course equivalents

Recommended Courses
Classical Civilization 265*/266*
Courses in Philosophy, History, and Religious Studies

Note 1 An English Honours student will take a minimum of 23 courses before graduation, including twelve approved English courses (see “Restrictions,” page 264) and eleven other courses. The student will also pass an honours comprehensive examination before graduating.

Note 2 Since most Graduate Schools require a comprehensive knowledge of all the periods of English literature, those students who plan to go on to graduate studies are advised to include in their programme the following courses: English 261, 270, 281*, 282*, 290*, 350, 370, 380, 451, 460, one of 341*, 342*, 343*, and 344*, two of 361*, 362*, and 363*.

Note 3 English 373 or 375 may be substituted for either 261 or 270, but not both.

Note 4 English 495, Senior Honours Essay may be chosen as one of these courses.

Honours English (Drama)

English and Drama Requirements
English 101
English 251
English 361*, 362*, 363*, 364*
English 225, 325, 425
English 329
Four of English 228*, 328*, 428*, 429*, 430*
One full course equivalent from English 261, 270, 373, 375, 281*/282*, 350, 370
One full course equivalent from English 300, 322, 341*, 342*, 343*, 344*, 314*, 315*.
Honours Programmes

Two approved English full course equivalents

Other Requirements
One full course equivalent in a foreign language
Two full course equivalents from Group B
Seven other full course equivalents

Recommended Courses
Greek 366*/375*, Latin 475*, French 460*,
German 221*/222*/, and Spanish 276*/316
Classical Civilization 265*/266
Courses in History, Philosophy, and Religious Studies

Honours English and French

English Requirements
English 101 or approved equivalent
English 251
One full course equivalent from English 361*, 362*, 363*
One full course equivalent from English 261, 270, 373, 375, 281*/282*, 350, 370
One full course equivalent from English 380, 451, 456, 341*, 342*, 343*, 344*, 314, 315*
Three other approved English full course equivalents (see Note)

French Requirements
French 100, 250, 350, 455*/456*
Four other approved French full course equivalents

Other Requirements
Two full course equivalents from Group B
Five other full course equivalents

Note English 395, Senior Honours Essay, may be chosen as one of these courses.

Honours English and German

English Requirements
English 101 or approved equivalent
English 251
One full course equivalent from English 361*, 362*, 363*
One full course equivalent from English 261, 270, 373, 375, 281*/282*, 350, 370
One full course equivalent from English 380, 451, 456, 341*, 342*, 343*, 344*, 314*, 315*
Three other approved English full course equivalents (See Note)

German Requirements
Seven full course equivalents selected in consultation with the department advisor.

Other Requirements
Two full course equivalents from Group B
Six other full course equivalents

Note English 495, Senior Honours Essay, may be chosen as one of these courses.
Honours English and History

*English Requirements*

English 101 or approved equivalent
English 251
One full course equivalent from English 361*, 362*, 363*
One full course equivalent from English 261, 270, 373, 375, 281*/282*, 350, 370
One full course equivalent from English 380, 451, 456, 341*, 342*, 343*, 344*, 315%*
Three other approved English full course equivalents

*(See Note)*

*History Requirements*

An Introductory History course
Four Honours History courses selected from the 200 or 300 range, at least one of which must be a Depth Study (i.e. in the 300 range)
Two Senior Seminars (History 400-455)

*Other Requirements*

One full course equivalent in a foreign language
Two full course equivalents from Group B
Four other full course equivalents

*Note*  *English 495, Senior Honours Essay, may be chosen as one of these courses.*

Honours English and Latin

*English Requirements*

English 101 or approved equivalent
English 251
One full course equivalent from English 361*, 362*, 363*
One full course equivalent from English 261, 270, 373, 375, 281*/282*, 350, 370
One full course equivalent from English 380, 451, 456, 341*, 342*, 343*, 344*, 314*, 315*
Three other approved English full course equivalents

*(See Note)*

*Latin Requirements*

Latin 190, 251, 352
Five other approved Latin full course equivalents

*Other Requirements*

Two full course equivalents from Group B
Five other full course equivalents

*Note*  *English 495, Senior Honours Essay, may be chosen as one of these courses.*

Honours English and Philosophy

*English Requirements*

English 101 or approved equivalent
English 251
One full course equivalent from English 361*, 362*, 363*
One full course equivalent from English 261, 270, 373, 375, 281*/282*, 350, 370
One full course equivalent from English 380, 451, 456, 341*, 342*, 343*, 344*, 314*, 315*
Three other approved English full course equivalents

*(See Note)*
Honours Programmes

Philosophy Requirements
Philosophy 221*/222*, 240 (or alternatively 140* and another half course in Philosophy), 280*/281*, 282*/283*
Philosophy 331, 399 (tutorial) One other Philosophy full course equivalent

Other Requirements
One full course equivalent in a foreign language
Two full course equivalents from Group B
Four other full course equivalents

Note English 495, Senior Honours Essay, may be chosen as one of these courses.

Honours English and Political Science

English Requirements
English 101 or approved equivalent
English 251
One full course equivalent from English 361*, 362*, 363*
One full course equivalent from English 261, 270, 373, 375, 281*/282*, 350, 370
One full course equivalent from English 380, 451, 456, 341*, 342*, 343*, 344*, 314*, 315*
Three other approved English full course equivalents (see note)

Political Science Requirements
Political Science 105*/106* or 115*/116
The equivalent of at least six further full courses in Political Science (at least one of which must be at the 400 or 500 level) which must be chosen so as to satisfy the Department's field requirements for Joint Honours programmes (see page 16).

Other Requirements
One full course equivalent in a foreign language
The equivalent of six other full courses (one of which should be in a social science other than Political Science).

Note English 495, Senior Honours Essay, may be chosen as one of these courses.

Honours English and Psychology

English Requirements
English 101 or approved equivalent
English 251
One full course equivalent from English 361*, 362*, 363*,
One full course equivalent from English 261, 270, 373, 375, 281*/282*, 350, 370
One full course equivalent from English 380, 451, 456, 341*, 342*, 343*, 344*, 314*, 315*
Three other approved English full course equivalents (see note)

Psychology Requirements
Psychology 101*/102*
Psychology 283*/284*
One-half course from Psychology 293*, *(295*, 297*
One-half course from Psychology 393*, 395*, 397*
Psychology 499 or English 495 (if 495 is chosen, it is counted as one of the three "other" courses)
Four additional full course equivalents in psychology

Note English 495, Senior Honours Essay, may be chosen as one of these courses.
**Honours Programmes**

*Other Requirements*
One full course equivalent in a foreign language
The equivalent of five other full courses (one of which should be in a social science other than psychology)

**Note** *English 495, Senior Honours Essay, may be chosen as one of these courses.*

One full course equivalent from English 380, 451, 456, 341*, 342*, 343*,
344*, 314, 315*
Three other approved English full course equivalents *(See Note)*

*Russian Requirements*
Seven full course equivalents selected in consultation with the departmental advisor

*Other Requirements*
Two full course equivalents from Group B
Six other full course equivalents

**Note** *English 495, Senior Honours Essay, may be chosen as one of these courses.*

*Honours English and Sociology*  
**English Requirements**
English 101 or approved equivalent
English 251
One full course equivalent from English 361*, 362*, 363*
One full course equivalent from English 261, 270, 373, 375, 281*/282*, 350, 370
One full course equivalent from English 380, 451, 456, 341*, 342*, 343*,
344*, 314*, 315*
Three other approved English full course equivalents *(see note)*

**Sociology Requirements**
Sociology 101*, 202*
Sociology 321*/322*
Sociology 425*/426*
Four additional full course equivalents in sociology

*Other Requirements*
One full course equivalent in a foreign language
The equivalent of six other full courses (one of which should be in a social science other than Sociology)

*Honours English and Spanish*  
**English Requirements**
English 101 or approved equivalent
English 251
One full course equivalent from English 361*, 362*, 363*,
One full course equivalent from English 261, 270, 373, 375, 281*/282*, 350, 370
One full course equivalent from English 380, 451, 456, 341* 342*, 343*,
344*, 314*, 315*
Three other approved English full course equivalents *(See Note 1)*

**Spanish Requirements**
Spanish 109, 255, 259, 458
Honours Programmes

above (See Note)

Other Requirements
Two full course equivalents from Group B
Five other full course equivalents

Note 1 English 495, Senior Honours Essay, may be chosen as one of these courses.

Note 2 Students planning to enter the teaching profession must comply with requirements as set down by the individual Colleges of Education in Ontario. In Spanish they should complete a minimum of eight full courses or equivalent, including Spanish 250, 350, 450

Honours French
Year 1 Recommended Programme
French 100
One of English, Philosophy, History, or another language
Three more courses

Year 2 French, minimum of three full courses or equivalent
One of English, Philosophy, History, or another language
Two more courses

Year 3 French, minimum of three full courses or equivalent
One of English, Philosophy, History, or another language
Two more courses

Year 4 French minimum of three full courses or equivalent
One of English, Philosophy, History, or another language
One more course

Note 1 Before graduation, the student must complete a minimum of ten full courses (or equivalent) in French. If he intends to enter the teaching profession, he must complete French 250, 350, and 455*/456*.

Note 2 To establish a Minor in a sister discipline, the student must complete five courses (fifteen hours) in that discipline.

Note 3 With the permission of the department, the student may spend his third year enrolled in an acceptable university in France or in the Province of Quebec.

Honours French and German
Year 1 Recommended Programme
French 100
German, one full course or equivalent
Three more courses

Year 2 French, minimum of two full courses or equivalent
German, minimum of two full courses or equivalent
Two more courses

Year 3 French, minimum of two full courses or equivalent
German, minimum of two full courses or equivalent
Two more courses

Year 4 French, minimum of two full courses or equivalent
German, minimum of two full courses or equivalent
Honours Prograntmea 27

**Note 1** The student may take the two required Social Science courses in the first year.

**Note 2** Before graduation, students must complete a minimum of eight full courses (or equivalent) in French and in German.

**Note 3** Students planning on entering the teaching profession should complete French 250, 350, and 455*/456*.

**Note 4** Before graduation, students must complete the requirements for Honours Courses as described on page 16 of the calendar.

**Note 5** With the permission of the departments the student may spend his third year enrolled in a university of a German and / or French speaking country. Inquiries about fellowships should be directed to the chairman of the departments.

### Honours French and Latin

**Year 1** *Recommended Programme*

- French 100
- Latin 190
- Three more courses

**Year 2** French, minimum of two full courses or equivalent

- Latin, minimum of two full courses or equivalent
- Two more courses

**Year 3** French, minimum of two full courses or equivalent

- Latin, minimum of two full courses or equivalent
- Two more courses

**Year 4** French, minimum of two full course or equivalent

- Latin, minimum of two full courses or equivalent
- Two more courses

**Note 1** Before graduation, students must complete the requirements for Honours Courses as described on page 16 of the Calendar.

**Note 2** Before graduation, the student must complete a minimum of eight full courses (equivalent) in French and in Latin.

**Note 3** Students planning to enter the teaching profession should complete French 250, 350, 455*/456*.

**Note 4** Latin 251-352 are required before graduation.

### Honours French and Political Science

**Year 1** *Recommended Programme*

- French 100
- Either Political Science 105*/106* or 115*/116*
- The equivalent of three other full courses

**Year 2** The equivalent of two full courses in French (which must include 250)

- The equivalent of two full courses in Political Science (see note)
- The equivalent of two other full courses

**Year 3** The equivalent of two full courses in French (which must include 350)

- The equivalent of two full courses in Political Science (see note)
- The equivalent of two other full courses
Honours Programmes

Year 4 The equivalent of two full courses
in French (which must include 455*/456*)
The equivalent of two full courses
in Political Science one of which
must be at the 400 or 500 level (see note)
The equivalent of one other full course

Note Political Science courses must be selected so as to satisfy the Department's field requirements for Joint Honours programmes (see p. 16)

Honours French and Russian

Year 1 Recommended Programme
French 100
Russian, one full course or equivalent
Three more courses

Year 2 French, minimum of two full courses or equivalent
Russian, minimum of two full courses or equivalent
Two more courses

Year 3 French minimum of two full courses or equivalent
Russian, minimum of two full courses or equivalent
Two more courses

Year 4 French, minimum of two full courses or equivalent
Russian, minimum of two full courses or equivalent
Two more courses

Note 1 The student may take the two required Social Sciences courses in the first year.

Note 2 Before graduation, students must complete a minimum of eight full course (or equivalent) in French and in Russian. Those planning to enter the teaching profession must complete French 250, 350, 455*/456*.

Note 3 Before Graduation, students must complete the requirements for Honours Courses as described on page 16 of the Calendar.

Honours French and Sociology

Year 1 Recommended Programme
French 100
Sociology 101*
Three and a half more courses.

Year 2 French 250
A minimum of one other full course in French.
A minimum of one other full course in Sociology.
Elective.

Year 3 French 350
A minimum of one other full course in French.
Sociology 321*/322*
A minimum of one other full course in Sociology.
Elective.

Year 4 French 455*/456*, 499
Sociology 425*/426*, 499
A minimum of one other course in Sociology.
Note 1 Before graduation, students must complete a minimum of eight full courses (or equivalent) in French and in Sociology. A total of twenty-three credits is required for graduation.

Note 2 Before graduation, students must complete the requirements for Honours Courses as described in the Calendar, P. 16.

Honours French and Spanish

Year 1 Recommended Programme
French 100
Spanish 190
Three more courses

Year 2 French, minimum of two full courses or equivalent
Spanish, minimum of two full courses or equivalent
Two more courses

Year 3 French, minimum of two full courses or equivalent
Spanish, minimum of two full courses or equivalent
Two more courses

Year 4 French, minimum of two full courses or equivalent
Spanish, minimum of two full courses or equivalent
Two more courses

Honours Geography

Year 1 Geography 101*—Introduction to Human Geography
Geography 102*—Introduction to Physical Geography
Five courses chosen after consultation with the Department

Year 2 Geography 200*—Biogeography and Ecology
Geography 201*—Climatology and Geomorphology
Geography 202*—Economic and Urban Geography
Geography 203*—Cultural and Regional Geography
Geography 260*—Cartography
Geography 275*—Air Photo Interpretation
Two courses chosen after consultation with the Department

Year 3 Geography 375—Quantitative Methods
Geography 391*—Field Research
One and one-half courses of Geography electives
Two courses chosen after consultation with the Department

Year 4 Geography 480*—Development of Geographic Thought
Geography 481*—Frontiers of Geography
Geography 490—Senior Honours Essay
Three courses chosen after consultation with the Department

* An asterisk indicates a half-year or semester course.
All others are two semester courses.

Note 1 While twenty-one courses is the minimum number of courses required for the degree of Bachelor of Arts (Honours Geography), students are encouraged to take an enriched programme of up to a twenty-four course maximum.

Note 2 The minimum and maximum number of Geography courses in the programme are respectively nine and twelve.

Note 3 To enter Year 2 of the Honours Geography programme, a student must
Honours Programmes

continue to achieve an overall average of "B-" as well as an average of "B" in his Geography courses.

Note 4 For the student wishing to concentrate his studies, all or part of the sequences of specialized geography courses below is suggested: In addition, courses closely related to the specialization may be elected from other disciplines.

a) Physical Sequence: 300* (Geomorphology); 301* (Climatology); 375* (Conservation and Resource Development); 400* and 401* (Special topics in Geomorphology); 451* and 452* (Soils and Rural Land Use); 470* and 471* (Advanced Air Photo Interpretation).

b) Economic-Urban Sequence: 310* and 311* (Advanced Economic Geography); 350 and 351* (Advanced Urban Geography); 404* and 405* (Advanced Quantitative Methods); 410* (Recreation Geography); 411* (Resources Management); 412* (Industrial Geography); 413* (Behavioural Studies); 415* (Special Topics, Urban); 451* and 452* (Soils and Rural Land Use).

c) Regional-Cultural Sequence: 220 (World Regional); 231* and 232* (Cultural Geography); 321* (United States); 322* (Canada); 323* (Selected Region); 340* (Historical Geography); 341 (Historical Geography of the United States and Canada); 345* (Political Geography); 420 (Advanced Canada); 421 (Western Europe); 423 (Eastern Europe); 424 (Soviet Union).

Note 5 Students may arrange a Joint Honours Programme with any other discipline in the University provided that the joint programme is approved by both Departments concerned. Several such programmes are outlined in the calendar.

Note 6 Since many departments doing graduate work in Geography demand proficiency in a foreign language, students intent on graduate work should consider taking a foreign language in their first year.

Note 7 Students intending to teach in secondary schools are advised to take at least two full Regional Geography courses.

Note 8 This programme prepares students for graduate study in Geography or in Planning, for entry to Secondary School teaching, or for research positions in industry and government.

Note 9 All Geography students are encouraged to take summer employment which will provide experience useful to a geographer. Where possible, the Department will provide information and assistance in securing such summer employment.

Note 10 For some courses participating students may be expected to make a small financial contribution to defray heavy equipment/travel costs, e.g., Geog. 391*.

Honours Geography and Earth Sciences

**Year 1 Recommended Programme**

Geography 101*/102*
Earth Sciences 130
Chemistry 121*/122*
Two other electives

**Year 2** Geography 200*/201*, 202*/203*, 260*/275
Earth Sciences 231*/232*, 238*, 241*
One other elective

**Year 3** Geography 271*
Geography 391* or Earth Sciences 237*
Two or more electives
Honours Programmes

One other elective

Year 4
Geography 480*/481*, 490
One Earth Science elective
Two other electives

Note  The degree requirements of The Faculty of Arts must be met for the B.A. Degree and of The Division of Environmental Studies for the B.E.S. Degree.

Honours Geography and History

Year 1  Recommended Programme
Geography 101*/102*
An Introductory History course
Three electives

Year 2  Two Honours History courses
Geography 200*/201*, 202*/203*
Two electives

Year 3  Two Honours History courses
Geography 375 and one other Geography course
One elective

Year 4  Two of History 400-455
Two Geography courses
Two electives

Note 1  The four undesignated courses in History in the Second and Third Years must be selected from courses in the 200 and 300 range in consultation with a departmental advisor so as to be tailored to the student's individual academic development. At least one of these courses must be a depth Study (i.e. in the 300 range).

Note 2  To meet the requirements for the Type A Certificate for high school teaching, 9 courses must be taken in either Geography or History.

Note 3  Completion of this programme can lead to a degree in either Arts or Environmental Studies, provided that electives are used to meet the other requirements for such a degree.

Honours Geography and Political Science

Year 1  Recommended Programme
Geography 101*/102*
Either Political Science 105*/106* or 115*/116*
The equivalent of three other full courses

Year 2  Geography 200*/201*, 202*/203*
Geography 271* or Political Science 224*
The equivalent of two other full courses in Political Science  (see note 1)
The equivalent of one and a half other full courses

Year 3  Geography 345*, 391*
The equivalent of one other full course in Geography
The equivalent of two full courses in Political Science (see note 1)
Honours Programmes

Year 4 The equivalent of two full courses in Geography
The equivalent of two full courses in Political Science one of which must
be at the 400 or 500 level (see note 1)
The equivalent of one other full course

Note 1 Political Science courses must be selected so as to satisfy the Department's
field requirements for Joint Honours programmes (see page 16)

Note 2 Students intending to qualify for the Type A certificate for high school
teaching must choose their electives so as to complete a minimum of nine
full courses in Geography.

Note 3 Completion of the programme leads either to the B.A. or the B.E.S.
provided that students choose electives so as to satisfy the degree
requirements either of the Faculty of Arts or the Division of
Environmental Studies.

Honours German and Russian

Year 1 Recommended Programme
German, one full course or equivalent
Russian, one full course or equivalent
Three more courses

Year 2 German, minimum of two full courses or equivalent
Russian, minimum of two full courses or equivalent
Two more courses

Year 3 German, minimum of two full courses or equivalent
Russian, minimum of two full courses or equivalent
Two more courses

Year 4 German, minimum of two full courses or equivalent
Russian, minimum of two full courses or equivalent
One more course

Note 1 Before graduation students must complete a minimum of seven full
German courses and seven full Russian courses.

Note 2 Before graduation students must complete the requirements for Honours
Courses as described on page 16 of this Calendar.

Note 3 With the permission of the departments the student may spend his third
year enrolled in a university of a German speaking country. Inquiries
about fellowships should be directed to the chairman of the department.

Honours German with minor in English or any other discipline

Year 1 One full German course or equivalent
One full English course or equivalent
Three more courses

Year 2 Minimum of three full German courses or equivalent
Minimum of one full English course or equivalent
Two more courses

Year 3 Minimum of three full German courses or equivalent
Minimum of one full English course or equivalent
Two more courses

Year 4 Minimum of three full German courses or equivalent
Minimum of one full English course or equivalent
Note 1 Before graduation students must complete the requirements for Honours Courses as described on page 16 of this Calendar.

Note 2 With the permission of the department the student may spend his third year enrolled in a university of a German speaking country. Inquiries about fellowships should be directed to the chairman of the department.

Honours History

Year 1 Any first-year programme that fulfils the general faculty requirements, normally including an introductory course in History (see page 00) is acceptable. History 110 is recommended.

Year 2 Three Honours History courses (see note 1).
   Three other courses (see note 2).

Year 3 Two Honours History courses (see note 1).
   Three other courses, one, it is suggested, being Hist. 350 (see note 2).

Year 4 Two of History 400-455
   One other Honours History course
   One other approved course

Note 1 Before graduation in Honours History a student must have completed at least eight and preferably nine honours History courses in addition to an Introductory history course. The Honours History courses must have been selected so as to ensure (a) sufficient breadth (b) development.
   (a) To ensure sufficient breadth they must include at least one full course from each of the following groupings. (In certain circumstances a full course offered by the Department but not listed below may be accepted as fulfilling a group requirement).

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>255</td>
<td>263*</td>
<td>265*</td>
<td>277</td>
</tr>
<tr>
<td>258</td>
<td>264*</td>
<td>266*</td>
<td>381*</td>
</tr>
<tr>
<td>260</td>
<td>355*</td>
<td>295*</td>
<td>282*</td>
</tr>
<tr>
<td>262</td>
<td>356*</td>
<td>296*</td>
<td>285</td>
</tr>
<tr>
<td>353</td>
<td>357*</td>
<td>280*</td>
<td>291*</td>
</tr>
<tr>
<td>351</td>
<td>358*</td>
<td>281*</td>
<td>292*</td>
</tr>
<tr>
<td>363</td>
<td>359*</td>
<td>282</td>
<td>370</td>
</tr>
<tr>
<td>392</td>
<td>360*</td>
<td>383*</td>
<td>372</td>
</tr>
<tr>
<td>397</td>
<td>362</td>
<td>384*</td>
<td>373R</td>
</tr>
<tr>
<td>364</td>
<td>386*</td>
<td>375</td>
<td></td>
</tr>
<tr>
<td>366</td>
<td>387*</td>
<td>377</td>
<td></td>
</tr>
<tr>
<td>367R</td>
<td>388</td>
<td>393</td>
<td></td>
</tr>
<tr>
<td>368</td>
<td>390</td>
<td>394</td>
<td></td>
</tr>
</tbody>
</table>

(b) To ensure development they must include at least four courses in the 300 and 400 range, two of which must be Senior Seminars.

Note 2 At least one course above the First Year level must be completed preferably by the end of the third year, both in the humanities (this includes language and literature, but not culture courses) and in the social sciences in addition to History. An extra course in history is strongly urged at third year level.

Note 3 Graduation in this programme qualifies a student for admission to the Type A course in History at a College of Education in Ontario.

Note 4 Students enrolled in Double Honours programmes do not have to fulfil the group (ACBD) requirements outlined in Note 1 (a).
Honours Programmes

Honours History and Philosophy

**Year 1** *Recommended Programme*

*One of Philosophy 221*/222* or 280*/281*

An Introductory History course

Three other courses to fulfill the general requirements

(see page 15)

**Year 2** *One of Philosophy 221*/222* or 280*/281*

*Philosophy 282*/283*

*Two Honours History courses (see note 2).*

*Two additional courses*

**Year 3** Philosophy 399 (tutorial)

Philosophy 346

*Two Honours History courses (see note 2).*

*Two additional courses*

**Year 4** *Two Philosophy courses*

*Two of History 400 to 455*

*One additional course*

**Note** The four undesignated courses in History in the Second and Third Years must be selected from courses in the 200 and 300 range in consultation with a departmental advisor so as to be tailored to the student's individual academic development. At least one of these courses must be in the 300 range.

Honours History and Political Science

**Year 1** *Recommended Programme*

An Introductory History course

Either Political Science 105*/106* or 115*/116*

The equivalent of three other full courses

**Year 2** *Two Honours History courses (see note 1).*

The equivalent of two full courses in Political Science (see note 2)

The equivalent of two other full courses

**Year 3** *Two Honours History courses (see note 1).*

The equivalent of two full courses in Political Science (see note 2)

The equivalent of two other full courses

**Year 4** *Two of History 400-455*

The equivalent of two full courses in Political Science one of which must be at the 400 or 500 level (see note 2)

The equivalent of one other full course

**Note 1** The four undesignated courses in History in the Second and Third years must be selected from courses in the 200 and 300 range in consultation with a departmental advisor so as to be tailored to the student's individual academic development. At least one of these courses must be in the 300 range.

**Note 2** Political Science courses must be selected so as to satisfy the Department's field requirements for Joint Honours programmes (see p. 16)

**Note 3** For admission to the Type A course at a College of Education two of the electives for additional courses in Honours History should be used.
Honours Latin

Year 1
Latin 190
Classical Civilization 251*/252*
Three more courses (see note 1).

Year 2
Latin, minimum of three full courses or equivalent
Classical Civilization 265*/266*
Two more courses

Year 3
Latin, minimum of three full courses or equivalent
Classical Civilization 350
Two more courses

Year 4
Latin, minimum of three full courses or equivalent
Two more courses

Note 1 Students intending to obtain a Type A certificate for teaching in Ontario High Schools must take a Minor in addition to their Latin programme. In Greek as a minor subject, three courses (nine hours) are required. In French, English, or Italian, five courses (fifteen hours) are required. The electives each year provide room for these requirements.

Note 2 Before graduation, students must complete a minimum of ten courses in Latin among which must be Latin 251*252*.

Honours Philosophy
Twenty full course equivalents
Ten in Philosophy, including 221*/222*, 240, 280*/281*, 282*/283*, 399 (tutorial), 499 (tutorial)
Ten others, including Group A and B requirements (see P. 16)

Honours Philosophy and Literature

Year 1 Recommended Programme
French 100 (or German 121*/122*)
English 101†
A Social Science
Two of
A Natural Science
Mathematics
History
Another language††
Another Social Science

Year 2 One of Philosophy 221*/222* or 280*/281*
Philosophy 282*/283* and one other Philosophy course
French: Minimum of two full courses
or equivalent (see note)
(of or German 261*/262* and one of
German 251*/252*, 271*/272*)
One elective (Social Science, if requirement not met in first year)

Year 3 Philosophy 331, 399 (tutorial), and
One of Philosophy 221*/222* or 280*/281*
French: Minimum of two full courses
Honours Programmes

381*/382*)
One elective

Year 4 Two full course equivalents in Philosophy
French: minimum of two full courses
or equivalent (see note)
(or German 451*/452*, 461*/462*
471*/472*)
Senior Essay

†In certain special cases, where the student can prove a high degree of
familiarity with English literature he may substitute French 100 or
German 121*/122*, whichever has not already been chosen. ††Those
taking the French option should normally take Latin 190.

Note Before graduation students must complete a minimum of eight courses (or
equivalent) in French. Students intending to teach French should complete
French 250, 350, 453*/456*.

Joint Philosophy—Mathematics

Programme Choice of Degree
Students in Years 1 and 2 may take this programme in either faculty,
but at the end of the second year, they will decide whether to continue
toward a degree in Arts or a degree in Mathematics. The programme
must then be approved by the Philosophy Department or by an
appropriate department of the Faculty of Mathematics respectively.

Requirements for all students
(Other requirements will depend on which degree is taken: the student
will have to add to these to meet the requirements of his faculty)

Philosophy 340, 358*/359*, 280*/281*, 282*/283*
Three others, one of which is in a value area

Mathematics 129, 130, 229
231 and 232 or
237 and one of 233, 239, 240
Two others

Further requirements for the degree B.Math.
(Mathematics and Philosophy) see page 109
Further requirements for the degree B.A.
(Philosophy and Mathematics)
Six more courses, including: A and B requirements for an Arts Degree

Honours Philosophy and
Political Science Philosophy Requirements
The equivalent of at least seven full courses in
Philosophy which must include 221*/222*, 240 (or 140*),
280*/281*, 282*/283*, 327*, 362*, and 399 (tutorial)

Political Science Requirements
Either Political Science 105*/106* or 115*/116*
The equivalent of at least six further full courses in Political Science
(one of which must be at the 400 or 500 level) which must be chosen so
as to satisfy the Department’s field requirements for Joint Honours
Programmes (see p. 16)
Honours Programmes

The equivalent of seven full courses, one of which must satisfy the Faculty's foreign language requirement and one of which should be in a social science other than Political Science.

**Honours Philosophy and Psychology**

*Philosophy Requirements*
- Philosophy 221*/222*, 280*/281*, 282*/283*, 240 or 340
- Philosophy 362*, 399 (tutorial)
One and one half other full course equivalents in Philosophy

*Psychology Requirements*
- Psychology 101*/102*, 283*/284*
- One half course from 293*, 245*, or 297*
- One half course from 393*, 395*, or 397*
Four other full course equivalents in Psychology

*Other Requirements*
- Either Philosophy or Psychology 499
Seven full course equivalents, including A and B requirements (see p. 13)

**Honours Philosophy and Sociology**

*Philosophy Requirements*
- Philosophy 221*/222*, 240 (or alternatively 140* and another half course in Philosophy), 280*/281*, 282*/283*
- Philosophy 362*, 399 (tutorial)
One and one half other full course equivalents in Philosophy

*Sociology Requirements*
- Sociology 101*
- Two courses from Sociology 202*, 321*, 322*, 323*, or 324*
- Three courses from Sociology 402*, 425*, 426* or 500*
- Sociology 466* and 467*
Three other full course equivalents in Sociology

*Other Requirements*
- Either Philosophy or Sociology 499
Seven full course equivalents, including A and B requirements (see page 13)

**Note** The following courses are recommended as electives for students with special interests: Sociology 603*, 631*, and 632*

**Honours Political Science**

**Year 1** Recommended Programme
- Either Political Science 105*/106* or 115*/116*
The equivalent of four other full courses

**Year 2** The equivalent of three full courses in Political Science (see note)
The equivalent of two other full courses

**Year 3** The equivalent of three full courses in Political Science (see note)
The equivalent of two other full courses

**Year 4** The equivalent of three full courses in Political Science at least two of which must be at the 400 or 500 level
Honours Programmes

Note  Political Science courses must be selected so as to satisfy the Department's field requirements for the Honours programme (see p. 16)

Honours Political Science and Psychology

Year 1  Recommended Programme
Either Political Science 105*/106* or 115*/116*
Psychology 101*/102*
The equivalent of three other full courses

Year 2  The equivalent of two full courses in
Political Science (see note)
Psychology 283*/284*
The equivalent of one other full course in Psychology (see note 1 under Honours Psychology)
The equivalent of two other full courses

Year 3  The equivalent of two full courses in
Political Science
The equivalent of two full courses in Psychology (see note 1 under Honours Psychology)
The equivalent of two other full courses

Year 4  The equivalent of two full courses in
Political Science one of which must be at the 400 or 500 level (see note)
The equivalent of two full courses in Psychology (see note 2 under Honours Psychology)
Either Political Science 499 or Psychology 499

Note  Political Science courses must be selected so as to satisfy the Department's field requirements for Joint Honours programmes (see p. 16)

Honours Political Science and Sociology

Year 1  Recommended Programme
Either Political Science 105*/106* or 115*/116
Sociology 101*
The equivalent of three other full courses

Year 2  The equivalent of two full courses in
Political Science (see note)
The equivalent of two full courses in Sociology (which must include 202*)
The equivalent of two other full courses

Year 3  The equivalent of two full courses in
Political Science (see note)
The equivalent of two full courses in Sociology (which must include 321*/322*)
The equivalent of two other full courses
Honours Programmes

at the 400 or 500 level (see note)
The equivalent of two full courses in
Sociology (which must include 425*/426*)
The equivalent of one other full course

Note Political Science courses must be selected so as to satisfy the Department's field requirements for Joint Honours programmes (see p. 16)

Honours Psychology

Year 1 Recommended Programme
Psychology 101*/102*
Four more courses

Year 2 Psychology 283*/284*
One full course in Psychology
(see Note 1)
Three more courses

Year 3 Two full courses in Psychology
(see Note 1)
Three more courses

Year 4 Psychology 499
Two full courses in Psychology
(see Note 2)
Two more courses

Note 1 Psychology 283*/284* and 499 are required of all students in Honours Psychology. In addition, Honours students are required to complete two Psychology Research half courses before entering the fourth year of the Honours Programme; the Research courses must include at least one from each of the following groups:

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>293*</td>
<td>393*</td>
</tr>
<tr>
<td>295*</td>
<td>395*</td>
</tr>
<tr>
<td>297*</td>
<td>397*</td>
</tr>
</tbody>
</table>

Note 2 It is recommended that in fourth year students include at least two Seminar half courses in their programme.

Note 3 See also Psychology and Sociology, Philosophy and Psychology, Psychology and Mathematics, Mathematics and Psychology, Political Science and Psychology. Other Joint Honours Programmes may be arranged by consultation between the students and the departments concerned.

Honours Psychology and Mathematics

Recommended Programme
Year 1 Psychology 101*/102*
Mathematics 129
Mathematics 130
Two more courses
(see Note 2)

Year 2 Psychology 283*/284* or
Mathematics 233
(see Note 3)
Honours Programmes

Psychology
Mathematics 229
Two full courses in Mathematics
(see Note 4)
One more course

Year 3 Two full courses in Psychology
(see Note 1 under Honours Psychology)
One full course in Mathematics
Three more courses

Year 4 Psychology 499
One full course in Psychology
(see Note 2 under Honours Psychology)
One full course in Mathematics
Two more courses

Note 1 Students in Years 1 and 2 may take this programme in either faculty but at end of the second year, they will decide whether to continue towards a degree in Arts or a degree in Mathematics.

Note 2 Students intending to concentrate in Computer Science should include Mathematics 132 in their programmes.

Note 3 Students electing to take Mathematics 233 instead of Psychology 283*/284* must include another full course in Psychology.

Note 4 Students entering Year 3 must have credit for the following courses in Mathematics:
   Mathematics 129; 130; 229; 231 and 232 or 237 and one of 233, 234, 239, 240.

Note 5 Students who decide at the end of their second year to continue toward the degree in Mathematics must pass at least seven further Mathematics courses approved by one of the departments in the Mathematics faculty.

   Students who intend to proceed to Pure Mathematics should include Mathematics 231, 232 in the second year of their programme.

   Students who intend to proceed to Applied Mathematics should include Mathematics 234, 237 in the second year of their programme.

   Students who intend to proceed to Computer Science should include Mathematics 240 in the second year of their programme. (Students should note that Mathematics 132 is a prerequisite for Mathematics 240.)

   Students who intend to proceed to Actuarial Science should include Mathematics 235 in the second year of their programme.

   Students who intend to proceed to Combinatorics and Optimization should include Mathematics 239 in the second year of their programme.

Honours Psychology and Sociology

Recommended Programme

Year 1 Psychology 101*/102*
Sociology 101*
Three more courses

Year 2 One course in Statistics
(see Note 1 below)
One full course in Sociology
One full course in Psychology
(see Note 1 under Honours Psychology)
Honours Programmes

Psychology
Two more courses

Year 3 Sociology 321*/322*
One full course in Sociology
Two full courses in Psychology
(see Note 1 under Honours Psychology)
Two more courses

Year 4 Psychology 499 or Sociology 499
Two full courses in Sociology
Two full courses in Psychology
(see Note 2 under Honours Psychology)

Note Students intending to do graduate work in Psychology should include Psychology 283*/284* in their programmes. Students intending to do graduate work in Sociology should include Sociology 202* in their programmes.

Honours Religious Studies

Year 1 Any first year programme that fulfils the general requirements of the Faculty of Arts. A 100-level RS course should be included.

Year 2 Religious Studies 223G*/224G*
Religious Studies 237*
One and one-half courses in Religious Studies
Three electives

Year 3 Religious Studies 336P, 231J, or 331J
Religious Studies 301*
One and a half other courses in Religious Studies
Two electives

Year 4 Three courses in Religious Studies at the 400 level
Two electives

Note 1 Each student is expected to select one area (e.g., philosophical, comparative, literary, historical) for specialization. At least three of the elective courses in Religious Studies are to be taken in the area of specialization.

Note 2 Elective courses in other disciplines should be chosen to provide the student with adequate background courses related to his area of specialization.

Note 3 Each programme should include at least one course which deals with the literary sources of religious traditions, (i.e., Scriptures).

Honours Russian Recommended Programme
with minor in English or any other discipline

Year 1 One full Russian course or equivalent
One full English course or equivalent
Three more courses

Year 2 Minimum of two full Russian courses or equivalent
Minimum of two full English courses or equivalent
Honours Programmes

Year 3 Minimum of three full Russian courses or equivalent
Minimum of one full English course or equivalent
Two more courses

Year 4 Minimum of three full Russian courses or equivalent
Minimum of one full English course or equivalent
One more course

Note Before graduation students must complete the requirements for Honours Courses as described on page 16 of the Calendar.

Honours Sociology

Year 1 Recommended Programme
Sociology 101*
Four and a half elective full year courses (or equivalent half courses)

Year 2 Sociology 202*
Two and one-half courses in sociology
Two elective full year courses (or equivalent half courses)

Year 3 Sociology 321*/322*
Two full year courses in sociology or equivalent half courses
Two elective full year courses (or equivalent half courses)

Year 4 Sociology 425*/426*
Sociology 499
One full or two half courses in Sociology
Two elective full year courses (or equivalent half courses)

Honours Sociology and Anthropology Recommended Programme

Year 1 Sociology 101*
Anthropology 101*/102*
Three elective full year courses (or equivalent half courses)

Year 2 Sociology 202*
One and one-half courses in Sociology
Two full courses in Anthropology (including a course in Ethnography)
Two elective full year courses (or equivalent half courses)

Year 3 Sociology 321*/322*
One full or two half courses in Sociology
Anthropology 370*
One and one-half courses in Anthropology
Two elective full year courses (or equivalent half courses)

Year 4 Sociology 425*/426*
Honours Programmes

equivalent half courses)
One full elective or two half courses
(See Note)

Note Students electing Sociology 499 should take this as their 4th year elective, in addition to the two full courses prescribed in Sociology.

Honours Spanish

Year 1 Recommended Programme
Spanish 190
One of English, Philosophy, History, or another language
Three more courses

Year 2 Spanish, minimum of three full courses or equivalent
One of English, Philosophy, History, or another language
Two more courses

Year 3 Spanish, minimum of three full courses or equivalent
One of English, Philosophy, History, or another language
Two more courses

Year 4 Spanish, minimum of three full courses or equivalent
One of English, Philosophy, History, or another language
One more course.

Note 1 Before graduation, the student must complete a minimum of ten full courses (or equivalent) in Spanish. If he intends to enter the teaching profession, he must complete Spanish 250, 350, and 450.

Note 2 To establish a Minor in a sister discipline, he must complete five courses (fifteen hours) in that discipline.

Note 3 With permission of the department, the student may spend his third year enrolled in an acceptable university in Spain or Mexico.

Note 4 Students registering in Honours Spanish are strongly advised to minor in French.

Area Study Programmes In certain Honours Courses, students may choose to place greater emphasis on one part of the world than on others. Students who are taking Honours Courses in History, Political Science, Economics or Geography, for example, may wish to concentrate on the application of these subjects to Latin America, Africa or the Soviet Union. In these cases students may, with the permission of the Department Chairman concerned, arrange to take courses related to the area in which they are particularly interested.

Renison College Social Science (Applied) Renison offers integrated courses in social work leading to either a general or an honours degree. Students are required to take core courses each year in sociology, social work, and psychology, plus two electives of their own choice. For further information write to: The Director, Social Science (Applied) Programme, Renison College, Waterloo, Ontario.
Honours Programmes

Graduate Studies

In addition to the general University graduate requirements set forth on page 162, graduate degree candidates in the Faculty of Arts must conform to certain other regulations set down by the Faculty.

1) At least half of the courses offered for graduate credit must be numbered 600 or above.

2) M.A. and M.A.Sc. candidates:
   All requirements for this degree must be met within a period of four years from initial registration, or within two years of completion of the course requirements, whichever is less. In exceptional circumstances, an extension of this time limit may be granted by petition of the department to the Faculty Graduate Affairs Group.

3) M. Phil. candidates:
   All requirements for this degree must be met within a period of five years from initial registration, in the case of students entering with an Honours B.A. or its equivalent, or within four years in the case of students entering with the M.A. degree, or within three years of the completion of the course work, whichever is less. In exceptional cases, an extension of this time limit may be granted by petition of the department to the Faculty Graduate Affairs Group.

4) Ph.D. candidates:
   All requirements for this degree must be met within a period of five years from initial registration, in the case of students entering with the Master's degree, or within six years in the case of students entering with an Honours B.A. or its equivalent. In exceptional circumstances an extension of this time limit may be granted by petition of the department to the Faculty Graduate Affairs Group.

5) Individual departments normally impose additional degree requirements over and above those laid down by the University and the Faculty. The departments should be consulted concerning any additional requirements they may stipulate.

Thesis Deadlines

Five copies of the completed thesis must be submitted to the Arts Faculty Graduate Office by the following dates:

M.A. Spring 1971 convocation: April 23, 1971
Fall 1971 convocation: September 17, 1971
Spring 1972 convocation: April 21, 1972

M.Phil. Spring 1971 convocation: April 16, 1971
Fall 1971 convocation: September 10, 1971
Spring 1972 convocation: April 14, 1972

Ph.D. Spring 1971 convocation: March 26, 1971
Fall 1971 convocation: August 20, 1971
Spring 1972 convocation: March 24, 1972

3 The Faculty of Engineering
The Co-operative Engineering Course

The Co-operative Engineering Course

The preparation for an engineering career includes both formal academic studies at a university and intensive training in the practice of engineering. A similar pattern is to be found in preparation for careers in medicine or law, and is characteristic of any development of professional competence. The Co-operative Engineering Programme at the University of Waterloo provides a completely integrated pattern of academic study and industrial experience in various phases of engineering with ultimate graduation requiring satisfactory performance in both areas. The degree programme covers almost five calendar years, comprising eight terms each of about four months' duration of university work on the campus which are pursued alternatively with six four-month terms of supervised training in the practical experiences fundamental to the development of the graduate engineer. The total time spent in study is the same as that encountered in the usual course of four "academic years."

While co-operative programmes have been offered in many other countries, and the inherent advantages are well recognized, the Co-operative Programme at the University of Waterloo is unique in Ontario and was until recently, unique in Canada.

The engineering curricula at the University of Waterloo provide a sound basis in Mathematics and Pure Science and in Engineering Science and Design. The first year of the programme is common for all programmes except Chemical Engineering and Systems Design. A substantial part of the work of the first and second years is common to all programmes. Starting with the second year (first year for Chemical Engineering and Systems Design) students elect one of the five principal divisions of engineering. The curriculum for each of the five basic programmes combines required "core" subjects essential to the field, and "elective" subjects permitting considerable diversity in individual programmes of study. An important part of the curriculum is a series of electives in the Humanities and Social Sciences.

The co-operative programme brings a student into direct contact with industry and the engineering profession and exposes him to problems typical of those encountered in practice. Students are introduced to full-scale engineering projects and operations, far beyond the scope of any university laboratory. Employment on the work terms generally is secured by students through on-campus interviews with Cooperative employers. Such arrangements and other features of the work terms are the responsibility of the Department of Co-ordination and Placement of the University which produces the necessary liaison between the University and the employers. Through personal experience in industry, the student's educational environment is extended and his total education advanced. The cooperative experience represents much more than an opportunity to secure financial assistance, or to make an early start of a vocation. It provides the maturing prospective engineer with an opportunity for self-discipline and direction, and allows an early appreciation of the social and personal aspects of engineering through direct association with a technological environment.

Through this carefully organized and implemented programme of co-operative study and work, it is felt that graduates will be well prepared for a career which requires high standards of professional skill and learning. The increasing dependence of our society on modern technology certainly requires engineers who, along with their technical ability, are prepared for individual responsibility and the knowledge to assume leadership in the development of new technology and its applications.
Admission

Degrees

The Degree of Bachelor of Applied Science (B.A.Sc) is awarded by the University in the following undergraduate courses:

Chemical Engineering
Civil Engineering
Electrical Engineering
Mechanical Engineering
Systems Design Engineering

All programmes are of modern scientific character and, instead of a separate programme in Engineering Physics, opportunity is provided for optional additional study in Mathematics and Science in each of the five main programmes. All programmes entail five years of undergraduate study on the co-operative system.

The Degree of Master of Applied Science (M.A.Sc.) and Doctor of Philosophy (Ph.D.) are also awarded in Engineering. For further details, consult the section of this calendar dealing with Graduate Studies Section 10, and the list of the particular courses in graduate work in the various departments.

Co-operative Programme

The eight terms of study and six terms of industrial employment provided in the programme are arranged as shown in the diagram below:

<table>
<thead>
<tr>
<th>1971 Fall</th>
<th>Winter</th>
<th>1972 Spring</th>
<th>Fall</th>
<th>Winter</th>
<th>1973 Spring</th>
<th>Fall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream &quot;A&quot; Term 1A</td>
<td>Second Term 1B</td>
<td>Work Term 1</td>
<td>Third Term 2A</td>
<td>Work Term 2B</td>
<td>Fourth Term 3</td>
<td></td>
</tr>
<tr>
<td>Stream &quot;B&quot; Term 1A</td>
<td>Work Term 1</td>
<td>Second Term 1B</td>
<td>Work Term 2</td>
<td>Third Term 2A</td>
<td>Work Term 3B</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Winter</th>
<th>1974 Spring</th>
<th>Fall</th>
<th>Winter</th>
<th>1975 Spring</th>
<th>Fall</th>
<th>1976 Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream &quot;A&quot; Term 3A</td>
<td>Work Term 4</td>
<td>Sixth Term 5</td>
<td>Work Term 4A</td>
<td>Seventh Term 6</td>
<td>Work Term 4B</td>
<td></td>
</tr>
<tr>
<td>Stream &quot;B&quot; Term 4</td>
<td>Work Term 5</td>
<td>Sixth Term 3B</td>
<td>Work Term 6</td>
<td>Seventh Term 4A</td>
<td>Eighth Term 4B</td>
<td></td>
</tr>
</tbody>
</table>

All Year 1 students enrol in September. These Year 1 students spend the first term together at the University, and, as indicated on the diagram also complete the programme and graduate together. Between the first and last terms, the diagram shows that each of employment opportunity on the co-operative programme. Both groups, of course, have the same total time on campus and in industry; one group having a double academic term at the start of the programme and the other having a double academic term at the end of the programme. The division at the end of the first term of study is based upon student preferences, financial considerations of students, etc. Precise dates for the beginning and end of the various terms are shown in academic calendar for the year. Students should read Section 15 for details of operation for the co-operative programmes.

The programme is Systems Design is not divided into two streams. All students in this programme follow a Stream "B" pattern.
Admission

other supporting documents should be forwarded as soon as they become available.

Admission cannot be granted until all the requirements have been met and all the required documents submitted. Applicants currently enrolled in Ontario Grade 13 who wish to be considered for Early Final Admission must apply before January 4, 1971. All other applicants must apply and have submitted all the necessary documents by July 1, 1971. Persons applying after these dates cannot be guaranteed consideration of their application.

Because of limited capacity the Engineering programme is limited in its enrollment, therefore most admissions are made early. Interested applicants are urged to apply for Early Final Admission rather than wait for the July 1st deadline.

Since many of the programmes offered at the University have limited enrolment, the possession of the minimum requirements does not in itself guarantee admission to any of the programmes. If clarification is required on any of the admission requirements, applicants should contact the office of the Registrar, University of Waterloo, Ontario.

The admission requirements listed in the Calendar are applicable for admission in September 1971.

Admission Deposit

Each applicant admitted to full time studies is required to submit a $50.00 admission deposit. The deposit will be refunded if notice of termination is received prior to August 1, 1971.

Application Documents

All applicants must submit an application form, and certified transcripts of secondary or post-secondary education. Applicants enrolled in Ontario Grade 13 in the 1970-71 academic year must apply on the "General Application for Admission to University 1971" form which is available from the secondary school. Applications should be submitted prior to January 4, 1971.

Applicants not enrolled full time in Ontario Grade 13 must apply on forms available from the Office of the Registrar. In addition at least two letters of reference are required. All educational institutions attended by the applicant must be accounted for on certified documents. Applicants from non-English speaking countries must arrange to submit certified English translations of their academic documents.

Ontario Grade 13 Applicants Requirements

For applicants currently enrolled full time in an Ontario Grade 13 programme of studies, the overall University requirement will be the assurance from the Secondary School that the prerequisites for the Secondary School Honour Graduation Diploma have been satisfied.

Applicants to the Faculty of Engineering will normally be required to achieve a 60% overall average on their Grade 13 standings as well as a 60% overall average in Mathematics A, Mathematics B, Physics and Chemistry. It is expected that applicants will present a balanced selection of Grade 13 courses.

Basis of Admission

Students enrolled full time in Ontario Grade 13 will be considered for Early Final Admission. The University expects to fill the majority of places available to Grade 13 applicants using the following criteria:

Grade 13 interim standing
Grade 12 final standing
Principal's recommendation
SACU aptitude and achievement tests results.
Admission

Applicants whose interim standings are not sufficient for Early Final Admission will be considered on the basis of Grade 13 final standings and qualified applicants will be admitted until the remaining places are filled.

Applicants who have spent more than the normal length of time in Secondary School to complete their University preparation may be required to present a higher admission average. Applicants who completed their Grade 13 studies in less than the normal period of time will be considered providing that the Grade 13 admission prerequisites are satisfied.

Successful applicants may expect to be notified after May 1, 1971 of their acceptance and will be allowed until June 1, 1971 to confirm the offer of admission.

The University reserves the right to withdraw the offer of admission if the applicant fails to complete his year satisfactorily.

Aptitude and Achievement Tests

Service for Admission to College and University - SACU. It is recommended that applicants write the Canadian Scholastic Aptitude Test (CSAT) and the Canadian English Language Achievement Test (CELAT) or the French equivalent.

Non-Ontario Grade 13 Applicants

Applicants who have taken their secondary school education in other than Ontario Grade 13 will be asked to submit the following certificates recognized as being equivalent to the Ontario Grade 13 certificate. These certificates may be accepted in so far as they meet the admission requirements of the University of Waterloo in subjects and percentages. Applicants from countries not mentioned in the following list can obtain detailed admission requirements from the Office of the Registrar.

Alberta
British Columbia
Manitoba
New Brunswick
Newfoundland
Nova Scotia
Prince Edward Island
Quebec
Saskatchewan

Senior Matriculation (Grade 12)
Senior Matriculation (Grade 13)
Senior Matriculation (Grade 12)
Senior Matriculation (Grade 13)
Year 1 Memorial University
Senior Matriculation (Grade 12)
1 Year University of Prince Edward Island
First Year CEGEP programme
Senior High School Leaving Certificates
Senior Matriculation (Grade 12)

England and Wales, West Indies, East and West Africa
Scotland
United States of America

The General Certificate of Education
with passes in at least five subjects,
two of which must be at Advanced Level
The Scottish Certificate of Education
High School Graduation plus an additional year of formal study in subjects comparable to Ontario Grade 13 subjects.

Successful applicants from other than Ontario Grade 13 will be notified any time after May 1, 1971. Places in Engineering are filled on a “first come” basis when entry qualifications are equal.

Admission as an Adult Student

Any student of mature age who has been away from formal education for more than two years and who does not possess the minimum
Examinations and Promotions

Grade 13 level Mathematics and Science subjects or their equivalent. Each application will be considered on its merits by the Admissions Committee.

Admission to Advanced Years

An applicant for admission to advanced standing must submit an official transcript from the University or educational institution which he has attended, showing in detail the courses which he has taken and his standing in each. Applicants should also submit documentation of their work experience. Because of the co-operative nature of the programme, no student will be admitted above the Year 3 Term A level. Any student thus admitted will be required to register in the “A” stream and to complete a minimum of three work terms. The level of advanced admission is determined by an examination of the applicants academic and work experience.

English Proficiency

Students from areas where English is not the common language must provide certified translation of academic certificates. In addition, the applicant may be required to take either “The English Proficiency Tests” prepared by the English Language Institute of the University of Michigan, or the examinations for “The Certificate of Proficiency in English” of the University of Cambridge, in order to satisfy the Admissions Committee that the applicant's knowledge of the English language is adequate to pursue his studies successfully.

Landed Immigrant Status

Because of the nature of the co-operative programme in Engineering where a student alternates four months of study with four months of industrial experience, applicants from other countries are strongly recommended to obtain landed immigrant status in Canada before applying for admission to the University. Immigrants from other countries are expected to have one year's residency in Canada before applying for admission to the co-operative programme.

Re-Admission

The University reserves the right to refuse admission to any candidate, and to refuse re-admission if, in the opinion of competent authority, a student is not profiting from University studies.

Registration

September 7, 8, 9, 10, 1971.

Fees

Refer to Section 13 page 502.

Examinations and Promotions

The Faculty constitutes the examining body for all University examinations, and they make decisions on grades, promotions, failures, deferred examinations and appeals, and prepare recommendations for granting degrees. Students are examined and marks are set for individual subjects on completion of the work for that subject. With few exceptions beyond first year, subjects are one term, in length; and promotion decisions are made at the end of each term. For the purposes of promotion the two terms of first year are considered as a unit and promotion decisions are made at the conclusion of the second term only. However a first year student is examined at the end of his first term and progress must be satisfactory for him to be allowed to proceed to the second term.

The procedures through which promotion decisions are made are as...
1) At the end of each term examining faculty submit marks to the Engineering Examinations and Promotions Committee, who prepare promotion recommendations for subsequent approval by the Executive Committee of the Engineering Faculty Council. Once approved the decisions are reported to the students through the Registrar's Office. All recommendations to award degrees must in addition by approved by Senate.

2) Promotion decisions are made at the end of each term except the first term. The decision for each student is based upon a weighted average computed from his marks in individual subjects following the weighting scheme for his department. For promotion a student must achieve an average of 60% or higher, except in special cases where, at the discretion of faculty, promotion may be granted with an average below 60%.

3) Averages reported to students are rounded to the nearest whole percent. In the special cases where promotion has been granted, the symbol "PG" is substituted for the numerical average; and a failed term is indicated by the "F". All promoted students will be shown as having obtained, First, Second or Third Class Honours according to the following table:—

<table>
<thead>
<tr>
<th>Rounded Average</th>
<th>Honours</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 to 100%</td>
<td>First Class</td>
</tr>
<tr>
<td>66 to 74%</td>
<td>Second Class</td>
</tr>
<tr>
<td>60 to 65%</td>
<td>Third Class</td>
</tr>
<tr>
<td>PG</td>
<td>Third Class</td>
</tr>
</tbody>
</table>

Students will be ranked in the order of overall averages. A student's class standing will be shown on his report.

4) Students who are not promoted at the end of the First Year will be required to repeat the second term, except the re-admissions will be denied if in the opinion of the faculty a student is deemed unlikely to profit from further study.

5) Students who are not promoted at the end of the third or subsequent terms will be required to repeat all or part of the work of the term failed.

Where timetables permit, repeating students may be excused from repeating individual courses in which good grades have been obtained, and permitted to register in other appropriate courses, at the discretion of the student's department.

6) A student may not repeat a given term more than once. Degree requirements must be fulfilled in not more than 10 terms of resident study.

7) Faculty Council may recommend or require a student to withdraw at any time if, in the opinion of the Council, the student is unlikely to profit from further study.

8) A student who withdraws from the programme less than four weeks before the commencement of the final examinations period in the programme shall be deemed to have failed the year or term in which he was enrolled at the time of withdrawal.

9) Reports to students will also indicate standings in each subject by letter grades according to the following table.—
Academic Programmes

<table>
<thead>
<tr>
<th>Grade</th>
<th>Range of Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>75 - 100</td>
</tr>
<tr>
<td>B</td>
<td>66 - 75</td>
</tr>
<tr>
<td>C</td>
<td>60 - 65</td>
</tr>
<tr>
<td>D</td>
<td>50 - 59</td>
</tr>
<tr>
<td>E</td>
<td>Less than 50</td>
</tr>
</tbody>
</table>

There is no “passing” or “failing” of individual subjects. Promotion is based on the overall average and does not require a minimum grade in any specific subject. There are no supplemental examinations.

10) In special cases other symbols may be substituted for the letter grades.

“AEG” indicates “aegrotat” signifying that the student’s work was incomplete for some accepted, well documented reason (such as sickness); that the examiner did not have sufficient information to set a mark but felt that the student should be promoted.

“DEF” indicates a deferred examination has been granted and that a promotion decision will not be made until the examination has been written and graded.

“INC” indicates that the work in the subject is incomplete and a promotion decision cannot be made until the deficiency is resolved.

“DNW” indicates that the student did not write the examination and that the overall average has been computed assuming a mark of zero in the subject.

11) Students who feel that assigned grades or the promotion decision do not reflect a just evaluation of their achievements, or who have done poorly because of sickness or unavoidable absence may appeal faculty decision. All appeals should be addressed to the Engineering Examinations and Promotions Committee. Appeals must provide all available evidence supporting the claim for each subject appealed. Doctor’s certificates and similar supporting documents should be included with the student’s statement. It is to the student’s advantage to file his appeal as early as possible, preferably before the Examinations and Promotions Committee meets to discuss the grades affected.

12) In some cases special programmes and changes in registration are permitted at the discretion of the department. All such arrangements must be indicated and approved before the end of the normal “Change Period”, which is a period of two weeks at the beginning of each term.

Academic Programmes

It is important to summarize the principles and objectives of the engineering curricula at Waterloo, as the role of the engineering graduate in a modern industrialized society. Technological advances and economic evolution produce an ever-changing environment in which it is seen that obsolescence comes to entire industries as well as to processes and products, and primary attention is necessarily focused on the capacity to innovate design in process and product. Engineers are undoubtedly amongst the most important leaders in such a society and the conditions noted lead to primary concern with fundamental education, versatility of mind, and the ability to maintain a position close to the frontiers of development.

Rigorous work in Mathematics and the Sciences is emphasized throughout the course, and the common work in these basic areas of Science in the first and second years is used in each departmental programme to support advanced studies in engineering analysis and
Academic Programmes

provides almost the same Mathematics, Physics, and Science courses as found in the first year in the Faculty of Science.

The core programmes for each of the five major divisions of engineering provide the foundation for professional activity in any field of engineering interest. A wide variety of elective courses are available in Engineering, Science, Mathematics, the Humanities, and Social Sciences, from which optional programmes may be developed under the guidance of faculty advisors.

The optional programmes that are made available under the curricula indicated should not be construed as specialization, but are rather intended to foster independent study and maturity of learning by permitting special undergraduate activity in subject areas which hold maximum interest. Certain courses, normally taken only at the post-graduate level, may in fact be included in under-graduate programmes where necessary prerequisites are met. It is most emphasized that professional specialization in engineering requires intensive study beyond the Bachelor's degree as well as extensive experience in practice.

It is important to realize that the separation of engineering studies into five basic curricula areas reflects primarily divisions of learning in engineering, rather than divisions by classes of industry, for instance. It is to be noted that the chemical industry, the aeronautical industry, the mining industry, the pulp and paper industry—every major industry in fact—requires engineers from all primary divisions of the profession.

Undergraduate study in any of the five basic divisions provided may lead, perhaps with further study or special experience as necessary, to professional activity in consulting work, or to staff positions in any kind of industry or any government agency, in research, education, design, design development, or administrative work.

Year 1 Engineering Students

All students enrolling in Year 1 are required to choose and register in one of the three programmes:

General Engineering (Normally these students proceed to Electrical, Civil or Mechanical Engineering in 2nd year but they may upon agreement transfer to Chemical Engineering in 2nd year)

Chemical Engineering (Normally these students remain in Chemical Engineering in 2nd year but they may upon agreement transfer to Civil, Mechanical or Electrical Engineering at 2nd year.)

Systems Design (Normally these students remain in Systems Design in 2nd year but on agreement they may transfer to Civil, Electrical or Mechanical Engineering in 2nd year.)

All Year 1 students enrolling in General and Chemical Engineering must register in the courses indicated in the following table:

<table>
<thead>
<tr>
<th>General Engineering</th>
<th>Chemical Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>TERM 1A</td>
<td></td>
</tr>
<tr>
<td>Mathematics 12</td>
<td>Mathematics 12</td>
</tr>
<tr>
<td>Mathematics 21</td>
<td>Mathematics 21</td>
</tr>
<tr>
<td>Chemistry 11</td>
<td>Chemistry 11</td>
</tr>
<tr>
<td>Physics 11</td>
<td>Physics 11</td>
</tr>
<tr>
<td>G.E. 111 Graphics</td>
<td>Ch.E. 10</td>
</tr>
<tr>
<td>G.E. 113 Measurement</td>
<td></td>
</tr>
<tr>
<td>Course of G.E. 101-102, 122</td>
<td></td>
</tr>
</tbody>
</table>
Chemical Engineering

TERM 1B
Mathematics 12
Mathematics 21
G.E. 111 Graphics
G.E. 120 Synthesis
G.E. 121 Digital Comp
G.E. 122 Elec & Magnetism
One of G.E. 101, 102 or 103

Students in Systems Design have an entirely separate programme as described on page 473 under the Department of Systems Design. They must register for the courses as described in Year 1 Systems Design.

Note  Asterisks signify a course given on alternate weeks.
Detailed course descriptions commence on page 172
At the completion of the First Year, students in the General Engineering programme are required to select one of the following major divisions of engineering.
Chemical Engineering
Civil Engineering
Electrical Engineering
Mechanical Engineering

Students already in Chemical Engineering or Systems Design will be assumed to continue in these programmes unless they apply to change to one of the other divisions.

Since the Faculty of Engineering is primarily oriented towards a modern scientific approach to engineering, students interested in Engineering Physics can register in any one of the four major engineering programmes and pursue a suitable course of study, including elective advanced courses in Mathematics, Chemistry and Physics. Alternatively, students primarily interested in Physics should consider major study directly in that field, as offered in the Faculty of Science.

Chemical Engineering

The courses offered by the Department of Chemical Engineering are intended to prepare students for professional careers in those fields of engineering where physical-chemical transformations of matter play a significant role. The academic curriculum is based on the concept that undergraduate studies, to be most effective in a scientific industrial age, must deal primarily with basic scientific and engineering principles. In the earlier years the subject matter is analytical and closely prescribed—mathematics, physics, and chemistry form the foundation. In the senior years, subjects such as transport processes, process system design, and economic analysis, enable the student to reach a more comprehensive understanding of his previous work.

Specialization is available through options oriented towards processes dealing with biological systems, extractive metallurgy or polymers, or towards more intensive studies in control and optimization theory or the theory of transport phenomena. The cooperative work assignments form an introduction to the different aspects of engineering such as research, development, design, production, economic factors, etc., and provide for relating theory and practice in education. Work programmes are
A. Core Programme

A. Mathematics and Science Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Lect.</th>
<th>Lab. or Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 22</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Math. 23</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Math. 31</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Math. 32</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Chem. 22</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 26</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Chem. 36</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

b. Engineering Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Lect.</th>
<th>Lab. or Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.E. 61</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>E.E. 10</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E. 12</td>
<td>3</td>
<td>2*</td>
</tr>
<tr>
<td>Ch.E. 16</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 17</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 18</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E. 21</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E. 22</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 23</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 31</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 32</td>
<td>3</td>
<td>2*</td>
</tr>
<tr>
<td>Ch.E. 33</td>
<td>3</td>
<td>Chem. Engineering Thermodynamics</td>
</tr>
<tr>
<td>Ch.E. 35</td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td>Ch.E. 36</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 41</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 42</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 51</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 61</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 62</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E. 71</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 72</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 95</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

B. Elective Courses

A minimum of 10 courses must be taken in addition to the core courses listed above in order to fulfill the requirements of the Chemical Engineering undergraduate programme. Four or five of these courses may be chosen from non-technical electives in the humanities or social sciences (one in each of the terms 2A, 2B, 3A, 3B, or 4A), and the remaining five or six courses must be technical electives, of which at least three of these are to be selected from any of the optional groups listed below. The other technical electives may be chosen from other Chemical Engineering courses or from other science or engineering courses according to interest, but the choice must be approved by the Associate Chairman (Undergraduate Studies).

Optional Groups

1) Chemical Engineering Science
- Ch.E. 535 Physico-chemical Properties of Gases and Liquids
- Ch.E. 543 Reactor Design
- Ch.E. 554 Chemical Engineering Analysis
Chemical Engineering

2) Polymer Science
Ch.E. 80 Introduction to Polymer Science
Ch.E. 81 Physical Chemistry of Polymers
Ch.E. 82 Polymer Technology

3) Extractive Metallurgy
Ch.E. 85 Introduction to Extractive Metallurgy
Ch.E. 86 Metallurgical Chemistry
Ch.E. 87 Principles of High Temperature Extractive Metallurgy

4) Mathematical Analysis and Control
Ch.E. 554 Chemical Engineering Analysis
Ch.E. 552 Process Dynamics and Control 2
Ch.E. 73 Process Control Laboratory
Ch.E. 650 or an approved course from Management Science or Mathematics is recommended if more than three courses in this option are desired.

5) Biochemical Engineering
Ch.E. 590 Introduction to Biochemical Engineering
Ch.E. 591 Fermentation Processes
Ch.E. 592 Processing of Biological Materials

6) Research Project
Ch.E. 98 Research and Design Project 1 (equivalent to one course)
Ch.E. 99 Research and Design Project 2 (equivalent to two courses)

Academic Programmes for Each Term (1971-72) Chemical Engineering

Year 2A, Fall 1971 and Winter 1972
Math. 22 Chem. 22
Math. 23 Chem. 26
E.E. 10 Ch.E. 31
Non-technical elective

Year 2B, Fall 1971 and Spring 1972
Math. 31 Ch.E. 16
Math. 32 Ch.E. 32
Chem. 36 Ch.E. 36
Non-technical elective

Year 3A, Winter 1971 and Spring 1972
Ch.E. 12 Ch.E. 21
Ch.E. 17 Ch.E. 41
Ch.E. 18
Non-technical elective

Year 3B, Fall 1971 and Winter 1972
Ch.E. 22 Ch.E. 42
Ch.E. 33 Ch.E. 71
Ch.E. 35
Technical elective
Non-technical elective

Year 4A, Fall 1971 and Spring 1972
Ch.E. 23 Ch.E. 95
Ch.E. 51 Technical elective
Ch.E. 61 Technical or non-technical elective
Ch.E. 72
Civil Engineering

Civil Engineers plan, design, and supervise the construction of such facilities as bridges, buildings, railways, highways, dams, water supply systems, and waste disposal systems. The demands of society for such facilities are so great that civil engineers, fulfilling these demands, spend well over a tenth of our total national income—more money than is spent by any other engineering or professional group.

The curriculum provides a modern approach to the subject based on a thorough grounding in mathematics and natural sciences. Because of the need for a broad understanding of the principles of Engineering, students are also introduced to other engineering subjects such as thermodynamics and electricity as a preparation for Civil Engineering studies. Whereas complete professional specialization can be achieved only in postgraduate study and in engineering practice, the students can find opportunity to pursue advanced undergraduate study in a variety of areas. For example:

a) Structural Engineering—intended for students primarily interested in design and construction of structures; emphasis is placed on a broad foundation in mechanics and behaviour of materials.

b) Environmental Health Engineering—the major attention in this option is given to studies of water and air resources supply, treatment, and disposal, industrial hygiene, radiation protection, control of communicable diseases and environmental sanitation and design of municipal facilities.

c) Transportation Engineering—is intended for the student interested in the planning, design, construction and traffic operation of streets and highways. Emphasis is placed on planning and design related to traffic demands.

d) Geotechnical Engineering—is designed to provide the student with an understanding of the engineering properties of soils and enable him to appreciate the methods behind the design of foundations of structures, earth retaining structures, earth dams and highway pavements.

e) Engineering Mechanics—for students with a strong interest in a rigorous study of mechanics and related fields, leading to an understanding of advanced structural analysis and serving as a preparation for graduate study in structural engineering, hydraulics, mechanics of solids and fluids, or properties of materials.

f) Hydraulic Engineering—is intended for the student interested in the planning, design and operation of water supply and management.

g) Experimental Mechanics—for students with an interest in the experimental investigations of static and dynamic response of structures and machines, in theory and technique of experimental methods and in the rheology of materials used in experimental mechanics.

h) Materials—is intended to provide the student interested in structural engineering, mechanics or properties of materials with a background in materials science.

A. Core Programme

a. Engineering Courses

E.E. 10 Introduction to Electrical Engineering
M.E. 12 Kinematics of Engineering
Civil Engineering

M.E. 15 Structure and Properties of Materials 1
M.E. 50 Thermodynamics

b. Civil Engineering Core Courses
C.E. 200 Systems 2 (Special Problems)
C.E. 201 Mechanics of Deformable Solids 1
C.E. 202 Mechanics of Deformable Solids 2
C.E. 221 Calculus 2
C.E. 222 Differential Equations
C.E. 223 Computer Programming
C.E. 232 Systems 1 (Economics and Social Sciences)
C.E. 241 Survey Camp
C.E. 298 Seminar
C.E. 299 Seminar
C.E. 303 Structural Analysis 1
C.E. 304 Structural Analysis 2
C.E. 305 Structure and Properties of Materials 2
C.E. 321 Statistics
C.E. 322 Engineering Analysis
C.E. 350 Fluid Mechanics
C.E. 351 Hydraulics
C.E. 361 Urban Planning
C.E. 362 Transportation Engineering
C.E. 371 Geology for Engineers
C.E. 372 Soil Mechanics
C.E. 398 Seminar
C.E. 399 Seminar
C.E. 400 Systems 3 (Project)
C.E. 401 Structural Steel
C.E. 402 Reinforced Concrete 1
C.E. 451 Water Resources and Sanitary Engineering
C.E. 471 Soil Engineering
C.E. 498 Seminar
C.E. 499 Seminar

B. Elective Courses
The technical electives may be selected from the list below in consultation with a Civil Engineering faculty advisor.
G.E. 61 History and Philosophy of Science
C.E. 403 Reinforced Concrete 2
C.E. 404 Design of Steel Structures
C.E. 452 Environmental Health Engineering
C.E. 481 Engineering Law
C.E. 500 Systems 4 (Project)
C.E. 501 Approximate Analysis of Structures
C.E. 502 Failure in Metal Assemblies
C.E. 504 Structural Analysis I
C.E. 505 Structural Analysis II
C.E. 506 Project Management
C.E. 507 Advanced Analysis of Structures
C.E. 510 Advanced of Materials Solids
C.E. 520 Computer Applications to Engineering Problems
C.E. 522 Engineering Analysis 2
C.E. 530 Fundamentals of Experimental Mechanics and Engineering Measurements
C.E. 531 Introduction to Experimental Strength Analysis
C.E. 540 Highway Engineering (Planning and Design)
C.E. 541 Pavement Materials
Civil Engineering

C.E. 543 Land Use Models
C.E. 546 Geometric Design of Highways
C.E. 551 Engineering Aspects of Surficial Soils
C.E. 560 Mechanical Behaviour of Materials
C.E. 572 Topics in Waste Treatment
C.E. 573 Hydraulic Considerations in Water Pollution
C.E. 580 Engineering Aspects of Water Resources Planning

Appropriate courses offered in other Departments and certain graduate courses are also available as technical electives upon the consent of the instructor.

### Academic Programmes for Each Term (1970-71)

#### Year 2A

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures hrs./week</th>
<th>Labs or each problems hrs./week</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.E. 10</td>
<td>Introduction to Electrical Engineering</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 12</td>
<td>Kinematics and Dynamics</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>C.E. 201</td>
<td>Mechanics of Deformable Solids 1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 221</td>
<td>Calculus 2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 232</td>
<td>Systems 1 (Economics and Social Sciences)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 241</td>
<td>Survey Camp**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.E. 298</td>
<td>Seminar</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-technical elective *</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Year 2B

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures hrs./week</th>
<th>Labs or each problems hrs./week</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.E. 15</td>
<td>Structure &amp; Properties of</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 50</td>
<td>Thermodynamics</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>C.E. 200</td>
<td>Systems 2 (Special Problems)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 202</td>
<td>Mechanics of Deformable Solids 2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 222</td>
<td>Differential Equations</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 223</td>
<td>Computer Programming</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 241</td>
<td>Survey Camp **</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.E. 299</td>
<td>Seminar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Year 3A

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures hrs./week</th>
<th>Labs or each problems hrs./week</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 303</td>
<td>Structural Analysis 1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 305</td>
<td>Structure and Properties of Materials 2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 321</td>
<td>Statistics</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>C.E. 350</td>
<td>Fluid Mechanics</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 361</td>
<td>Urban Planning</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>C.E. 371</td>
<td>Geology for Engineers</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 398</td>
<td>Seminar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Year 3B

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures hrs./week</th>
<th>Labs or each problems hrs./week</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 304</td>
<td>Structural Analysis 2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 322</td>
<td>Engineering Analysis</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 351</td>
<td>Hydraulics</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>C.E. 362</td>
<td>Transportation Engineering</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>C.E. 372</td>
<td>Soil Mechanics</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 399</td>
<td>Seminar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Electrical Engineering

Year 4A

The 4A programme consists of five courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 400</td>
<td>Systems 3 (Project)</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 451</td>
<td>Environmental Health</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>and any two of</td>
<td></td>
</tr>
<tr>
<td>C.E. 401</td>
<td>Structural Steel</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 402</td>
<td>Reinforced Concrete I</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 471</td>
<td>Soil Engineering</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>plus one elective ***</td>
<td></td>
</tr>
</tbody>
</table>

Year 4B

The programme consists of 6 courses, 4 that are technical electives and 2 that are non technical electives (the non technical electives can be replaced by technical electives), and CE 499, the class professor hour.

Alternate Weeks

* Non Technical electives: To be chosen from courses available during the particular term provided that no scheduling conflicts exist. Examples: English, Fine Arts, German, Russian, Philosophy, Political Science, Psychology, Religious Studies, Anthropology, Sociology, General Engineering.

**Survey Camp. given in the Fall of each year prior to registration for either 2A or 2B.

*** The technical elective could be CE 401, 402, or 471.

Electrical Engineering

The curriculum in Electrical Engineering is designed to teach those fundamental physical and engineering sciences which form the basis of the work of electrical engineers. After the common first year programme in Engineering consists of sixteen core courses and a minimum of nine technical electives (taken during the last two terms): these technical electives include the possibility of working on a design type of project. In addition, students are normally required to take one non-technical elective course in each term, and one general seminar course. The department uses a broad interpretation of what constitutes a “non-technical elective”.

The normal recommended programme shown below involves a course load (excluding seminar) of 5 courses per term; however, students are allowed to depart from this normal load within the framework of the following rules and within the constraints of the timetable:

The technical programme will consist of a minimum of all 16 core courses and 9 technical electives (including the possibility of 1 or 2 final year project electives).

The non-technical programme will consist of one general seminar course and one non-technical elective per term, except that students requiring more than six successful terms to complete the technical programme are not required to pass more than six non-technical electives.

A student must carry at least 4 courses per term and may carry at most 6 courses per term (excluding seminar).

The maximum number of terms of resident study to be as stipulated in the Calendar (viz. 10 terms, see page 47.

The normal rules of the cooperative programme will apply. By special permission the number of cooperative work terms may be reduced, but a
first year)—unless he is a student admitted to advanced standing, as defined in the Calendar (see page 50).

The student must register his course load at the start of each term. Department permission at the time of registration will be required for departing from the normal load of 5 courses in any one term.

Permission to carry 6 courses in any one term will normally be given only if the student holds an A average in the previous term.

The promotion criteria will be as laid down in the Faculty rules, (see page 50) and the student will be examined on the basis of the courses for which he is registered at the time of examination.

<table>
<thead>
<tr>
<th>Programme</th>
<th>(a) Core (Years 2 and 3)</th>
<th>Lect.</th>
<th>Lab</th>
<th>Sem.</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.E. 217</td>
<td>Electronic Computers &amp; Numerical Analysis</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 233</td>
<td>Physical Electronics</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 241</td>
<td>Electric Networks 1</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 261</td>
<td>Selectromechanics</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 271</td>
<td>Electric &amp; Magnetic Field</td>
<td>2</td>
<td>3*</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 316</td>
<td>Probability &amp; Statistics</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 324</td>
<td>Principles of Digital Computers</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 342</td>
<td>Electric Networks 2</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 351</td>
<td>Electronics 1</td>
<td>2</td>
<td>3*</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 352</td>
<td>Electronics 2</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 362</td>
<td>Energy Conversion</td>
<td>2</td>
<td>3*</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 372</td>
<td>Electromagnetic Theory &amp; Applications</td>
<td>2</td>
<td>3*</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 380</td>
<td>Introduction to Systems &amp; Control</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>M.E. 50</td>
<td>Thermodynamics</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Math. 22</td>
<td>Calculus 2</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Math. 35</td>
<td>Calculus 3</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

(b) Technical Electives

<table>
<thead>
<tr>
<th>Programme</th>
<th></th>
<th>Lect.</th>
<th>Lab</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>E.E. 425</td>
<td>System Simulation</td>
<td>2</td>
<td>3**</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 426</td>
<td>Switching Systems</td>
<td>2</td>
<td>3**</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 427</td>
<td>Design of Discrete Signal Systems</td>
<td>2</td>
<td>3***</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 428</td>
<td>Communication Theory I</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 429</td>
<td>Communication Theory</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 434</td>
<td>Magnetic Materials and Quantum Electronics</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 435</td>
<td>Semiconductor Devices 1</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 436</td>
<td>Semiconductor Devices 2</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 453</td>
<td>General Electronic Circuits</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 454</td>
<td>Pulse and Switching Circuits</td>
<td>2</td>
<td>3**</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 463</td>
<td>Introduction to Power Engineering</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 464</td>
<td>Power Apparatus</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 473</td>
<td>Microwave Engineering</td>
<td>2</td>
<td>3**</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 474</td>
<td>Antenna and Propagation Engineering</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 481</td>
<td>Control Systems</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 499A</td>
<td>Project</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>E.E. 499B</td>
<td>Project</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>E.E. 543</td>
<td>Electric Networks 3</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>
Normal Academic Programmes for each term (1971-72) Electrical Engineering

Note: Students may depart from this programme within the framework of the rules given above, and within the constraints of the timetable.

2A Term: Winter 1971, Fall 1971, Winter 1972
M.E. 50; Math 22; E.E. 201; E.E. 241; E.E. 271; non-technical elective.

2B Term: Summer 1971, Fall 1971, Summer 1972

3A Term: Winter 1972, Summer 1972
E.E. 301; E.E. 316; E.E. 342; E.E. 351; E.E. 362; non-technical elective.

3B Term: Fall 1971, Winter 1972

4A Term: Summer 1971, Fall 1971, Summer 1972
E.E. 401 and a non-technical elective plus 5 technical electives† from E.E. 425; E.E. 426; E.E. 428; E.E. 435; E.E. 454; E.E. 463; E.E. 473; E.E. 481; E.E. 499A; Math 44; E.E. 546.

4B Term: Winter 1972

The undergraduate course descriptions will be found on page 251.

† With the approval of the Department, students may take technical courses offered by other departments.

Mechanical Engineering

The scope of mechanical engineering is so wide and its services so universally needed as a basic part of all kinds of engineering work that the mechanical engineer is in demand in a variety of industries.
where he would deal with steam, diesel or other internal combustion engines, and with hydraulic or gas turbines; in the field of heating, ventilating and refrigeration; in the design and manufacture of material handling equipment, automobiles, locomotives, aircraft, rockets, marine vessels, furnaces, boilers, pressure vessels, heat exchangers, motors, generators and machine tools. He is employed in industries such as steel production, mining, transportation, communications, oil refining, chemicals manufacture, paper, sugar, textiles, the government, and construction. In the last few years additional demands have been imposed by the requirement that Mechanical Engineers understand and lead in the development of new methods of energy conversion and other technologies of the space age. The undergraduate programme in Mechanical Engineering is designed to provide the student with a firm grasp of the basic fundamentals in the mathematical, physical, chemical, and engineering sciences, and also provides an opportunity (on a limited scale) for specialization in the later years. The degree of B.A.Sc. in Mechanical Engineering carries exemption from parts 1 and 2 of the Institution of Mechanical Engineers (London) Examination.

Organization of the Mechanical Engineering undergraduate programme is founded on a core of subjects that must be taken by all students. The first year is common with other branches of engineering. The second year provides elementary courses in Mechanical Engineering and certain branches of Civil and Electrical Engineering together with further development in mathematics and physics. Opportunities for specialization occur during the third and fourth years, there being a choice of elective subjects available to permit pursuit of individual interests. A coherent set of electives in a particular technical area is termed an Option. Examples of such Options are the following:

a) The Thermodynamics-Fluid Mechanics Option: The courses in this option deal with a broad range of applications of the principles of thermodynamics and fluid mechanics, with emphasis on topics of industrial significance.

b) Solid Body Mechanics and Mechanical Design Option. The courses offered in this option range from those which provide the mathematical and physical basis of the subject matter through to those which are largely applied. Subjects treated are: mechanics (including vibrations); theories of elasticity, plasticity and fracture; choice of working stress, mechanical design and design optimization. Students taking this option will be prepared for careers in design and development, or graduate study.

c) Manufacturing Sciences Option—is designed to provide the student with an understanding of industry from the viewpoint of its organization, its processes, and the application of mathematics to its operation. It is suggested for those students primarily interested in the industrial aspects of mechanical engineering.


e) Geophysical (Environmental) Fluid Dynamics Option—For students interested in the control of air and water pollution and noise abatement, or who wish to embark later on a research career in meteorology,
Mechanical Engineering

_f) General Mechanical Engineering Option_ — The General Mechanical Engineering Option is designed to give the student a general background rather than specialize in any particular option. The course material has been carefully chosen to equip the student for a broad range of Mechanical Engineering practice including research.

A. Core Programme  

a) Credit courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Lect.</th>
<th>Lab. or Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.E. 14 Electromagnetics</td>
<td>2</td>
<td>3*</td>
</tr>
<tr>
<td>E.E. 32 Electronics</td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td>M.E. 1 Advanced Calculus</td>
<td>2</td>
<td>2*</td>
</tr>
<tr>
<td>M.E. 2 Statistics for Engineers</td>
<td>3</td>
<td>2*</td>
</tr>
<tr>
<td>M.E. 3 Ordinary Differential Equations</td>
<td>3</td>
<td>2*</td>
</tr>
<tr>
<td>M.E. 4 Numerical Analysis</td>
<td>3</td>
<td>2*</td>
</tr>
<tr>
<td>M.E. 10 Systems Dynamics</td>
<td>3</td>
<td>1*</td>
</tr>
<tr>
<td>M.E. 12 Dynamics</td>
<td>3</td>
<td>1*</td>
</tr>
<tr>
<td>M.E. 15 Structure and Properties of matter</td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td>M.E. 16 Modern Physics</td>
<td>3</td>
<td>1*</td>
</tr>
<tr>
<td>M.E. 19 Mechanics of Deformable Solids 1</td>
<td>2</td>
<td>2*</td>
</tr>
<tr>
<td>M.E. 20 Mechanics of Deformable Solids 2</td>
<td>2</td>
<td>2*</td>
</tr>
<tr>
<td>M.E. 21 Kinematics and Dynamics of Machines</td>
<td>2</td>
<td>3*</td>
</tr>
<tr>
<td>M.E. 30 Structure and Properties of matter 2</td>
<td>2</td>
<td>3*</td>
</tr>
<tr>
<td>M.E. 50 Thermodynamics</td>
<td>3</td>
<td>1*</td>
</tr>
<tr>
<td>M.E. 51 Fluid Mechanics 1</td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td>M.E. 53 Heat Transfer 1</td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td>M.E. 60 Control Theory</td>
<td>3</td>
<td>3*</td>
</tr>
</tbody>
</table>

b) Non-Credit Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Lect.</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.E. 200 Introduction to Mechanical Engineering 1</td>
<td>1</td>
</tr>
<tr>
<td>M.E. 300 Introduction to Mechanical Engineering 2</td>
<td>1</td>
</tr>
<tr>
<td>M.E. 400 Introduction to Mechanical Engineering 3</td>
<td>1</td>
</tr>
</tbody>
</table>

B. Elective Course

a) Non-technical electives: Students entering the programme will take three non-technical electives.

b) Technical Electives: Eight elective courses are required in addition to the core courses listed above to fulfill the requirements of the Mechanical Engineering programme. Also each student will complete a two-term Mechanical Engineering Project (ME 82) or four additional technical electives. Electives should be chosen largely from a single option and the choice must be approved by a designated faculty member.

a) Thermodynamics—Fluid Mechanics Option

<table>
<thead>
<tr>
<th>Course</th>
<th>Lect.</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.E. 52 Air Conditioning</td>
<td></td>
</tr>
<tr>
<td>M.E. 54 Thermodynamics 2</td>
<td></td>
</tr>
<tr>
<td>M.E. 55 Refrigeration Engineering</td>
<td></td>
</tr>
<tr>
<td>M.E. 56 Heat Transfer 2</td>
<td></td>
</tr>
<tr>
<td>M.E. 58 Internal Combustion Engines</td>
<td></td>
</tr>
<tr>
<td>M.E. 59 Energy Conversion</td>
<td></td>
</tr>
<tr>
<td>M.E. 62 Fluid Mechanics 2</td>
<td></td>
</tr>
<tr>
<td>M.E. 64 Industrial Aerodynamics</td>
<td></td>
</tr>
<tr>
<td>M.E. 555 Thermodynamics 3</td>
<td></td>
</tr>
<tr>
<td>M.E. 557 Combustion 1</td>
<td></td>
</tr>
<tr>
<td>M.E. 560 Instrumentation</td>
<td></td>
</tr>
<tr>
<td>M.E. 561 Fluid Control Systems</td>
<td></td>
</tr>
<tr>
<td>M.E. 562 Control Theory 2</td>
<td></td>
</tr>
<tr>
<td>M.E. 563 Turbomachines</td>
<td></td>
</tr>
</tbody>
</table>
M.E. 564 Dynamics of Biomedical Systems
M.E. 565 Gas Dynamics 1
M.E. 566 Turbulent Flow 1
M.E. 567 Aerodynamics of Flight
M.E. 568 Acoustics
M.E. 576 Control System Design

b) Solid Body Mechanics and Mechanical Design Option
M.E. 22 Mechanical Design 1
M.E. 523 Mechanical Design 2
M.E. 524 Advanced Dynamics
M.E. 525 Mechanical Vibrations
M.E. 527 Mechanics of Deformable Solids 3
M.E. 528 Experimental Mechanics
M.E. 549 Analysis of Design of Machine Tools
M.E. 626 Creep, Fatigue and Brittle Fracture
S.D. 501 Human Factors
S.D. 502 Ergonomics

c) Manufacturing Sciences Option
M.E. 41 Manufacturing Science 1
M.E. 42 Manufacturing Science 3
M.E. 43 Manufacturing Science 4
M.E. 45 Manufacturing Science 6
M.E. 46 Manufacturing Science 7
M.E. 47 Analysis and Design of Manufacturing Systems
M.E. 49 Metrology
M.E. 544 Manufacturing Science 5
M.E. 548 Numerical Control of Machine Tools 1
M.E. 549 Analysis of Design of Machine Tools

suggested electives from other options and departments
M.E. 22 Mechanical Design 1
M.E. 531 Physical Metallurgy 1
M.E. 534 Properties of Polymers
S.D. 501 Human Factors
S.D. 502 Ergonomics
Ch.E. 80 Introduction of Polymer Science
Ch.E. 81 Physical Chemistry of Polymers
M.S. 404 Industrial Psychology

d) Engineering Materials Option
M.E. 32 Physical Metallurgy 2
M.E. 33 Materials Science Laboratories
M.E. 90 Engineering Physics
M.E. 531 Physical Metallurgy 1
M.E. 534 Properties of Polymers
M.E. 537 Ceramics
M.E. 638 Physical Examination of Materials
M.E. 641 Mechanical Metallurgy

Suggested electives from other options and departments
M.E. 22 Mechanical Design 1
M.E. 41 Manufacturing Science 1 (Plasticity)
M.E. 56 Heat Transfer 2
M.E. 527 Mechanics of Deformable Solids 3
M.E. 544 Manufacturing Science 5 (Welding)
M.E. 62 Fluid Mechanics 2
M.E. 69 Introduction to the Environment Sciences
M.E. 566 Turbulent Flow 1
M.E. 568 Acoustics
M.E. 570 Geophysical Fluid Dynamics 1
M.E. 571 Air Pollution 1
M.E. 572 Ocean Engineering

Graduate courses in this field may also be available to selected undergraduate students.

f) General Mechanical Engineering Option
Programme should include all of the following courses:
M.E. 22 Mechanical Design 1
M.E. 32 Physical Metallurgy
M.E. 41 Manufacturing Science 1
M.E. 56 Heat Transfer 2
M.E. 62 Fluid Mechanics 2
M.E. 528 Experimental Mechanics
M.E. 563 Turbomachines

G) Courses Open to All Options
M.E. 2 Statistics for Engineers
M.E. 501 Partial Differential Equations
M.E. 502 Functions of Complex Variables
M.E. 503 Advanced Vectors, Tensors and Matrices
M.E. 504 Numerical Analysis 2

Academic Programmes for Each Term (1970-71)

Year 2A Fall 1971 and Winter 1972
M.E. 1
M.E. 2
M.E. 15
M.E. 19

Year 2B Summer 1971 and Fall 1971
M.E. 3
M.E. 20
M.E. 4

Year 3A Summer 1971 and Winter 1972
M.E. 5 (Summer 71 only)
M.E. 10
M.E. 21
M.E. 30

One group (g) elective
(Winter 72 only)

Year 3B Fall 1971 and Winter 1972
M.E. 53
M.E. 60
E.E. 32

Year 4A Summer 1971 and Fall 1971
M.E. 82 or 2 technical electives
1 non-technical elective
3 technical electives
Systems Design

The Department of Systems Design (formerly the Department of Design) was formed at Waterloo in 1965. Since that time it has received international recognition for its graduate programmes, research activities and design projects. The most widely known of these many efforts include the Department's design and research work for Exop '67, Canada's Centennial World Exposition, its sponsorship of three international design conferences, its research into design morphology, and its development of creative teaching methods from the point of view of pedagogy, content and advanced hardware facilities. In 1969 the department extended its scope of interest and began offering a distinctive undergraduate programme.

Systems Design Undergraduate Programme

A system can be defined in its most general form as a collection or assemblage of items united by some form of interaction or inter-dependence. In this sense a set of particles executing attraction on one another is a system; so is an organization of human beings; so is an electrical network; and so is practically any conceivable set of interrelated entities. Thus the study of systems can have very broad applications. Indeed the study of systems can have very broad applications. Indeed the distinguishing characteristic of system theory is its generality.

Within the last decade it has become increasingly apparent that effective solutions to problems involving both society and technology must be based on a broad systems point-of-view. Not only must the overall technical factors of these problems be carefully considered, but the economic, social, human and political parameters must be given equally careful attention. When large scale problems are under study, few people can be knowledgeable in the complete span of factors and parameters which must be considered. For these cases, solutions must be arrived at by interdisciplinary teams where each member contributes his own special expertise. In order to work effectively on this team, each member needs to be aware of the fundamental systems and design aspects of the problem.

The undergraduate programme in Systems Design Engineering at Waterloo is a study of those basic skills required for system analysis, simulation, optimization and design. Numerous examples may be cited where these Systems Design fundamentals may be applied: transportation, engineering design, computer applications, production, planning and scheduling, environmental pollution, education, etc. Of course the importance of specialized expertise in these areas should not be minimized, but these skills usually work most effectively toward problem solutions when operating within an overall systems context.

The tools for systems problem solving are becoming more powerful and sophisticated; thus larger and more complex systems may be successfully investigated. Recent development include an increasing awareness of the theories of communication, progress in the areas of Systems Theory, Human Systems Engineering and Socio-Economic Systems, developments in the theories of Design and Planning and, of
The undergraduate programme in Systems Design Engineering has been created to provide each student with a broad background and capability in the following areas:

- applied mathematics
- engineering systems
- socio-economic systems
- human systems engineering
- computer applications
- design and project planning

These fundamentals are, for the most part, covered in the first three academic years of the programme. During the fourth and final year, each student may choose a set of technical electives within a topic area according to his individual interests. These elective courses enable each student to begin a programme of professional specialization. At present there are a number of areas to choose from including:

- Computer Systems
- Control Systems
- Human Systems Engineering
- Management Systems
- System Theory
- Industrial and Product Design
- Transportation Systems
- Water Resource Systems

An integral part of the programme during the second, third and fourth years is the Systems Design Workshop. In the Workshop, each student learns to tackle real-life systems problems at a progressively more sophisticated level. These problems are selected to challenge the students to become active partners in the educational process. It is here that the student learns to meaningfully apply his lecture material, develop his skills for interdisciplinary work, and test his design, planning and organizational abilities. Moreover, in the Workshop he learns how to acquire knowledge and techniques in the face of new and demanding problems. In a fast changing world where old ideas and skills can rapidly become obsolete, this can be an important asset indeed.

The Systems Design Engineering programme is specifically oriented towards developing graduates who can solve problems lying at the interface of technology and the human environment. It is therefore attractive to those students who are technically oriented and also have a strong parallel interest in social and human problems.

Graduates of Systems Design Engineering will find employment opportunities in a number of diverse fields although to some extent, the elective area chosen by the student in the fourth year will determine more specifically what he does upon graduation.

<table>
<thead>
<tr>
<th>A. Core Programme</th>
<th>Lect</th>
<th>Tut</th>
<th>Lab./Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.D. 110 Calculus 1</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>S.D. 111 Calculus 2</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>S.D. 112 Finite Mathematics</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>S.D. 113 Linear Algebra</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>S.D. 114 Design of Experiments</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>S.D. 120 Digital Computation 1</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>S.D. 121 Digital Computation 2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
S.D. 216 Theory and Applications of Statistics 2 1
S.D. 217 Differential Equation 2 1
S.D. 221 Numerical Analysis and Computation 2 1
S.D. 322 Computer Simulation of Systems 2 1
S.D. 323 Computer Aided Design 2 1
S.D. 241 Human Systems Engineering 2 1
S.D. 242 Human Systems Engineering 2 1
S.D. 343 Human Systems Engineering 2
S.D. 444 Human Systems Engineering 2
S.D. 151 Physics 1 3 2
S.D. 152 Physics 2 3 2
S.D. 251 Physical Systems 1
S.D. 352 Physical Systems 2 2 1
S.D. 453 Physical Systems 3 2 1
S.D. 180 Graphics 2 1
S.D. 130 Engineering Economics 2 1
S.D. 231 Micro-Economics Analysis and Policy 2
S.D. 332 Statistical Models Socio-Economic Systems 2
S.D. 334 Elements of Operations Research 2 1
S.D. 336 Conflict Analysis 2 1
S.D. 433 Macro-Economics and Public Policy 2 1
S.D. 454 Optimization Theory 2 1
S.D. 160 Engineering Synthesis 2 2 2
S.D. 261 Systems Design Workshop 1 2 4
S.D. 262 Systems Design Workshop 2 2 4
S.D. 363 Systems Design Workshop 3 2 4
S.D. 364 Systems Design Workshop 4 2 4
S.D. 465 Systems Design Workshop 5 2 4
S.D. 466 Systems Design Workshop 6 2 4
S.D. 381 Applied Electronics 2 1 3
E.E. 271 Electricity and Magnetism 2 3
G.E. 31 Thermodynamics 2 1
G.E. 41 Mechanics of Deformable solids 2 1 2

B. Elective Courses Nine Technical Elective Courses are required in addition to the core courses listed above to fulfill the requirements of the Systems Design Engineering programme. Students are also required to enroll in one non-technical course each semester; a special General Studies Series of courses is being developed for this purpose.

Academic Programmes for each term (1971-72) Systems Design

Year IA Fall 1971 (Class of 1976)
S.D. 110
S.D. 112
S.D. 114
S.D. 120
S.D. 150
S.D. 180

General Studies 1.

Year IB Spring 1972 (Class of 1976)
S.D. 111
S.D. 151
Solid Mechanics Division

General Studies 2

*Year 2A Winter 1972 (Class of 1975)*

- S.D. 215
- S.D. 231
- S.D. 241
- S.D. 217
- E.E. 271
- S.D. 261

General Studies 3

*Year 2B Fall 1971 (Class of 1974)*

- S.D. 216
- S.D. 221
- S.D. 242
- S.D. 251
- S.D. 262
- G.E. 41

General Studies 4

*Year 3A Spring 1972 (Class of 1974)*

- S.D. 322
- S.D. 334
- S.D. 336
- S.D. 352
- S.D. 363
- Tech. Elective

General Studies 5

Solid Mechanics Division

With the rapid change in technology, the subdivision of engineering reflected in the traditional undergraduate departments is augmented spontaneously with new natural groups in the more active areas. Recognizing the need for such new groups while maintaining the contact within the established professional subdivisions in engineering, this faculty in 1968 established the organization unit of Graduate Divisions cutting across departmental boundaries. The Solid Mechanics Division is the first such division, arising out of the need in various branches of engineering based on the science of applied mechanics. In recognition of this need and the particular potential for development at the University of Waterloo in the fields of Solid Mechanics, a $600,000.00 National Research Council of Canada Special Development Grant was awarded, this grant being administered by the Chairman of the Solid Mechanics Division. The Division is primarily active at the level of graduate study and research; members of the Division are simultaneously members of a Department of the University.

The range and level of the Division's activities compares very favourably with those of major centres for research and graduate studies in Solid Mechanics in the world. Currently, there are approximately 90 graduate students working in the field of Solid Mechanics. Approximately 50 of these are Ph.D. candidates. There are about 20 full-time faculty members of the Division and an equal number of research professors, visiting professors and post-doctoral fellows. The laboratories of the Division contain well over a million dollars worth of investment in modern equipment, including a comprehensive facility for material and structural testing, shaking tables for vibrations research, soils testing equipment, as well as the complementary instrumentation and data acquisition equipment.

Prospective graduate students may enroll in one of the Engineering Departments. Financial assistance is available.
processes in solid mechanics, theory of plasticity, instability and vibrations, soil mechanics, fatigue and fracture mechanics, experimental stress analysis, structural optimization, reliability of structures, aero-elasticity and hydro-elasticity, manufacturing technology, and solid bio-mechanics. Further details on the activities, seminars, publications, and graduate courses of the Solid Mechanics Division may be obtained by writing to

Chairman, Solid Mechanics Division,
University of Waterloo,
Waterloo, Ontario, Canada.

Chairman of the Division
M.Z. Cohn, C.Sc. (Bucharest)
S.T. Ariaratnam, B.Sc. (Eng.) (Ceylon), M.Sc. (London), Ph.D. (Cambridge)
D.J. Burns, B.Sc., Ph.D. (Bristol)
R.N. Dubey, B.Sc. (Hons.) (Patna), B.Sc. (Eng) (Bihar), Ph.D. (Waterloo)
D.C. Ferguson, B.A.Sc. (Toronto)
R. Green, B.Sc. (Eng.), M.Sc. (Queen's), M.Sc. (Waterloo), Ph.D. (Texas)
D.E. Grierson, B.A.Sc., M.A.Sc., Ph.D. (Waterloo)
P. Kneen, B.E. (Melbourne) (Hons.), Ph.D. (Waterloo)
S.G. Krishnasamy, B.E. (Madras), M.Sc. (Bangalore), Ph.D. (Waterloo)
F. Legerer, M.Sc. (Vienna), Ph.D. (Vienna)
H.H.E. Leipholz, Dipl.Ing., Dr.Ing., Docent habil (Stuttgart)
B. LeLievre, B.Eng. (West Australia), M.A.Sc., Ph.D. (Waterloo)
W.C. Lennox, B.A.Sc., M.Sc. (Waterloo), Ph.D. (Lehigh)
N.C. Lind, M.Sc. (Tech. Univ. of Denmark), Ph.D. (Illinois)
E.L. Matyas, B.A.Sc. (Toronto), D.I.C., Ph.D. (London)
G.M. McNeice, B.A.Sc. (Waterloo), Ph.D. (London)
J.T. Pindera, Dr. of Tech. Sc. (Warsaw), Docent habil (Cracow)
J. Roorda, B.A.Sc. (Waterloo), Ph.D. (London)
D.M.R. Taplin, A.C.T. (Hons.), B.Sc. (Aston), D.Phil. (Oxford)
T.H. Topper, B.A.Sc. (Toronto), Ph.D. (Cambridge)

Graduate Courses in Solid Mechanics

Below is a list of courses offered by the Departments of Civil and Mechanical Engineering which are directly related to the field of Solid Mechanics. The course descriptions, where available, may be found in the appropriate Department listings.

M.E. 528 Experimental Mechanics
M.E. 611 Mechanics of Continua
M.E. 622 Mechanical Design 4
M.E. 626 Creep, Fatigue and Brittle Fracture
M.E. 641 Mechanical Metallurgy
M.E. 643 Manufacturing Science 2
M.E. 647 Manufacturing Science 8
M.E. 649 Theory of Machining
M.E. 710 Analytical Methods in Vibrations
M.E. 736 Ductility, Fracture and Strengthening of Metals
Biomedical Research Group in the Faculty of Engineering

Members of the Biomedical Research Group include experts outside of the Faculty of Engineering with common research interests. The research projects are directly related to functions of the human body and studies in this area require some knowledge of related disciplines. It is intended that biomedical engineers function as part of an interdisciplinary team. The current research in the group involves electromagnetic effects on tissue, properties of bone, blood flow, surgical cutting tools, the application of fluid control devices to biological flow systems, nerve conduction, and radiation effects on cancer.

Chairman  K.R. Piekarski, Dipl.Ing., Ph.D. (Cambridge)
S.A. Alpay, Dipl.Ing., Dr.Ing. (Berlin)
G.M. Bragg, B.A.Sc. (Toronto), Ph.D. (Cambridge)
D.C. Ferguson, B.A.Sc. (Toronto)
T.M. Fraser, M.D., Ch.B. (Edinburgh), M.Sc. (Ohio State)
J. Kruuv, B.A.Sc., M.Sc., Ph.D. (Western)
W.M. Mansour, B.Sc., M.A.Sc., Ph.D. (Toronto)
H.R. Martin, B.Sc., M.Sc., Ph.D. (Nottingham)
D.G. McFadden, M.D. (Orthop. Surg.)
D.R. McTavish, M.D., F.R.C.F.S.(c), F.R.C.F.S.(c)
R.A. Snyder, B.Sc., Ph.D. (Western)
K.D. Srivastava, B.Sc., B.E. (Hons) (Roorkee) Ph.D. (Glasgow)
A.B. Strong, B.A.Sc. (Waterloo) M.Sc. (Imperial) Ph.D. (Waterloo)
T.E. Unny, B.E., M.Tech., Dr.Ing. (Dresden)
L.Y. Wei, B.S., M.S., Ph.D. (Illinois)
M.M. Yovanovich, B.Sc., M.S., M.E., Sc.D. (MIT)
4 Division of Environmental Studies
Introduction

July 1, 1969 was the inaugural day of a new academic division at the University of Waterloo. This Division of Environmental Studies is comparable to the organization of a regular Faculty, such as Arts, Science, and engineering but is unique in its outlook. It concentrates on all modes of knowledge needed to attack one particular problem area: man and his environment.

The Division of Environmental Studies has within it two types of academic groups—the professional Schools, and the non-professional Departments:

- School of Architecture
- School of Urban and Regional Planning.
- Department of Geography
- Department of Man-Environment Studies.

The professional Schools are specialized, but they are not narrow. Through the Division of Environmental Studies, they are integrated into the mainstream of the university's concern with man and his environment. In addition to educating professionals, they also provide a vital input to the non-professional education side, since they are strongly research oriented—continually seeking, developing, and implementing new knowledge both for the benefit of society and for the benefit of students.

The non-professional Departments represent a grouping of studies which have the interaction of man with his environment as their core. Both the Man-Environment and Geography Departments are interdisciplinary in nature and interact with many fields of study and research from the Arts, Science, Social Sciences, Mathematics, and Engineering.

One of the innovative aspects of the Division of Environmental Studies is the high degree of interaction among its four units. Professors in each School or Department participate in the programmes of the other units, and it is an objective of the Division to make all faculty available to students in any unit of the Division. Interaction with other parts of the University is also fostered, and joint appointments of faculty members with other Faculties and Schools have been made. Students are not only free to, but are encouraged to choose courses from across the whole university.

The School of Architecture

Architecture is the art of translating the needs, aspirations and abilities of society into the structuring of man-built shelters and their environments. It must reflect the greatness and excitement inherent in the exuberance of life and society. An architect must be the creator of buildings, systems of buildings and major segments of the physical environments within which contemporary and future society will function. The School's overriding task is to help students become sensitive to the needs of mankind, and to the changes in these needs commanded by science and technology. The School explores a wide variety of disciplines to equip students with a correlated understanding of these disciplines to Architecture.

The School strives to be a centre for research in order to generate new knowledge and understanding of Architecture and bridge the gap between the humanities and the engineering sciences. The concepts of systems engineering and applied computer science are part and parcel of the preparation of architects in environmental studies.
understanding gives these Architects their excellence. The School of Architecture, in the Division of Environmental Studies, interacts with other environmental disciplines, and draws upon the strengths of other faculties within the University.

Since September 1967, the Bachelor of Environmental Studies/Architecture 3-year programme, leading to a two-year professional Bachelor of Architecture programme, has been offered at the University. The programme is on a co-operative basis, with study and work terms alternating, with the exception of the first two terms, every four months. The curriculum is studio or problem-oriented with courses organized around four major themes.

The main current research activities of Architectural faculty members are computer generated architectural layout, design protocol analysis, environmental perception and group behaviour in problem solving sessions.

The School of Urban and Regional Planning emphasizes the integrated planning of regions, large and small, including both the urban and rural components. In order to implement this approach the School of Planning has gathered a team of faculty with diverse academic backgrounds and various kinds of planning experience.

The emphasis of the programme is on developing an understanding of the role of urban and regional planning in our society. Planning is presented as a process involving problem focusing, goal formulation, survey and analysis, design, action programmes, and implementation. The broad education aim is both to impart an understanding of this process to the student and to prepare him for being an effective participant in the process. Realizing this concept requires the orchestration within the programme of selected elements from the discipline of Geography, which plays a central role, and from other sciences, social sciences, and applied sciences. For this reason, the School of Planning has been located in a Division with an interdisciplinary approach to a wide range of environmental issues.

Within the School, the established undergraduate and graduate Master's and Ph.D. programmes in planning will continue to be offered. The undergraduate programme, the only undergraduate Planning-programme recognized by the Town Planning Institute of Canada, is a four-year Honours programme. The graduate programme, at the Master's and Doctoral level, is designed to meet the needs of both the student who enters from a related discipline and wishes a broad integrating framework, and the student who enters from the undergraduate Planning programme and is seeking an opportunity to specialize. Areas of special interest are regional planning methodology, resource planning, outdoor recreation planning, and the social aspects of planning.

The Department of Geography

Geography is concerned with both the natural and man-made environment, studying how man has shaped it to his needs, how patterns of human activities are structured over space, and how these are influenced by environmental factors. Geography is considered both a natural and social science and flourishes in an academic organization where the multidisciplinary approach is emphasized. The new Bachelor of Environmental Studies (B.E.S.) programme in Honours Geography provides students with almost unlimited freedom to choose supporting electives from across the whole university. Thus, in consultation with professors, every student will be able to have a tailor-made programme.
Besides educating geographers for further graduate work, for teaching, or for jobs with government, industry, and planning agencies, the Geography Department makes a major contribution to the programs in other units of the Division and other parts of the University. For example, a student registered in Arts may still take a substantial number of Geography electives. Also, the students in the Planning programme will continue to take a core of Geography courses most relevant to urban and regional planning.

The Department of Geography has both Master's and Ph.D. graduate programmes. At the graduate level the course work and research are concentrated on some specific subfield of Geography. The Department's areas of research specialization include geomorphology, air photo interpretation, urban and economic geography, agricultural geography and rural development, regional planning and development, and Europe.

The Department of Man-Environment Studies represents a completely new attempt to develop a programme of honours-level education focused on significant issues and problems rather than on a particular academic discipline or profession. As an approach to a type of liberal education, it has been endorsed by leading scholars and teachers. A number of universities have discussed how such an approach might be incorporated into the traditional university structure. The University of Waterloo in 1969 created the new structure in the form of the Department of Man-Environment Studies to accommodate this new multidisciplinary approach.

A wide range of significant problems and issues of the contemporary world can be seen as different expressions of the many ways in which people, either individually or in organizations, relate to their environment, in its social, man-made physical, or natural aspects. The growing world population, the drive for economic and social development and the awesome potential of modern technologies guarantee continued man-environment questions for the future, not the least of which is the ultimate one of survival in a liveable world.

The programme of Man-Environment Studies is necessarily a diversified one, but it retains throughout a basic theme of man-environment interrelationships. The student will study Man from a biological and psychological viewpoint, as well as different social institutions and processes of social change. He will also study environment in the form of man-made physical habitats and the more natural ecological systems. More importantly, he will be investigating various interactions among all of these as he examines a range of expressed problems to be solved, or creative potentials to be realized, to provide for this approach to education. Considerable academic innovation has been necessary or desirable. Team teaching, seminar "learning cells", special small group projects, the use of various media, and field trips are all included. The process is one in which faculty and students will, in most cases, together be developing new insights and understanding in the spirit of incisive inquiry, drawing upon all academic disciplines of relevance to a given problem. The faculty bring to the programme educational qualifications in fields such as biology, economics, sociology, social welfare, anthropology, psychology, fine arts, and communications science, as well as a variety of other experience from such diverse areas as ecological research, the creative arts, international development, economic studies, and urban affairs. During the conduct of the programme, whatever background the faculty can bring to topics under study is supplemented by the participation of faculty from other units in the Division or other Departments in the
Degrees The Division of Environmental Studies offers a Bachelor of Environmental Studies (B.E.S.), Bachelor of Architecture (B. Arch.) Master of Arts (M.A.) and a Ph.D. Degrees may be obtained in the following areas:

B.E.S. — Honours Man-Environment Studies (four years)
B.E.S. — Honours Geography (four years)
B.E.S. — Major in Geography (three years)
B.E.S. — Honours Urban and Regional Planning (four years)
B.E.S. — Architecture (three years), on rotating work/study co-operative scheme
B.Arch — Professional Architecture (two years, with co-operative work terms)
M.A. — Geography
M.A. — Regional Planning and Resource Development
Ph.D. — Geography
Ph.D. — Regional Planning and Resource Development

The student should choose the unit most suited to his interests, but in fact he may have considerable freedom to switch after Year 1 to another unit of the Division, or to some programmes in the Faculty of Arts or the Faculty of Science (depending on his Year 1 choices). Students who register in other Faculties for Year 1 may also have considerable flexibility in transferring into the Division after Year 1. Transfers in later years may be possible on the basis of individual assessment.

Admission Requirements

General Application for admission to the Division of Environmental Studies should be made as early in the year as possible. Academic certificates (not diplomas) and other supporting documents should be forwarded as soon as they become available.

Admission cannot be granted until all the requirements have been met and all the required documents submitted. Applicants currently enrolled in Ontario Grade 13 who wish to be considered for Early Final Admission must apply before January 4, 1971. All other applicants must apply and have submitted all necessary documents by July 1, 1971. Persons applying after these dates cannot be guaranteed consideration of their application.

Since many of the programmes offered at the University have limited enrolment, the possession of the minimum requirements does not in itself guarantee admission to any of the programmes. If clarification is required on any of the admission requirements, applicants should contact the Office of the Registrar, University of Waterloo, Waterloo, Ontario.

The admission requirements listed in the calendar are applicable for admission in September 1971.

Admission Deposit Each applicant admitted to full time studies is required to submit a $50.00 admission deposit. The deposit will be refunded if notice termination is received prior to August 1, 1971.

Application Documents All applicants must submit an application form, and certified transcripts of secondary or post-secondary education. Applicants enrolled in Ontario Grade 13 in the 1970-71 academic year must apply on the “General Application Form.”
Admission Requirements


Applicants not enrolled full time in Ontario Grade 13 must apply on forms available from the Office of the Registrar. In addition at least two letters of reference are required. All educational institutions attended by the applicant must be accounted for on certified documents. Applicants from non-English speaking countries must arrange to submit certified English translations of their academic documents.

Ontario Grade 13 Applicants

Requirements

For applicants currently enrolled full time in an Ontario Grade 13 programme of studies, the overall University requirement will be the assurance from the Secondary School that the prerequisites for the Secondary School Honour Graduation Diploma have been satisfied. Applicants to the Division of Environmental Studies will normally be required to achieve a 60% overall average in their Grade 13 standings. For specialization in geography, man-environment studies, and urban and regional planning, students must have successfully completed the prerequisites for the Secondary School Honour Graduation Diploma.

For specialization in architecture, students must have successfully completed the prerequisites for the Secondary School Honour Graduation Diploma. The specific grade 13 requirements are a 60% overall average in mathematics A (or equivalent) and physics. It is expected that applicants will present a balanced selection of Grade 13 courses.

Because of the increasing use of statistics and quantitative methods in environmental research, it is recommended, but not mandatory, that students present at least one Ontario Grade 13 mathematics paper, or its equivalent, for admission to programmes in Environmental Studies.

Basis of Admission

Students enrolled full time in Ontario Grade 13 will be considered for Early Final Admission. The University expects to fill the majority of places available to Grade 13 applicants using the following criteria:

Grade 13 interim standing
Grade 12 final standing
Principal's recommendation
SACU aptitude and achievement tests results.

Applicants whose interim standings are not sufficient for Early Final Admission will be considered on the basis of Grade 13 final standings and qualified applicants will be admitted until the remaining places are filled.

Applicants who have spent more than the normal length of time in Secondary School to complete their University preparation may be required to present a higher admission average. Applicants who completed their Grade 13 studies in less than the normal period of time will be considered providing that the Grade 13 admission prerequisites are satisfied.

Successful applicants may expect to be notified after May 1, 1971 of their acceptance and will be allowed until June 1, 1971, confirm the offer of admission.

The University reserves the right to withdraw the offer of admission if the applicant fails to complete his year satisfactorily.

Aptitude and Achievement Tests

Service for Admission to College and University - SACU. It is recommended that applicants write the Canadian Scholastic Aptitude Test
Non-Ontario Grade 13 Applicants

Applicants who have taken their secondary school education in other than Ontario Grade 13 will be asked to submit the following certificates recognized as being equivalent to the Ontario Grade 13 certificate. These certificates may be accepted in so far as they meet the admission requirements of the University of Waterloo in subjects and percentages. Applicants from countries not mentioned in the following list can obtain detailed admission requirements from the Office of the Registrar.

Alberta
British Columbia
Manitoba
New Brunswick
Newfoundland
Nova Scotia
Prince Edward Island
Quebec
Saskatchewan
England and Wales, West Indies, East and West Africa
Scotland
United States of America

Senior Matriculation (Grade 12)
Senior Matriculation (Grade 13)
Senior Matriculation (Grade 12)
Senior Matriculation (Grade 13) subjects.
Year 1 Memorial University
Senior Matriculation (Grade 12)
Year 1 University of
Prince Edward Island
First Year CEGEP programme
Senior High School Leaving Certificate.
Senior Matriculation (Grade 12)
The General Certificate of Education
with passes in at least five subjects,
two of which must be
at Advanced Level.
The Scottish Certificate of Education
High School Graduation plus an
additional year of formal study in
subjects comparable to Ontario Grade 13 subjects.

Admission as an Adult Student

Any student of mature age who has been away from formal education for more than two years and who does not possess the minimum requirements for admission may apply to enter as an adult student. It is recommended that applicants attempt to obtain standing in at least one Ontario Grade 13 level subject or its equivalent. This subject should relate to the applicant's proposed programme of study at University. Each application will be considered on its merits by the Admissions Committee.

Admission as a Part-time Student

Any candidate wishing to enrol as a part-time student may be allowed to take a maximum of two courses per session. If he wishes to take courses toward a degree, he must meet the regular admission requirements (see above). If he wishes to take courses for University credit but does not wish to pursue a degree, he may be admitted as a non-degree student.

Admission to Advanced Years

An applicant for admission to advanced standing must submit an official transcript from the University or educational institution which he has attended, showing in detail the courses which were taken and the standing in each course. Normally a student granted admission with advanced standing may receive credit for courses taken elsewhere:

a) if the grade earned in such courses is at least C
b) if such courses are relevant to a student's proposed programme in the Division of Environmental Studies.

A) and if the appropriate Division of Environmental Studies department recommends that such courses be credited to the student.
Examinations and Standings

English Proficiency

Students from areas where English is not the common language must provide certified translation of academic certificates. In addition, the applicant may be required to take either “The English Proficiency Tests” prepared by the English Language Institute of the University of Michigan, or the examinations for “The Certificate of Proficiency in English” of the University of Cambridge, in order to satisfy the Admissions Committee that the applicant’s knowledge of the English language is adequate to pursue his studies successfully.

Landed Immigrant Status

Because of the nature of the co-operative programme in architecture where a student attends four months of study with four months of industrial experience, applicants from other countries are strongly recommended to obtain landed immigrant status in Canada before applying for admission to the University. Immigrants from other countries are expected to have one year of residency in Canada before applying for admission to the co-operative programme.

Re-Admission

The University reserves the right to refuse admission to any candidate, and to refuse re-admission if, in the opinion of competent authority, a student is not profiting from University studies.

Registration

September 7, 8, 9, 10, 1971.

Fees

Refer to Section 13 page 502

Examinations and Standings

The following regulations govern the practice of the Division of Environmental Studies in regard to final examinations, standing and make-up examinations. These regulations also apply to part-time students and special programmes.

Students should note that the Division of Environmental Studies operates under a “course system” in which student progress is measured by courses successfully completed rather than by years. Students who have passed fewer than five courses will be considered Year 1 students; those who have passed at least five courses but fewer than ten will be considered Year 2 students; those with at least ten but fewer than sixteen, Year 3, and those with sixteen or more, Year 4.

1. Final Examination

a) In all courses each student is required to submit, in such form and at such time as may be determined by the instructor, evidence of satisfactory participation in term work. The marks obtained for work during term are used in part, in determining standing. At the discretion of the chairman of the department or the director of the School concerned and of the Dean, a student may be barred from the final examination if the course requirements are not completed to the satisfaction of his instructor.

b) Failure to write an examination is ordinarily considered a failure to pass. A student who defaults a final examination, except for a properly certified reason, shall have no make-up examination privileges and must repeat the work in class. If a student fails for medical reasons to write, a Doctor’s certificate, covering the precise period of absence, must be filed in the Registrar’s Office within one week of the set examination date.

c) Appeals against faculty decisions made under these regulations may be made in writing to the Examinations and Standings Committee of the Division Council through the appropriate Undergraduate Affairs Officer.
member. Where final written examinations are required they shall be held in April or May; oral examinations may be required at the discretion of individual departments. The normal time for written examinations is three hours.

2. Standing

a) Letter grades signify the following standings in individual courses:
   
<table>
<thead>
<tr>
<th>Grade</th>
<th>Standing</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Excellent</td>
</tr>
<tr>
<td>B</td>
<td>Good</td>
</tr>
<tr>
<td>C</td>
<td>Average</td>
</tr>
<tr>
<td>D</td>
<td>Poor but passing</td>
</tr>
<tr>
<td>F</td>
<td>Failure</td>
</tr>
</tbody>
</table>

Standing in an individual subject is determined by combining the marks assigned for term work with those obtained in the final examination.

b) For the purpose of striking averages, the following weights will be assigned to grades received in individual courses:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>13</td>
</tr>
<tr>
<td>A-</td>
<td>12</td>
</tr>
<tr>
<td>B</td>
<td>10</td>
</tr>
<tr>
<td>B-</td>
<td>9</td>
</tr>
<tr>
<td>C</td>
<td>8</td>
</tr>
<tr>
<td>C-</td>
<td>6</td>
</tr>
<tr>
<td>D</td>
<td>5</td>
</tr>
<tr>
<td>D-</td>
<td>4</td>
</tr>
<tr>
<td>F</td>
<td>2</td>
</tr>
<tr>
<td>F-</td>
<td>0</td>
</tr>
</tbody>
</table>

For the purpose of calculating overall standing on a subject by subject basis, the following weights will be assigned to grades received in individual courses:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>14</td>
</tr>
<tr>
<td>A+</td>
<td>13</td>
</tr>
<tr>
<td>B</td>
<td>11</td>
</tr>
<tr>
<td>B+</td>
<td>10</td>
</tr>
<tr>
<td>C</td>
<td>8</td>
</tr>
<tr>
<td>C+</td>
<td>7</td>
</tr>
<tr>
<td>D</td>
<td>5</td>
</tr>
<tr>
<td>D+</td>
<td>4</td>
</tr>
<tr>
<td>F</td>
<td>2</td>
</tr>
<tr>
<td>F+</td>
<td>1</td>
</tr>
<tr>
<td>F-</td>
<td>0</td>
</tr>
</tbody>
</table>

c) Over-all standing is determined by the cumulative average of grades assigned for all courses taken at the University except where a course is retaken, when the second grade will be included in the cumulative average regardless of whether it is higher or lower than the first. The first grade will, however, remain on the student's record. Overall standing is indicated by the following terms:

<table>
<thead>
<tr>
<th>Cumulative Average</th>
<th>Honours Programme</th>
<th>General Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-14</td>
<td>First Class Honours</td>
<td>A</td>
</tr>
<tr>
<td>9.00-11.99</td>
<td>Second Class Honours</td>
<td>B</td>
</tr>
<tr>
<td>6.00-8.99</td>
<td>Third Class Honours</td>
<td>C</td>
</tr>
<tr>
<td>3.00-5.99</td>
<td>Conditional</td>
<td>Failure</td>
</tr>
<tr>
<td>2.99 or below</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

d) The only general programme in the Division is the General Geography programme. A regular (full-time) student in the General programme must in each academic year enrol in at least five courses, but in no more than six. A regular student in the Honours programmes must each year enrol in at least six courses (unless otherwise specified in a departmental Honours programme), but in no more than seven.

e) Students may be enrolled for reduced programmes with the approval of the Division or of one of the departments (depending upon the status of the student), and of the Examinations and Standing Committee.

While such programmes are intended to provide greater flexibility, the only formal restriction imposed by the Division is that no Honours Degree shall be granted to a student who has not completed at least one year (other than year one) of his academic work as a full-time student in the Honours course.

f) To be considered in good standing in the General Programme, a student must maintain a cumulative over-all average of at least 6 (C-) as well as an average of at least 7 (C) in his field of specialization. If at any time a student's over-all average falls between 3 (D-) and 5.99 or his average in his field of specialization below 7 (C), he will be granted conditional status for one year, during which period he must make reasonable progress toward obtaining good standing or he will be asked to withdraw. A student whose cumulative over-all average falls below 3 (D-) may continue only with the permission of the Examinations and Standings Committee.

g) To be considered in good standing in the Honours programme, a
Examinations and Standings

(except otherwise specified in a departmental Honours programme). If an Honours degree candidate’s average falls below the prescribed minimum, he will be considered a candidate for the General degree and the regulations in (f) above will apply. If, subsequently, he raises his average to the required level, he may through his Department Chairman or School Director petition the Examinations and Standings Committee to review his case.

h) Even while otherwise in good standing, a student who fails more than two full courses at the annual examinations may be required to withdraw.

i) A student who has been required to withdraw for academic reasons may be eligible to apply for re-admission after one year’s absence.

In addition to the above, the following regulations apply to the School of Architecture:

Examinations and Promotions
To pass from one term in the B.E.S. (Arch) and B.Arch programmes to the next term it is necessary for the student to:
1) obtain an overall average of 60% in all subjects in any term.
2) fail not more than two subjects; a passing grade in any subject is 50%.

The following conditions have been set out for those students who have not obtained an average of 60% and passed with a 50% average in each course:

Failing Average
A student may be advised by the programme director either that he should withdraw from the programme or that he should repeat the term that he has failed.

Supplementary Examinations
If a student fails one or two subjects he is required to pass a supplementary exam in those subjects before being allowed to continue in the course. Examinations will be arranged in accordance with University policy. A student failing to pass in the studio must complete a design project during his work term.

Incomplete Marks
Any student who receives an incomplete standing in any subject will not be readmitted until it has been completed.

Deferred Examination
Arrangements will be made in accordance with University policy.

3. Make-up Examinations
A student will be eligible for make-up examinations only when failure to pass is attributable to extraordinary circumstances. In addition, he must have attended a reasonable number of lectures in the course in which he proposes to write, and must have satisfied all term work requirements:

b) must have secured the permission of the professor concerned and of the Examinations and Standings Committee.

c) make-up examinations are held in late July or early August. Application for these examinations must be filed by the end of June 1971, on forms provided by the Office of the Registrar. Applications received after this date will not be accepted and the student will be considered to have defaulted the examinations. Fees for make-up examinations must accompany the application and, if the student subsequently decides not to write the examination, this fee is not refunded. Make-up examinations must be written at the next regular make-up period.
certified reason, will be considered to have failed the examination. If the student fails to write for medical reasons, a Physician’s certificate covering the precise period of absence must be filed in the Office of the Registrar within one week of the set examination date.

Academic Programmes

A student who has not determined in what field or subject he wishes to concentrate should study the Calendar carefully. After examining the suggested departmental programmes, he should read the descriptions of separate courses in order to have a more comprehensive idea of what the content of any programme would include. He should consult his School Guidance Officer, the chairman of any University department, or the Registrar, by letter or in person for additional clarification or information.

Course and Programme Changes

a) Students may add and drop half-courses during the first three weeks of the Fall and Winter terms upon having the appropriate change form completed.

b) Students may add and drop full year courses during the first three weeks of the Fall term upon having the appropriate change form completed.

c) After these periods, students will be allowed to add courses only with the permission of the instructor and the appropriate undergraduate officer and upon completing the appropriate change form.

d) After these periods, students enrolled in more courses than their programmes require may, upon having the appropriate change form completed, with the signature of the appropriate undergraduate officer, drop courses to reduce their programmes to the specified minimum up to but not later than four weeks prior to the end of lectures in the courses being dropped.

e) Students may reduce their programmes below the specified minimum only under extraordinary circumstances and only with the approval of the Examinations and Standings Committee upon recommendation from their major department.

f) A course that has not been dropped officially (i.e. recorded in the Registrar's Office) prior to the last four weeks of lectures in that course will receive a grade and be counted in the student's average.

Department of Man-Environment Studies

Honours Bachelor of Environmental Studies in Man-Environment Studies

The Department of Man-Environment Studies offers a four-year honours programme. Its main approach is through issue or problem oriented study of man-environment interrelationships, supported by related study in the contributory academic disciplines. The objectives of this programme can be seen from four points of view; that of the student, that of the Division of Environmental Studies, that of the University community, and that of society in general.

For a student, the programme provides one means to obtain a broad-based educational experience which at the same time answers to a degree the growing demand for contemporary “relevance” in the approach and content of higher education. It is not intended for those who desire a programme with sufficient technical input to satisfy some professional qualification at the undergraduate level; however it can
Department of Man-Environment Studies

through graduate study.

For the Division of Environmental Studies, the Man-Environment programme can provide some of the input into the pre-professional training of planners and architects as well as useful perspectives for those who will ultimately enter careers in fields such as teaching, administration and overseas development work. The Department is also in a favourable position to keep in touch with developments in a wider range of academic subjects so that professional programme students are constantly encouraged to form their ideas, attitudes, and goals in the wider context of Man and his environment.

By making some of its elective courses available to students based elsewhere in the university, the Department gives encouragement to the development of an environment-oriented outlook among students whose primary interest otherwise lies in some one particular discipline or profession. The Department can also play a useful function in providing an interdisciplinary focus whereby on-going research in a number of departments in several faculties of the university could be related in a problem-oriented manner.

From the point of view of society in general, the programme offers an educational opportunity which many of today’s students find more challenging than some traditional alternatives. The programme being developed is one which encourages students to acquire an intellectual acumen that is not artificially constrained by academic disciplinary boundaries, to obtain a considerable degree of understanding of complex environmental problems, and to develop some of the technical and other pre-requisite skills which are related to their solution. To the extent the programme succeeds in doing this, it would provide for society a type of well educated person who in due course could usefully contribute to the policy-making function in the public service or in the private sector, or serve particularly well the role of advocate, critic, or initiator in the continuous process of social change and adjustment.

Curriculum

The main feature of this programme is a series of core seminars and workshops (the M-ENV 190*-191 through to 490*-491 series). This consists of problem-oriented sessions on various man-environment themes, and includes seminars, discussions, special small group projects, field trips and some laboratory or studio work where appropriate. Although this series is under the direction of a faculty coordinator, the programme calls upon “resource persons” from the Department, the Division, the University, or the community-at-large. It is intended to provide the opportunity for students, faculty, and others to explore together themes of mutual interest. It is hoped to foster through this experience both a unique spirit of enquiry and approach to environmental issues and a high level of faculty-student rapport.

During the first two years the core seminars are supplemented by some required courses which draw upon material from the biological and social sciences, and elementary data gathering and research techniques. Otherwise, a student is free to round out his own programme of studies with elective choices. The electives may be chosen from a wide range of courses offered within the Division of Environmental Studies and by other departments within the University. They permit a student to extend or deepen his own interests, knowledge or skills in particular areas. Students are urged to give careful consideration to the selection of electives in terms of the objectives they may wish to pursue after obtaining a B.E.S. For the third and fourth year in particular, elective choices should be made in consultation with faculty advisors.
The Honours programme requires a minimum of six courses or the equivalent per semester for the first two years and five courses or their equivalent per semester in the third and fourth years. Each student must have completed twenty-two full courses or the equivalent before graduation and a grade average of B must be maintained in the required courses. The programme is as follows:

**Year 1**
- M-ENV 120* Biological Perspectives on Man's Function and Behaviour
- M-ENV 121* Psychological Perspectives on Man's Function and Behaviour
- M-ENV 130*/131* Aspects of Canadian Society
- M-ENV 150* Man-Environment Research
- M-ENV 190*/191* Core Seminar
- *Electives* five half year courses or equivalent

**Year 2**
- M-ENV 200* Ecology and Environment
- M-ENV 220* Man and Resource Use
- M-ENV 230*/231* Aspects of Canadian Society
- M-ENV 250*/251* Quantitative Techniques for Environmental Problems
- M-ENV 290*/291* Core Seminar
- *Electives* four half year courses or equivalent

**Year 3**
- M-ENV 390*/391* Core Seminar
- *Electives* eight half year courses or equivalent

**Year 4**
- M-ENV 490*/491* Core Seminar
- *Electives* eight half year courses or equivalent

---

### Department of Geography

#### Honours Bachelor of Environmental Studies in Geography

**Nature of the Programme**

The Honours Geography programme provides a sound, well-rounded foundation in the discipline, and prepares the student for specialization at the graduate level in almost any aspect of Geography. The programme includes a group of mandatory core courses that provides a balance of content and technique. The content courses include a series of integrated courses in both physical and human geography, using a systems approach. The technique courses include field methods, air photo interpretation, cartography, statistical analysis, and computer use. The fourth year includes a seminar on the philosophy and research frontiers of Geography and a research project known as the Senior Honours Essay.

In the programme there is emphasis on both the development of theory and methodology and on practical application of geographical concepts to the economic, social, and political problems of Canada and other parts of the world. The "applied geography" aspects of the programme are enhanced by the availability in the Division of elective courses in Planning and Man-Environment Studies given by faculty with academic and practical experience in urban and regional planning, resource management, conservation, sociology of rural development, environmental design, and engineering systems analysis.

Although the programme is broad in scope, it permits a student to specialize in one of three major aspects of the discipline: physical, economic-urban, or cultural-regional geography. Advanced elective
Department of Geography

courses are available in each of these three streams, and further concentration is possible by careful selection of courses from related fields in other parts of the university.

The programme is liberal in that the only requirement other than the core of Geography courses is that five of the elective courses be taken outside of the Division of Environmental Studies. These may be taken all in one discipline or all in different disciplines.

Students should note that geography courses are open to any student in the University. Students taking the geography programme in the Faculty of Arts will receive a B.A. degree and those in the Division of Environmental Studies will receive a B.E.S. (Bachelor of Environmental Studies) degree.

Honours Geography

Year 1
Geography 101* Introduction to Human Geography
Geography 102* Introduction to Physical Geography
Five courses chosen after consultation with the Department

Year 2
Geography 200* Biogeography and Ecology
Geography 201* Climatology and Geomorphology
Geography 202* Economic and Urban Geography
Geography 203* Cultural and Regional Geography
Geography 260* Cartography
Geography 275* Air Photo Interpretation
Geography 271* Introduction to Quantitative Research Methods
One and one-half courses chosen after consultation with the Department

Year 3
Geography 391* Field Research
Two courses of Geography electives
Two and one-half courses chosen after consultation with the Department

Year 4
Geography 480* Development of Geographic Thought
Geography 481* Frontiers of Geography
Geography 490 Senior Honours Essay
Three courses chosen after consultation with the Department

*An asterisk indicates a half-year or semester course. All others are two semester courses.

Note 1 While twenty-one courses is the minimum number of courses required for the degree of Bachelor of Environmental Studies (Honours Geography), students are encouraged to take an enriched programme of up to twenty-four course maximum.

Note 2 The minimum and maximum number of Geography courses in the programme are respectively nine and twelve unless a student takes an enriched programme in which case additional geography electives may be chosen.

Note 3 Students must take a minimum of five courses in Faculties or Schools other than the Division of Environmental Studies.

Note 4 To enter Year 2 of the Honours Geography programme, a student must achieve in Year 1 a minimum overall average of B- and an average of B in Geography 101*/102*. In subsequent years, a student must continue to achieve an overall average of B- as well as an average of B in his Geography courses.

Note 5 It is recommended that all honours students concentrate their studies in third and fourth year. The department offers specialized Streams in (a) Physical Geography (b) Economic Geography (industrial/rural and developmental) (c) Human Geography (d) Cultural Geography (e) Cartography (f) Air Photo Interpretation (g) Quantitative Research Methods.
areas of specialization can be obtained from other disciplines in the University.

Note 6 Students may arrange a joint honours programme with any other discipline in the University provided that the joint programme is approved by both Departments concerned. Several such programmes are outlined in the sections at the beginning of the Calendar.

Note 7 Since many departments doing graduate work in Geography demand proficiency in a foreign language, students intent on graduate work should consider taking a foreign language in their first year.

Note 8 Students intending to teach in secondary schools are advised to take at least two full Regional Geography courses.

Note 9 This programme prepares students for graduate study in Geography or in Planning, for entry to Secondary School teaching, or for research positions in industry and government.

Note 10 All Geography students are encouraged to take summer employment which will provide experience useful to a geographer. Where possible, the Department will provide information and assistance in securing such summer employment.

Note 11 For some courses participating students may be expected to make a small financial contribution to defray heavy equipment/travel costs e.g. Geog. 391*.

General Geography Programme

Year 1 Geography 101* Introduction to Human Geography
Geography 102* Introduction to Physical Geography
Four courses selected in consultation with the Department

Year 2 Geography 200* Biogeography and Ecology
Geography 201* Climatology and Geomorphology
Geography 202* Economic and Urban Geography
Geography 203* Cultural and Regional Geography
three courses selected in consultation with the Department

Year 3 Geography 381* Nature of Geography
One and one-half courses of Geography electives
Three courses selected in consultation with the Department

Note 1 Fifteen credits is the minimum requirement for the degree of Bachelor of Environmental Studies (Geography Major). However, an enriched programme of up to eighteen credits may be arranged.

Note 2 A minimum of five geography credits constitutes a Geography Major but up to seven Geography credits may be taken in this programme. Students taking an enriched programme may choose additional geography electives.

Note 3 Students must take a minimum of four courses in Faculties or Schools other than the Division of Environmental Studies.

Note 4 Students must maintain an overall average of C- with an average of C in their geography courses.

School of Urban and Regional Planning

Honours Bachelor of Environmental Studies in Urban and Regional Planning

Nature of the Programme

The Honours B.E.S. Urban and Regional Planning is offered by the School of Urban and Regional Planning, Division of Environmental Studies. It provides a broad liberal education plus an understanding of related areas of specialization at the Honours level which will prepare students for graduate study in Urban and Regional Planning, for entry to professional practice in urban and regional planning in governmental and private agencies, or for careers in research.
intellectual development and an understanding of the social, economic, geographical, ecological and political factors underlying the planning process.

The programme gives a well-rounded preparation for a wide variety of professional or graduate work in urban planning, regional planning and resource development. The student is also given an opportunity to pursue a special interest in economic or social issues in planning, or the planning applications of quantitative methods. This is done through the selection of elective courses. Students are also encouraged to select Senior Honours Essay Topics from these special fields of interest.

The School has faculty with academic and practicing experience in urban and regional planning, urban design, the governmental process of planning, regional economic development, conservation, resource inventory and development, regional science, sociology and ecology. Specialists in other departments, offer a range of other courses including the philosophy of urbanism, urban geography, resource economics and transportation engineering.

Considerable emphasis is placed on confronting the student with a variety of field experiences. Students will be expected to defray some part of the cost of field trips.

The integration of planning experience into the programme is considered an important part of the education process. Students are encouraged to gain experience during the summer vacation period. The School endeavours to help students find suitable work, particularly between their second and third, and third and fourth years. It provides the maturing prospective planner with an opportunity for a better understanding of the discipline and allows for an early appreciation of personal compatibility, aptitude and natural inclination. It is hoped that through the work of the Professional Liaison Officer the student will be brought into direct contact with the profession and be exposed to problems typical of those encountered far beyond the scope of any university laboratory or classroom. In seeking assistance for finding meaningful planning experience, students will be asked to give permission for the release of their marks to employers. Academic marks are usually included in the student record which are sent to prospective employers during the interview process.

The programme is recognized by the Town Planning Institute of Canada and will qualify graduating students for obtaining employment with a planning agency or with consulting or other agencies working in the planning field, or to do Graduate work in Planning.

Honours Urban and Regional Planning

Year 1 Recommended Programme

Planning 156*/157* Introduction to Urban and Regional Planning Concepts/Introduction to Urban and Regional Planning Techniques
Geography 101*/102* Introduction to Human Geography/Introduction to Physical Geography
Sociology 101* Introduction to Sociology
Economics 101*/102* Introduction to Economics
Philosophy 125* (or other Philosophy) Fundamentals of Social and Political Philosophy

Electives two courses from Quantitative methods, introductory Mathematics or Computer Science, French, Fine Arts, Music or Drama, Biology, Earth Sciences, Anthropology, Man-Environment courses, or any other course offered.
Year 2
Planning 255* Planning Surveys and Analysis
Planning 256* Principles of Environmental Design
Planning 222* Canadian Regional Issues
(or Geography 322* Regional Geography of Canada)
Electives two
Geography 270* Introduction to Cartography and Air Photo Interpretation
Geography 202* Some Basic Topics of Economic and Urban Geography
Planning 271* Quantitative Research Methods
Electives two courses, from economic issues: Economics 201*/202*, Geography 203*; introductory courses in Political Science, courses in Man-Environment studies, or any other courses offered.

Year 3
Planning 307* Social Research Techniques
Planning 332* The Sociology of Regions
Planning 333* The Sociology of Regional Planning
Planning 357* Conservation and Resource Development
Planning 358* Regional Planning and Development
Planning 391* Field Research Methods and Projects
Electives three courses from Planning 314; Planning 344* economic issues: Geography 310*/311*; urban issues: Geography 350*/351*; social issues: Sociology 210*; recreation issues: Geography 410*. Philosophy 425*, Man-Environment courses, or any other courses offered.

Year 4
Planning 456 Political and Administrative Processes in Urban and Regional Planning
Planning 480 The Philosophy and Methodology or Urban and Regional Planning
Planning 490 Senior Honours Essay
Electives three courses, from: Quantitative methods: Planning 316*, 317*, 318*, 319*; urban issues: Planning 414; economic issues: Economics 450; Social issues: Planning 415*; Sociology 212*; or any other courses offered.

Regional Planning Courses
Courses marked with an asterisk are half-year courses. Two half-year courses occurring in sequence and given in the same timetable slot are designated as follows: e.g. Planning 332*/333*.

Note 1
Courses marked with an asterisk are half-year courses. Two half-year courses occurring in sequence and given in the same timetable slot are designated as follows: e.g. Planning 332*/333*.

Note 2
To enter Year 2 of the Honours Planning Programme, a student must obtain a minimum overall grade point average of 9 (B-) in his Year 1 studies, and a grade point average of 10 (B) in Planning 156* and Planning 157*. In subsequent years a student must obtain an overall grade point average of 9 (B-) as well as a grade point average of 10 (B) in his Planning courses.

Note 3
This programme is recognized by the Town Planning Institute of Canada and will qualify graduating students for obtaining employment with a planning agency, with consulting or other agencies working in the planning field, or for graduate study in Planning.

Note 4
Honours Planning students are encouraged to spend two summers working with an agency involved in planning administration or research, or other work related to planning in both private organizations and public agencies. Students will be responsible for obtaining employment, but the School will assist them by providing information and guidance. Please contact the Professional Liaison Officer.

Note 5
Planning 156* is offered in the Fall term for Honours Planning students only, and in the Winter term for students other than Honours Planning.

Note 6
Students interested in the Political Science electives, Pol. Sci.330 and 340, are advised to first complete an introductory course from Pol. Sci.
School of Architecture

Note 7 Planning 332*/333* may be taken in either Year 3 or 4, but must be taken in a single year.

Note 8 Students selecting Quantitative Methods electives in the 4th year are required to select Planning 319*; and, if they wish, any of Planning 316*, 317*, 318*.

Note 9 Planning 307* may be taken in Year 2 or 3.

School of Architecture

Philosophy of the School of Architecture

There is a growing sense of urgent need to make the man-made environment more responsive to man’s aspirations and more sensitive to natural ecology. The shaping of the environment is a large and complex process and the aspirations of society, diverse and dynamic. These demand the interaction of architects with a variety of disciplines with special concerns for the environment and its people. For this reason, the education of the student toward an understanding of contemporary problems, of the forces entering into the creation of environment, and of the interdependency of these forces is the common experience shared by all disciplines striving to establish a basis for future interdisciplinary team activities. The School provides a programme for the development of an architect, competent in his field to work effectively within real-world constraints of contemporary practice, able to renew and adapt his abilities for creating and improving the environment to a changing profession and society, and skilled in interdisciplinary team-work where these can be communicated.

The five basic principles underlying the academic programme in Architecture are as follows:

1) The student will first study the environment for a thorough understanding of the factors which advance man’s condition in the community and time in which he lives, and the fundamentals, theories and practices for shaping the environment for human goals. This co-operative pre-professional programme will be the prerequisite for the professional studies in Architecture and will terminate with a degree of Bachelor of Environmental Studies/Architecture.

2) The student will broaden his knowledge of drafting and drawing, construction methods and detailing, office organization outside the University during his work term and the office experience so gained should apply to the experience required for professional registration.

3) Following his Environmental Studies programme, the student will spend four additional academic terms in professional courses in Architecture. This professional programme allows the individual latitude to choose programmes that match his aptitudes and motivations to the range of roles in the profession of architecture. This concentration of study leads to the professional degree, Bachelor of Architecture.

4) Many courses related to professional practice, sometimes offered in schools of architecture, will be provided jointly by the professional institutes and the School as continuing education subsequent to academic studies, but prior to professional registration.

5) An advisory board, appointed from professional and business communities in Canada and the United States, will help determine performance criteria for new programmes.

Degrees B.E.S./Arch. comprises six terms of pre-professional studies and four
School of Architecture

Studies/Architecture (B.E.S./Arch.). This degree indicates appropriate preparation for four subsequent academic terms of study and two work terms, one four months and one eight months, leading to the professional degree, Bachelor of Architecture (B.Arch.).

†See section on Co-operative Programme.

Non-Architecture Students

Students not enrolled in the curriculum of Architecture may take any architectural course listed in the recommended core programme with the exception of courses in the theme area of Design. Prerequisites indicated in the course descriptions are primarily for Architectural students. For Non-Architectural students, prerequisite evaluation must be carried out by the respective teaching staff.

B.E.S./Architecture Programme

The purpose of the B.E.S./Architecture Programme is to educate future architects to an understanding of the beliefs and needs of the individual and of society, and to a willingness to take an active role in creating and improving the environment; to a clarification of the interaction of seemingly unrelated disciplines, and to know the principles and values that surround the creation of any artifact; to a comprehension of the many forms of creative expression; and to an understanding of the present as a part of a historical process. The programme helps the student to predict the effects of science, technology and man's creations on the environment, and to understand that continuing studies will help the future architect to become sensitive to the needs of mankind in a never-ending cycle of change.

The programme is founded on four broad study themes:

1) the design studio, studies in design fundamentals and concepts, theories and methods, and a workshop for application and experimentation of theories.
2) Studies of systems and measures including computer, physical and material sciences
3) cultural history in the human environment.
4) environmental studies, including natural and human ecology

See section II of the Academic Calendar for course descriptions and arrangement. p 172

Bachelor of Architecture Programme

The purpose of the Bachelor of Architecture programme is to permit the student who has earned his Bachelor of Environmental Studies/Architecture degree to concentrate more deeply on courses from a variety offered in environmental studies, city and regional planning, structural synthesis, and related mechanical engineering, selected with regard to the student’s capabilities and interests; and a new emphasis on architecture and parametric design, systems and computer-aided design and analysis to gain knowledge, skill and the critical sense needed to render effective his professional role as an architect.

The programme will resemble a graduate programme where each student will be assigned to a faculty advisor who will approve his course and will select from the various courses offered to him the courses appropriate to his interests and role as an architect.

Certain courses and skills such as specification writing, estimation and quantity surveying, laws of professional practice, building bylaws, etc., will be taken as continuing education co-operatively with the Ontario Architectural Association, or other professional organizations prior to professional registration.
School of Architecture

See section 11 of the Academic Calendar for course descriptions and arrangement. p 172

Co-operative Programme

The Bachelor of Environmental Studies programme includes six terms of study, three four-month co-op work terms and one four-month self-work term in which it is the student's responsibility to find employment. The subsequent Bachelor of Architecture programme consists of four terms of academic study and two co-op work terms, one four months and one eight months. The terms are arranged as indicated on the following chart.

Objectives of the Work Terms

At the end of the self-work term of the B.E.S. (Arch.) programme a student should:

1) have attained some skill in non-verbal communication;
2) have identified the role in the profession for which he has aptitude and interest;
3) have become knowledgeable of the more common processes by which the man-built environment is changed.

At the end of Co-op Work Term 1, a student should:

1) have attained skill in non-verbal communication;
2) recognize the constraints of current practice;
3) have learned to perform some activity related to the roles in the profession for which he has aptitude and interest.

At the end of Co-op Work Term 2, a student should be able to:

1) detail some aspect of the man-made environment and appreciate the contribution details make to the whole;
2) demonstrate skills for professional roles;
3) reflect broadened experience in the process of creating the man-made environment.

At the end of Co-op Work Term 3, a student should be able to:

1) understand thoroughly the real-world constraints on the creative process and the methods and procedures in the current practice of the profession to be effective within these constraints;
2) demonstrate skills and maturity of judgement for the roles in the profession his interests and aptitudes have directed.

For the Bachelor of Architecture programme, at the end of Co-op Work Term 4, a student should be able to:

1) separate, organize and conceptualize some real-world aspects of the man-built environment for either a governmental agency, planning office, an industry related to architecture, a research agency involved in studying problems related to human settlements, or an architect's office;
2) demonstrate skills and maturity in judgements based on experience.
3) reflect his broadened experience in the process of creating the man-made environment.

At the end of Co-op Work Term 5, a student should have:
1) completed all the research work related to his thesis, utilizing multidisciplinary resources and work experience;
2) broadened his experience in the process of creating the man-made environment;
3) demonstrated professional skills and mature judgements for the roles experienced.

-Operative Work Term Schedule

**Bachelor of Environmental Studies/Architecture**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>term 1</td>
<td>Winter</td>
<td>Winter</td>
<td>Winter</td>
</tr>
<tr>
<td>Term 2</td>
<td>Term 3</td>
<td>Term 4</td>
<td>Term 5</td>
</tr>
<tr>
<td>Term 3</td>
<td>Work</td>
<td>Work</td>
<td>Work</td>
</tr>
<tr>
<td>Term</td>
<td>Term 1</td>
<td>Term 2</td>
<td>Term 3</td>
</tr>
</tbody>
</table>

**Bachelor of Architecture**

<table>
<thead>
<tr>
<th>1975</th>
<th>1976</th>
</tr>
</thead>
<tbody>
<tr>
<td>term 4</td>
<td>term 4</td>
</tr>
<tr>
<td>Term 7</td>
<td>Term 8</td>
</tr>
<tr>
<td>Term 8</td>
<td>Term 9</td>
</tr>
<tr>
<td>Term 9</td>
<td>Term 10</td>
</tr>
</tbody>
</table>

"dent must find his own employment."
Mathematics and Computer Building
5 Programme of Integrated Studies
Programme of Integrated Studies

Resource People

Professorial Associate  J.R. Gray

(part-time)  G. Haggar, B.A. (Windsor), M.A. (Fordham), Ph.D. (Columbia)
D.J. Harding, B.A., M.A. (Saskatchewan), PH.D. (Simon Fraser)

Assistant Professor  F.D. Kemp, B.A. (Texas Christian), Ph.D. (Harvard)
(on loan) half-time  L.W. Kendall, B.A. (Slippery Rock)

Assistant Professor  K.A. Rowe, B.A. (Toronto), M.S. (Wisconsin), Ph.D. (Illinois)

The programme is designed to be largely student initiated and student oriented. The student may set his own goals and proceed toward them by whatever means he deems fit. He may do independent research, course work, seminars and tutorials, special projects and field work, or any combination of the above.

The student's resources are many. There are resource people assigned within the unit for the purpose of guiding him toward integration of the material he gathers; there is the valuable inter-change and interaction between himself and his fellow students in the unit, and there is the opportunity to turn to the wider university community for knowledge. All the resources of the University are available to him, subject only to the limitations of time and space.

Admission  Applicants to Integrated Studies are admitted on the basis of a personal interview with a committee composed of students and faculty. Those who show the strongest aptitude for self-direction and independent study and the ability to flourish in an unstructured academic setting will be given strongest consideration. Applicants should have a minimum of 60% in the prerequisites required for the Secondary School Honour Graduation Diploma, although consideration will be given to those not possessing the minimum requirements, if they indicate the desire and ability for independent study. Admission procedure information may be obtained by writing directly to the Assistant Registrar for Integrated Studies.

Degree  It is anticipated that a three-year, general degree will be available to those who wish to pursue a degree, although it is hoped that students applying to Integrated Studies will have only a minimum interest in the earning of a degree. The criteria for the degree will be open and the mechanics for obtaining the degree will be flexible to allow the widest spectrum of choice of academic endeavour. Discussions are presently under way to examine the possibility of developing criteria and means by which students may pursue bachelor degrees outside of the usual framework.
6 Inter-Faulty Programme
Inter-Faculty Programme Board

Director W.U. Ober, B.A. (Washington and Lee), Ph.D. (Indiana)

Members of the Board: P.G. Cornell, E.D., M.A., Ph.D. (Toronto) Faculty of Arts

W.F. Forbes, D.I.C./Ph.D., D.Sc. (London) Faculty of Mathematics

G.R. Francis, B.A. (Toronto), B.A. (McGill), M.A. (British Columbia), Ph.D. (Michigan) Division of Environmental Studies

G.S. Kenyon, B.P.E. (British Columbia), M.S. (Indiana), Ph.D. (New York) School of Physical Education and Recreation

A.M. McLachlin, M.A. (Toronto), B.D., Th.D. (Emmanuel) St. Paul's United College

D.E. Smucker, B.A. (Bluffton), B.D. (Princeton Theological Seminary), (Chicago) Conrad Grebel College

L.A.K. Watt, B.Sc. (Manitoba), M.S. (Chicago), Ph.D. (Minnesota) Faculty of Engineering

R.G. Woolford, M.Sc. (Western), Ph.D. (Illinois) Faculty of Science

The Inter-Faculty Programme Board, a Senate-sponsored body with membership broadly representative of Faculties, Divisions, and Colleges on campus, is introducing the following kinds of activities:

1) The Board originates and sponsors multidisciplinary courses open as electives to properly qualified students within the university. These courses, some of which will be concerned with crucial problems confronting today's world and approaches to their solutions, are intended specifically for students enrolled in existing programmes.

2) The Board is prepared to sponsor certain non-specialist courses that Faculties may request for students in their programmes.

3) The Board is considering the introduction of multi-disciplinary and thematic programmes leading to bachelor's degrees.

4) From time to time the Board sponsors guest lecturers, special speakers, and colloquia.

Inquiries concerning Inter-Faculty Studies should be addressed to the Director, Inter-Faculty Programme Board, University of Waterloo.

A brochure describing in detail courses and programmes in Inter-Faculty Studies offered in 1971-72 is available upon request from the Director, Inter-Faculty Programme Board, University of Waterloo.
7 The Faculty of Mathematics
Admission Requirements

The Faculty of Mathematics

The Faculty of Mathematics of the University of Waterloo was inaugurated as a separate faculty in 1966. General Honours programmes in Mathematics had been offered through the Faculties of Arts and Science for a number of years and the continued growth and development of these programmes made it natural to unite them under one faculty. At the same time, this unification has led to greater flexibility in choice of electives.

Each year students enter the University with additional secondary school background, and the enrolments in classical areas of pure and applied mathematics are rapidly increasing at almost the same rate as enrolments in the newer technological areas of statistics, computer science, and combinatorics and optimization.

The University of Waterloo has pioneered in making courses in Computer Science readily available, from the very first year, to Mathematics students. On the other hand, students specializing in Computer Science are required to obtain an extensive mathematical background.

Graduate work in the Faculty of Mathematics is very active. A large number of graduate degrees have been conferred and active research is carried on in many areas. Further information is given later in the Calendar in the sections devoted to undergraduate and graduate course descriptions.

Faculty of Mathematics Brochure

Students requiring further information should contact the Dean of the Faculty of Mathematics. The Faculty also publishes a brochure largely devoted to a discussion of mathematical careers, and contains detailed information concerning the Co-operative Mathematics programme and other programmes in the Faculty of Mathematics.

Degrees

Students in the Faculty of Mathematics may take a three-year Pass Degree programme, a four-year General Degree programme, or a four-year Honours Degree programme. The Co-operative Mathematics programme is merely a rearrangement in the scheduling of academic terms so as to permit considerable practical experience.

Students who successfully complete programmes in the Faculty of Mathematics will be awarded the degree of Bachelor of Mathematics (B.Math.), Master of Mathematics (M.Math.), Master of Philosophy (M.Phil.) and Doctor of Philosophy (Ph.D.) by the University. A student may, as the programme descriptions on pages 335 to 361 show, specialize in Applied Analysis and Computer Science, Applied Mathematics, Combinatorics and Optimization, Pure Mathematics, or Statistics.

Admission Requirements

General

Application for admission to the Faculty of Mathematics should be made as early in the year as possible. Academic certificates (not diplomas) and other supporting documents should be forwarded as soon as they become available.

Admission cannot be granted until all the requirements have been met and all the required documents submitted. Applicants currently enrolled in Ontario Grade 13 and who wish to be considered for Grade 13 must submit an Application for Grade 13 admission no later than May 15 of the year of intended admission.
Admission Requirements

after these dates cannot be guaranteed consideration of their application.

Applicants should note that St. Jerome's College also offers programmes leading toward the B.Math. degree in conjunction with the University and that applicants may register for the register for the regular programmes (not co-operative) through St. Jerome's college.

Since many of the programmes offered at the University have limited enrolment, the possession of the minimum requirements does not in itself guarantee admission to any of the programmes. If clarification is required on any of the admission requirements, applicants should contact the Office of the Registrar, University of Waterloo, Waterloo, Ontario.

The admission requirements listed in the calendar are applicable for admission in September 1971.

Admission Deposit

Each applicant admitted to full time studies is required to submit a $50.00 admission deposit. The deposit will be refunded if notice of termination is received prior to August 1, 1971.

Application Documents

All applicants must submit an application form and certified transcripts of secondary or post-secondary education. Applicants enrolled in Ontario Grade 13 in the 1970-71 academic year must apply on the “General Application for Admission to University 1971” form which is available from the secondary school. Applications should be submitted prior to January 4, 1971.

Applicants not enrolled full time in Ontario Grade 13 must apply on forms available from the Office of the Registrar. In addition at least two letters of reference are required. All educational institutions attended by the applicant must be accounted for on certified documents. Applicants from non-English speaking countries must arrange to submit certified English translations of their academic documents.

Ontario Grade 13 Applicants Requirements

For applicants currently enrolled full time in an Ontario Grade 13 programme of studies, the overall University requirement will be the assurance from the Secondary School that the prerequisites for the Secondary School Honour Graduation Diploma have been satisfied.

Applicants to the Faculty of Mathematics will normally be required to achieve a 60% overall average in their Grade 13 standings.

For admission to the regular programme, applicants must submit a 60% overall average in the specific requirements, mathematics A (or equivalent) and mathematics B (or equivalent).

For admission to the co-operative programme applicants must submit a 66% overall average in the specific requirements mathematics A (or equivalent) and mathematics B (or equivalent). It is expected that applicants will present a balanced selection of Grade 13 courses.

Basis of Admission

Students enrolled full time in Ontario Grade 13 will be considered for Early Final Admission. The University expects to fill the majority of places available to Grade 13 applicants using the following criteria:

Grade 13 interim standing
Grade 12 final standing
Principal's recommendation
SACU aptitude and achievement tests results.
Admission Requirements

and qualified applicants will be admitted until the remaining places are filled.

Applicants who have spent more than the normal length of time in Secondary School to complete their University preparation may be required to present a higher admission average. Applicants who completed their Grade 13 studies in less than the normal period of time will be considered provided that the Grade 13 admission prerequisites are satisfied.

Successful applicants may expect to be notified after May 1, 1971 of their acceptance and will be allowed until June 1, 1971 to confirm the offer of admission.

The University reserves the right to withdraw the offer of admission if the applicant fails to complete his year satisfactorily.

Aptitude and Achievement Tests

Service for Admission to College and University - SACU. It is recommended that applicants write the Canadian Scholastic Aptitude Test (CSAT) and the Canadian English Language Achievement Test (CELAT) or the French equivalent.

Non-Ontario Grade 13 Applicants

Applicants who have completed their secondary school education in jurisdictions other than Ontario Grade 13 will be asked to submit the following certificates recognized as being equivalent to the Ontario Grade 13 certificate. These certificates may be accepted in so far as they meet the admission requirements of the University of Waterloo in subjects and percentages. Applicants from countries not mentioned in the following list can obtain detailed admission requirements from the Office of the Registrar.

Alberta

British Columbia

Manitoba

New Brunswick

Newfoundland

Nova Scotia

Prince Edward Island

Quebec

Saskatchewan

England and Wales, West Indies, East and West Africa

Scotland

United States of America

Senior Matriculation (Grade 12)

Senior Matriculation Grade 13)

Senior Matriculation (Grade 12)

Senior Matriculation (Grade 13)

Year 1 Memorial University

Senior Matriculation (Grade 12)

I year University of Prince Edward Island

First Year CEGEP programme

Senior Matriculation (Grade 12)

The General Certificate of Education

with passes in at least five subjects.

two of which must be at Advanced Level.

The Scottish Certificate of Education

High School Graduation plus an additional year of formal study in subjects comparable to Ontario.

Grade 13 subjects.

Admission as an Adult Student

Any student of mature age who has been away from formal education for more than two years and who does not possess the minimum requirements for admission may apply to enter as an adult student. It is recommended that applicants attempt to obtain standing in Ontario Grade 13 level Mathematics courses or their equivalent. Each application will be considered on its merits by the Admission Committee.
If the applicant wishes to take courses on a regular basis toward a degree, the regular admission requirements as indicated above must be met.

**Admission to Advanced Years**

An applicant for admission to advanced standing must submit an official transcript from the University or educational institution which he has attended, showing in detail the courses which were taken and the standing in each course.

Students applying to a co-operative programme may not be admitted above the Year 2 Term A level.

Students accepted from other University of Waterloo Faculties may be given credit toward a B.Math degree for courses taken if the mark obtained was equivalent to 50 or greater (equivalent to 60 or greater for Mathematics courses). Students accepted from other academic institutions may be given credit toward a B.Math degree for courses taken if the mark obtained was equivalent to 60 or greater.

**Transfer of Credits**

Students being readmitted to the faculty of Mathematics or accepted by transfer from other faculties of the University of Waterloo will be given credit for a course taken if the mark obtained was (A) equal or greater than 60 for Mathematics courses (B) 50 or greater for other courses. Students accepted by transfer from other universities will be given credit for a course taken if the mark obtained was 60 or greater (or equivalent).

**Transfer Privileges**

The first year Mathematics programme is set up so that students who select Physics and Chemistry as elective courses may, on successful completion of Year 1 apply to transfer to the second year of the Faculty of Science or the Faculty of Engineering. Similarly, students who complete successfully Year 1 Science or Year 1 Engineering may apply to transfer to Year 2 in the Faculty of Mathematics.

Students who have successfully completed Year 1 Arts and who have taken Mathematics may transfer to Year 2 of the Faculty of Mathematics. Similarly, students who successfully complete Year 1 Mathematics may transfer to Year 2 of the Faculty of Arts.

**English Proficiency**

Students from areas where English is not the common language must provide certified translations of academic certificates. In addition, the applicant may be required to take either “The English Proficiency Tests” prepared by the English Language Institute of the University of Michigan, or the examinations for “The Certificate of Proficiency in English” of the University of Cambridge, in order to satisfy the Admission Committee that the applicant's knowledge of the English language is adequate to pursue his studies successfully.

**Landed Immigrant Status**

Because of the nature of the co-operative programme where a student alternates four months of study with four months of industrial experience, applicants from other countries are strongly recommended to obtain landed immigrant status in Canada before applying for admission to the University. Immigrants from other countries are expected to have one year's residence in Canada before applying for admission to the co-operative programme.

**Re-Admission**

The University reserves the right to refuse admission to any candidate, and to refuse re-admission if, in the opinion of competent authority, a student is not likely to profit from University studies.
The Faculty constitutes the examining body for all examinations. The time normally allowed for each examination is three hours.

Since September 1970, the Faculty has been operating under a "course credit system" in which student progress will be measured by courses successfully completed rather than by years. A student who has passed fewer than Five courses is considered a first-year student. A student who has passed at least Five courses, but fewer than Ten is considered a second-year student; at least Ten but fewer than Sixteen a third-year student; Sixteen or more, a fourth-year student.

The following regulations govern the practice of the Faculty in regard to standings, promotions, and supplemental examinations:

1) All examination results are considered by the Faculty Committee on Standings and Promotions and, subsequently, by Faculty Council and are then issued to individual students by the Registrar.

2) At the end of each academic year a student's standing is determined by the Cumulative Average of all courses previously taken at the University of Waterloo, whether passed or failed. To proceed in good standing requires a minimum cumulative average of 50% overall and 55% in Mathematics. If a student fails to meet the above required averages the Committee on Standings and Promotions may admit the student to a probationary year. If the student fails to improve his average he may be required to withdraw from the Faculty. Normally a student will not be allowed more than one probationary year.

3) In addition to the numerical scale 0-100, the following designations may be used from time to time.

INC (term work, lab work, examinations, etc. are incomplete).
AEG (aegrotat - signifying the student's work or examination was incomplete for some acceptable reason (such as illness) and his instructor felt the student should receive credit for the course but a numerical mark could not be set).
CR (credit granted - in rare cases not covered by AEG).
NMR (No mark reported).
DEF (deferred examination officially permitted).
AEG or CR will count as a course passed towards the total necessary but will not count in the cumulative averages. INC or DEF will indicate a situation that will have to be resolved to the satisfaction of the Standings and Promotions Committee.

4) Full time students are required to take a minimum of five courses (except in their terminal year). No course may be dropped later than one month prior to the end of lectures in the term/year of the course. (D.M.R.'s will automatically count as zero in the cumulative averages.)

5) Where a student has failed one or more examinations, he may be granted supplemental privileges. A student may not write supplementals in more than 2 full year-equivalent courses. A supplemental in any course may be granted or not granted at the discretion of the instructor involved. In the absence of a recommendation by the instructor involved, a supplemental may be granted by the Standings and Promotions Committee only if the mark is 40-49 inclusive. Supplemental marks are not used in computing the cumulative averages. Supplemental examinations will be held in July for students in the Regular programme. Applications for supplemental examinations must be filed by
student subsequently decides not to write the examination, the fee is not refunded. No supplemental examinations for Mathematics students on the course Credit System will be granted except with the express permission of the Standings and Promotions Committee, this to be effective after the April 1971 examination period.

6) Cases may arise where a student passes a course but would like to repeat it in order to raise his mark. This may be done but both marks will show on his record and both marks will be counted in the cumulative average and the course will count only once toward the total number of required courses for a degree.

7) Failed non-compulsory courses need not be repeated but may be replaced by some other non-compulsory course.

8) If a student fails to write an examination for medical reasons, a doctor's certificate covering the precise period of absence must be filed in the Office of the Registrar before the end of the examination period.

9) All examinations which receive a failing mark are automatically re-read.

Any student wishing to appeal his mark(s) must do so by contacting the Registrar's Office within one month of the official announcement of term or year marks. There will be a charge of $5.00 per course appealed, to be refunded if the mark is raised.

10) A student may normally spend only four academic years to complete a three-year programme or five academic years to complete a four-year programme.

11) After four years students must have completed the requirements at least for the Pass degree. Within five academic years the student must apply for the award of a particular degree by filling out an "Intent to Graduate" form. In doing so he presents the courses considered to satisfy the requirements for the degree. If, at the end of five years, a student has fulfilled the requirements for two or more degrees he will be awarded the highest degree (Pass, General, Honours).

12) Continuance in the Cooperative programme is contingent upon acceptable performance on work terms.

13) A student may withdraw from the University up to and including the last day of lectures without being held responsible for that term's/year's courses.

Academic Programmes

In each of the following programmes a student must take a minimum of 5 courses and may take no more than 8 courses in each academic year. This requirement is waived in the terminal year.

A student is required to take at least two Mathematics courses in each year including the terminal year.

In his third academic year each student is expected to affiliate himself with a department.

Three Year Pass Degree Programme. B.Math. (Pass)

The minimum requirements for this degree are a total of 16 courses including:

- A minimum of 6 Mathematics courses.
- A minimum of 6 electives.

The following courses are compulsory and must be included in the programme.

Mathematics 119 or 129; 120 or 130; 132
Academic Programmes

The cumulative averages required are 50% overall and 55% in the Mathematics courses.

A normal programme is described below:

**Year 1** 6 courses of which 2 are Mathematics courses and 4 are electives, one of which may be another Mathematics course.

**Year 2** 5 courses of which 2 are Mathematics courses and 3 are electives, one of which may be another Mathematics course.

**Year 3** Similar to Year 2.

**Four Year General Programme. B.Math. (Gen.)**

The minimum requirements for this degree are a total of 21 courses including:
- A minimum of 12 Mathematics courses.
- A minimum of 6 electives.

The following courses, or the corresponding courses for Honours students, must be included:
- Mathematics 119; 120; 132; 217; 219; 312; 319.

The cumulative averages required are 50% overall and 55% in the Mathematics courses. A student must complete this programme in not more than five academic years.

A normal programme is:

**Year 1** 3 Mathematics courses and 3 electives.

**Year 2** 3 Mathematics courses and 2 electives, one of which may be another Mathematics course.

**Year 3** 3 Mathematics courses and 2 electives, one of which may be another Mathematics course.

**Year 4** 3 Mathematics courses and 2 electives which may be Mathematics courses.

Students interested in one of the following areas are encouraged to incorporate any or all of the suggested courses.

- **Actuarial Science** 235; 243; 335; 336.
- **Computer Science** 132; 240; 334; 340.
- **Combinatorics and Optimization** 239; 243; 351 or 352.

**Teaching**

Students normally take 300 and 446 and include courses from 239, 240, 307, 330, 334, 425, 436 in their programme.

Students in the Co-operative Teaching Option will include Psyc.241/242, Phil.311/312, and Soc.207G among their electives.

Other course suggestions may be obtained from each of the Mathematics departments.

**Four Year Honours Programme. B.Math. (Hon.)**

The minimum requirements for this degree are a total of 24 courses including:
- A minimum of 15 Mathematics courses.
- A minimum of 6 electives.

The following courses must be included:
- Mathematics 129; 130; 132; 229; 233; 237; 329 or 341; 332 or 342-343.
The cumulative averages required are 60% overall and 65% in the Mathematics courses. A student must complete this programme in not more than five academic years.

A programme which will provide the minimum course requirements is described below. Better students are encouraged to take an additional elective in each of years 2, 3, and 4.

*Year 1* Mathematics 129; 130; 132 and three electives.

*Year 2* Mathematics 229; 233; 237.
   One other Mathematics course.
   Two electives, one of which may be another Mathematics course.

*Year 3* At least four three hundred level Mathematics courses which include the Departmental requirements.
   Two electives, one of which may be another Mathematics course.

*Year 4* Honours Mathematics students will normally take at least four four-hundred level Mathematics courses or their equivalent.
   Students in Joint Mathematics programmes will normally take at least two four-hundred level Mathematics year courses or equivalent.
   Two electives, one of which may be another Mathematics course.

It should be noted that timetables are based on recommended programmes and students deviating markedly from these programmes may encounter timetable conflicts. Each student entering Year three is to be affiliated with a department and all Honours students should consult with their department to ensure that the departmental regulations are fulfilled. Some of the departmental requirements are set out below.

**Applied Analysis and Computer Science** Mathematics 240; one of 334, 340, 363.

**Applied Mathematics** Four full year courses chosen from among 234a, 234b, 360a, 360b, 361a, 361b, 363, 434, 462.

**Combinatorics and Optimization** Mathematics 239; 345 or 351 or 352; three of 451, 452, 453, 454, 455, 456, 457, 458, 460.

**Teaching Option** Students normally take 300 and 446 and include courses from 239, 240, 307, 330, 334, 425, 436 in their programme.
   Students in the Co-operative Teaching Option will include Psyc.241;/242, Phil.311/312 and Soc.207G among their electives.

**Pure Mathematics** Mathematics 341; 342; 343; 344; two four hundred level courses in Pure Mathematics.

**Statistics** Mathematics 338; 438; 439; 440.

**Actuarial Science** Mathematics 235; 336; 437; one of 335, 435, 461.
Academic Programmes

Joint Mathematics Programmes

Honours Applied Mathematics
with Physics Minor

Year 1
Mathematics 129, 130, 132
Physics 121*/122* or 162*/163*
Chemistry 131
One elective

Year 2
Mathematics 229, 233, 234, 237
Physics 252*/253*, 255*
Physics 256* or 259* or 1/2 elective

Year 3
Mathematics 332, 360a, 360b, 363, and or 442*
Physics 355*, 358*/359*
One or one and a half electives, depending on the combination of mathematics courses chosen.

Year 4
Mathematics 329, 441, two of 361, 462 434.
Physics 441, 435*
One half elective.

Mathematics - Economics
Programme

Choice of Degree
Students in Years 1 and 2 may take this programme in either faculty, but at the end of the second year, they will decide whether to continue toward a degree in Arts or a degree in Mathematics. The programme must then be approved by both the Economics Department and by the appropriate department in the Faculty of Mathematics.

Requirements for all students
(Other requirements will depend on which degree is taken; the student will have to add to these to meet the requirements of his faculty.)

Economics
101/2.
201/2 or 203/4.
231/2 or 205/6. 460.
Three others, one of which must be 300 if Math 233 is not selected.

Mathematics
1) 129, 130, 229.
2) 237; one of 228, 233, 234, 239, 240.
3) Two others.

†Math 132 is a prerequisite for Math 240, and should be taken in Year 1 by students wishing to specialize in Computer Science.

Further requirements for the degree B.Math. (Mathematics and Economics)
Students entering Year 3 must have credit for the five Mathematics courses specified under (1) and (2) above. They must pass at least seven further Mathematics courses approved by one of the departments in the Mathematics Faculty.

See page 108 for Mathematics courses required for students studying toward a B.Math. (Honours).

Further requirements for the degree B.A. (Economics and Mathematics)

Please refer to the Faculty of Arts portion of the Calendar.
Mathematics - Geography 

Programme

Choice of Degree

Students in Years 1 and 2 may take this programme in either faculty, but at the end of the second year, they will decide whether to continue toward the degree B.E.S., B.A. or B.Math. The programme must then be approved by both the Geography Department and by the appropriate department in the Faculty of Mathematics.

Requirements for all students

(Other requirements will depend on which degree is taken; the student will have to add to these to meet the requirements of his faculty.)

Geography

101/2, 202/1 202/3, 375.

Three others.

Mathematics

1) 129, 130, 229.

2) 237; one of 228, 233, 234, 239, 240.

3) Two others.

†Math 132 is a prerequisite for Math 240, and should be taken in Year 1 by students wishing to specialize in Computer Science.

Further requirements for the degree B.Math. (Mathematics and Geography)

Students entering Year 3 must have credit for the five Mathematics courses specified under (1) and (2) above. They must pass at least seven further Mathematics courses approved by one of the departments in the Mathematics Faculty.

See page 108 for Mathematics courses required for students studying toward a B.Math. (Honours).

Further requirements for the degree B.A. (Geography and Mathematics)

Please refer to the Faculty of Arts portion of the Calendar.

Mathematics - Philosophy

Programme

Choice of Degree

Students in Years 1 and 2 may take this programme in either faculty, but at the end of the second year, they will decide whether to continue toward a degree in Arts or a degree in Mathematics. The programme must then be approved by both the Philosophy Department and by the appropriate department in the Faculty of Mathematics.

Requirements for all students

(Other requirements will depend on which degree is taken; the student will have to add to these to meet the requirements of his faculty.)

Philosophy

280/1, 282/3, 340, 358/9.

Three others, one of which is in a value area.

Mathematics

1) 129, 130, 229

2) 237; one of 228, 233, 234, 239, 240.

3) Two others.

†Math 132 is a prerequisite for Math 240, and should be taken in Year 1 by students wishing to specialize in Computer Science.

Others

One foreign language.

Further requirements for the degree B.Math. (Mathematics and Philosophy)

Students entering Year 3 must have credit for the five Mathematics courses specified under (1) and (2) above. They must pass at least seven further Mathematics courses approved by one of the departments in the Mathematics Faculty.

See page 108 for Mathematics courses required for students studying toward a B.Math. (Honours).

Further requirements for the degree B.A. (Philosophy and Mathematics)

Please refer to the Faculty of Arts portion of the Calendar.
Mathematics - Psychology Programme

Choice of Degree
Students in Years 1 and 2 may take this programme in either faculty, but at the end of the second year, they will decide whether to continue toward a degree in Arts or a degree in Mathematics. The programme must then be approved by both the Psychology Department and by the appropriate department in the Faculty of Mathematics.

Requirements for all students
(Other requirements will depend on which degree is taken; the student will have to add to these to meet the requirements of his faculty.)

Psychology
101/102; 499; five additional psychology courses chosen in consultation with the Psychology Department to fulfill their research requirements.

Mathematics
129; 130; 132; 229; 233; 237; 329 or 341; 332 or 342/3, and four additional mathematics courses chosen in consultation with a department in the Faculty of Mathematics.

Further requirements for the degree B.Math. (Mathematics and Psychology)
Students entering Year 3 must have credit for the five Mathematics courses specified under (1) and (2) above. They must pass at least seven further Mathematics courses approved by one of the departments in the Mathematics Faculty.

See page 108 for Mathematics courses required for students studying toward a B.Math. (Honours).

Further requirements for the degree B.A. (Psychology and Mathematics)
Please refer to the Faculty of Arts portion of the Calendar.

Co-operative Mathematics Programme

The arrangement of a Co-operative programme is as shown.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream A</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Stream B</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Students entering in September 1971 split into two streams which spend alternating four-month terms in University (the numbered squares) and in Industry (shaded squares); these students will graduate in May 1976, with the equivalent of two years' work experience. The University's Co-ordination Department provides liaison between the University and Industry, and makes arrangements for placing of students during their work terms.

The University does not guarantee that all students will obtain positions. Every effort is made to place each student in a position consistent with his interests and capabilities, and experience indicates that there are sufficient positions for all conscientious students who maintain good academic records. However, some students do not obtain positions because of lack of maturity or ability to impress company representatives. Students are required to work at least two terms with each employer. However, companies are not obligated to have a student assigned to a firm in any particular year. The University's Co-ordination Department endeavors to contact each student at the beginning of each term and to find suitable positions for him.
Academic Programmes

responsibility. Because of this, most stay with their first employer for most, if not all, of their work terms. Many join the company after graduation; however, there is no obligation on either part.

Graduates of a Co-operative programme, because of the experience gained during their university careers, can generally expect to earn a higher salary and attain positions of greater responsibility sooner than graduates of the Regular programme.

It should be expected that a student in this programme will need financial assistance. By the time living expenses are paid, it is doubtful that enough money can be saved to completely cover the next term at university. However, since work terms occur more frequently in this programme than in the regular one, the student has a better opportunity to pay for his own education. This is particularly true in Years 3 and 4 when salaries are higher.

Admission

Students in the Co-operative programme are subject to the same rules as Regular students, modified as follows:

A student entering the Co-op programme must have a minimum Grade 13 average of 60% and must have at least 66% in Mathematics A or Mathematics B (or equivalents).

A student normally may transfer from a Regular programme into a Co-operative programme only at the beginning of year 2, and only if he has
1) successfully completed each of Math 129, 130, and 132, with an average of at least 65% for the three courses.
2) a cumulative average of at least 60%

Standings and Promotions

Students in the Co-operative programme are subject to the same rules as Regular students, modified as follows:

1) Continuance in the Co-operative programme is contingent upon acceptable performance on work terms.
2) Students with an overall cumulative average of less than 55% in Years 1 or 2 may not proceed in the Co-operative programme. These students will become Regular students and they will be governed by the rules for Regular students.

Honours Programme

A programme which will provide the minimum course requirements is described below. Better students are encouraged to take an additional elective in each of Years 2, 3, and 4.

Year 1 Mathematics 129; 130; 132 and three electives.

Year 2 Mathematics 229; 233; 237; 240.

Two electives, one of which may be Math 234, 235, 239.

In Years 3 and 4 the following options are available:

Year 3 Actuarial Science

Students should have taken Mathematics 235 in Year 2.

Mathematics 329; 332; 336; one additional Mathematics course.

Two electives, one of which may be a Mathematics course.

Computer Science

Students should have taken Mathematics 240 in Year 2.

Four Mathematics courses including Mathematics 329; 332; at least one of 334, 340.

Two electives, one of which may be a Mathematics course.
Academic Programmes

Optimization
Students should have taken Mathematics 239 in Year 2.
Four Mathematics courses including Mathematics 329; 332; 352.
Two electives, one of which may be another Mathematics course.

Statistics
Mathematics 329; 332; 338; one additional Mathematics course.
Two electives, one of which may be a Mathematics course.

Teaching Option
See page.

Year 4
Actuarial Science:
Four Mathematics courses including Mathematics 437, 461.
Two electives, one of which may be another Mathematics course.

Computer Science:
Four Mathematics courses chosen in consultation with the Department Chairman.
Two electives, one of which may be another Mathematics course.

Optimization:
Four Mathematics courses including two of Mathematics 451, 452, 454, 455, 456.
Two electives, one of which may be another Mathematics course.

Statistics:
Four Mathematics courses including Mathematics 438, 439, 440.
Two electives, one of which may be another Mathematics course.

Teaching Option:
See page 109.

Chartered Accountancy Option
It is possible for students enrolled in the Co-operative Mathematics Programme to choose their non-Mathematics elective courses in such a manner that they may be able to write their final Chartered Accountancy examinations within a few months after graduation. This programme is offered in co-operation with the Institute of Chartered Accountants of Ontario.

Year 1
Mathematics 129, 130, 132.
B Term - Economics 102. Economics 257
one elective.

Year 2
Mathematics 229, 233, 237.
Mathematics 240 or one other Mathematics course.
Law.
A Term - Economics 356
Auditing Theory.
B Term - Economics 357
One elective.

Year 3
Mathematics 329, 332.
Two of Mathematics 338, 340, 352.
Theory of Management.
Chartered Accountancy Theory 366, 367
Electives  Students enrolled in the Co-operative Mathematics programme have a
total choice of nine non-Mathematics electives before graduating - 3 in
Year 1, and 2 in each of the succeeding years. This permits a sampling
of various courses in Science and/or Humanities or will permit a student
to graduate with a strong minor subject. For example, the following
programme has been set up for students wishing to have a minor in
Economics.

<table>
<thead>
<tr>
<th>Suggested Courses for an Economic Minor</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>Econ. 101</td>
<td>Econ. 102</td>
<td>Econ. 102</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Econ. 256</td>
<td>Econ. 257</td>
<td>Econ. 257</td>
<td></td>
</tr>
<tr>
<td>1A</td>
<td>Econ. 256</td>
<td>Econ. 257</td>
<td>Econ. 257</td>
<td></td>
</tr>
<tr>
<td>2A</td>
<td>Econ. 257</td>
<td>Econ. 366</td>
<td>Econ. 367</td>
<td></td>
</tr>
<tr>
<td>2B</td>
<td>Econ. 378</td>
<td>Econ. 378</td>
<td>Econ. 378</td>
<td></td>
</tr>
<tr>
<td>3A</td>
<td>Econ. 379</td>
<td>Econ. 379</td>
<td>Econ. 379</td>
<td></td>
</tr>
<tr>
<td>3B</td>
<td>Econ. 379</td>
<td>Econ. 379</td>
<td>Econ. 379</td>
<td></td>
</tr>
<tr>
<td>4A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

One or two further courses in Economics.

A minor in Psychology may also be taken. It should be noted that the
following courses will be offered each Spring term: Psychology 112, 211,
and 212. With this in mind, students should select other Psychology
courses in Fall and Winter terms.

For a minor in Physics, it is recommended that students so interested
should elect the B stream since this stream coincides with the academic
terms of the Co-operative Applied Physics programme. Recommended
courses are:

**Year 1** Physics 162, 163.

**Year 2** Physics 252, 256 in A term
Physics 253, 255 in B term

**Year 3** Two of Physics 362/363, 355, 358/359,

**Year 4** 4A and 4B coincide with the regular academic year and Physics electives
can be decided upon at the commencement of the academic year.

It is also possible to take a minor in Chemistry since the Co-operative
Applied Chemistry programme has both A and B streams as in
Co-operative Mathematics. Recommended Chemistry courses are:

**Year 1** Chemistry 121/122.

**Year 2** Chemistry 206 in A term.
Chemistry 201, 205 in B term.

**Year 3** Chemistry 301, 306 in A term.
Chemistry 305 in B term.

Laboratories in Years 2 and 3 are optional for Co-operative Mathematics
students.

Other individual courses which have been popular in the past are:
English 116, 117.
Philosophy 125, 140, 150.
Political Science 103, 104.
Academic Programmes

Laboratories in Years 2 and 3 are optional for Co-operative Mathematics students.

Other individual courses which have been popular in the past are:
English 116, 117.
Philosophy 125, 140, 150.
Political Science 103, 104.
Physics 250, 251.
Sociology 100.
Anthropology 101, 102.

Applied Analysis and Computer Science Department

The great computational speed made available by the electronic computer has revolutionized the approach taken toward problem solving and research in many areas. In recent years a knowledge of Computer Science has become a valuable asset for work in many fields including various branches of Mathematics, Chemistry, Physics, the Biological Sciences and even Economics, Business Administration and the various Social Sciences.

The usefulness of the computer to solve problems in so many fields has resulted in a shortage of people qualified to work in the area of Computer Science. This demand for qualified personnel is reflected in the large enrolment of students in the department's Computer Science course, particularly in the Co-operative programme.

In addition to providing the student with a strong core of Mathematics subjects, the Computer Science programme gives him a solid ground in programming languages, computer software, computer systems, data structures and numerical analysis. At the more theoretical level, students are given basic courses in switching and automata theory, computer system organization and logic design, Turing machines and computability theory.

Upon completion of the Computer Science programme, the student is well prepared to pursue a high level career in the computing profession. In addition, he is groomed to enter into a graduate studies programme in Computer Science.

In Applied Analysis, among others, functional equations are studied, that is, the theory of determining functions from elementary equations containing them. It is a field of mathematics with a two century history, although the somewhat more general theory has developed only in the last two decades. Functional equations have applications in many classical and modern disciplines including probability and information theory, mathematical psychology, nomography, functional analysis, geometry and universal algebra. After attending these courses, the student will be well prepared for graduate studies in several fields of Mathematics and its applications to science, engineering and social sciences.

The Applied Mathematics Department

The Honours Mathematics graduate of the Applied Mathematics programme is expected to be able to apply sophisticated mathematical techniques to the solution of complex problems which arise in this technological age. The graduate must also be capable of adapting to a rapidly changing environment. Tomorrow's problems may be quite different from the problems of today. He must be capable of abstracting from a practical physical problem to a mathematical problem which adequately describes the physical situation.

With this in mind, the undergraduate programme in Honours Applied Mathematics has been designed to give, in the first three years, a strong foundation in the techniques of calculus and its applications. In the fourth year, the emphasis is on the development of an understanding of the mathematical structure of various branches of Mathematics.
Mathematical Physics. Because of the emphasis on Mathematics in the Physical Sciences, students are encouraged to select outside electives in Science. Particularly useful are Chem. 121*/122*, Phys. 121*/122* (or 162*/163*), 252*/253*, 255*/259*, 355*, 358*/359*. For those students who wish a greater emphasis in Physics, the Department offers the programme "Honours Applied Mathematics with Physics Minor"

Combinatorics

Combinatorics, also referred to as combinatorial mathematics and combinatorial analysis, can be described as the study of the arrangement of elements into sets. Examples of this type of mathematics are found in magic squares known to the Chinese 4,000 years ago, in permutations studied at least 3,000 years ago, and in today's newspapers which occasionally publish mathematical puzzles of a combinatorial nature. Fascinating new combinatorial problems have arisen in the study of both Pure and Applied Mathematics and entire new subjects are developing. A particularly fine example is the theory of linear graphs which has recently blossomed. Combinatorics cuts across many areas of mathematics, and researchers in the field today study a wide diversity of intriguing problems.

Optimization

The ultimate objective of nearly every Applied Mathematics study is to improve something, and this is especially true in Business and Industry, and to a certain extent in Pure Science. A variety of mathematical methods have evolved which can be classified as optimization techniques. Every student of calculus finds the maximum of a function by setting its derivative equal to zero. The engineer uses more sophisticated methods of analysis to optimize hardware design. The well known travelling salesman problem in which a salesman desiring to visit a number of cities selects an itinerary to minimize travelling cost is an example of a combinatorial optimizing problem.

Optimization is particularly important in Business and Industry. For example, in an inventory or a scheduling problem the purpose of developing a mathematical model is to minimize cost or maximize efficiency or some other criterion. During the past decade several new general optimization techniques (e.g. linear programming, dynamic programming) have been developed specifically to handle such optimization problems.

The following undergraduate courses are offered by the Department of Combinatorics and Optimization: 239, 245, 351, 352, 417, 418, 419, 420, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460.

Department of Pure Mathematics

In Pure Mathematics one is concerned with the structure of numbers, space and logical deduction and with more general structures based on these. Powerful methods and tools have been developed and investigated (and are being improved) in order to arrange, to condense and to simplify the overwhelming quantity of mathematical results men have created over thousands of years. The theories of sets, groups, rings, geometries, lattices, topological spaces are examples for this modern approach, which also led to spectacular solutions of famous problems unsolved in the past. Again and again new developments in Pure Mathematics have led to important discoveries in the applied areas. Study of Pure Mathematics leads to fundamental knowledge about mathematical structures, important for theory and applications, and moreover, to a general understanding of rigorous reasoning.

Among other things, geometrical and algebraical structures are...
Academic Programmes

Academic Programmes

studied, a field of mathematics with a two millennium history, although the development of the general theory began in the 19th century with the creation of non-euclidean geometries, groups, rings, fields, geometries of Mobius, Lie, geometries over fields. The theory has applications in many mathematical disciplines, but also in physics (for instance, theory of relativity), astronomy, mineralogy (theory of crystals).

Department of Statistics

In science one attempts to learn about the real world by making inferences from experiment. In thus reasoning from observations to a general conclusion, some degree of uncertainty results. One aspect of statistics studies this form of reasoning and utilizes probability theory to specify the exact degree of uncertainty involved. Other aspects of statistics deal with such subjects as the design of experiments which tries to ensure the data have the information required, and decision theory, which considers the probable losses due to uncertainty when given courses of action are followed.

In addition to the Regular and Cooperative honours Statistics programmes, the Department offers a joint honours programme with Psychology. Other joint programmes can be arranged. The following courses in probability and statistics are offered by the Department: Mathematics 233, 338, 438, 439, 440, 465, 466.

The Department also provides two introductory courses for non-mathematicians (Mathematics 243, 51) and a course on the logic and methods of experimental design (Mathematics 449). The latter is meant primarily for students who are not specializing in Statistics, but who wish to apply it in other fields.

The Department of Statistics also has responsibility for Actuarial students and courses. The Regular and Cooperative programmes in Actuarial Science are planned to provide the knowledge of pure and applied mathematics which the Actuary must possess, and to provide theoretical preparation for the first five examinations of the Society of Actuaries. By carefully selecting their electives, students can also gain valuable background knowledge in economics, finance, administration and law. Courses designed specifically for actuarial students are: Mathematics 235, 335, 336, 435, 437, 461.
8 The Faculty of Science
The Faculty of Science

The first students were enrolled in the Faculty of Science in the autumn of 1959. Enrolments have increased significantly thereafter until by the autumn of 1970 over 1650 full-time students, of which more than 230 are graduate students, are taking programmes within the Faculty. In addition, courses are provided for students in arts, environmental studies, engineering, mathematics and kinesiology and recreation.

There are five teaching departments in the Faculty of Science: Biology, Chemistry, Earth Sciences, Physics and the School of Optometry. Extensive instruction is also given by members of the University's Faculties of Arts and Mathematics. Astronomy and Biophysics are taught in the Physics Department; Biochemistry is offered in the Chemistry Department; Botany, Microbiology and Zoology and certain courses embracing these fields together (e.g. Genetics, Cell Biology and Ecology) are taught in the Department of Biology. All the departments as well as the School of Optometry offer post-graduate programmes and research facilities and these are listed in Section 11 of this Calendar—Course Descriptions. The new M.Sc. programme in Earth Sciences offers specialization in the area of Environmental Geology while the new Optometry graduate programme offers M.Sc. studies in Physiological Optics. General regulations governing post-graduate studies are set forth in Section 10. The majority of the graduates in Honours programmes in Science undertake some post graduate study.

The School of Optometry in the Faculty of Science developed from the former College of Optometry in Toronto. This has been integrated into the Faculty of Science and offers a 5-year programme leading to the degree of Doctor of Optometry (O.D.). This new programme commenced in September of 1967 and further information appears on page 144.

Most Science students are enrolled on a full-time basis. Each year of any programme in this Faculty except Co-operative Applied Physics and Co-operative Applied Chemistry is offered in two terms throughout a conventional academic year. The Applied Physics and Applied Chemistry programmes are given exclusively on a co-operative basis with alternating terms of academic and industrial work; refer to Section 15 for further information on the Cooperative programmes.

The Dean and Department Chairmen will be pleased to receive inquiries about the programmes in this Faculty. A student contemplating post-graduate study should direct his correspondence to the chairman of the department in which he proposes to specialize.

Degrees

The degree of Bachelor of Science (B.Sc.) is awarded by the University on the successful completion of many of the undergraduate programmes involving Biology, Chemistry, Earth Sciences and Physics which are listed below. The ordinary or pass-level B.Sc. will be awarded on completion of the General Science Programme in either the three or four-year option. The honours degree, B.Sc. (Honours), will be awarded on completion of any of the honours programmes shown under Academic Programmes. The O.D. (Doctor of Optometry) degree is described above. M.Sc. and Ph.D. degrees are discussed in Section 11.
Admission Requirements

General
Application for admission to the Faculty of Science should be made as early in the year as possible. Academic certificates (not diplomas) and other supporting documents should be forwarded as soon as they become available.

Admission cannot be granted until all the requirements have been met and all the required documents submitted. Applicants currently enrolled in Ontario 13 who wish to be considered for Early Final Admission must apply before January 4, 1971. All other applicants must apply and have submitted all the necessary documents by July 1, 1971. Persons applying after these dates cannot be guaranteed consideration of their application.

Since many of the programmes offered at the University have limited enrolment, the possession of the minimum requirements does not in itself guarantee admission to any of the programmes. If clarification is required on any of the admission requirements, applicants should contact the office of the Registrar, University of Waterloo, Ontario.

The admission requirements listed in the Calendar are applicable for admission in September 1971.

Admission Deposit
Each applicant admitted to full time studies is required to submit a $50.00 admission deposit. The deposit will be refunded if notice of termination is received prior to August 1, 1971.

Application Documents
All applicants must submit an application form, and certified transcripts of secondary or post-secondary education. Applicants enrolled in Ontario Grade 13 in the 1970-71 academic year must apply on the "General Application for Admission to University 1971" form which is available from the secondary school. Applications should be submitted prior to January 4, 1971.

Applicants not enrolled full time in Ontario Grade 13 must apply on forms available from the Office of the Registrar. In addition, at least two letters of reference are required. All educational institutions attended by the applicant must be accounted for on certified documents. Applicants from non-English speaking countries must arrange to submit certified English translations of their academic documents.

Ontario Grade 13 Applicants
For applicants currently enrolled full time in an Ontario Grade 13 programme of studies, the overall University requirement will be the assurance from the Secondary School that the prerequisites for the Secondary School Honour Graduation Diploma have been satisfied.

Applicants to the Faculty of Science will normally be required to achieve a 60% overall average in their Grade 13 standings as well as 60% overall average in Mathematics A, Physics and Chemistry. Applicants for the Co-operative Applied Physics Programme must present a 70% overall average in mathematics and physics. It is expected that applicants will present a balanced selection of Grade 13 courses.

Basis of Admission
Students enrolled full time in Ontario Grade 13 will be considered for Early Final Admission. The University expects to fill the majority of places available to Grade 13 applicants using the following criteria:

Grade 13 interim standing
Grade 12 final standing
Principal's recommendation
SACU aptitude and achievement tests results
Admission Requirements

Applicants whose interim standings are not sufficient for Early Final Admission will be considered on the basis of Grade 13 final standings and qualified applicants will be admitted until the remaining places are filled.

Applicants who have spent more than the normal length of time in Secondary School to complete their University preparation may be required to present a higher admission average. Applicants who completed their Grade 13 studies in less than the normal period of time will be considered provided that the Grade 13 admission prerequisites are satisfied.

Successful applicants may expect to be notified after May 1, 1971 of their acceptance and will be allowed until June 1, 1971 to confirm the offer of admission.

The University reserves the right to withdraw the offer of admission if the applicant fails to complete his year satisfactorily.

Aptitude and Achievement Tests

Service for Admission to College and University - SACU. It is recommended that applicants write the Canadian Scholastic Aptitude Test (CSAT) and the Canadian English Language Achievement Tests (CELAT) or the French equivalent.

Non-Ontario Grade 13 Applicants

Applicants who have taken their secondary school education in other than Ontario Grade 13 will be asked to submit the following certificates recognized as being equivalent to the Ontario Grade 13 certificate. These certificates may be accepted in so far as they meet the admission requirements of the University of Waterloo in subjects and percentages. Applicants from countries not mentioned in the following list can obtain detailed admission requirements from the Office of the Registrar.

Alberta
British Columbia
Manitoba
New Brunswick
Newfoundland
Nova Scotia
Prince Edward Island
Quebec
Saskatchewan

Senior Matriculation (Grade 12)
Senior Matriculation (Grade 13)
Senior Matriculation (Grade 12)
Year 1 Memorial University
Senior Matriculation (Grade 13)
Senior Matriculation (Grade 12)
1 year University of Prince Edward Island First Year CEGEP programme
Senior High School Leaving Certificate
Senior Matriculation (Grade 12)

England and Wales, the General Certificate of Education
West Indies, East and West Africa
Scotland
United States of America

with passes in at least five subjects, two of which must be at Advanced Level
The Scottish Certificate of Education
High School Graduation plus an additional year of formal study in subjects comparable to Ontario Grade 13

Admission as an Adult Student

Any student of mature age who has been away from formal education for more than two years and who does not possess the minimum requirements for admission may apply to enter as an adult student. It is recommended that applicants attempt to obtain standing in Ontario Grade 13 level Mathematics and Science subjects or their equivalent. Further information will be provided to those applicants who indicate an interest in this type of admission.
Admission to Advanced Years

An applicant for admission to advanced standing must submit an official transcript from the University or educational institution which he has attended, showing in detail the courses which were taken and the standing in each course. Students applying to a co-operative programme may not be admitted above the Year 3, Term A level. Any student thus admitted would be required to register in the “A” stream and to complete a minimum of three work terms.

Students within the University desiring to transfer into the Science Faculty will be given a choice of two methods. A and B below.

Guidelines for transferring into Science from other institutions are presently under discussion and will appear in future calendars.

A) Admission credit for courses passed with a grade of C or better without a cumulative average, or

B) Admission credit for all relevant courses (including D’s) passed, but with a cumulative average based on all courses attempted, whether passed or failed.

English Proficiency

Students from areas where English is not the common language must provide certified translation of academic certificates. In addition, the applicant may be required to take either “The English Proficiency Tests” prepared by the English Language Institute of the University of Michigan, or the examination for “The Certificate of Proficiency in English” of the University of Cambridge, in order to satisfy the Admission Committee that the applicant’s knowledge of the English language is adequate to pursue his studies successfully.

Landed Immigrant Status

Because of the nature of the co-operative programme in Science where a student attends four months of study with four months of industrial experience, applicants from other countries are strongly recommended obtain landed immigrant status in Canada before applying for admission to the University. Immigrants from other countries are expected to have one years residency in Canada before applying for admission to the co-operative programme.

Re-Admission

The University reserves the right to refuse admission to any candidate, and to refuse re-admission if, in the opinion of competent authority, a student is not profiting from University studies. Normally a student who has failed the equivalent of two University “years” here or elsewhere will not be admitted to the Faculty of Science.

Registration

September 7, 8, 9, 10, 1971.

Fees

Refer to Section 13 page 502.

Examinations and Standings

The following regulations govern the practice of the Faculty of Science in regard to final examinations, standing and make-up examinations. These regulations also apply to part-time students and special programmes.

Students should note that the Faculty of Science now operates under a “course system” in which student progress is measured by courses successfully completed rather than by years. Students who have passed fewer than five courses will be considered Year 1 students; those who have passed at least five courses but fewer than ten will be considered Year 2 students; those with at least ten but fewer than fifteen will be considered Year 3 students; and those with at least fifteen but fewer than twenty will be considered Year 4 students.
the Optometry programme for those students in their graduating year.

1) Final Examinations

a) The faculty constitutes the examining body for all examinations. All examination results are considered by the Examinations and Standings Committee and subsequently by the Faculty Council. After the results have been considered by these bodies, they will be issued to individual students by the Registrar. Appeals against faculty decisions made under these regulations may be made in writing to the Examinations and Standing Committee.

b) For Students in Regular Programmes:
Final examinations in one-term courses are held in December or in April-May. Final examinations for all full year courses are held in April-May, and cover the whole work of each course. Make-up examinations are held in July. The time normally allowed for each examination is three hours.

c) For Students in Cooperative Programmes:
In Year 1, final examinations in one-term courses are held at the end of the term in which the course is taken, whereas final examinations in full-year courses are held at the end of the second term and cover the whole work of each such course. Beyond first year, final examinations are usually held at the end of each term. The time normally allowed for each examination is three hours.

d) In all courses each student is required to submit, in such form and at such time as may be determined by the instructor, evidence of satisfactory participation in term work. The marks obtained for work during term are used, in part, in determining standing. The ratio in which marks for term work and written examinations are combined is at the discretion of the individual departments. To pass in a course, a student must obtain a minimum of 50% in the combined term and examination marks. At the discretion of the chairman of the department concerned and of the Dean, a student may be barred from the final examination if the course requirements are not completed to the satisfaction of his instructor. Some courses and/or instructors may not require final examinations; in such cases term work only will be used in determining a final grade.

e) Failure to write an examination is considered a failure to pass. A student who defaults a final examination, except for a properly certified reason, shall have no make-up examination privileges and must repeat the work in class. If a student fails to write for medical or health-related reasons, a Doctor's certificate, covering the precise period of absence, must be filed in the Registrar's Office within one week after the examination should have been written.

f) All examinations which receive a failing grade are automatically re-read.

2 Standing

a) Marks in individual courses will be reported in numerical grades in the scale 0 to 100. These may be interpreted as follows:

<table>
<thead>
<tr>
<th>Numerical Range</th>
<th>Grade Equivalent</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>85-100</td>
<td>A +</td>
<td>Excellent</td>
</tr>
<tr>
<td>75-84</td>
<td>A</td>
<td>Very Good</td>
</tr>
<tr>
<td>66-74</td>
<td>B</td>
<td>Good, Above</td>
</tr>
<tr>
<td>60-65</td>
<td>C</td>
<td>Average</td>
</tr>
<tr>
<td>50-59</td>
<td>D</td>
<td>Fair, average</td>
</tr>
<tr>
<td>Below 50</td>
<td>F</td>
<td>Failure</td>
</tr>
</tbody>
</table>
Examinations and Standings

In addition to the numerical scale above, the following designations may be used from time to time:

INC (either term work, lab work, examinations, etc., are incomplete)
AEG (aegrotat—signifying the student's work or examination was incomplete for some acceptable reason (such as illness) and his instructor felt the student should receive credit for the course but a numerical mark could not be set.)
CR (credit granted—in rare cases not covered by AEG.)
NMR (no mark reported)
DEF (deferred examination officially granted.)
DNW (final examination not written)

AEG or CR will count as a course passed towards the total necessary but will not count in the overall average. INC, NMR, DNW or DEF will indicate a situation that will have to be resolved to the satisfaction of the Examinations and Standings Committee.

Unless there are medical or other extenuating circumstances, a DNW will usually be counted as a ZERO mark in determining standing.

Note: The Science Faculty plans to adopt a grading system similar to the grading system used in the Arts Faculty in which a 15 point scale from A+ to F- is used rather than a percentage system. Since a Senate Committee is presently studying a common grading system for the entire University the effective date for the above plan has been deferred until Sept. 1971. Further details of this new grading system will be announced later.

b) Overall standing will be determined at the end of each year by the cumulative average of all courses taken at the University (at any time, whether passed or failed).

To proceed in the General programme requires a cumulative average of 50% overall; if a field of specialization is chosen after Year 1, a 60% cumulative average in this field will also be required. To proceed in an Honours programme requires a cumulative average of 60% overall and 60% in the course of the major subject(s). The Optometry programme is evaluated in the same manner as the regular Honours programmes of the Faculty.

Since Year 1 is essentially a common year any student passing all courses with the required overall average may enter any Year 2 programme in good standing (i.e. a C or better standing in a major field, subject while desirable, will not be required). If an upper year student fails to meet either of the above required cumulative averages he will be designated as in Conditional Standing for the following year. A General student in Conditional Standing must improve his standing to at least the minimum overall level noted or else he will be required to withdraw from the Faculty; students in the 4-year majoring programme may be transferred to the 3-year programme where no major field average is required. An Honours student in Conditional Standing may elect to transfer to the General programme in good standing (if this is possible) or may endeavour to improve his Honours average to the cumulative minimum required; if such improvement is not forthcoming such a student will be transferred to the General programme. Alternatively, the Examinations and Standing Committee may decide that such a student must transfer to the General programme (either option). An Honours student in Conditional Standing may be required by his major Department to repeat certain courses in which he has done poorly or he may elect to do so himself in order to improve his performance in
Examinations and Standings

A student's standing (overall) will be recorded each year according to the following terms:

<table>
<thead>
<tr>
<th>Cumulative Average</th>
<th>Honours Programme</th>
<th>General Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>75.00-100</td>
<td>First Class Honours</td>
<td>A</td>
</tr>
<tr>
<td>66.0-74.9</td>
<td>Second Class Honours</td>
<td>B</td>
</tr>
<tr>
<td>60.00-65.9</td>
<td>Third Class Honours</td>
<td>C</td>
</tr>
<tr>
<td>50.0-59.9</td>
<td></td>
<td>D</td>
</tr>
</tbody>
</table>

Below these levels will be Conditional Standing (first time) or Failure, required to withdraw (second time such level in the same programme is achieved). If a regular (full-time) student, even in good standing, fails more than two full-year courses or their equivalent in a given year he may be transferred to the General programme or else he may be asked to withdraw if his Department feels he is making unsatisfactory progress towards a degree. Students thus asked to withdraw may be eligible to apply for re-admission only after a one year's absence. Students asked to withdraw after the equivalent of two "years" in Conditional or "Failed" standing (here or elsewhere) will normally not be re-admitted.

Note In cases where a course (failed or passed) is repeated, both marks will be used in calculating the student's cumulative overall average. If a passing grade is achieved more than once in the same course, it will still only count as one course passed towards the total necessary for graduation. Students in good standing will not normally repeat courses they have passed. No course may be repeated more than once.

c) Programme selection:
Full-time students. All first year students must take a minimum of 5 courses and no more than 6 courses will be permitted except in exceptional cases. In subsequent years, a General student will normally take 5 courses minimum, 6 courses maximum per year, unless fewer are needed for graduation. Honours students in upper years will follow Departmental recommendations (usually 5-7 courses per year). An extra course once completed will normally count as a course passed or failed as well as in calculation of the cumulative average (the only exception to this would be for graduating students taking more than the minimum number of courses needed for graduation). All students taking extra courses should have a cumulative average of 70% or better (or in the case of Year 1 students, a Grade 13 average of 70% or better).

Part-time studies or reduced programmes: Except in exceptional circumstances, an Honours programme may not be taken on a completely part-time or reduced-programme basis; at least two of the upper three years must be taken on a full-time (full programme) basis and no student may spend more than 5 years of full-time study (or its equivalent) for an Honours degree. The Science Faculty does not encourage part-time studies but will allow the General degree in either option, to be pursued on a part-time or reduced-programme basis subject to approval by the Associate Dean (Undergraduate Affairs) and the Department concerned (where the programme involves a major field). Normally, no first year programme for a full-time student may be reduced below the 5 course minimum except in very exceptional circumstances.

d) Co-operative Programmes: Students in Co-operative Honours Applied Chemistry and Co-operative Honours Applied Physics will be evaluated by the rules shown modified where necessary to suit their special needs.
Examinations and Standings

I Evaluations in Year 1 will be made at the end of term 1B on the entire year's work. Students must have a 60% average to proceed to term 2A. Those below this average may be transferred to the General programme (non-Co-op) in good standing if possible or may be allowed to repeat the 1B term in Conditional Standing in order to remain in the Co-op programme. Students who have done very poorly and who are felt unable to repeat the 1B term will be transferred to the Year 1 regular programme in Conditional Standing, or else may be asked to withdraw from the Faculty.

II Upper year assessments will be made on a term by term basis and cumulative average, make-up examination privileges, conditional or good standing, etc., decided then. Beyond Year 1, the Chemistry and Physics programmes are mostly composed of one-term courses in which all marks are final. Depending on electives chosen there is some mixture of term and full-year courses. Assessments made in terms 2A and 3A will be on the basis of marks in all courses taken; no make-up examinations will be given in the first half of a full-year course; for assessments in terms 2B and 3B, marks given for the second half of a full-year course will be the final mark for the course and will replace the A term mark for averaging purposes. Make-up examinations may be allowed in one-term courses at any time and in full-year courses at the end of the second term only. Terms 4A and 4B of the Physics and Chemistry programmes will normally be assessed as a unit at the end of the 4B term when both terms are taken consecutively from September to April. Students from both Applied Chemistry and Applied Physics may be transferred to the General programme (non-Co-op) if they are deemed to be making unsatisfactory progress towards their Honours degree. Normally, a student may take no more than two upper year terms on a part-time or reduced-programme basis and must have special permission from his Department to do so.

Make-up Examinations The Faculty of Science will no longer grant automatic supplemental examinations to all students in good standing. This is in line with general practice in other Faculties and Universities operating on a credit system. It has been the experience in the Faculty of Science at Waterloo that the majority of students who have failed courses have subsequently failed to pass supplemental examinations. The Science Faculty realizes that course prerequisites are important to students proceeding to a Science degree and will endeavour to grant make-up examination privileges to deserving students in good standing but only in a limited number of cases according to the following general principles:

A) In failed courses in Year 1 where such courses are prerequisites for required Year 2 programmes (normally Chemistry, Physics and Calculus which are recommended or required by many programmes).

B) In failed courses for students in their graduating year where only one or two such courses remain to be completed for a degree.

C) In all other years, normally only where such failed courses could not be repeated and where a student's progress could be unduly held up by lack of one prerequisite. Non-prerequisite courses would have to be repeated, i.e. most Arts courses and non-required Mathematics or Science courses, and many others could be repeated on a co-requisite basis.

D) In any case where failure to pass is attributable to extraordinary circumstances, especially medical or health-related problems.
Examinations and Standings

satisfied the student has a fair chance to pass the examination—the student's overall University record may be used in making this assessment). Regardless of standing, no student will be allowed make-up privileges if he has failed more than two full courses or their equivalent in a given year (except on medical grounds as in D).

Make-up examinations will be held in July for regular programmes. Applications for these examinations must be filed by the end of June on forms provided by the Office of the Registrar. In co-operative programmes, make-up examinations will be written in the term immediately following that in which the respective final examinations are written. Fees for make-up examinations must accompany the application. If the student decides not to write the examination, the fee is not refunded.

Except in extraordinary circumstances, (e.g. D above), when a make-up examination is passed, the course will count as a course passed toward the degree, but the mark obtained will not be counted in determining cumulative averages (i.e. the original mark will normally be the mark which counts).

Other General Comments

a) Transfer Students: Students will be accepted for transfer from other Year 1 programmes in the University or from other Universities. Their programmes will be evaluated in terms of the number of course credits allowed and the number remaining for a degree. Students from other Universities will not have previous background used in calculating Cumulative Averages. Students from other Faculties at Waterloo may have cumulative averages include courses transferred for credit (See Admission Requirements).

Students will be accepted for transfer at other than the Year 1 level but will normally be required to complete at least the equivalent of two years' work in the Faculty of Science (i.e. at least 10 full-year courses) regardless of the number of transfer credits they present.

b) Transferability or Upgrading of B.Sc. Degree: A student who has graduated with a 3-year General degree may successfully complete the requirements of the 4-year degree with an official major field designation and exchange his old diploma for a new one, although he will not "graduate" a second time. Normally a student from this University or from another University may not upgrade a General B.Sc. or its equivalent to a Waterloo Honours B.Sc. However, from time to time such conversion privileges may be allowed in exceptional cases on the recommendation of the Department(s) concerned and with the approval of the Examinations and Standings Committee.

c) Future Requirements: The Faculty of Science changed to a course-credit system in 1969. As the Faculty gains experience in the operation of such a system, these rules may be modified from time to time. Every effort will be made to operate consistent practices within each programme and broadly across the Faculty and the University where desirable. Normally, students will be given advance warning of changes in regulations but the Faculty reserves the right to make changes without notice where necessary.

Course and Programme Changes

a) Students may add and drop half courses during the first three weeks of the Fall, Winter and Spring terms upon having the appropriate change form completed.

B) Students may add and drop full-year courses during the first three weeks of the Fall term upon having the appropriate change form completed.
officer and upon completing the appropriate change form.

d) After these periods and until the last day of lectures, students may reduce their programmes from honours to general where appropriate.
e) Extra courses may be dropped after the normal three week change period but normally not after November 15 or July 1 for Fall and Spring one-term courses or March 1 for Winter one-term or full-year courses. An extra course is defined as one course beyond the minimum of five required in Year 1 or any year of the General Programme or one beyond the published minimum required for an Honours Programme (usually 5-7 courses depending on major field of study). Under the course-credit system, extra courses, once completed, are included in the cumulative average. All students other than those in Year 1 should clearly indicate to the appropriate Faculty advisor at Registration time which courses are to be regarded as extra.

Academic Programmes

Students entering first year in the Faculty of Science are essentially enrolled in a common year. Year 1 Co-operative Applied Chemistry, Co-operative Applied Physics or Optometry are labelled as such but all other students are officially in Year 1 Regular Science. Year 1 Regular Science students are not designated as Honours or General or according to any specific programme. Essentially the same courses are available to all first year students and any student may enter any Year 2 programme in Science provided he or she has taken the necessary courses in Year 1 and has achieved the necessary passing average.

In descriptions of programmes to follow, the term "course" refers to a course which extends for one full academic year; two half-year (or one-term) courses are the equivalent of one full course (one-term courses are marked with* following the course number). The symbol* after the number of laboratory hours indicates a laboratory taken in alternate weeks.

First Year Programmes (Regular and Co-operative) The Year 1 Science programme requires 5 full courses in first year of which at least two must be Faculty of Science courses and one of which should be an Arts elective (preferably English or Psychology). Only students who Grade 13 average was 70% or better may select 6 courses if they wish and no more than 6 courses will be allowed except in exceptional cases. Year 1 Optometry students should normally select only 5 courses.

Courses should be chosen with a Year 2 goal in mind or else should be made general enough to cover many Year 2 programmes. The recommended Year 1 selections for various Year 2 Honours or General Science-Major programmes are shown below; in most cases the number of required courses has been held to only two with up to two more recommended (but not compulsory). Students may enter any Year 2 programme if they achieve the average necessary and have taken the required courses. Students who elect 6 courses instead or 5 will have one less elective to take in one of the upper years, or else may enrich their programme with extra courses.
### Regular Programmes

<table>
<thead>
<tr>
<th>Major Field of Study</th>
<th>Options Required in Year 1</th>
<th>Options Recommended in Year 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology (see Note 1)</td>
<td>Biology 132, Chemistry 121*-142*</td>
<td>Physics 101*-102*, Mathematics 130</td>
</tr>
<tr>
<td>Biology and Chemistry (see Note 1)</td>
<td>Biology 132, Mathematics 130, Chemistry 121*-122*</td>
<td>Physics 101*-102*; or 121*-122* or 162*-163*</td>
</tr>
<tr>
<td>Chemistry</td>
<td>Mathematics 130, Chemistry 121*-122*</td>
<td>Physics 121*-122* or 162*-163*</td>
</tr>
<tr>
<td>Biology and Chemistry (see Note 2)</td>
<td>Mathematics 130, 131, Chemistry 121*-122*</td>
<td>Mathematics 132</td>
</tr>
<tr>
<td>Earth Sciences</td>
<td>Earth Sciences 130, Chemistry 121*-142*</td>
<td>Physics 101*-102*; or 121*-122* or 162*-163*</td>
</tr>
<tr>
<td>Earth Sciences and Geography</td>
<td>Earth Sciences 130, Geography 101*-102*, Chemistry 121*-142*</td>
<td>Biology 132, Chemistry 121*-142*</td>
</tr>
<tr>
<td>Optometry</td>
<td>Mathematics 125, Physics 121*-122* or 162*-163*, Psychology 101*-102*</td>
<td>Mathematics 130</td>
</tr>
<tr>
<td>Physics (see Note 2)</td>
<td>Mathematics 130, Physics 121*-122* or 162*-163*</td>
<td>Mathematics 131, Chemistry 121*-122*</td>
</tr>
</tbody>
</table>

### Co-operative Programmes

<table>
<thead>
<tr>
<th>Major Field of Study</th>
<th>Options Required in Year 1</th>
<th>Options Recommended in Year 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Chemistry (see Note 3)</td>
<td>Mathematics 130, Chemistry 121*-122*</td>
<td>Mathematics 132</td>
</tr>
<tr>
<td>Applied Physics (see Note 3)</td>
<td>Mathematics 130, Physics 121*-122* or 162*-163*</td>
<td>Mathematics 131, Chemistry 121*-122*</td>
</tr>
</tbody>
</table>

---

**Note 1** Students wishing to pursue Honours Biology or Honours Biology and Chemistry who elect Physics 121*-122* or Physics 162*-163* in Year 1 would normally be expected to elect Physics 222*-223* (Electricity and Magnetism) in Year 2 or 3. The one year sequence Physics 101*-102* is not normally followed by any upper year Physics courses except for 301*-302*.

**Note 2** Students desiring the Biophysics option of the Honours Physics programme are advised to include Biology 132 in their programme unless they achieved at least 75% in Grade 13 Biology. Students wishing the Theoretical Physics option are advised to select Mathematics 130, 131 and 132.

**Note 3** Students on the Co-operative plan have two methods of taking Year 1 Applied Chemistry or Physics: Stream "A"—two terms in a row (September-April) or Stream "B"—full term on campus (September-December), winter term at work (January-April) and spring term on campus (April-August). Since no Biology or Earth Sciences courses are offered in the spring term (April-August), only students who plan to take Co-op Stream "A" may elect these courses. Stream "B" students must elect both Chemistry 121*-122* and Physics 162*-163* or
Note 4  The Ontario Department of Education has strongly recommended that all students who are preparing to teach science in high school should take at least one full-year course in Biology.

A brief discussion of the above courses and some other courses available for selection is given below. See the course descriptions towards the back of the Calendar for more details. (Section 11)

Faculty of Arts Courses

Usually selections are made from the introductory courses offered in various Departments. English 102 (Regular students only), 105*, 108*, and 190* are strongly recommended for consideration as are Psychology 101* and 102*. Some other popular selections might be Anthropology 101* and 102*, Economics 101* and 102*, French 100, Geography 101* and 102*, German 101* and 102*, History 101*-102* or 103*-104* or 120, Philosophy 100* or any of Philosophy 125*, 135*, 140*, 150*, Political Science 105* and 106*, Russian 101* and 102*, Sociology 101* and various courses in Religious Studies. Other selections may be suitable if offered.

Faculty of Mathematics Courses

There are 3 first-year Mathematics courses, 130 (Calculus), 131 (Algebra and Solid Geometry) and 132 (Introduction to Computer Science) which may be chosen. Calculus is either required or recommended in all programmes in Science and should be strongly considered. Only students who are above average in Mathematics (e.g. approximately 70% or better in Grade 13 Mathematics A and B) should normally choose all three Mathematics courses. Mathematics 125 (Calculus plus other topics) is offered for year 1 Optometry students instead of Mathematics 130.

Faculty of Science Courses

Introductory courses are offered in Biology, Chemistry, Earth Sciences and Physics. Courses from two of these areas must be elected. Although there are several first year courses available in Physics there is sufficient overlapping of material that only one of the full-year sequences may be chosen, i.e. only one of Physics 101*-102*, 121*-122*, 162*-163*. Chemistry 121* is available to all students in the fall term and a choice of 122* or 142* in the winter term (122* is also offered in the spring term for Co-op students). Because the material does not overlap, students may select both 122* and 142* if they wish.

Biology

Biology 132—Principles of Biology (2 lectures, 3 hours laboratory) This course is the normal selection for those wishing a Biology elective in first year. It is for all students whether or not Grade 13 Biology was taken. Students with 75% or better in Grade 13 Biology may by-pass this course and select a year 1 programme without Biology 132—entry into Year 2 Honours Biology will be allowed. Alternatively, such superior Biology students who have achieved at least a 70% overall Grade 13 average will be allowed to select a second-year Biology course instead of Biology 132.

Earth Sciences

Earth Sciences 130—Introductory Geology (2 lectures, 3 hours laboratory) This course is an ideal elective for first year students who are not familiar with this area. It is not necessary to have a Geography or other specific high school background for this course. Students with potential interest in Geochemistry or Geophysics should select this course.

Chemistry
Academic Programmes

Chemistry 122* General Chemistry for the Physical Sciences (3 lectures, 3 hours laboratory, offered in winter and spring terms.)
Chemistry 142* General Chemistry for the Life Sciences (3 lectures, 3 hours laboratory, winter term only)

Physics
Physics 101* General Physics (3 lectures, fall term)
Physics 102* General Physics (3 lectures, winter term)
Physics 121* Introductory Physics 1 (3 lectures, 3 hours laboratory or 2 hours tutorial, fall term)
Physics 122* Introductory Physics 2 (3 lectures, 3 hours laboratory or 2 hours tutorial, offered in winter or spring term)
Physics 162* Mechanics, Wave Motion and Heat 1 (3 lectures, 3 hours laboratory or 2 hours tutorial, fall term)
Physics 163* Mechanics, Wave Motion and Heat 2 (3 lectures, 3 hours laboratory or 2 hours tutorial, offered in winter or spring term)

The normal prerequisite for all Chemistry and Physics courses beyond the first-year level is Physics 121*-122*. Students of demonstrated ability (at least 75% average in Grade 13 Physics and Mathematics A) who prefer an enriched, and slightly more challenging, course are encouraged to take Physics 162*-163*. Physics 101*-102* is a one-year survey of the main fields of Physics for students who do not plan to take courses in this subject beyond the first year although it can be used as prerequisite for Physics 301*-302*. Students do not need Grade 13 Physics as prerequisite to take 101*-102* or 121*-122 although it would be desirable.

Honours Programmes
The normal route to attain professional standing in Science is to take an Honours Programme in the appropriate field or combination of fields. The Honours Programmes are of four years' duration and are approximately 20-24 courses in length depending on the programme and in some cases on the electives chosen; they are rather specialized in content, and the syllabus in each is prescribed in terms of a core of compulsory courses plus various electives which allow some flexibility of choice. Most Honours Programmes allow at least 25% of the courses to be taken as electives of the student's choice, although recommended courses are shown as a guide. The minimum standard for graduation from any Honours Programme is a cumulative (overall) average of 60% calculated for all courses taken (in any year—whether passed or failed) plus a 60% cumulative average for the major field courses. Those graduating with at least second-class honours standing are granted preferred treatment for post-graduate study in Canadian Universities. Graduates of certain Honours Programmes may be eligible for admission to Type A (specialist) courses for prospective high school teachers at a College of Education in Ontario.

Honours Biology (For Year 1, see page 000)

<table>
<thead>
<tr>
<th>Year 2</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 233</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 234</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 235</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 266</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

The following Honours Programmes are available
### Academic Programmes

#### Two-non-Biology electives
(Physics 301*-302* and Chemistry 338 are recommended).

<table>
<thead>
<tr>
<th>Year</th>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>3t</td>
<td>Biology 333 Invertebrate Zoology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Biology 334 The Vascular Plants; Cytogenetics and Morphogenesis</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Biology 335 Microbiology 1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Biology 337 General Physiology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Chemistry 337 Biochemistry 1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Note regarding electives
*All Honours Biology students who have completed their third year are required to participate in an off-campus field course held in April.

#### Year 4
5 courses, at least 3 of which are Biology 400-level courses.
This year is designed to be the specialist year. The student now has a wide grounding in basic biology and biochemistry and can choose courses covering his particular area of interest.

#### Honours Biology and Chemistry
(For Year 1, see page 130)

<table>
<thead>
<tr>
<th>Year</th>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Chemistry 210* Non-Aqueous Solvents and Non-Transition Metal Chemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Chemistry 211* Chemical Bonding in Inorganic Chemistry</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Chemistry 260* Organic Chemistry 1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Chemistry 261* Organic Chemistry 2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Chemistry 220* Introductory Analytical Chemistry</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Chemistry 221* Analytical Chemistry of Multi-Component Systems</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Chemistry 291* Laboratory (winter term)</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Elective (Mathematics 236 recommended)</td>
<td>as specified</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biology 233 Vertebrate Zoology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Biology 234 The Plant Kingdom</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Biology 235 Fundamentals of Microbiology</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Chemistry 325 Physical Chemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Chemistry 336 Organic Chemistry 2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Chemistry 337 Biochemistry 1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Elective (Physics 222*-223* strongly recommended if Physics 121*-122* or 162*-163* taken in Year 1)</td>
<td>as specified</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Two of:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 333 Invertebrate Zoology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 334 The Vascular Plants; Cytogenetics and Morphogenesis</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
### Academic Programmes

<table>
<thead>
<tr>
<th>Year</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Chemistry 341</td>
<td>Inorganic and Nuclear Chemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Chemistry 437</td>
<td>Biochemistry 2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective</td>
<td></td>
<td>as specified</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Three of:</strong></td>
<td>Any 400-level courses offered in Biology</td>
<td>as specified</td>
<td></td>
</tr>
</tbody>
</table>

### Honours Chemistry

**Year 2**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 210*</td>
<td>Non-Aqueous Solvents and Non-Transition Metal chemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 211*</td>
<td>Chemical Bonding in Inorganic Chemistry</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 220*</td>
<td>Introductory Analytical Chemistry</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry 221*</td>
<td>Analytical Chemistry of Multi-Component Systems</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 260*</td>
<td>Organic Chemistry 1</td>
<td>2</td>
<td>3*1</td>
</tr>
<tr>
<td>Chemistry 261*</td>
<td>Organic Chemistry 2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 250*</td>
<td>Introductory Thermodynamics</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 251*</td>
<td>Applications of Chemical Thermodynamics</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 252*-253*</td>
<td>Quantum Chemistry 1 &amp; 2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 291*</td>
<td>Laboratory (winter term)</td>
<td>0</td>
<td>9</td>
</tr>
</tbody>
</table>

**One full-year Elective** *(Physics 222*-223* recommended for consideration in either Year 2 or 3).*

**Note** *The Chemistry Curriculum is presently under revision. The new Year 2 is shown above. Years 3 and 4 will not be changed until 1972-1973 and will appear in the next calendar.*

### Year 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 331</td>
<td>Inorganic Chemistry 1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 335</td>
<td>Physical Chemistry 2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 336</td>
<td>Organic Chemistry 2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 355</td>
<td>Laboratory in Physical Chemistry</td>
<td>0</td>
<td>6</td>
</tr>
</tbody>
</table>

**Two electives** *(subject to availability and compatibility with the timetable, the following are suggested: Physics 226*-227*, Mathematics 219, 240a*-240b*, 243, Chemistry 337, 400*, 405*, 425*)

### Year 4

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 431</td>
<td>Inorganic Chemistry 2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 435</td>
<td>Physical Chemistry 3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 436</td>
<td>Organic Chemistry 3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 439</td>
<td>Advanced Laboratory</td>
<td>0</td>
<td>9</td>
</tr>
</tbody>
</table>

**Two electives** *(subject to availability and compatibility with the timetable, the following are suggested: Physics 352*-353*, Mathematics*)
Honours Chemistry (Mathematics Option)  

(For Year 1, see page 130)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 210*</td>
<td>Non-Aqueous Solvents and Non-Transition Metal Chemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 211*</td>
<td>Chemical Bonding in Inorganic Chemistry</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 220*</td>
<td>Introductory Analytical Chemistry</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry 221*</td>
<td>Analytical Chemistry of Multi-Component Systems</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 260*</td>
<td>Organic Chemistry 1</td>
<td>2</td>
<td>3+4</td>
</tr>
<tr>
<td>Chemistry 261*</td>
<td>Organic Chemistry 2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 250*</td>
<td>Introductory Thermodynamics</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 251*</td>
<td>Applications of Chemical Thermodynamics</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 252*-253*</td>
<td>Quantum Chemistry 1 &amp; 2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 291*</td>
<td>Laboratory (winter term)</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Math 240a*-240b*</td>
<td>Applications in Computer Science</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

One of:

- Mathematics 233 Probability & Statistics 2 1
- Mathematics 236 Elementary Differential Equations 2 0
- Mathematics 243 Statistics for the Sciences 2 1

Physics 222*-223* or 252*-253* Electricity & Magnetism 1 and 2 2 3*

Note 1 The Chemistry Curriculum is presently under revision. The new Year 2 is shown above. Years 3 and 4 will not be changed until 1972-3 and will appear in the next calendar.

Year 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 331</td>
<td>Inorganic Chemistry 1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 335</td>
<td>Physical Chemistry 2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 336</td>
<td>Organic Chemistry 2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 355</td>
<td>Laboratory in Physical Chemistry</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Mathematics 219</td>
<td>Linear Algebra</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 237</td>
<td>Differential &amp; Integral Calculus</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

One of:

- Chemistry 337 Biochemistry 1 2 0
- Physics 226*-227* Optics 2 3*
- Physics 352*-353* Electronics 2 3*

An additional Mathematics course approved by the Chemistry Department.

Year 4

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 431</td>
<td>Inorganic Chemistry 2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 435</td>
<td>Physical Chemistry 3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 436</td>
<td>Organic Chemistry 3</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>
Academic Programmes

Mathematics 329 Abstract Algebra 2 0
Mathematics 343 Complex Variable Theory 2 0
Mathematics 434 Differential Equations of Mathematical Physics

One of:
Chemistry 437 Biochemistry 2 3
Chemistry 440 Polymer Chemistry 2 0
Chemistry 439 Advanced Laboratory 0 6

Note Other Mathematics courses may be substituted for Mathematics courses listed subject to the approval of the Chemistry Department.

Honours Chemistry (Physics Option) (For Year 1, see page 130

Year 2
Chemistry 210* Non-Aqueous Solvents & Non-Transition Metal Chemistry 2 3
Chemistry 211* Chemical Bonding in Inorganic Chemistry 2 0
Chemistry 220* Introductory Analytical Chemistry 1 6
Chemistry 221* Analytical Chemistry of Multi-Component Systems 2 0
Chemistry 250* Introductory Thermodynamics 2 1
Chemistry 251* Applications of Chemical Thermodynamics 2 1
Chemistry 252*-253* Quantum Chemistry 1 & 2 2 1
Chemistry 291* Laboratory (winter term) 0 9
Chemistry 260* Organic Chemistry 1 2 3
Chemistry 261* Organic Chemistry 2 2 1
Physics 222*-223* or 252*-253* Electricity & Magnetism 1 and 2 2 3*
Physics 226* Optics 2 3*
or 255* Quantum Physics & Optics 2 3*

Note The Chemistry Curriculum is presently under revision. The new Year 2 is shown above. Years 3 and 4 will not be changed until 1972-1973 and will appear in the next calendar.

Year 3
Chemistry 331 Inorganic Chemistry 1 2 3
Chemistry 335 Physical Chemistry 2 2 0
Chemistry 336 Organic Chemistry 2 2 3
Chemistry 355 Laboratory in Physical Chemistry 0 6
Mathematics 237 Differential and Integral Calculus 3 0
Physics 352* Electronics 2 3*
Physics 324* Atomic and Nuclear Physics 3 0

Year 4
Chemistry 431 Inorganic Chemistry 2 2 0
Chemistry 435 Physical Chemistry 3 2 1
Chemistry 436 Organic Chemistry 3 2 0
Mathematics 450 Applied Analysis 2 0
Physics 362* Classical Mechanics 1 and 2 3 0
Physics 435* Solid State Physics 3 0

One of:
Chemistry 437 Biochemistry 1 2 0
### Co-operative Applied Chemistry

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 210*</td>
<td>Non-Aqueous Solvents and Non-Transition Metal Chemistry (A Stream)</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 211*</td>
<td>Chemical Bonding in Inorganic Chemistry (B Stream)</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 260*</td>
<td>Organic Chemistry 1</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 250*</td>
<td>Introductory Thermodynamics</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 252*</td>
<td>Quantum Chemistry 1</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 220*</td>
<td>Introductory Analytical Chemistry</td>
<td>1</td>
</tr>
</tbody>
</table>

One elective

It is recommended that Physics 222*-223* or 252*-253* be strongly considered as electives sometime during Years 2 & 3.

### Year 2B

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 211*</td>
<td>Chemical Bonding in Inorganic Chemistry (A Stream)</td>
<td>2</td>
</tr>
<tr>
<td>or</td>
<td>Chemistry 210* Non-Aqueous Solvents and Non-Transitional Metal Chemistry (B Stream)</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 261*</td>
<td>Organic Chemistry 2</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 251*</td>
<td>Applications of Chemical Thermodynamics</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 253*</td>
<td>Quantum Chemistry 2</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 221*</td>
<td>Analytical Chemistry of Multi-Component Systems</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 291*</td>
<td>Laboratory</td>
<td>0</td>
</tr>
</tbody>
</table>

One elective

### Note

The Chemistry Curriculum is presently under revision. The new year 2 is shown above. Years 3 and 4 will not be changed until 1972-1973 and will appear in the next calendar. Students taking term 2B in the spring and fall of 1971 will follow the description outlined in the previous calendar, i.e. Chemistry 201*, 205* and 3 electives (with Chem. 200* and Math 51* recommended).
Academic Programmes

Electives (2 required):

- Physics 243* (if not taken previously) 3 3* (lab required)
- Physics 352* Electronics 3 3* (lab required)
- Engineering elective as specified
- Non-Chemistry Science elective as specified

**Year 3B**

- Chemistry 302* Modern Organic Analysis 2 3
- Chemistry 305* Applied Physical Chemistry 3 3
- Electives (3 required):
  - Chemistry 303* Introductory Polymer Chemistry 3 3
  - Chemistry 307* Introductory Biochemistry 3 3
  - Chemistry 318* Instrumental Measurements 2 Arts, Engineering or Science elective 1 3

**Year 4A**

- Chemistry 400* Electrochemistry and Corrosion 3 3*
- Chemistry 429 Project Laboratory 0 9
- Chem. Eng. 61* Engineering Economics 3 0
- Electives (2 required):
  - Chemistry 403* as specified
  - or Chem. Eng. 81* Physical Chemistry of Polymers as specified
  - Chemistry 405* Surface Chemistry 3 0
  - Chemistry 407* Applied Biochemistry 3 3
  - Chemistry 408* Instrumentation 1 Arts, Engineering or Science elective 1 3

**Year 4B**

- Chemistry 425* Chemical Kinetics 2 0
- Chemistry 429 Project Laboratory 0 9
- Chemistry 410* Applied Chemistry Seminar 0 1
- Electives (2 required):
  - Chemistry 412* Analysis of Materials 2 3
  - Chemistry 413* Properties of Polymers 3 3
  - or Chem. Eng. 82 Polymer Processing 3 0
  - Chemistry 415* Catalysis 3 0
  - Chemistry 418* Instrumentation 2 Arts, Engineering or Science elective 1 3

**Note 1** All electives chosen must be from those offered, compatible with the timetable. Choice of electives must be approved by the Chemistry Department.

**Note 2** Only two of the Chemistry electives in terms 4A and 4B will be offered each year according to demand.

Honours Earth Sciences (Geology Option)

(For Year I, see page 130)

**Year 2**

- Earth Sciences 231* Mineralogy 2 3
- Earth Sciences 232* Petrography 2 2
- Earth Sciences 237* Field Geology 0 4
- Earth Sciences 238* Historical Geology 2 2
- Earth Sciences 240* Geomorphology 2 3
- Earth Sciences 241* Geophysical Methods
Chemistry 218*  Development of Chemical Bonding and Structure 2 1
Arts Elective as specified
One of:
Mathematics 130  Calculus 3 0
Mathematics 132  Introduction to Computer Science 2 2
Mathematics 243  Statistics for the Sciences 2 1
Year 3
Earth Sciences 330  Igneous and Metamorphic Petrology 2 3
Earth Sciences 334  Paleontology 2 2
Earth Sciences 335  Stratigraphy and Sedimentation 2 3
Earth Sciences 340  Structural Geology 2 2
Arts Elective as specified
One of:
Biology 333  Invertebrate Zoology 2 3
Physics 250*-251*  The Solar System—The Stellar System 3 0
or other Science elective as specified
Year 4
Earth Sciences 430  Economic Geology 2 3
Earth Sciences 436  Thesis 0 3
Earth Sciences 437  Crustal Evolution 2 2
Non-Earth Sciences as specified
Two courses from:
Earth Sciences 368*-369*  Geophysics 1 and 2 2 0
Earth Sciences 431  Geochemistry 2 2
Earth Sciences 432*  Precambrian Geology 2 2
Earth Sciences 434*  Biostratigraphy 2 2
Earth Sciences 438*  Engineering Geology 2 1
Earth Sciences 439*  Groundwater Geology 3 0
Earth Sciences 440*  Quaternary Geology 2 3
†Courses marked * are half courses: two of these make the equivalent of one course selection.

Honours Earth Sciences and Geography
Year 1  (For a complete discussion of Year 1, see page 130
Lectures  Labs
Earth Sciences 130  Introductory Geology 2 3
Geography 101*  Introduction to Human Geography 2 2
Geography 102*  Introduction to Physical Geography 2 2
Chemistry 121*  Chemical Structure and Periodicity 3 3
Chemistry 142*  General Chemistry for the Life Sciences 3 3
Two electives as specified
Year 2
Earth Sciences 231*  Mineralogy 2 3
Earth Sciences 241*  Optical Mineralogy 2 3
Earth Sciences 332*  Petrography 2 2

Academic Programmes
### Academic Programmes

<table>
<thead>
<tr>
<th>Subject</th>
<th>Year</th>
<th>Course Code</th>
<th>Credits</th>
<th>Lectures</th>
<th>Labs or Tut</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Sciences 237*</td>
<td></td>
<td>Field Geology</td>
<td></td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Earth Sciences 238*</td>
<td></td>
<td>Historical Geology</td>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 240*</td>
<td></td>
<td>Geomorphology</td>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Geography 200*</td>
<td></td>
<td>Principles of Biogeography and Ecology</td>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Geography 201*</td>
<td></td>
<td>Basic Topics of Physical Geography</td>
<td>0</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Geography 202*</td>
<td></td>
<td>Economic and Urban Geography</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Geography 203*</td>
<td></td>
<td>Cultural and Regional Geography</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>One elective</td>
<td></td>
<td></td>
<td></td>
<td>as specified</td>
<td></td>
</tr>
<tr>
<td><strong>Year 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 330</td>
<td></td>
<td>Igneous and Metamorphic Petrology</td>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Earth Sciences 334</td>
<td></td>
<td>Paleontology</td>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 335</td>
<td></td>
<td>Stratigraphy and Sedimentation</td>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Earth Sciences 340</td>
<td></td>
<td>Structural Geology</td>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>One Geography elective</td>
<td></td>
<td></td>
<td></td>
<td>as specified</td>
<td></td>
</tr>
<tr>
<td>One elective</td>
<td></td>
<td></td>
<td></td>
<td>as specified</td>
<td></td>
</tr>
<tr>
<td><strong>Year 4</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 436</td>
<td></td>
<td>Honours thesis</td>
<td></td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Three other Earth Sciences courses at the 400 level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One of Geography 420-432</td>
<td></td>
<td>Geographic Analysis of Selected World regions</td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

### Honours Physics

(For Year 1, see page 130)

#### Basic Programme

The basic Honours Programme is in the form of a core of required courses, plus appropriate electives. The programme should include a total of at least fifty lecture hours beyond first year.

<table>
<thead>
<tr>
<th>Year 2</th>
<th>Core</th>
<th>Lectures</th>
<th>Labs or Tut</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 252*-253*</td>
<td>Electricity and Magnetism</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Physics 252L*-253L*</td>
<td>Electricity and Magnetism Labs</td>
<td>0</td>
<td>3*</td>
</tr>
<tr>
<td>Physics 256*</td>
<td>Optics (first term)</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 256L*</td>
<td>Optics Laboratory</td>
<td>0</td>
<td>3*</td>
</tr>
<tr>
<td>Physics 255*</td>
<td>Quantum Physics (second term)</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 237</td>
<td>Differential and Integral Calculus</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 31*</td>
<td>Differential Equations</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Electives: Courses totalling 5½ lecture hours.†

Mathematics 31* may be replaced by Mathematics 236.

<table>
<thead>
<tr>
<th>Year 3</th>
<th>Core</th>
<th>Lectures</th>
<th>Labs or Tut</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 360*</td>
<td>Intermediate Laboratory</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Physics 362*-<em>363</em></td>
<td>Classical Mechanics 1 and 2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 364*-<em>365</em></td>
<td>Physical Mathematics 1 and 2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 354*</td>
<td>Atomic and Molecular Physics</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 355*</td>
<td>Nuclear and Particle Physics</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 358*</td>
<td>Thermodynamics</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 359*</td>
<td>Statistical Mechanics</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Electives: Courses totalling 5½ lecture hours.†
Academic Programmes

Year 4

Core
Physics 434 Introductory Quantum Mechanics 2 1
Physics 441 Electromagnetic Theory 2 1
Electives: Courses totalling 11 lecture hours.

†Note When choosing electives, three hours of laboratory is considered equivalent to one lecture hour, unless otherwise stated.

Elective Programmes

The elective courses noted in the basic programme may be chosen from a wide range of courses offered by the Physics Department and by other departments of the University. By careful selection of his electives, a student can deepen his knowledge of experimental or theoretical physics, or obtain a background in another subject (e.g. Astronomy, Geophysics, Chemistry, Mathematics, Computing). The choice of electives must be made to fit the student's timetable, and must be approved by the Chairman of the Department of Physics.

The flexibility of this "core plus electives" structure is demonstrated by the following examples of possible programmes, all of which are sufficient preparation for graduate work in Physics, although each has a slightly different emphasis. Details of other possible programmes may be obtained from the Chairman of the Physics Department.

Ex. 1 Honours Physics (with extra emphasis on experimental physics)
Core plus: Year 2 Physics 259*, 259L*, 270*-271*, Mathematics 240a* and 240b*
Year 3 Physics 352*-353*, 352L*-353L*
Year 4 Physics 432*, 433, 435*, 436
Two of: Physics 442*, 443*, 444*, 445*

Ex. 2 Honours Physics (especially suitable as preparation for high school teaching)
Core plus: Year 2 Chemistry 210*-211*, Mathematics 219, 240a*-240b* or Physics 250*-251*
Year 3 Physics 352*, 352L*, and one of 353* and 353L*, 368* and 369*, 371*.
Year 4 Physics 433, 435*, Chemistry 325, Science 400, Arts Elective*

Ex. 3 Honours Physics (with Biophysics)
Core plus: Year 2 Mathematics 51*, Chemistry 250*, 266*-267*.
Year 3 Physics 380*, 381*, 352*, 352L*
Year 4 Physics 435*, 444*, 480*, 481*, Chemistry 337, Biology 337

Ex. 4 Honours Physics (with Computing)
Core plus: Year 2 Physics 259*, 259L*, Mathematics 240a*-240b*, Arts Elective*
Year 3 Two of Mathematics 51*, 334, 340
Year 4 Physics 352* and 352L*, 353* and 353L*, 435*, E.E. 324*, two Mathematics courses at the third or fourth year level, Elective*

Ex. 5 Honours Physics (with Chemistry)
Core plus: Year 2 Chemistry 210*-211*, 250*-251*, Mathematics 240a* or 240b*
Year 3 Physics 352*, 352L*, Chemistry 266*-267*
Year 4 Physics 432*, 435*, Chemistry 335, 341, two electives.

Ex. 6 Honours Physics (with Astrophysics)
Core plus: Year 2 Physics 250*, 251*, 270*, Mathematics 240a*-240b*
Year 3 Two of: Physics 350*, 351*, 449*, 450*, 451*
One of: Physics 352* and 352L*, 353* and 353L*, 352L*, 353L*, 371*, Arts elective
Theoretical Physics Programme

Students with an interest in theoretical physics may wish to emphasize the more mathematical aspects of the subject. A suitable programme consists of the “Honours Physics” core plus the following elective scheme:

Core plus: Year 2 Physics 259*, 259L*, Mathematics 219, elective*
Year 3 Mathematics 329, elective*.
Year 4 Physics 431, 435*, 437*, plus either: Physics 436 plus electives totalling 4 lecture hours Or Mathematics 332, 343, 434.

Note 1 Students interested in this programme are advised to take Mathematics 130, 131 and 132 in Year 1 to ensure having the necessary prerequisites for later year Mathematics courses.

Note 2 The only restriction on elective courses is that there is to be a minimum of duplication.

Note 3 The maximum compulsory laboratory work in this programme is an average of 3 hours in each of the second and third years.

Co-operative Applied Physics (Honours)

Applied Physics is an honours programme and is also in the form of a core of required courses plus appropriate electives. At the post-graduate level an Applied Physicist is one who does his research in an area where the results he obtains are potentially useful in industry, even though his work is fundamental physics. The electives in the second, third and fourth years of the undergraduate programme allow students to strengthen any complementary areas of interest whether that interest involves some specific field in physics or some other subject. The work terms are normally arranged to provide complementary, practical experience in research and development laboratories, in Government and Industry. This experience gives the student a deeper insight into the meaning and methods of research, as well as incentive to develop his course work. This provides a contribution to the development of a scientist that cannot be learned in lecture courses.

Information about the Co-op work terms and the Co-ordination Department can be found starting on page 546. Both “A” and “B” streams run until the end of academic term 2B whereupon the “A” stream has a double work term to combine with the “B” stream in academic term 3A. Thereafter only the “B” stream is run. Both streams enjoy the same number of work terms and stream “A” has the advantage of more senior work experience.

Year 2A (For Year 1, see page 130)

<table>
<thead>
<tr>
<th>Core</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 252* Electricity &amp; Magnetism 1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Physics 252L* Electricity &amp; Magnetism 1 Laboratory</td>
<td>0</td>
<td>3*</td>
</tr>
<tr>
<td>Physics 256* Optics</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 256L* Optics Laboratory</td>
<td>0</td>
<td>3*</td>
</tr>
<tr>
<td>Mathematics 237a Differential &amp; Integral Calculus</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 31* Differential Equations</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Electives: Courses totalling 3½ lecture hours.

Year 2B

<table>
<thead>
<tr>
<th>Core</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 253* Electricity &amp; Magnetism 2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Physics 253L* Electricity &amp; Magnetism 2</td>
<td>0</td>
<td>3*</td>
</tr>
</tbody>
</table>
### Academic Programmes

<table>
<thead>
<tr>
<th>Year</th>
<th>Core</th>
<th>Electives: Courses totalling</th>
</tr>
</thead>
<tbody>
<tr>
<td>3A</td>
<td>Physics 354* Atomic and Molecular Physics</td>
<td>2 lecture hours.†</td>
</tr>
<tr>
<td></td>
<td>Physics 358* Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Physics 360* Intermediate Laboratory</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Physics 362* Classical Mechanics 1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Physics 364* Physical Mathematics 1</td>
<td>0</td>
</tr>
<tr>
<td>3B</td>
<td>Physics 355* Nuclear and Particle Physics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Physics 359* Statistical Mechanics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Physics 363* Classical Mechanics 2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Physics 365* Physical Mathematics 2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Electives</td>
<td>5 lecture hours.†</td>
</tr>
<tr>
<td>4A</td>
<td>Physics 434 Introductory Quantum Mechanics</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Physics 441 Electromagnetic Theory</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Electives</td>
<td>11 lecture hours.†</td>
</tr>
<tr>
<td>4B</td>
<td>Physics 434 Introductory Quantum Mechanics</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Physics 441 Electromagnetic Theory</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Electives</td>
<td>11 lecture hours.†</td>
</tr>
</tbody>
</table>

†Note When choosing electives, three hours of laboratory is considered equivalent to one lecture hour, unless otherwise noted.

### Options

Some suggested programmes are given below.

**Ex. 1 Co-op Applied Physics (Solid State)**

Core plus: Year 2A Physics 259*, 259L*, 271*, Chemistry 200* or Mathematics 240b*

Year 2A Physics 270*, Mathematics 240a*

Year 2B Physics 259*, 259L*, 271*, Chemistry 200* or Mathematics 240b*

Year 3A Physics 352*, 352L*, 353*, and 353L*

Year 3B Physics 353*, 353L*, 355*, 355L*, 355L*

Year 4A Physics 433, 435*, 436, Chemistry 301*

Year 4B Physics 452*, 433, 436, 442.

**Ex. 2 Co-op Applied Physics (Biophysics)**

Core plus: Year 2A Chemistry 260*, Elective*

Year 2A Physics 380*, Mathematics 51*, Chemistry 261*

Year 2B Physics 259*, 259L*, 271*, Chemistry 200* or Mathematics 240b*
Optometry Programme

Within the Science Faculty, the School of Optometry offers a five year programme leading to the degree Doctor of Optometry. The first is a pre-optometrical year preparatory to the four years of the professional optometrical programme.

The immediate purpose of the programme is to qualify men and women for the practice of Optometry. However, the programme is designed to provide the student with sufficient general and specialized knowledge in Science so that he may follow a career in research and teaching if he so wishes. Students who desire to transfer from Optometry to other areas in Science, especially General Science, may do so at any time, although it is best to do so after Years 1 or 2. Students thus transferring will receive credit for all appropriate courses taken and will then take whatever courses are necessary to complete the programme chosen.

Upon completion of their training in Optometry graduates will be eligible to apply for registration as optometrists in the province of their choice or to undertake Graduate Studies. Graduate training will lead to the degrees of Master of Science and Doctor of Philosophy. A graduate programme in Physiological Optics, leading to the Master of Science degree, is now available.

Inquiries regarding admission requirements should be sent to the Registrar of the University. Specific admissions requirements and regulations for Examinations and Standings may be found on page 123. The Optometry programme requires the same academic standard as do the Honours programmes in the Faculty. All other inquiries relating to the course should be sent to the Secretary of the School of Optometry at the University.

Students who have completed the equivalent or more of Year 1 General Science (Optometry) at another university may apply for direct admission to Year 2 and they may be granted full credit for Year 1. If they have taken additional courses which may be equivalent to those required in the upper years of the programme, they may unon

Ex. 3 Co-op Applied Physics (and Chemistry)
Core plus: Year 2A Chemistry 260*, Arts Elective*
Year 2B Chemistry 200*, 250*, Physics 259*, 259L*
Year 3A Chemistry 301* or 261*
Year 3B Physics 371*, Chemistry 305*
Year 4A Physics 352*, 352L*, 435*, 436, Chemistry 400*
Year 4B Physics 353*, 353L*, 432*, 436, Chemistry 303* or 307*

Ex. 4 Co-op Applied Physics (with Computing)
Core plus: Year 2A Mathematics 219a, 240a*
Year 2B Mathematics 219b, 240b*, Physics 259*, 259L*
Year 3A Mathematics 340
Year 3B Mathematics 340, Physics 371*
Year 4A Mathematics 334, Physics 352*, 352L*, 435*, 436
Year 4B Mathematics 51*, 334, Physics 353*, 353L*, 436,
be granted for courses in which the grade obtained was less than "C" (60%). Credits are not normally granted for any optometry courses, e.g. Optometry 211*, Optometry 214, etc. Priority in admissions to Year 2 is given to those students completing Year 1 at the University of Waterloo and applicants are advised that the number of students who may be admitted to Year 2 is limited.

Note †As in the case of other professions, graduates in Optometry must hold the certificate of the licensing body of the Province in which they elect to engage in practice.

Academic Programme

For Year 1, see page 130. This Pre-Optometrical year is the normal Year 1 programme of the Faculty of Science with Mathematics 125, Physics 121*-122* or 162*-163*, Psychology 101*-102* required. Recommended options are Biology 132 and Chemistry 121*-142*. (Chemistry 111*-112* is recommended instead of 121*-142* for those students lacking a good Chemistry background in Ontario Grade 13 Chemistry or its equivalent.)

<table>
<thead>
<tr>
<th>Year 2</th>
<th>Lectures</th>
<th>Labs</th>
<th>Clinics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 201</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anatomy, Histology and Embryology (fall term—full course)</td>
<td>4</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 216*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to Organic and Biochemistry</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Physics 236*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optics</td>
<td>3</td>
<td>3*</td>
<td>0</td>
</tr>
<tr>
<td>Psychology 205*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensory Processes</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Psychology 206*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceptual</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Optometry 200*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History and Orientation</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Optometry 211*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physiological Optics</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Optometry 214*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anatomy of the Eye and Associated Structures (winter term—full course)</td>
<td>5</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Optometry 216*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Geometrical Optics</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 3</th>
<th>Lectures</th>
<th>Labs</th>
<th>Clinics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 301</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertebrate Physiology</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Psychology 283*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statistical Methods in Psychology</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Psychology 284*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental Design</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Optometry 301*-311</td>
<td>Physiological</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Optometry 302*-312</td>
<td>Clinical Optometry</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Optometry 305*-315*</td>
<td>General Pathology</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Optometry 306*-316*</td>
<td>Optometrical Optics</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Optometry 401*-411*</td>
<td>Physiological Optics</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Optometry 402*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical Optometry</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Optometry 412*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical Optometry</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Optometry 404*-414*</td>
<td>Physiology of Visual Systems</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Optometry 405*-415*</td>
<td>Ocular Pathology</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Optometry 406*-416*</td>
<td>Optometrical Optics</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Optometry 408*-418*</td>
<td>Optometry Clinic</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Optometry 409*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light and Illumination</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Optometry 417*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometrical Specialties</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>
The General Science Programme

The General Science Programme is available as a three- or four-year option. Students may specialize in a particular subject area in the three-year programme or may elect to pursue a broad range of Science subjects (essentially a "non-major" programme). The three-year programme is titled "General Science" with no area of specialization designated. The four-year programme is the official majoring General Science programme. It is only available with a selected major field (Biology, Chemistry, Earth Science, Physics). It is officially titled "General Science, Biology Major", "General Science, Chemistry Major", etc.

Graduates of the three-year programme who have taken the required courses are qualified to apply for admission to medical school in Ontario. Students who have passed the first year of the programme with appropriate choice of courses are qualified to apply for admission to a dental school. Graduates also may be eligible for admission to the Type B course at a College of Education in Ontario or for various industrial positions such as senior laboratory technicians, technical sales representatives, and so forth.

Graduates of the four-year programme who have taken appropriate courses will be eligible for certain categories of industrial and government employment for which the three-year programme will not fit them; likewise they can meet the subject requirements for application to Type-A courses at a College of Education in Ontario with specialization in a single subject.

Depending on the option chosen, a student may graduate with the General B.Sc. after either three or four years; the graduation diploma will indicate whether the three or four-year programme has been completed. A student who has graduated from the three-year programme may apply to register for the four-year programme; upon successful completion of the latter, a new graduation diploma will be issued in exchange for the original, but the student will not graduate a second time. Students may transfer from one of these options to the other; for transfer from the three-to the four-year programme, the student must...
General Science—Three-year Programme

The three-year programme requires the successful completion (with at least a D grade in each) of 15 courses for the B.Sc. Normal progress is 5 courses per year. At least half of the 15 courses must be Science courses and normally no more than 7 courses are allowed from the same subject area (i.e. no more than 7 Biology courses or 7 Mathematics courses or 7 English courses, etc.). Also, at least 6 of the 15 courses must be at the 200-level or higher.

If a student wishes to specialize in a particular subject area in Science he (or she) is advised to follow the recommendations of Years 1-3 of the four-year programme. Alternatively a broader selection of science subjects may be chosen but students should be warned not to make their course selection so broad and varied as to find their background of little use following graduation. The responsibility of arranging a programme selection over the three years ultimately rests with the student and he (or she) should ensure it meets his (her) needs. To ensure that proper advice is available and given regarding course selection, the student's programme must be approved at Registration time each year by a Faculty advisor.

Students are encouraged to take at least 4 courses (an average of better than one per year) from non-Science areas such as Arts or Mathematics.

The minimum standard for graduation from the three-year programme will be a cumulative (overall) average of 50% calculated for all courses taken (in any year—whether passed or failed).

Recommended Programme

**Year 1** Any 5 courses, two of which must be Science courses. Since Year 1 is common to all subsequent programmes in Science, the student is advised to select a Year 1 programme which can lead to an area of specialization in Year 2 if desired (see page 130).

**Year 2** 5 courses of which 2 or 3 should normally be Science courses.

**Year 3** 5 courses of which 2 or 3 should normally be Science courses.

**Note** Selections should be made so that at the end of Year 3 the total programme will include 15 courses (total) completed with at least half of them in Science and no more than 7 from the same subject area. In addition at least 6 of the 15 courses must be 200 or higher level courses.

Some possible electives (other than Year 1 courses described on page 141)

The following list, while not complete, indicates some of the courses from which a choice should be made. Since some Departments offer Honours or General equivalents of the same course area or Co-operative or Regular versions of the same course area, duplication of subject matter is not allowed. It is usually obvious from the course descriptions where such duplication is possible and care should be taken to avoid it as credit for only one of such overlapping courses will be allowed (e.g. credit for one of Chemistry 26*, 236, 266*-267*; one of Chemistry 202*, 242, 226*-227*, 328, one of Physics 101*-102*, 121*-122*, 162*-163*; one of English 116*-117*, 130; etc.) In addition, where Departmental course listings clearly indicate an elective as available only to Arts students, or Engineering students or Physical Education students, etc., such courses may not be selected in the General Science programme.
The General Science Programme

Students must also have any necessary prerequisites listed before attempting upper year courses; these are listed in the Departmental descriptions. More courses are offered under the Science listing this year (e.g. Science 251*) and are especially recommended for consideration.

*Science courses recommended (other than Year 1 courses)*

Biology 234, 243*-244*, 245*-246*
333, 334, 335, 337
but *not* 110*, 131, 201, 233, 235, 301, 303*-304*

Chemistry 218*-219*, 266*-227* or 328, 266*-266*-267*
325, 337, 341
but *not* 216*

Earth Sciences 231*, 232*, 237*, 238*, 240*, 241*
330, 334, 335, 340, 368*-369*

Physics 222*-223*, 226*-227*, 250*-251*, 301*-302*
324*-325*, 352*-353* and 352L*-353L*, 358*-359*
368*-369*, 380*-381*

Science 209*, 238*, 251*, 252*, 400, 451*, 452*
but *not* 100*, 200*-201*, 237*

*Mathematics courses recommended*

Mathematics 130, 131, 132 (if not taken in Year 1); 236, 240a, 240b, 243

*Arts courses recommended*

The listings shown here are not comprehensive but are a guide to courses popular with Science students in the past or courses which may be more relevant to students in Science programmes. Especially recommended are selections involving Canadian studies and problems (see Course Description section at the back of the Calendar describing these and other courses.) Subject to availability and timetabling any of these courses may be selected: (usually the 100-level introductory course is necessary to take a 200 or higher level course).

Anthropology 101*-102*, 218*-219*, 233* 234*-235*
Arts 100, 120*-121*
Economics 101*-102*, 241*-242*
English 102, 105*, 108*
190*, 211*-212*, 236*-237*, 240R, 311*
French 100, 265*-266*, 365-366*
Geography 101*-102*, 195*, 321*-322*, 341
German 111*-112*201*-202*
History 101*-102*, 103*-104*, 120, 223*, 224*,
Philosophy 100 or any 2 of 125*, 135*, 140*, 150*; 221*-222, 240
Political Science 105*-106*, 260
Russian 101*-102*, 201*-202*
Religious Studies courses as desired or any other courses from Arts areas not mentioned (e.g. Classics, Fine Arts, Italian, Spanish, etc.)
The four-year programme requires the successful completion with at least a D grade in each) of 20 courses for the B.Sc. Normal progress is 5 courses per year. An official major field (from Biology, Chemistry, Earth Science and Physics) must be selected: at least 8 courses from this major field must be completed as specified and normally not more than 10 courses from the major field area will be allowed.

While considerable flexibility to take electives exists in this programme, students must take the courses required by their major Departments (there are at least 8 free electives available in each programme; Departments may have published recommendations regarding electives which should be strongly considered although they are not compulsory). Upon graduation, at least half of the 20 courses presented must be Science courses. Students are encouraged to take at least 4 courses (an average of one per year) from non-Science areas such as Arts or Mathematics.

The minimum standard for graduation from the four-year majoring programmes will be a cumulative (overall) average of 50% calculated for all courses taken (in any year—whether passed or failed) plus a 60% cumulative average for the major field courses. Students who do not maintain their major field average in the four-year programme will be transferred to the three-year (“non-major”) programme where a major field average is unnecessary.

Recommended Programme

The selection of courses in upper years will be restricted partly by limitations imposed by the timetable, and partly by the necessity in many courses of having completed prerequisites. Each student's programme must therefore be approved by the Chairman of the Department of his major field.

The following programmes are those recommended by the department for major study in their fields. The university will make every effort to ensure that the timetable accommodates these programmes.

Note: (1971-72 only) Students entering Year 4 of this programme whose normal Year 1 programme was 6 courses rather than 5 will be required to present 15 courses over Years 2-4 and thus a total of 21 for graduation.

Biology Major

Year 1 Including Biology 132 and Chemistry 121*-142* (see page 130).

Year 2 Two of: Biology 233, 234, 235
Chemistry 266*-267*
Two non-Biology electives

Year 3 Two of three† of: Biology 333, 334, 335, 337
Chemistry 337
Two or one non-Biology electives.

†Students wishing to apply for the Ontario Department of Education Type A certificate must choose three courses in Biology in Year 3 or take a third Biology course as an extra course. In Year 4, three Biology courses should be selected.

Year 4 Five courses at least two† of which are 400-level Biology courses or courses from the above list.
The General Science Programme

301*-302* and Chemistry 328 are especially recommended

Chemistry Major

Year 1 Including Chemistry 121*-122* and Mathematics 130 (see page 130).

Year 2 Chemistry 226*-227*, 266*-267*
Three electives†

Year 3 Chemistry 218*-219*, 325
Three electives†

Year 4 Chemistry 341
Two of: Chemistry 335# (3 hours lab.), 336#, 337, 437, 440
Two electives†

†Electives At least 3 other non-Chemistry Science courses (usually one per year) should be selected in Years 2-4. Some possible choices can be found in the elective listings for the three-year programme, especially recommended for consideration are Mathematics 236, Biology 245*-246*, Physics 222*-223* (Year 2); Mathematics 243, Science 251*-252*, Physics 226*-227*, 250*-251*, Chemistry 336 or 337 (Year 3); Science 400 (Year 4).

#One of the courses Chemistry 335 or 336 must be taken to qualify for graduation from the four-year programme with a Chemistry major.

Earth Science Major

Year 1 Including Earth Sciences 130 and Chemistry 121*-142* (see page 000)

Year 2 Two of: Earth Sciences 231* 232*, 237*, 238*, 240*, 241*
Two of: Chemistry 218* plus another 200-level one-term Chem. course, Science 251*-252*, Mathematics 243, Physics Elective, Arts Elective

Year 3 Two or three of: Earth Sciences 330, 334, 335, 340
One of two of: Chemistry 226*-227*, Biology 234, Physics 250*-251*, Mathematics 132
Arts elective.

Year 4 Two or three of: Earth Sciences 368*-369*, 430, 431, 432*, 434*, 437, 438*, 439*, 440*
Three or two non-Earth Sciences electives

* Half courses: 2 of these make the equivalent of one course selection.

Physics Major

Year 1 Including Physics 121*-122* or 162*-163* and Mathematics 130 (see page 130).

Year 2 Physics 222*-223*, 226*-227*
One of: Mathematics 132, 236, 237
One of: Chemistry 218*-219*, 266*-267*, Science 251*-252*, Earth Sciences 130 or 231*-241*
Elective
358*-359*, 368*-369*, 380*-381*
Two or one of: Mathematics 219 or 243; Chemistry 218*-219* or 325
Arts or Mathematics Elective

Year 4
Two or three of: Physics 250*-251*, 352* and 352L*-353* and 353L*,
358*-359*, 362*-363*, 364*-365*, 368*-369*, 480*-481*, 441
Two or one non-Physics Science courses
Arts or Mathematics Electives
A Professor at Work in His Office
9 The School of Physical Education and Recreation
School of Physical Education and Recreation

The School of Physical Education and Recreation was formed in 1966 as the School of Physical and Health Education and assumed its present name in 1968 when a degree programme in Recreation was added. The School consists of three departments. The Departments of Kinesiology (formerly Physical and Health Education) and Recreation which administer the academic and research programmes of the school and, the Department of Athletics which conducts programmes of Intercollegiate and Intramural Athletics and, a service programme in physical education for all students, faculty and staff.

Honours programmes in Kinesiology and Recreation are offered on both a regular and a co-operative basis.

The programmes have been designed to provide preparation for persons planning to enter one of the many areas open in physical education, health education and recreation. Sufficient elective courses are offered to permit considerable latitude to the individual in preparing for his chosen career.

The programmes in Kinesiology meet the requirements for admission to the Type "A" Certificate course in Physical and Health Education at a College of Education in Ontario. Graduates from the Recreation programme will be granted, upon application, the Municipal Recreation Directors' interim Type "A" Certificate from the Youth and Recreation Branch of the Department of Education of Ontario.

The co-operative course gives the student an opportunity, unique in Canada, to gain experience in several of the career fields open to Kinesiology and Recreation graduates. Work opportunities are planned in educational institutions, community recreation departments and private agencies such as YM-YWCA. Arrangements for work assignments are made through the Co-ordination Department of the University, which provides a liaison between the campus and the field. The co-operative programme, besides presenting an opportunity for practical experience and financial assistance, enables the student to assess the several career areas and to bring a more mature outlook to his formal university preparation. Students should refer to section 13 of the calendar for further details of operation of the co-operative programmes.

The academic programmes in Kinesiology are multi-disciplinary in nature. Extensive laboratory facilities permit the senior students to encounter at first hand the problems inherent in human physical activity.

The academic programme in Recreation emphasizes the social sciences and the principles of administration, design and planning as they apply to the organized use of leisure. Elective courses in Recreation are planned for 1971-72.

Degrees Upon successful completion of the programme the honours degree of Bachelor of Physical Education and Recreation (B.P.E.R.) is awarded by the University.

Regular Programme The regular programme consists of eight academic terms in a period of four years. All courses are offered in the Fall and Winter terms. Students in all years enrol in September.

Co-operative Programme All Year 1 students enrol in September. Precise dates for the beginning and end of each of the other terms are shown in the academic calendar for the year. The eight terms of study and six terms of employment
Admission Requirements

General Application for admission to the School of Physical Education and Recreation should be made as early in the year as possible. Academic certificates (not diplomas) and other supporting documents should be forwarded as soon as they become available.

Admission cannot be granted until all the requirements have been met and all the required documents submitted. Applicants currently enrolled in Ontario Grade 13 who wish to be considered for Early Final Admission must apply before January 4, 1971. All other applicants must apply and have submitted all the necessary documents by July 1, 1971. Persons applying after these dates cannot be guaranteed consideration of their application.

Since many of the programmes offered at the University have limited enrolment, the possession of the minimum requirements does not in itself guarantee admission to any of the programmes. If clarification is required on any of the admission requirements, applicants should contact the office of the Registrar, University of Waterloo, Ontario.

The admission requirements listed in the Calendar are applicable for admission in September 1971.

Admission Deposit Each applicant admitted to full time studies is required to submit a $50.00 admission deposit. The deposit will be refunded if notice of termination is received prior to August 1, 1971.

Application Documents All applicants must submit an application form, and certified transcripts of secondary or post-secondary education. Applicants enrolled in Ontario Grade 13 in the 1970-71 academic year must apply on the "General Application for Admission to University 1971" form which is available from the secondary school. Applications should be submitted prior to January 4, 1971.

Applicants not enrolled full time in Ontario Grade 13 must apply on forms available from the Office of the Registrar. In addition, at least two letters of reference are required. All educational institutions attended by the applicant must be accounted for on certified documents. Applicants from non-English speaking countries must arrange to submit certified English translations of their academic documents.
Admission Requirements

Ontario Grade 13 Applicants

Requirements For applicants currently enrolled full time in an Ontario Grade 13 programme of studies, the overall University requirement will be the assurance from the Secondary School that the prerequisites for the Secondary School Honour Graduation Diploma have been satisfied. Applicants to the School of Physical Education and Recreation will be required to achieve a 60% overall average in their Grade 13 standings.

Students electing the Recreation programme are encouraged to select a Grade 13 programme that includes geography and biology.

Students electing the Kinesiology programme are encouraged to select a Grade 13 programme that includes one or more of the following subjects: mathematics, chemistry, physics or biology.

It is expected that applicants will present a balanced selection of Grade 13 courses.

Basis of Admission Students enrolled full time in Ontario Grade 13 will be considered for Early Final Admission. The University expects to fill the majority of places available to Grade 13 applicants using the following criteria:

- Grade 13 interim standing
- Grade 12 final standing
- Principal's recommendation
- SACU aptitude and achievement tests results.

Applicants whose interim standings are not sufficient for Early Final Admission will be considered on the basis of Grade 13 final standings and qualified applicants will be admitted until the remaining places are filled.

Applicants who have spent more than the normal length of time in Secondary School to complete their University preparation may be required to present a higher admission average. Applicants who completed their Grade 13 studies in less than the normal period of time will be considered providing that the Grade 13 admission prerequisites are satisfied.

Successful applicants may expect to be notified after May 1, 1971 of their acceptance and will be allowed until June 1, 1971 to confirm the offer of admission.

The University reserves the right to withdraw the offer of admission if the applicant fails to complete his year satisfactorily.

Aptitude and Achievement Tests Service for Admission to College and University - SACU. It is recommended that applicants write the Canadian Scholastic Aptitude Test (CSAT) and the Canadian English Language Achievement Test (CELAT) or the French equivalent.

Non-Ontario Grade 13 Applicants Applicants who have taken their secondary school education in other than Ontario Grade 13 will be asked to submit the following certificates recognized as being equivalent to the Ontario Grade 13 certificate. These certificates may be accepted in so far as they meet the admission requirements of the University of Waterloo in subjects and percentages. Applicants from countries not mentioned in the following list can obtain detailed admission requirements from the Office of the Registrar.

- Alberta: Senior Matriculation (Grade 12)
- British Columbia: Senior Matriculation (Grade 13)
- Manitoba: Senior Matriculation (Grade 12)
- New Brunswick: Senior Matriculation (Grade 13)
- Newfoundland: Year 1 Memorial University
- Nova Scotia: Senior Matriculation (Grade 12)
- Prince Edward Island: 1 Year University of Prince Edward Island
### Admission Requirements

#### Saskatchewan
- Senior High School Leaving Certificate
- Senior Matriculation (Grade 12)

#### England and Wales, West Indies, East and West Africa, Scotland
- The General Certificate of Education with passes in at least five subjects
- two of which must be at Advanced Level
- The Scottish Certificate of Education

#### United States of America
- High School Graduation plus an additional year of formal study in subjects comparable to Ontario Grade 13

---

### Admission as an Adult Student

Any student of mature age who has been away from formal education for more than two years and who does not possess the minimum requirements for admission may apply to enter as an adult student. It is recommended that applicants attempt to obtain standing in at least one Ontario Grade 13 level subject or its equivalent. This Subject should relate to the applicants proposed programme of study at University. Each application will be considered on its merits by the Admission Committee.

### Admission to Advanced Years

An applicant for admission to advanced standing must submit an official transcript from the University or educational institution which he has attended showing in detail the courses which he has taken and his standing in each. Applicants should also submit documentation of their work experience. Because of the co-operative nature of the programme, no student will be admitted above the Year 3 Term A level. Any student thus admitted will be required to register in the “A” stream and to complete a minimum of three work terms. The level of advanced admission is determined by an examination of the applicant’s academic and work experience.

### English Proficiency

Students from areas where English is not the common language must provide certified translations of academic certificates. In addition, the applicant may be required to take either “The English Proficiency Tests” prepared by the English Language Institute of the University of Michigan, or the examinations for “The Certificate of Proficiency in English” of the University of Cambridge, in order to satisfy the Admission Committee that the applicant’s knowledge of the English language is adequate to pursue his studies successfully.

### Landed Immigrant Status

Because of the nature of the co-operative programme in Physical Education and Recreation where a student alternates four months of study with four months of practical experience, applicants from other countries are strongly recommended to obtain landed immigrant status in Canada before applying for admission to the University. Immigrants from other countries are expected to have one years residency in Canada before applying for admission to the co-operative programme.

### Re-Admission

The University reserves the right to refuse admission to any candidate, and to refuse re-admission if in the opinion of competent authority, a student is not profiting from University studies.

### Registration

September 7, 8, 9, 10, 1971.
Examinations and Promotions

The Faculty constitutes the examining body for all University Examinations. The arrangement of the co-operative physical education and recreation programme is shown on page 154. The first two terms, or semesters, comprise the "First year" and courses that extend over the full two terms will have final examinations at the end of the second term. Any other courses that are of single term duration will have final examinations at the end of the term.

The following regulations govern the conduct of examinations and the promotions policy of the School of Physical Education and Recreation of the University.

1) All examination results are considered by the Faculty Committee on Examinations and Promotions and subsequently by the Faculty Council. After the results have been considered by these bodies, they will be issued to individual students by the Registrar.

2a) Standing in individual subjects will be granted by letter grade as follows:

<table>
<thead>
<tr>
<th>Range of Marks</th>
<th>Letter Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>75-100</td>
<td>A</td>
</tr>
<tr>
<td>66-74</td>
<td>B</td>
</tr>
<tr>
<td>60-65</td>
<td>C</td>
</tr>
<tr>
<td>50-59</td>
<td>D</td>
</tr>
<tr>
<td>Below 50</td>
<td>S</td>
</tr>
<tr>
<td>Supplemental Allowed</td>
<td>F</td>
</tr>
</tbody>
</table>

b) Standing in a year's programme is to be interpreted as follows:

<table>
<thead>
<tr>
<th>Range of Marks</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>75-100</td>
<td>First Class Honours</td>
</tr>
<tr>
<td>66-74</td>
<td>Second Class Honours</td>
</tr>
<tr>
<td>60-65</td>
<td>Third Class Honours</td>
</tr>
<tr>
<td>50-59</td>
<td>Pass</td>
</tr>
</tbody>
</table>

3) In order to enter the third and subsequent terms a student must maintain an overall average of 50% and a minimum average of 60% in kinesiology and recreation courses of the term. Students failing to secure these averages normally will be required to repeat all or part of the work of the term last completed.

Where timetables permit, repeating students may be excused from repeating individual courses in which satisfactory grades have been obtained, and permitted to register in other appropriate courses.

4) All failing papers will be reread before marks are published.

5) To be eligible for supplemental examinations the student must have a final overall average of 50% and an average of 60% in the kinesiology and recreation courses. Supplemental examinations will be written in the term immediately following that in which the respective final examinations were written with the exception of an exam written at the end of first term in Year 1. A student may not write supplemental examinations to raise the standing in subjects already passed.

6) No student will be permitted to continue in course if he fails a supplemental examination in a course which is required as a prerequisite for further study, except with the approval of the Examinations and Promotions Committee and the appropriate department of the school. Where a necessary prerequisite subject has not been cleared, a student may either repeat the year or term, or remain out of course until the deficiency is cleared at a subsequent examination.
Academic Programmes

Honours Kinesiology

An asterisk (*) following a course number indicates a term course. (Common to Regular and Co-operative Programmes)

**Year 1**

Kinesiology 102*, 103*, 185*, 186*
Two of (one each term) Kinesiology 140*, 141*, 160*, 161*, 171*
or Recreation 102*
Psychology 101*, 102*
Sociology 101*
One other term course in Sociology
Physics 103*
Biology 110*
One elective each term

**Honours Kinesiology Co-operative Programme**

**Year 2, Term 2A (Fall)**
Kinesiology 200*, 216*, 222*, 285*
Two electives (one may be in Kinesiology)

**Year 2, Term 2B (Spring)**
Kinesiology 321*, 335*, 355*, 410*, 451*, 286*

**Year 3, Term 3A (Winter)**
Kinesiology 217*, 385*
One Kinesiology elective
Biology 303*
Two electives

**Year 3, Term 3B (Fall)**
Kinesiology 320*, 425*, 368*
Biology 303*
Two electives (one may be in Kinesiology)

**Year 4, Term 4A (Spring)**
Kinesiology 400*, 430*, 485*
Four Kinesiology electives

**Year 4, Term 4B (Winter)**
Kinesiology 470*, 486*
Three Kinesiology electives
Two electives

**Honours Kinesiology Regular Programme**

**Year 2 (Fall Term)**
Kinesiology 200*, 216*, 285*
One Kinesiology elective
Two electives

**Year 2 (Winter Term)**
Kinesiology 217*, 222*, 286*
One Kinesiology elective
Academic Programmes

Year 3 (Fall Term) Kinesiology 321*, 335*, 385*
One Kinesiology elective
Biology 302*
One elective

Year 3 (Winter Term) Kinesiology 330*, 355*, 386*
One Kinesiology elective
Biology 302*
One elective

Year 4 (Fall Term) Kinesiology 400*, 410*, 425*, 485*
Three electives (at least two in Kinesiology)

Year 4 (Winter Term) Kinesiology 430*, 451*, 470*, 486*
Three electives (at least two in Kinesiology)

Note 1 The student should consult his faculty advisor when electing courses. Certain professional careers, including secondary school teaching, have somewhat specific under-graduate course requirements.

Note 2 Students electing Biology and/or Physics as minor areas will take Biology 131 or 132 and/or Physics in Year 1 in place of the term course in Biology (Zoology) and/or Physics (Mechanics in Human Movement) shown above.

Honours Recreation

Year 1 (Fall, Winter) Recreation 102*-103*
Sociology 101*,
Psychology 101*, 102*
Biology 131
English 16*-17*
Geography 101*
Planning 156*
Recreation 185/186
One elective

Year 2, Term 2A (Fall) Economics 101*
Psychology 211*
Sociology 210*
Recreation 201*, 285*
Two electives

Year 2, Term 2B (Spring) Recreation 215*
Recreation 225*
Recreation 230*
Recreation 240*
Two Recreation Electives from Recreation 226*, 280*, 315*, 320*

Year 3, Term 3A (Winter) Sociology 212*
Geography 344*
Economics 102*
Recreation 310*
Recreation 350*
One elective

Year 3, Term 3B (Fall) Sociology 310*
Planning 311*
Academic Programmes

Recreation 386*
Three electives

Year 4, Term 4A (Spring)  Recreation 440*
                        Recreation 470*
                        Two electives from Recreation
280*, 315*, 320*, 400*, 420*
                        Two electives

Year 4, Term 4B (Winter) 1 Political Science
                        Recreation 325*
                        1 elective from Recreation
280*, 315*, 320*, 400*, 410
420*
                        Three electives

Note  Since the current curriculum is under review, the students are advised to consult the Department for specific course requirements
10 Graduate Studies
Graduate Studies

Degrees

Courses leading to the degree of Arts (M.A.) are offered in Economics, English, French, Geography, German, History, Philosophy, Political Science, Psychology, Regional Planning & Resource Development, Russian, and Sociology.

Courses leading to the degree of Master of Applied Science (M.A.Sc.) are offered in Applied Psychology, Chemical Engineering, Civil Engineering, Systems Design, Electrical Engineering, Management Science, and Mechanical Engineering.

Courses leading to the degrees of Master of Mathematics (M.Math.) are offered in Mathematics.

Courses leading to the degree of Master of Applied Science (M.A.Sc.) are offered in Biology, Chemistry, Earth Sciences Physics, and Physiological Optics.

Courses leading to the degree of Master of Philosophy (M.Phil.) are offered in English, German, History, Mathematics and Philosophy.

Courses leading to the degree of Doctor of Philosophy (Ph.D.) are offered in Biology, Chemical Engineering, Chemistry, Civil Engineering, Systems Design, Electrical Engineering, Geography, German, Management Science, Mathematics, Mechanical Engineering, Philosophy, Physics, Psychology, Regional Planning & Resource Development, and Sociology.

Other Departments are planning to offer graduate programmes in the near future. Detailed information concerning specific courses may be obtained from the Dean of Graduate Studies.

Minimum Requirements for the Master’s Degree

Each candidate for the Master’s degree shall have a Supervisor or Advisor who will submit a programme of study for approval by the Department in which he is enrolled.

The minimum requirements for the Master’s degree are satisfied when the candidate has successfully completed either:

1) four two-term courses (or eight term courses) accepted for graduate credit by his Department, plus a paper or project requiring a study in depth on a topic approved by his Department (which may be part of one of the courses submitted for graduate credit), or

2) Two two-term courses (or four term courses) accepted for graduate credit by his Department, plus a thesis embodying the results of his research on a topic approved by the Department.

Candidates must obtain an average of at least 66% in the courses presented in fulfillment of the degree requirements. A failing grade in any course will occasion an automatic review of the candidate’s status by his Department, and may, in some cases, result in the requirement to withdraw from the programme.

In the case of a Master’s programme involving a thesis, five copies of the thesis are submitted by the candidate to the Graduate Studies Committee of the Faculty to be read and judged by at least two members of the faculty, one of whom is the Supervisor. When all requirements for the degree have been met and the thesis has been accepted, it is bound and two copies are deposited in the Library, one is deposited in the Department, one is given to the Supervisor, and one is returned to the candidate.

The minimum period of registration for the Master’s degree is one academic year from an honours Bachelor degree or equivalent, except in the case of a thesis-based programme, for which the minimum period is two academic years.
taken to complete the requirements depends on the candidate and may be considerably longer than the minimum. The period of required full-time attendance at the University is laid down by the Faculty.

The requirements for the degree must be completed within the time period stipulated by the Faculty in which the student is enrolled. Normally three years are considered sufficient time to complete all requirements. In special circumstances an extension may be granted by the Faculty. In any case, the candidate must remain continuously registered at the University to the end of the term in which he completes the degree requirements.

The M.Phil. is a scholarly degree intermediate between the M.A. and the Ph.D. Candidates are normally admitted to the M.Phil. programme after having completed an honours Bachelor's degree.

Each candidate for the M.Phil. shall have a Supervisor who will submit a programme of study for approval by the Department in which he is enrolled.

The minimum requirements for the M.Phil. are satisfied when the candidate has:

1) successfully completed six two-term courses (or twelve term courses),
2) presented and defended a thesis embodying the results of his study on an approved topic.

When his Department considers that a Candidate must have some level of competence in a particular foreign language or languages, the successful demonstration of this competence becomes a requirement for the degree.

The candidate might also be required to pass a comprehensive examination, at the discretion of the Department.

Candidates must obtain an average of at least 66% in the courses presented in fulfillment of the degree requirements. A failing grade in any course will occasion an automatic review of the candidate's status by his Department, which may result in the requirement to withdraw from the programme. Candidates who enter the M.Phil. programme after receiving a Master's degree will be given credit for the courses submitted for the Master's degree.

Five copies of the M.Phil. thesis are submitted by the candidate to the Graduate Studies Committee of his Faculty to be read and judged by at least two members of the University faculty. The candidate shall defend his thesis in an oral examination before an Examining Committee appointed by the Graduate Studies Committee of the Faculty. When all the requirements for the degree have been met and the thesis has been accepted, it is bound and two copies are deposited in the Library, one is deposited in the Department, one is given to the Supervisor, and one is returned to the candidate. If the candidate has written a Master's thesis of very high calibre, the M.Phil. thesis requirements may be waived at the discretion of the Department.

The minimum period of registration for the M.Phil. degree is two academic years from an honours Bachelor's degree or one year from a Master's degree or its equivalent. The actual time taken to complete the requirements depends on the candidate and may be considerably longer than the minimum. The period of required full-time attendance at the University is laid down by the Faculty.

The requirements for the degree must be completed within the time period stipulated by the Faculty in which the student is enrolled. Normally five years are considered sufficient time to complete all requirements.
the Faculty. In any case the candidate must remain continuously registered at the University to the end of the term in which he completes the degree requirements.

In exceptional circumstances, a student may apply for permission to transfer from the M.Phil. programme to the Ph.D. programme in the same field by petitioning the Graduate Studies Committee of his Faculty through his Department. If the petition is granted, the Committee will specify the additional requirements which the candidate must fulfill for the Ph.D. degree.

In exceptional circumstances, a candidate for the Ph.D. may apply for permission to transfer to the M.Phil. programme in the same field of study by petitioning the Graduate Studies Committee of his Faculty through his Department. If the petition is granted, the Committee will specify the additional requirements which the candidate must still fulfill for the M.Phil. degree. In particular, a candidate who has not passed a comprehensive examination in the Ph.D. programme must pass the comprehensive examination in the M.Phil. programme.

The Ph.D. degree is granted by the University to candidates who have demonstrated both achievement in independent research in a particular field, and a broad knowledge of that field. The first requirement is satisfied when the candidate has presented and defended a thesis embodying the results of his own original research on an approved topic. The second requirement is satisfied when the candidate has demonstrated a broad knowledge of his field to the satisfaction of the Faculty, normally by the successful completion of an assigned programme of courses and a comprehensive examination, as determined by the Department in which he is enrolled. When his Department considers that a candidate must have some level of competence in a particular foreign language or languages, the successful demonstration of this competence becomes a requirement for the degree. For further information, the minimum degree requirements specified by each Faculty should be consulted.

Each candidate shall have his programme of study and research approved by the Graduate Studies Committee of the Faculty in which he is enrolled. He will be responsible to a Supervisor who shall be approved by the same Committee. The Supervisor will be assisted by an Advisory Committee also appointed by the Faculty.

The minimum period of registration for the Ph.D. is two years from the completion of a Master's Degree, or three years from completion of the Honours Bachelor's. The actual time required to satisfy the degree requirements may be considerably longer. The period of required, full-time attendance at the University is laid down by the Faculty. The acceptance of the transfer of credits for prior registration at another University will be determined in individual cases by the Graduate Studies Committee of the Faculty. The requirements for the degree must be completed within the time period stipulated by the Faculty in which the student is enrolled. Normally five years are considered sufficient time to complete all requirements. In special circumstances an extension may be granted by the Faculty. In any case, the candidate must remain continuously registered at the University to the end of the term in which he completes the degree requirements.

The Ph.D. thesis examination is the culmination of the candidate's research programme. It exposes his work to scholarly criticism by members of the University and gives him the opportunity to defend it.

When the candidate gives notice of his readiness to submit the thesis, the Graduate Studies Committee of the Faculty in which he is enrolled...
of whom at least one must be from a department other than the candidate's own and one from outside the University. The candidate's Supervisor is a member of this committee. Normally internal members of the Examinining Committee will be drawn from the Advisory Committee.

Five copies of the thesis are submitted to the Graduate Studies Committee of the Faculty. Four are distributed to members of the Examining Committee and the fifth to the Faculty Graduate Office where it is available for examination by any member of the University for four weeks. The Faculty Graduate Office announces the submission of the thesis and the date and location of its defence by notices circulated in all departments of the University. Major criticisms of the thesis by members of the University other than those on the Examining Committee must be submitted in writing to the Graduate Studies Committee of the Faculty concerned no later than one week before the thesis defence.

The thesis defence is an oral examination conducted by an impartial Chairman appointed by the Dean of Graduate Studies. Any member of the University is free to attend. The candidate first presents his thesis orally with whatever aids he requires to make an effective presentation. He is then questioned on the thesis. The Chairman will give priority to questions from members of the Examining Committee and any member of the University who has submitted written criticism. Any member of the Examining Committee who cannot attend the defence must submit a written report on the thesis to the Graduate Studies Committee of the Faculty at least one week before the defence. The Graduate Studies Committee will then appoint a delegate to carry his report to the examination.

Four decisions are open to the Examining Committee. The thesis can be accepted as submitted, accepted with minor modifications, accepted with major modifications, or rejected. Minor modifications are defined as corrections which can be made immediately to the satisfaction of the Supervisor. When a thesis is accepted with major modifications, a brief outline of the modifications must be included in the Examining Committee's report. It is then the responsibility of the candidate's Supervisor to demonstrate to the Graduate Studies Committee of the Faculty that the required changes have been made to the satisfaction of all members of the Examining Committee. When the thesis has been rejected, the candidate may not resubmit it for six months from the date of the original defence.

If the Examining Committee is not prepared to reach a decision concerning the thesis at the time of the thesis defence, it is the responsibility of its Chairman to determine what additional information is required by the Committee to reach a decision, to arrange to obtain this information for the Committee, and to call another meeting of the Committee as soon as the required information is in his hands. It is also the Chairman's responsibility to inform the candidate that the decision is pending. The candidate should not normally be required to present himself before the Examining Committee at the second meeting.

On the basis of the Examining Committee's report and its own records of the candidate's progress in his assigned programme of study, the Graduate Studies Committee of the Faculty decides whether the candidate has fulfilled the requirements for the Ph.D.. If its decision is that he has, it forwards the supporting documentation to the Dean of Graduate Studies with the request that he recommend to Senate that the degree be awarded. The Dean of Graduate Studies examines this request in light of the report to him from the chairman of the thesis committee. If he is satisfied of the candidate's eligibility for the
Definitions

Council which is specifically given authority to decide in such cases.

When the recommendation for the award of the Ph.D. degree has been made to Senate, the thesis is bound and two copies are deposited in the Library, one is deposited in his Department, one is given to the Supervisor, and one is returned to the candidate.

Admission Requirements

General Application for admission to Graduate Studies should be made as early in the year as possible on forms provided by the Associate Registrar (Graduate Studies). Official academic transcripts and other supporting documents should be forwarded as soon as they become available. Most departments have specific deadlines by which application must be made. Prospective graduate students should contact the department to which they seek admission for further information.

Only students who are graduates of approved universities and colleges are eligible for admission to Graduate Studies. In addition, the department of the University of Waterloo in which the applicant intends to pursue graduate studies must approve his application and his proposed programme.

Admission to Graduate studies cannot be granted until all requirements have been met and all documents submitted.

Applicants for Graduate Study must be admitted by the Graduate Studies Committee of the appropriate Faculty. Students who, in the opinion of that Committee have insufficient background to permit them to complete the requirements for the Master's Degree in one academic year, will be required to take a programme extending over at least two academic years. The candidacy of each applicant for a Doctoral Degree must be approved by the Committee regardless of the institution at which the candidate has completed his previous work. At the discretion of the Committee, an applicant may be required to write a set of qualifying examinations.

A student is expected to assume full responsibility for knowing the regulations and pertinent procedures as set forth in this calendar.

Definitions

The following definitions are applicable to prospective applicants and to students currently enrolled in graduate studies at the University of Waterloo. Graduate students from other universities who spend a resident period at the University of Waterloo but are not candidates for a Waterloo degree will pay fees as per graduate students.

Classification of graduate students is made by the Graduate Admissions Committee for each respective Faculty.

Regular Full-Time Graduate Students Students possessing an Honours Bachelor's Degree or equivalent with such standing that they have been accepted by a Faculty Graduate Committee to study for a higher degree.

A full-time graduate student is taken to mean a graduate student enrolled for more than the equivalent of a one-term course in any given term.

Qualifying (Full-Time) Students Students possessing a university degree, who, in the opinion of the Faculty Graduate Committee concerned, may not yet be prepared to undertake full-time study for a degree and who have been given a leave of absence of up to two years and have been registered as eligible for leave in one of the Faculties where such leave is available.
Definitions

of undergraduate studies. These students are not candidates for a degree. Completion of the work of the qualifying year does not automatically entitle a student to proceed toward a higher degree. In exceptional cases a student may remain in this class for two (2) years. If it is apparent at the end of the first or second year, that the student is not qualified to proceed to a degree, he may be refused enrolment in Graduate Studies, but will be granted a Certificate of Attendance for the time he has spent at the University of Waterloo.

Regular Part-Time Graduate Students

Students admitted as regular graduate students, but who, with the permission of the Faculty Graduate Committee concerned, are studying for a graduate degree on a part-time basis. A part-time graduate student is taken to mean a graduate student enrolled for not more than the equivalent of a one-term course in any given term.

Special Part-Time Graduate Students

Students possessing a university degree who are taking one or more graduate courses but are not intending to proceed to a degree or a diploma. (Students who obtain credits in this category and subsequently decide to proceed to a degree will pay fees according to their category at that time.)

Note 1 Two or more courses: full-time fee.
Note 2 Classification of graduate students is made by the Graduate Admissions Committee for each respective Faculty.

dmission of Students from Other Countries

Students from other countries where English is not the common language must provide certified translations of academic transcripts. In addition the applicant will be required to take either “The English Proficiency Test” prepared by the English Language Institute of the University of Michigan, or the examination for “The Certificate of Proficiency in English” of the University of Cambridge, or the “Test of English as a Foreign Language” administered by the Educational Testing Service of Princeton University.

Re-Admission

The University reserves the right to refuse admission to any candidate, and to refuse re-admission if, in the opinion of competent authority, a student is not progressing satisfactorily.

Examinations

Letter grades will be used to designate standing in individual graduate courses

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>75 - 100%</td>
</tr>
<tr>
<td>B</td>
<td>66 - 74%</td>
</tr>
<tr>
<td>C</td>
<td>60 - 65%</td>
</tr>
<tr>
<td>F</td>
<td>Less than 60% (failure)</td>
</tr>
</tbody>
</table>

Students must obtain an average of at least 66% in the set of courses which they present in fulfillment of course requirements for any graduate degree.

Certain graduate courses (designated “no letter grade” in the Calendar) carry no letter grades and will be marked “Pass”, or “Fail”.

Fees

Refer to Section 13 Page 502

Registration (Fall Term)

September 10 Friday, Graduate Studies.

All students are required to register at the commencement of each term at the time and place designated by the Associate Registrar, Graduate Studies.
Determining Rheological Properties of liquids and solids
11 Course Descriptions
School of Architecture

Professor and Director  T.E. Bjornstad, B.Arch. (Iowa State), AIA, MRAIC
† Professor and Dean of the  P.H. Nash, B.A., M.A., (California); C.E. (Grenoble); M.C.P., M.P.A.,
Division  Ph.D. (Harvard); A.I.P.
Associate Professor  A. Banerji, B.Arch (Calcutta), M.Arch (North Dakota State)
Associate Professor  S. Schultz, B.S.M.E. (New Hampshire)
Assistant Professor  O. Dutt, B.A. (Punjab), B.Sc., Hons.Eng. (London), M.S. (Wisconsin),
Ph.D. (Waterloo)
† Assistant Professor  S.K. Gupta, B.Sc., M.Sc (Punjab), M.A., Ph.D. (Toronto)
† Assistant Professor  E.M. Pallet  B.S., M.Music (Oregon), Ph.D. (Michigan State)
Assistant Professor and Associate Director  R.M. Schuster, B.S., M.S. (North Dakota State), Ph.D. (Iowa State)
Assistant Professor  J.C. Somfay, B.Arch (N.S.W. Sydney), M.Arch (Toronto)
Assistant Professor  F. Thompson, B.Arch., M.Arch (Toronto)
Visiting Professor  K. Orbo, B.Arch (Artisans College, Haslev, Denmark)
Lecturer  R.N. Mukerjea, B.Arch (I.I.T.Kharagpur), M.A.Sc (Waterloo)
†Divisional Appointments:  Faculty members appointed in other Schools or Departments of the Division of Environmental Studies

Undergraduate Architecture Courses

Courses for B.E.S./ARCH Programme

Systems and Measures  Preparation into know the application of mathematics, statistics and computer science as tools for analyzing quantitative and behavioral problems as prerequisites for ensuing studies; to deliberately develop an understanding of the qualities of materials and structural behaviour; to propose alternatives in structural engineering; and to perform independent mathematical checks on simple, statically determinate and indeterminate structures.

102*  Mathematics  Calculus and Vector Geometry
Purpose:  To prepare the student to use mathematics for analyzing quantitative, behavioural and simple engineering problems.
Content:  Elementary differential and integral calculus, applications to problems involving rates of change, areas, volumes, centroids, moments of inertia; introductory vector geometry in two and three dimensions.
Prerequisite: none
4 hours per week (Fall Term)

103*  Statistics  Linear Algebra and Statistics
Purpose:  To provide the base for valid surveying, researching and analyzing of quantitative and behavioural problems.
Content:  Descriptive statistics, sampling, curve fitting, regression and correlation; matrix methods and simple Markov chains; emphasis on the description of environmental processes through observational data.
Prerequisite: Arch 102* or Math 130*
3 hours per week (Winter term)

112* & 113*  Computer Science  Introduction to Programming
Purpose:  To convey a brief understanding of computers as operating systems and a working knowledge of computers as problem solving tools.
Content:  This course is essentially the same as Math 132. It

systems and on solving architectural problems. The programming language applied is Fortran with Watfive. A machine language simulation “Spectre” is also taught for a better understanding of the way computers operate.
Prerequisite: none
3 hours per week (Fall and Winter terms)

163* Statics Physical and Material Science
Purpose: To teach the student to know and to use fundamentals of statics to solve routine problems in simple mechanics.
Content: Basic concepts, forces, moments, moment of a force and system of forces, resolution of forces, transformation of couples; resultant of concurrent and non-concurrent force systems; centre of gravity of a system of forces and moments, of a body or mass, of composite body; equilibrium, free body diagrams, calculation of reactions, shears, moments, bar forces in trusses; friction, moment of inertia.
Prerequisite: Arch 102* or Math 130*
4 hours per week including laboratory session (Winter term)

212* or FE† Computer Science
Simulation
Purpose: To understand how to simulate interacting time/space event by use of computer, and to apply such simulation techniques to the solution of architectural problems.
Content: The simulation programming will be developed in Fortran so as to build up meaningful architectural simulation concepts necessary in architectural planning. Specific simulation languages such as G.P.S.S. will be introduced.
Prerequisite: Arch 112* or Math 132
3 hours per week (Winter term)

213* or FE† Computer Generated Design
Architectural Design 1
Purpose: To develop an understanding of the design logic used for generating preliminary design layout through applied methodologies, analysis and synthesis.
Content: An overview of design logic and computer system requirements currently used for architectural design.
Prerequisite: Arch 212* or Math 240 or Math 340
4 hours per week (Spring Term)

262* Strength of Materials Physical and Material Science
Purpose: To understand the internal action and behaviour of structural members; to diagram and calculate action and behaviour for simple beam and column systems.
Content: Concept of simple stress and strain; statically indeterminate axially loaded members; thermal stresses, torsion; shear and bending moments in simple beam systems; shear and moment diagrams, qualitative deflected shapes, flexural and shearing stresses, deflection calculations; combined stresses, beams of different materials; introduction to compression members, Euler's formula.
Prerequisite: Arch 163*
4 hours per week including laboratory session (Fall term)

263* Theory of Structures 1 Physical and Material Science
Purpose: To analyze the behaviour of statically determinate structural building systems and to calculate reactions, shears, moments of their...
wind, snow, earthquake; reactions, determinancy and indeterminancy, stability and indeterminancy of structural systems; shears, moments and qualitative deflected shapes of compound beams and rigid frames; bar forces in pin-connected frameworks; approximate methods of analysis for high rise building frames; deflection calculations by the moment area method, moment diagrams by parts; influence lines, loading criteria, Betti's law and Müller-Breslau principle.

Prerequisite: Arch 262

4 hours per week including laboratory session (Spring term)

303* or FE† Economics  
Economic Structure of the Urban Environment

Purpose: To understand and to relate his talents to the dynamic process of economic interactions in public and private sectors that shape the environment.

Content: The economic structure of the urban environment; the function of the enterprise system in private, public and public-private sectors and its organizational patterns for shaping the environment.

Prerequisite: none

2 hours per week (Fall term)

43* or FE† Computer Generated Design 2

Purpose: To use the computer for generating architectural design directly from constraint factors. To display the resulting plans by use of the plotter.

Content: Input from various other courses is formulated into comprehensive data structures and simulated behaviour patterns; methods of synthesis problem-solving techniques, analysis of thought processes and protocol analyses. Project oriented course, where student chosen projects with instructor approval can be processed.

Prerequisite: Arch 213*

4 hours per week (Fall or Winter term)

363* Theory of Structures

Physical and Material Science

Purpose: To analyze the behaviour of statically indeterminate structural building systems and to calculate reactions, shears, moments of their components subjected to live and dead loads.

Content: Advantages, limitations and principles of indeterminate structures; analysis of compound and continuous beams and rigid frames by consistent deformations, moment distribution, slope deflection; analysis of continuous beams having differential support settlement, of frames subjected to side-sway; analysis of pin-connected frameworks by virtual work; joint loading, thermal stresses; application of loading criteria; introduction to arches.

Prerequisite: Arch 263*

4 hours per week including laboratory session (Fall term)

372* Mechanical Systems 1

Principles and Theory of Mechanical Systems

Purpose: Introduction to basic fundamentals of the controlled environment.

Content: Thermodynamics; combustion; heat transfer; aerodynamics; illumination; acoustics.

Prerequisite: Arch 293

4 hours per week including laboratory session (Winter term)

†See section on Electives for explanation of FE.
Ecology

Courses in this Theme Area prepare the student to understand the structure and function of Man in the pre-existing environment as an individual and as a social animal; to recognize and be critical of the human/physical complex and its management for desirable human goals and quality in the natural and man-made Environments.

122* Man & His Environment  
Ecological and Environmental Studies  
*Purpose:* To provide an introductory overview of man-environment studies which will help situate the role and contribution of architecture.  
*Content:* A problem and issue-oriented review of the major man-environment problems, their causes and some possible solutions; the emerging field of environmental studies; architecture as one of the environmental professions.  
*Prerequisite:* none  
2 hours per week (Fall term)

222* or TE† Ecology & the Ecosystem  
Natural Ecology - Introduction to Ecological Systems  
*Purpose:* To introduce the main concepts and principles of ecology as a basis for understanding the consequences of man-made changes in the natural environment.  
*Content:* Cycling of elements, energetics and structural organization of major ecological systems; population dynamics; impact of natural resource management practices and urban and industrial development on the environment; incorporating environmental quality considerations into development activities; “designing with nature”.  
*Prerequisite:* Arch 122*  
2 hours per week (Fall term)

223* or TE† Human Ecology  
Social Behaviour as the Human/Physical Interface  
*Purpose:* To understand the psycho-biological and social basis of human behaviour as individuals and in groups.  
*Content:* The biological and psychological basis of perception and cognition of environments; factors affecting percepts, images and meanings; small groups and the social environment; the structure, functioning and change of neighbourhoods and communities.  
*Prerequisite:* Arch 122*  
2 hours per week (Spring term)

†See section on Electives for explanation of TE.

Culture

Courses in cultural history give the student a critical and creative understanding of the basic ingredients of all creative work, recognizing the seemingly unrelated forces for change in the cultural history of man, and comprehending the present as a part of the historical past.

142* Iconography  
Conventions  
*Purpose:* To understand that every stage of Western Culture expresses its notions of environmental order through its arts by conventional expressions and to be able to view contemporary culture by identifying our own inventions and what is part of our inheritance from the past.  
*Content:* Selected schemes of order, such as fate, providence, natural law, the symbol of power, the symbol of authority, the symbol of salvation.
School of Architecture

arts; the development of one or two archetypal symbols in literature and
the visual arts, directed to lead into more detailed studies of symbolic
patterns in Iconography 2.
Prerequisite: none
2 hours per week (Fall term)

143* Iconography 2 A Survey of the Symbolic Nature of the Environment
Purpose: To critically and creatively understand the basic unit of
"material" in all artistic creation, the icon.
Content: A study centred on Greek Art to initiate the student into the
stream of cultural history and the complex problems, what is the artist,
the quality of human existence, culture, environment, as well as the
working of the icon from raw state of perceived image to its function as
an expressive symbol in poetry, music, dance, architecture, and other
works of art; a study of modern work in comparison to Greek
achievement.
Prerequisite: Arch 142*
2 hours per week (Winter term)

242* Foundations of Europe Sense of Periods and Styles
Purpose: Awareness of the foundations of Europe.
Content: Patterns of life and concepts of order and conduct, models of
the universe and other, moving metaphors and myths by means of study
of the thoughts, acts, art, architecture, technology, literature, music and
town design of the West from the break-up of the Roman Empire until
the Renaissance, with attention to such styles as the Latin Provincial,
the early Christian, the early Celtic, the Anglo-Saxon, the Norse, the
Carolingian, the Ottonian, the Romanesque, and the several Gothic.
Prerequisite: Arch 143*
2 hours per week (Fall term)

243* Renaissance to Revolution Sense of Periods and Styles
Purpose: To follow in historical sequence the understanding of cultural
history.
Content: History of the West, its metaphorical imagination, with an
analysis of the various styles emerging out of provincial and
international Gothic, especially Italian use of classical models, the spread
of this "renaissance" mode, leading to considerations of the Mannerist,
the Baroque, and the Rococo, the Neoclassical, and with investigation of
the course of men's attitudes of humanism, nationalism, and
Reformation through the Enlightenment of the French Revolution and
Hume's dethronement of Reason.
Prerequisite: Arch 242*
2 hours per week (Spring term)

342* or FE† Romanticism and Sense of Periods and Styles
20th Century Purpose: To follow in historical sequence the understanding of cultural
history through the first half of the 20th Century.
Content: Depicts "modern" culture as one in which the notion of
environmental order as the fulfillment of natural law is replaced by a
notion of order as the creation of the autonomous human will; studies
the revolutionary rhetoric and style of the early 19th Century Romantic
writers, the "alienation" in the writings of Marx, Nietzsche, and other
writers of the 19th and 20th Centuries, the changing views of humanity
arising out of the insights of such writers as Darwin, Freud and Jung,
and some conventions of romantic art and architecture of both 19th and
Design

The courses in design studio combine design fundamentals and design concepts, along with the opportunity to involve analysis and synthesis, professional and scientific insights, application of tools and methods for designing artifacts for man, and an awareness of the inherent physical characteristics and limitations of media and materials. The objectives of the studio are: (1) to guide the student in observing aspects of the physical and social environment; to find, categorize and associate the information into fundamental structures and patterns of relationships; (2) to apply theories generated in the lecture courses to situations in the physical environment, implementing by categorizing the courses into behaviour of materials, structures and mechanical systems, behaviour of man, and communications; (3) to provide the student with an opportunity to develop skill in using different “techniques” for analyzing and synthesizing problems in the physical environment; (4) to establish a relationship between faculty and students where all faculty members are consultants to the students; (5) to provide a vehicle for persons from faculties of different disciplines and from the real-world to discuss with students their problems and projects from different points of view.

192* Design Fundamentals  
*Design Fundamentals and Workshop  
*Purpose: To give the student a working knowledge of qualities of materials and structural forms, and of the fundamentals of observation and graphic communication.  
*Content: Perceptual techniques and methods; principles of graphic communication, what “media” are and what are their best application; the qualities of materials in construction and the qualitative, behavioural characteristics of structural forms and shapes; perspectives, and instrument and free-hand drawing.  
*Prerequisite: none  
*8 hours per week including lectures and workshop (Fall term)

193* Design Fundamentals & Studio  
*Purpose: To teach the student to see, to be aware of his surrounding environment, to record this awareness, analyze and evaluate it critically.  
*Content: Space notation, serial vision; the sensory input and stimuli of the environment to man, pattern recognition; design exercises for the student to observe and communicate about the action and reaction of materials in the environment, the individual responses physiologically and psychologically to objects in the environment, and the methods of communicating specific messages from man to man using graphic media.  
*Prerequisite: Arch 192*  
*14 hours per week including lectures and workshop (Winter term)

292* Design Concepts & Studio  
*Purpose: To develop in each student an ability to design using methods adapted to the individual’s aptitudes, and an attitude to people and their ideas in the creative process.  
*Content: Aesthetics, its philosophy and application to design; empirical methods, systematic methods, intuitive and creative processes; individual and group designing behaviour, synectics and other group inter-action techniques; student involvement in small space design exercises where
School of Architecture

methods of solution, generate alternative solutions, and evaluate the alternatives.
Prerequisite: Arch 193*
14 hours per week including lectures and workshop (Fall term)

293* Design Concepts & Studio Design Concepts and Studio
Purpose: To develop in the student an ability to generate alternative solutions to problems and to critically evaluate them.
Content: Design morphology and evaluation techniques; synectics and other group action techniques and the role other disciplines play in the architectural design process; current symbolism in design of large spaces (for "privacy and community") to develop skills in brainstorming, synectics as solution generators, defining methods of solution, formulating alternatives and evaluating alternatives.
Prerequisite: Arch 292.
14 hours per week including lectures and workshop (Spring term)

392* Design Concepts & Studio Design Concepts and Studio
Purpose: To develop in the student the skill for designing buildings using rational methods in which disparate systems are analyzed for alternative forms and synthesized with the help of other disciplines.
Content: Design team concept; selecting appropriate analysis for design and communication technique to facilitate decision-making; the affect of legal and administrative controls on the design process; the influence of mechanical and structural systems on form, some historical examples; industrialization of buildings and building components; student selected project on building scale to develop design skill and meaningful coordination of the task with other disciplines.
Prerequisite: Arch 293*
21 hours per week including lectures and workshop (Winter term)

393* Design Concepts & Studio Design Concepts and Studio
Purpose: To develop the ability in the student to design some aspect of the urban environment in collaboration with other disciplines.
Content: The analysis and exploration of relationships between physical, social, political and economic systems that influence the physical environment; techniques for defining the patterns of interaction and predicting the influence on physical form involving other disciplines; student selected project to explore the techniques and design with others at the city or community scale.
Prerequisite: Arch 392*
21 hours per week including lectures and workshop (Fall term)

Courses for Bachelor of Architecture Programme

The courses for the Bachelor of Architecture Programme are intended to prepare the student to demonstrate professional skill in separating, organizing and conceptualizing actual problems in the man-made environment in his role as an architect, alone and in a team; to synthesize with others; to synthesize mechanical, structural and functional systems into architectural expressions which adapt to social needs and aspirations of society, user, client and community, alone and with the help of others; to adapt his skills to (a) real world constraints, (b) to the evolution of social, economic and technological changes, and (c) to influence change both in constraints and evolution, alone and with the aid of others; to communicate skillfully, verbally and graphically, the
procedures in professional practice for defining and solving environmental problems; to organize patterns of behaviour which assure continuing development for professional competence and relevance at all times; and to pass the examination for registration as an architect if he aspires to become a practicing professional.

452* Specifications

**Specifications**

*Purpose:* To introduce the student to the format, methods and problems of modern specification writing for architects and engineers.

*Content:* Architectural working drawings and specifications; bidding requirements; general conditions; general requirements; trade divisions; reference and source material; assembly and reproduction; structural, mechanical and electrical consultants.

*Prerequisites:* B.E.S./ARCH standing

2 hours per week (Spring Term)

453* Professional Practice

**The Profession**

*Purpose:* To acquaint the student with the legal and ethical aspects of architectural practice in Canada and in Ontario in particular.

*Content:* Contracts, bonds and insurance, mechanics liens, by-laws and regulations, architectural partnership. The legal background, client-architect relations, partial services, professional problems.

*Prerequisite:* B.E.S./ARCH standing

2 hours per week (Fall Term)

552* or FE† Management & Estimating

**Management and Estimating**

*Purpose:* To expose the student to the administrative responsibilities of the practicing architect’s work in the building industry.

*Content:* Bidding, bid opening and analysis; contract award; administration of the contract; contractors organization; sub-contractors; labour relations; estimating and cost control.

*Prerequisite:* Arch 453*

3 hours per week (Fall Term)

553* or FE† Development & Financing

**Development and Financing**

*Purpose:* To introduce the student to the important determinates of the development, growth and re-planning of the various man environments.

*Content:* Development law; land use development; land use planning; appraisal; mortgage lending and accounting.

*Prerequisite:* Arch 552*

3 hours per week (Winter Term)

423* or TE† Urban Planning

**Introduction to Urban Theory**

*Purpose:* To understand the forces for obsolescence, change and growth in urban systems and to critically analyze and define patterns of interaction in the urban scene.

*Content:* The changing ecological structure of the city and consideration of the technological, economic and social forces accounting for these changes; ecological and location theories; accelerated urbanization; large scale urban systems.

*Prerequisite:* none

2 hours per week (Fall Term)

472* Mechanical Systems 2

**Mechanical Engineering**

*Purpose:* To teach the student the rational and analytical approach for selecting and sizing devices for mechanical systems.

*Content:* Heating, ventilating and air conditioning systems for buildings; plumbing systems; electrical systems; refrigeration systems; air conditioning systems; heating systems; ventilation systems; air conditioning systems.
462* Structural Synthesis 1

**Structural Steel Design**

**Purpose:** To give the student a working knowledge of the behaviour and design of the structural components of systems constructed with steel.

**Content:** Design and behaviour of structural steel systems, application of current building specifications; proportioning structural elements based on pertinent design considerations; preliminary design of structural steel frames, connections, bolted and welded; criteria for choosing steel systems; introduction to plastic design.

**Prerequisite:** Arch 372*

3 hours per week including laboratory session (Spring term)

463* Structural Synthesis 2

**Concrete and Timber Design**

**Purpose:** To gain a working knowledge of the behaviour and design of concrete and timber structures.

**Content:** Design and behavior of structural concrete systems, application of building specifications; analysis and design of concrete elements using ultimate strength principle and moment coefficients; criteria for choosing structural concrete systems; introduction to prestressed concrete. Behaviour and design of modern wood structures; fasteners, ring connectors and their significance in timber construction; proportioning and design of sawed and laminated timber members, using analytical methods.

**Prerequisite:** Arch 462*

4 hours per week including laboratory session (Fall term)

†See section on electives for explanation of TE

492*, 493*, 592*, 593* Design Studio

**Architectural Design and Correlation**

**Purpose:** To give the student an opportunity to select the area of concentration, which he wants to search and expand for developing his aptitudes, and which will through research and scholarship contribute to the base of knowledge for architecture.

**Content:** In term 7 the student will apply himself to architectural design and correlation directed by the faculty. In term 8 a thesis or thesis project will be chosen by the student with the approval of the faculty advisor in one of the areas of concentration offered that matches his interests and aptitudes. The thesis programme will be developed and written in Term 8. All research work regarding the thesis must be completed by the end of Co-op Work Term 5†; his work during the Co-op Work Term 5 will be compatible and will be integrated with the nature of the thesis. Term 9 will be spent on developing the thesis. In Term 10 the student will be required to analyze and evaluate his thesis as to its validity and success as a solution for the established needs and constraints of the project, and present it for faculty evaluation before obtaining his Bachelor of Architecture degree. The use of the computer is encouraged. Maximum effort will be spent in the Studio where the student will be exposed to a variety of disciplines, viewpoints and personalities in their observation of environmental aspects, structures of relationships and application of theories to achieve architectural design and correlation. The student shall be involved in the total process of architectural design. Five areas of concentration in Architectural Design
strengths of the University.

a) **Building design**, a concentration in the programming for, the design of, and the presentation for decision-making of a complex building or building type.

b) **Urban Design**, a concentration in the aspects of providing a group of buildings for an urban social group and the presentation of its provision for decision-making.

c) **Parametric Design**, a concentration in the scientific approach to architectural design, incorporating systems and computer aided analysis and design; design parameters, their definitions and evaluation; data storage, retrieval and methods of manipulation for architectural design. Develop a design of an aspect of building, urban or structural design and its presentation for decision-making.

d) **Architectural Structural Design**, a concentration in the design of structures for buildings meeting current and emerging needs, the development of an aspect of architectural structural design and its presentation for decision-making.

e) **Building Technology**, a concentration in the new fabrication techniques, structural possibilities, materials in modern industry for the design of new industrialized application for buildings or building components; the development of an aspect of building technology and its presentation for decision-making.

**Prerequisites**: B.E.S./Arch or its equivalent.

21 hours per week in Terms 7 and 8; 32 hours per week in terms 9 and 10.

†See co-operative work term schedule chart.

**Electives**

Students are permitted to study courses given by the University at large which are in the area of the student's individual interest. This will hopefully provide better orientation and more interdisciplinary communication relevant to the student's academic pursuits.

Electives are divided into the following two categories:

(TE) Courses selected by the student, but restricted to a certain theme area of the recommended core programme, thus termed theme elective (TE). Departmental approval required.

(FE) Courses selected by the student without restrictions as long as the course is approved by Senate. Courses in this category are termed free electives (FE). Departmental approval is suggested.

Each student pursuing a degree in B.E.S./ARCH must have accumulated 1½ course credits in the theme area of Ecology by or before his 6th academic term.

Each student pursuing a degree in B/Arch must have ½ course credits in the theme area of Ecology by or before his 10th academic term.
**Recommended Core Programme for the Degree of B/Arch**

<table>
<thead>
<tr>
<th>Theme Areas</th>
<th>Term 7 S (4A)</th>
<th>Term 8 F (4B)</th>
<th>Term 9 F (5A)</th>
<th>Term 10 W (5B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systems and Measures</td>
<td>½ Arch 452*</td>
<td>½ Arch 453*</td>
<td>½ Arch 552* or FE</td>
<td>½ Arch 553* or FE</td>
</tr>
<tr>
<td>Systems and Measures</td>
<td>Specifications</td>
<td>Professional Practice</td>
<td>Management &amp; Estimating</td>
<td>Development &amp; Financing</td>
</tr>
<tr>
<td>½ Arch 472*</td>
<td>Mechanical Systems 2</td>
<td>½ Arch 462*</td>
<td>½ Arch 463*</td>
<td>Structural Synthesis 1</td>
</tr>
<tr>
<td>½ Arch 462*</td>
<td>Structural Synthesis 2</td>
<td>½ Arch 423* or TE</td>
<td>Urban Planning</td>
<td></td>
</tr>
<tr>
<td>Ecology</td>
<td>2 Arch 492</td>
<td>2 Arch 493</td>
<td>3 Arch 592</td>
<td>3 Arch 593</td>
</tr>
<tr>
<td>Design</td>
<td>Design</td>
<td>Design</td>
<td>Design</td>
<td>Design</td>
</tr>
<tr>
<td>Studio</td>
<td>Studio</td>
<td>Studio</td>
<td>Studio</td>
<td>Studio</td>
</tr>
</tbody>
</table>

**Note**
- Bold blocks indicate elective courses; see section on electives.
- (TE) Elective in the same theme area.
- (FE) Free elective with Department approval.
- Also, each course has credit value indicated in small square.
### Recommended Core Programme for the Degree of B.E.S./Arch

<table>
<thead>
<tr>
<th>Theme Areas</th>
<th>Term 1</th>
<th>Term 2</th>
<th>Term 3</th>
<th>Term 4</th>
<th>Term 5</th>
<th>Term 6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F (1A)</td>
<td>W (1B)</td>
<td>F (2A)</td>
<td>S (2B)</td>
<td>W (3A)</td>
<td>F (3B)</td>
</tr>
<tr>
<td>Systems and Measures</td>
<td>½</td>
<td>½</td>
<td>½</td>
<td>½</td>
<td>½</td>
<td>½</td>
</tr>
<tr>
<td></td>
<td>Arch 102*</td>
<td>Math</td>
<td>Arch 103*</td>
<td>Statistics</td>
<td>Arch 212*</td>
<td>FE Computer Science Simulation</td>
</tr>
<tr>
<td></td>
<td>Arch 112*</td>
<td>Computer Science</td>
<td>Arch 113*</td>
<td>Computer Science</td>
<td>Arch 213*</td>
<td>FE Computer Generated Design 1</td>
</tr>
<tr>
<td></td>
<td>½</td>
<td>½</td>
<td>½</td>
<td>½</td>
<td>½</td>
<td>½</td>
</tr>
<tr>
<td></td>
<td>Arch 163*</td>
<td>Statics</td>
<td>Arch 262*</td>
<td>Strength of Materials</td>
<td>Arch 263*</td>
<td>Theory of Structures 1</td>
</tr>
<tr>
<td></td>
<td>Arch 303* or FE Economics</td>
<td>Arch 313* or FE Computer Generated Design II</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ecology</td>
<td>½</td>
<td>½</td>
<td>½</td>
<td>½</td>
<td>½</td>
<td>½</td>
</tr>
<tr>
<td></td>
<td>Arch 122*</td>
<td>Man &amp; His Environment</td>
<td>Arch 222* or TE Ecology and the Ecosystem</td>
<td>Arch 223* or TE Human Ecology</td>
<td>Arch 372*</td>
<td>Mechanical Systems 1</td>
</tr>
<tr>
<td>Culture</td>
<td>½</td>
<td>½</td>
<td>½</td>
<td>½</td>
<td>½</td>
<td>½</td>
</tr>
<tr>
<td></td>
<td>Arch 142*</td>
<td>Iconography 1</td>
<td>Arch 143*</td>
<td>Iconography 2</td>
<td>Arch 243*</td>
<td>Renaissance to Revolution</td>
</tr>
<tr>
<td></td>
<td>Arch 242*</td>
<td>Foundations of Europe</td>
<td>Arch 243*</td>
<td>Foundations of Europe</td>
<td>Arch 342*</td>
<td>JEN Romanticism &amp; 20th Century</td>
</tr>
<tr>
<td>Design</td>
<td>1</td>
<td>1½</td>
<td>1½</td>
<td>1½</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Arch 192</td>
<td>Design Fundamentals</td>
<td>Arch 193</td>
<td>Design Fundamentals and Studio</td>
<td>Arch 292</td>
<td>Design Concepts &amp; Studio</td>
</tr>
<tr>
<td></td>
<td>Arch 293</td>
<td>Design Concepts &amp; Studio</td>
<td>Arch 293</td>
<td>Design Concepts &amp; Studio</td>
<td>Arch 392</td>
<td>Design Concepts &amp; Studio</td>
</tr>
<tr>
<td></td>
<td>Arch 393</td>
<td>Design Concepts &amp; Studio</td>
<td></td>
<td></td>
<td>Arch 393</td>
<td>Design Concepts &amp; Studio</td>
</tr>
</tbody>
</table>

**Note**  
Bold blocks indicate elective courses; see section on electives.  
(TE) Elective in the same theme area.  
(FE) Free elective with Department approval.  
Also, each course has credit value indicated in small square.
Arts

Undergraduate Course

100 Communications
An examination of the origins, evolution and future dimensions of communications media designed to facilitate an understanding of the adequacies and inadequacies of media, to relate them to the purposes of human awareness and to explore needs and means of maintaining accountable controls over the media. Such a course would seek to assist students in discovering the range of informational, research and exploratory resources open to them, gaining some preliminary experience in utilizing such sources and applying a critical judgement of material secured.

211*/212* Computing Techniques in Language and Literature
An introduction to computer programming, with special emphasis on the manipulation of language data. The programming language used will be PL/I. Applications will include word indexes, text concordances, methods of computer-aided text comparison.
No prerequisite: No previous knowledge of computing is assumed. 212* Presupposes 211* or permission of the instructor.

The following courses are administered by Conrad Grebel College.

120*/121G Focal Issues in Contemporary Society
An attempt to bring together and condense what are believed to be essential elements of the several social science disciplines. The core of the study that will be used is a group of selected contemporary issues with implications that cut across all the various disciplines. Some effort will be made to discuss values deemed appropriate for our age. Integrating universal concepts or problems to be dealt with are: personality, work, community, and society.

00G Seminar in the 20th Century Values
The purpose of this course is to help members of the university struggle with current value questions in various areas of human activity. It will include questions in the areas of genetics, computerscience, communications, medicine, and others. Faculty from the University of Waterloo and several other universities will participate. Open to third and fourth year students from any discipline in the University. 3 lectures.

The following courses are administered by Renison College

220R Chinese Thought and Culture
An introduction to China's traditional culture nexus as shown in literature, religion, and philosophy.

221R Contemporary Changes in China's Traditional Culture Pattern and its Institutional Framework.
The Programme

The Departments of Economics, History and Political Science co-operate in the offering of a special programme in Canadian Studies designed to provide the student with an interdisciplinary approach to the study of all aspects of Canada.

Students who propose to concentrate in Canadian Studies (see the outline of the programme on P. 18 of the Calendar) complete a standard first year programme (in which French 100 is required) and then follow the Honours programme of one of the above departments, or a double honours programme with two of the above departments.

In each of Years 2, 3, and 4 the student takes the equivalent of three full courses (four if double honours) in his major department(s), one of which (or one each if double honours) is the department's principal Canadian course at that level. In each year electives are chosen from among the various Canadian content courses offered by each participating department (as listed below).

The core course for each year of the programme is an interdisciplinary study of Canadian problems, offered either in a lecture/tutorial format or a seminar format (depending on the number of students registered), and staffed by interested faculty members of the participating departments and of the University and by eminent scholars from other parts of Canada who will visit the University for brief or extended periods during the year.

The student is granted, upon successful completion of the 22-course programme, an Honours B.A. in his major subject with the subtitle of Canadian Studies.

Core Courses

Canadian Studies 200
An interdisciplinary course offered both through lectures and intensive discussion groups and designed to introduce the student to an interdisciplinary approach to the study of Canada. Particular themes for the course will be announced at the time of registration.

Canadian Studies 300.
A seminar course, staffed by at least two faculty members from different departments, in which particular themes and problems relating to Canada will be investigated. The content of the programme each year will vary according to the interest and inclinations of faculty and students.

Canadian Studies 400.
An extensive senior research essay, supervised by a committee composed of faculty members from two or more of the participating departments, which deals with a specific aspect of Canada utilizing material and methods from several different disciplines.

Courses Offered By The Participating Departments

1) Introductory Courses.

Economics 101* Introduction to Economics
102* Introduction to Economics
Canadian Studies

History 101/102 An Introduction to Western Civilization
110 An Introduction To Historical Method

Political Science 105* Introduction to the Political Process 1
106* Introduction to the Political Process 2
115* Introduction to Politics 1
116* Introduction to Politics 2

2) Principal Canadian Content Courses

Economics 241* Economic History of Canada
242* Economic History of Canada
380 Industrial Organizations and Public Policy

History 265* Canadian History 1
266* Canadian History 2
382 Regional Approach to Canadian History
383* History of French Canada to 1867
384* History of French Canada Since 1867
386* Ontario History to Confederation
387* Ontario History Since Confederation
388 History of Canada-American Relations
420 Senior Seminar in Canadian History
421 Senior Seminar in Ontario History
422 Senior Seminar in French Canadian History
424 Senior Seminar in Canadian Labour History

Political Science 260 Canadian Government and Politics
330 Public Administration
340 Urban Politics
341* Provincial Politics
435* Canadian Constitutional Law
442* Politics in Ontario
443 Politics in Western Canada
444* The Politics of French Canada
474* Canadian Labour in Politics
532* Canadian Foreign Policy

3) Other Canadian Content Courses

Economics 231* National Income Determination
232* Employment and Public Policy
320 North American Economic History
330 Public Finance
340 International Trade and Finance
370 Labour Economics

History 390 History of North American Indians

Political Science 373* Political Parties
374* Interest Group Politics
376* Uninstitutionalized Political Movements
451* Comparative Politics in the Commonwealth
472* Voting Behaviour
534* Comparative Foreign Policy
572* Public Opinion and Propaganda
Department of Biology

Professor and Chairman of P.S. Corbet, B.Sc. (Reading), Ph.D. (Cambridge), D.Sc. (Reading)

Professor C.H. Fernando, B.Sc. (Ceylon), D.Phil. (Oxford), F.R.E.S.
Professor A.D. Harrison, M.Sc., Ph.D. (Cape Town)
Professor H.B.N. Hynes, Ph.D., D.Sc. (London), A.R.C.S.
Professor J.K. Morton, B.Sc., Ph.D. (Durham), F.L.S.
Associate Professor E.B. Dumbroff, M.Forestry. Ph.D. (Georgia)
Associate Professor H.C. Duthie, B.Sc., Ph.D. (Wales)
Associate Professor and Undergraduate Officer
Professor H.H.N. Eydt, M.Sc., Ph.D. (McMaster)

Associate Professor and Graduate Officer
Professor W.E. Inniss, M.S.A. (Toronto), Ph.D. (Michigan State)

Associate Professor and Associate Chairman of Department
Professor W.B. Kendrick, B.Sc., Ph.D. (Liverpool)
Associate Professor P.E. Morrison, M.Sc. (Western), Ph.D. (McMaster)
Associate Professor J.J. Pasternak, M.A. (Toronto), Ph.D. (Indiana)
Associate Professor G. Power, B.Sc. (Durham), Ph.D. (McGill)
Assistant Professor J.C.H. Carter, B.A. (Toronto), M.Sc., Ph.D. (McGill)
Assistant Professor A.M. Charles, M.Sc., Ph.D. (Manitoba)
Assistant Professor R.G.H. Downer, B.Sc., M.Sc. (Queen's University, Belfast), Ph.D. (Western)
Assistant Professor N.N. Kapoor, M.Sc. (Punjab), Ph.D. (McMaster)
Assistant Professor C.I. Mayfield, B.Sc., Ph.D. (Liverpool)
Assistant Professor J.E. Thompson, B.Sc. (Toronto), Ph.D. (Alberta)
Assistant Professor K. Zachariah, B.Sc. (Madras), B.A. Hons. (Oxon), M.A., Ph.D. (Princeton)

Undergraduate Course Descriptions

By special arrangement, courses labelled (t) may be taken in 2 sequential halves by students in co-operative programmes. Cooperative students in other Departments or Faculties should note there are available a number of one-term electives (e.g. 243*, 244*, 245*, 246*) offered in the fall or winter terms.

Students registered for one or more of the courses 431, 433, 437, 438 and 441 (all marked with t) are required to participate in an off-campus field course held during the week that follows Labour Day in September of their final year.

All Honours Biology students who have completed their third year are required to participate in an off-campus field course held in April following examinations, but before the official end of term. This is an essential course.

110* Introductory Zoology

An introduction to the principles of Zoology. The course will include a survey of cell structure and function, animal growth and development, genetics, and ecological concepts, with emphasis placed on the role of man as the central figure in the biosphere.

2 lectures, 3 hours laboratory. Winter term. (For students of Physical Education).

131 Introduction to Biology

The principles of biology are developed by reference to all biology (including genetics), growth and development, and to selected organisms. Man is discussed as a biological organism.
Department of Biology

(For students in Faculties other than Science)

132 Principles of Biology
An introductory course designed to give a grounding in the main branches of Biology. Emphasis is laid on an understanding of biological processes and on relating these to the structure and diversity of living organisms.
2 lectures, 3 hours laboratory
(For Science students only)

201 Anatomy, Histology and Embryology
A survey of functional mammalian anatomy and histology, with particular emphasis on the human, and an introduction to basic embryology.
4 lectures, 6 hours laboratory. Fall Term. (Full course).
(Primarily for students of Optometry. Available also to students in faculties other than Science.)

233 Vertebrate Zoology
The evolution of the vertebrate body as exemplified by both living and fossil members of the group. Laboratory dissections form an integral part of the course.
Prerequisite: Biology 132.
2 lectures, 3 hours laboratory
(For Honours Biology and 4-year Biology majors only)

234† The Plant Kingdom
A survey of the main groups of plants in relation to their structure, biology and phylogeny.

a) Non Vascular Plants
Fall term

b) Vascular Plants
Winter term
Prerequisite: Biology 131 or 132.
2 lectures, 3 hours laboratory

235 Fundamentals of Microbiology
Introduction to fundamental theories, principles and methods of microbiology. Structure, systematics, growth and metabolism of microorganisms. Outline of the major groups of microorganisms. Discussion of their role in natural habitats, industrial processes and disease.
Prerequisite: Biology 132
2 lectures, 3 hours laboratory
(Only for Honours Biology and 4-year Biology majors and Regular Honours Chemistry students.)

243* Principles of Vertebrate Zoology 1
An introduction to the vertebrates: their taxonomy, anatomy, distribution and evolution.
Prerequisite: Biology 110*, 131 or 132
2 lectures, 3 hours laboratory. (Fall term.)

244* Principles of Vertebrate Zoology 2
An introduction to important physiological processes in vertebrates, and a discussion of structure as it relates to organ systems and function.
Prerequisite: Biology 243*
2 lectures, 3 hours laboratory. (Winter term.)

245* General Microbiology 1
History and scope of microbiology. Study of the characteristics of bacteria and other microorganisms.
2 lectures, 3 hours laboratory. (Fall term.)
(Not available to students who are Honours Biology or 4-year Biology majors.)

246* General Microbiology 2
Relationship of microorganisms to man and his environment.
2 lectures, 3 hours laboratory, (winter term.)
(Not available to students who are Honours Biology or 4-year Biology majors.)

251* Genetics and Evolution These courses are now offered as Science 251* and 252* and are
252* Biology and Society described in the Science course listings

301 Vertebrate Physiology The physiology of the major organ systems of the vertebrate body, with
emphasis on the human. The topics discussed include circulation,
respiration, digestion and nutrition, metabolism, muscle, nervous system,
special senses, and the endocrine system.
Prerequisites: Biology 131 or 132.
2 lectures, 3 hours laboratory
(Primarily for students of Optometry. Available also to students in
faculties other than Science).

303* Vertebrate Physiology An integrated study of basic physiological phenomena with particular
emphasis placed on the cardiovascular and respiratory systems. Other
topics which will be discussed include digestion, excretion and
endocrinology.
Prerequisites: Biology 110* or 131 or 132.
2 lectures, 3 hours laboratory, Fall Term. (Primarily for students of
Physical Education. Available also to students in faculties other than
Science).

304* Vertebrate Physiology A detailed study of physiological processes associated with nerve and
muscle function, and consideration of the integrative role of the central
nervous system.
Prerequisite: Biology 110* or 131 or 132.
2 lectures, 3 hours laboratory, Winter Term, (Primarily for students of
Physical Education. Available also to students in faculties other than
Science).

333 Invertebrate Zoology A survey of the major invertebrate phyla with emphasis on the anatomy,
taxonomy, and ecology of selected representatives.
Prerequisite: Biology 110*, 131 or 132
2 lectures, 3 hours laboratory

334† a) The Vascular Plants A study of the higher plants, emphasizing aspects of their structure,
development and ecology.
Fall term.

b) Cytogenetics and Morphogenesis An introduction to the structure, function and development of cells and
tissues, cell and nuclear division; chromosome mechanisms and the
principles of heredity.
Winter term.
Prerequisite: Biology 234
2 lectures, 3 hours laboratory

335† Microbiology 1 Detailed study of microorganisms. The cultural, morphological,
structural and biochemical characteristics of bacteria.
Prerequisite: Biology 233 or permission of the instructor.
2 lectures, 3 hours laboratory

337† General Physiology A survey of fundamental life processes in animals and plants including
energy production, biosynthesis, growth, development, absorption and
...
Department of Biology

2 lectures, 3 hours laboratory

351* Human Biology 1 An approach to man as a "biological machine", and discussions of changes in certain physiological processes and the effect of these changes on homeostasis.
3 lectures
(Not available to students who are Honours Biology or 4-year Biology majors).

352* Human Biology 2 A physiological and behavioural approach to man's performance under specific environmental pressures. Such topics as the physiological effects of industrial pollution, crowding, high and low temperatures will be discussed.
3 lectures
(Not available to students who are Honours Biology or 4-year Biology majors)

431± Ecology An analysis of the freshwater, marine and terrestrial environments and the communities of organisms they support. The distribution and numbers of plants and animals. Animal movements and migrations.
Prerequisites: Biology 233, 234 and 333
2 lectures, field studies.

432 Microbial Ecology Roles of microorganisms in natural and special environments, with emphasis on the methods for studying the nature and functions of microbial populations.
Prerequisites: Biology 235, Chemistry 337
2 lectures, 3 hours laboratory

433± Entomology An introduction to the classification, functional anatomy and physiology of insects.
2 lectures, 3 hours laboratory
Prerequisite: Biology 333

434 Genetics A survey of genetics with emphasis on bacterial and bacteriophage genetics and the molecular basis of gene action.
Prerequisite: Biology 337
2 lectures, 3 hours laboratory

435 Microbial Physiology The study of microorganisms with special reference to the structure, physiology and metabolism of bacteria. Structure-function inter-relations; biosynthetic processes, cellular regulatory mechanisms, quantitative experimental methodology.
Prerequisite: Biology 235, Chemistry 337.
2 lectures, 3 hours laboratory

437± a) Biosystematics A study of living organisms in relation to evolutionary processes and classification.
Fall term.

Winter term.
Prerequisite: Biology 334
2 lectures, 3 hours laboratory or tutorial
438+ a) Mycology  Selected topics in fungal systematics and ecology. A survey of economic and medical mycology.

*Fall term*

b) Phycology  A study of selected topics in the biology of algae.

*Winter term.*

Prerequisite: Biology 234

2 lectures, 3 hours laboratory


Prerequisite: Biology 337, Chemistry 337

2 lectures, 3 hours laboratory

441+ Plant Physiology  A detailed study of water relations, mineral nutrition, metabolism and growth and development in plants.

Prerequisites: Biology 337, Chemistry 337

2 lectures, 3 hours laboratory

442 Animal Physiology  A comparative study of basic physiological processes in animals with emphasis placed on current research trends.

Prerequisites: Biology 337, Chemistry 337

2 lectures, 3 hours laboratory

443 Microbiology 2 Properties of pathogenic microorganisms and special groups related to food and fermentation microbiology.

Prerequisite: Biology 335

2 lectures, 3 hours laboratory

51* Our Biological Environment.  The Land

These courses are now offered as Science 451* and 452* and are described in the Science Course Listings.

52* Our biological Environment.  The Water.

Note  *Biology 632 Statistical Procedures for Biologists may be taken in place of a 400-level course by Honours Biology students.*

499 Senior Honours Project  Each student will work under the direction of a member of the department on an experimental study. The results of this will be presented in thesis form and this will be critically examined by members of this and, where pertinent, other departments. Before selecting this course students must obtain approval for doing so from both the professor under whose direction they wish to work and the chairman of Biology.

**Graduate and Research Programmes**

Fields in which research is in progress in the department are as follows:

Macromolecular synthesis and metabolism in bacteria and the mode of action of chemical inhibitors of microorganisms.


The ecology of the algae in lakes and streams, the dynamics of their growth and the mechanisms of their distribution and flotation.
Department of Biology

composition of the peat.

The invertebrate fauna of running water and the fate of organic matter in streams.

Reproduction in invertebrates with special reference to the physiological inter-relationships of nutrition, food reserves, hormones and maturation of the gonads.

Biology of salmonid fishes and fluvial forage fishes.

Developmental genetics of Protozoa and Nematodes. Taxonomic, developmental and ecological studies of Fungi Imperfecti.

Computer pattern recognition techniques in fungal taxonomy.

DNA hybridization in fungi.

Biochemical and structural studies of cellular membranes in plant and animal systems.

Carbon metabolism in facultative bacteria and their control mechanisms.

Properties of microorganisms related to the food and fermentation industries.

Colonization of small aquatic habitats.

Physiology and ecology of soil microorganisms.


Metabolic pathways in autotrophic systems. Organisms involved in sulfide pollution of inland lakes.

Hormonal control of metabolism with particular emphasis on invertebrates. Biochemical and physiological changes associated with development.

Respiratory physiology and behaviour of stream animals.

Mineral nutrition of higher plants and mechanisms of seed dormancy.

Cytology and development of lower plants.

Ecology of limnetic zooplankton.

Graduate Course Descriptions

All graduate courses are full-year courses.

602 Fish Biology and Physiology Discussion of various aspects of biology and physiology of fish.

603 Paleobotany A course dealing with the evolution of the plant kingdom with emphasis upon the Fern-Pteridosperm complex and microfossils in the Pleistocene. Aspects of Phylogeny and Paleobotany are studied.

604 Advanced Plant Ecology and Plant Geography Methods of quantitative plant ecology, plant distribution and plant sociology.

605 Limnology 1 A discussion of the fundamentals of limnology and current limnological literature.

606 Phycology An advanced discussion of the algae.

(Offers in 1972/73 and alternate years thereafter.)

607 Advanced Microbiology A discussion of selected topics in Microbiology.

608 Advanced Genetics Discussion of selected topics in modern genetics.
609 Parasitology Parasitism in the animal kingdom. Classification, ecology, physiology, immunology and vectors. Discussion of selected topics. *(Offered in 1972/73 and alternate years thereafter.)*

610 Evolution and Biosystematics An advanced study of living organisms in relation to evolutionary processes and classification.

611 Advanced Animal Physiology 1 Critical discussion of selected topics in animal physiology.

612 Advanced Plant Physiology 1 Critical discussion of selected topics in plant physiology.

613 Mycology Critical discussion of selected mycological topics—taxonomy, ecology, plant pathology.

618 Advanced Microbial Physiology Discussion of selected topics in microbial physiology.

620 Advanced Cytology Selected approaches to the biochemical and structural organization of cells.

621 Advanced Animal Physiology 2 Critical discussion of selected topics in animal physiology.

622 Advanced Plant Physiology 2 Critical discussion of selected topics in plant physiology.

623 Floral Morphology and Taxonomy An advanced study of floral structure relating to phylogeny and classification.

625 Limnology 2 An advanced discussion of selected topics in limnology. *(Prerequisite: Biology 605 or equivalent. Offered in 1971/72 and alternate years thereafter)*

628 Advanced Genetics 2 Discussion of selected topics in genetics and developmental biology. *(Prerequisite: Biology 608 or equivalent.)*

632 Statistical Procedures for Biologists Selected topics in molecular biology will be presented at an advanced level with the aim of evaluating recent work and developments. Basic concepts and interrelationships will be emphasized.

667 Molecular Biology A critical consideration of statistical techniques used in the design and analysis of biological experiments.

699 Thesis.
Undergraduate Course Descriptions

10 Introduction to Chemical Engineering

Units and dimensions. Stoichiometry: simple mass and energy balances. Free hand sketching and blue-print reading. Introductory chemical engineering laboratories including experiments in measurement.

2 lectures, 2 hours lab., 1 hour tutorial, two terms.

12 Chemical Process Principles

The equilibrium stage concept. Cascades of stages with and without reflux; example of separation by distillation, extraction, adsorption and leaching. Small solids: their description, separation and collection.

Prerequisite: Ch. E. 32.

3 lectures, 2 hours problems (alternate weeks), one term.

16 Inorganic Chemistry

Introduction to the periodic classification and electronic structure of the elements. The chemistry of the main groups. Preparation and properties of the elements.

4 lectures, 4 hours problems (alternate weeks), one term.
17 Applied Mathematics 1 Laplace transforms, introduction to vector analysis and matrix algebra, formulation of ordinary and partial differential equations describing physical systems.  
3 lectures, one term.

2 lectures, 3 hours problems (alternate weeks), one term.

21 Transport Processes 1 (Fluid Mechanics) Physical properties of fluids and fundamental concepts of fluid flow. Conservation laws for mass, momentum, energy, and entropy. Applications to a variety of engineering problems. 
3 lectures, 3 hours laboratory, one term.

22 Transport Processes 2 (Heat Transfer) Introduction to heat transfer. Steady and transient heat conduction. Laminar and turbulent convection, the laminar boundary layer, momentum-heat transfer analogies. Heat transfer with change of phase. Radiant heat transfer. 
Prerequisite: Ch.E. 21. 
3 lectures, one term.

Prerequisite: Ch.E. 22 
3 lectures, one term.

31 Physical Chemistry 1 Principles of thermodynamics. One component systems, pure phase (gases, liquids and crystals), phase equilibria. 
3 lectures, one term.

Prerequisite: Ch.E. 31. 
3 lectures, 2 hours problems (alternate weeks), one term.

33 Chemical Engineering Thermodynamics Technical thermodynamic power plant cycles, refrigeration cycles, high pressure equilibria, analysis of flow processes. 
Prerequisite: Ch.E. 32. 
3 lectures, one term.

3 lectures, one term.

36 Physical-Chemical Laboratory A laboratory to demonstrate common physico-chemical principles and techniques of physical measurements. Training in technical report writing is included. Experiments on viscosity of gases and liquids, chemical kinetics, adsorption, homogeneous and heterogeneous catalysis, thermochemistry, phase equilibria, diffusion, determination of molecular weight of polymers and complex formation. 
3 hours laboratory, one term.
41 Reaction Kinetics 1 Introduction to kinetics and mechanism of elementary chemical processes in homogeneous systems: reversible, consecutive and simultaneous reactions, interpretation of kinetic data, homogeneous catalysis, chain reactions.
Prerequisite: Ch.E. 32
3 lectures, one term.

42 Reaction Kinetics 2 Use of material balances: design of isothermal flow stirred tank and batch reactors by analytical, graphical and numerical techniques; non-isothermal design for simple cases.
Prerequisite: Ch.E. 41
3 lectures, one term.

Process Dynamics and Control Block and signal flow diagrams, proportional-integral-derivative controllers, frequency response techniques, analytical and graphical stability criteria. Introduction to modern control theory.
Prerequisites: Math. 31, Ch.E. 22.
3 lectures, one term.

61 Engineering Economics The study of the economic processes involved in the chemical industry; this will include process design development, cost estimation, profitability and optimum design with an introduction to linear programming
3 lectures, one term.

62 Process Systems Design The undergraduate curriculum is co-ordinated and brought together to accomplish the basic objective of the process engineer, the design of an integrated process.
2 lectures, 3 hours problems, one term.

71 Chemical Engineering Laboratory 1 Experiments in the application of physical and chemical principles to engineering analysis, phase equilibrium, fluid flow and heat transfer.
Prerequisites: Ch.E. 12, Ch.E. 21
4 hours laboratory, one term.

72 Chemical Engineering Laboratory 2 Experimental studies with pilot plant equipment in the representative unit operations: evaporation, distillation, absorption, extraction, drying, humidification and reactors.
Prerequisites: Ch.E. 71
6 hours laboratory, one term.

73 Process Control Laboratory Experiments on process dynamics and control and analog simulation of chemical processes. Time constant, step and frequency response, controller settings, and cascade control of thermal, liquid level, and reaction systems.
Prerequisite: Ch.E. 51.
4 hours laboratory, one term.

80 Introduction to Polymer Science Basic concepts of polymer chemistry, classification of polymers, introductory physical chemistry of polymers, organic chemistry of polymerization reactions, reactions of polymers, naturally occurring polymers.
3 lectures, one term.

81 Physical Chemistry of Polymers Polymer solutions, molecular characterization of polymers, molecular weight distributions, morphology and crystallinity in polymers, reaction
82 Polymer Technology
Technically important polymers, thermo-viscoelastic properties, dimensional and chemical stability, polymer processing, rheology, compounding and mixing, thermo-forming processes, film formation, fibre forming, chemistry of thermo-setting and curing reactions.
Prerequisite: Ch.E. 81.
3 lectures, one term.

85 Introduction to Extractive Metallurgy
The application of principles of thermodynamics and kinetics to metallurgical processes. Pyrometallurgy, electrometallurgy and hydrometallurgy are covered. Extraction of metals is analysed from the point of view of abundance, ease of extraction and useful properties of the metal. The chemical nature of ores, as well as important intermediates.
3 lectures, one term.

86 Metallurgical Chemistry
Ionic equilibria. Thermodynamics and kinetics of reactions in solution. Bonding, stability and stereochemistry of coordination compounds and mechanisms of their reactions. Introductory hydrometallurgy; corrosion and homogeneous catalysis.
3 lectures, one term.

87 Principles of High Temperature Extractive Metallurgy
Detailed study of the underlying principles of several metallurgical processes of importance in Canada. Subjects covered include kinetics and mechanisms of roasting and reduction reactions, industrial roasting, blast furnace and electric furnace reduction: nature of melts and slags, slag metal reactions; converting, refining and fuse salt electrolysis. Problems being worked on in various extractive metallurgy research laboratories will be reviewed.
3 lectures, one term.

95 Seminar
Study and presentation of material in recent literature, or from industrial experience.
1 hour, one term.

98 Research and Design Project 1
Equivalent to one course, one term.

99 Research and Design Project 2
Prerequisite: Ch.E. 98.
Equivalent to two courses, one term.

535 Physico-chemical Properties of Gases and Liquids
The most up-to-date methods available for the estimation of the more important physico-chemical properties of gases and liquids in cases where experimental values are not to be found. Prediction is usually based on correlations of a form suggested in part by theory, with empirical constants based on experimental data.
Prerequisite: Ch.E. 32
3 lectures, one term.

543 Reactor Design
Kinetics of heterogeneous and catalytic reactions; reactor design and scale-up procedures.
Prerequisite: Ch.E. 42.
3 lectures, one term.
Department of Chemical Engineering

552 Process Dynamics and Control 2
Analog computation, time domain analysis, control of complex chemical systems.
Prerequisite: Ch.E. 51
3 lectures, one term.

554 Chemical Engineering Analysis
Application of advanced mathematical techniques to the analysis of chemical engineering processes.
Prerequisite: Permission of instructor.
3 lectures, one term.

590 Introduction to Biochemical Engineering
Aspects of the biological sciences, primarily microbiology and biochemistry, of interest to the biological process industries (fermentation and food products) and to environmental pollution (air and water). Classification and growth characteristics of micro-organisms. Physico-chemical properties of biological compounds. Metabolism and biochemical kinetics.
3 hours lectures and laboratory, one term.

591 Fermentation Processes
Methods of solving engineering problems imposed by both physical and biological factors in the food and fermentation technologies: the unifying principles of the processing operations involved in the production of antibiotics, yeasts, enzymes, beverage alcohol and other microbial products, and in biological waste treatment.
Prerequisite: Ch. E. 590 (or permission of instructor)
3 hours lectures and laboratory, one term.

592 Processing of Biological Materials
Methods of solving engineering problems imposed by both physical and biological factors in the food and fermentation technologies: a fundamental approach to formulation, preservation, and quality control procedures (mixing, extrusion, emulsification, heating, drying, irradiation, refrigeration, etc.).
Prerequisite: Ch. E. 590 (or permission of instructor)
3 hours lectures, one term.

Graduate Course Descriptions

The Department of Chemical Engineering offers courses of study leading to the degree of Master of Applied Science (M. A. Sc.) and Doctor of Philosophy (Ph. D.). The Master of Applied Science programme may be followed in either one of two directions: a course-work (“professional-development”) option, which requires course work and an engineering design or analysis report; and a research option, which requires less course work and a research thesis. The first of these is intended to give a fuller understanding of fundamentals and greater mastery of the application of these principles to the solution of complex realistic problems. The second option offers training in fundamentals and in research methods, and is excellent preparation for those whose primary interest is a career in research.

In addition to general and specialized graduate courses for research students, the Department offers a number of courses each year designed to be particularly suitable for the professional option in the M. A. Sc. programme. Graduate course requirements are measured in “units”. A course lasting one semester may be considered to be one unit. Normally, four units per semester are considered a full load, but if more than six units are taken, a student should usually be considered to be concurrently pursuing a research degree.
to carry fewer units.

In addition to the regular schedule, either option in the M. A. Sc. programme may be carried out on a co-operative basis. The professional option is particularly designed to meet the needs of a co-operative programme.

The Master's Degree Programme

The professional option requires a total of eight units of course work in addition to the submission of an acceptable engineering report. Normally, at least five units of work will be chosen from courses offered by the Chemical Engineering Department. Other courses may be chosen from outside Departments or from other Chemical Engineering courses. The Engineering report will have a nominal value of one to two units, and represents evidence that the student is capable of obtaining and presenting a satisfactory solution to an original engineering problem of some complexity. The research option requires a total of four units of course work at the graduate level, in addition to the submission of a thesis reporting the results of original research. The courses to be taken will be selected in consultation with the student's research advisor. However, it is expected that every student in the research option will take at least two courses offered by the Chemical Engineering Department.

The Ph.D. Programme

The Ph.D. degree is awarded primarily for the successful completion of original research of high calibre. The general requirements are described in the section dealing with Graduate Studies and particular requirements are available from the Department of Chemical Engineering on request. The courses to be taken by a student in the Ph.D. programme will be determined by his Advisory Committee, and will normally consist of about four to eight units of work, in addition to the research thesis.

A student in the Ph.D. programme is not accepted as a candidate for the Ph.D. degree by this Department until he has presented and successfully defended to his Committee a proposal for research.

Research Activities

Graduate research may be pursued in a number of major areas of investigation which are listed below. In addition to work in these fields, a wide variety of research is carried out in less intensively developed areas.

Major areas of research are:

1 Biochemical Engineering

Heat transfer, mass transfer, and fluid flow in biological processes of industrial interest: chemical engineering design of fermentation, food processing and waste treatment facilities.

2 Chemical Kinetics and Catalysis

Investigation of reaction rates in inorganic and organic systems. Selectivity studies in catalysis, homogeneous catalysis, heat and mass transfer in heterogeneous systems; chemical reaction engineering.

3 Process Control and Dynamics

Simulation, process control theory, applications of theory to actual chemical systems, computer control, process analysis and dynamics, operations research, optimal design, control of chemical plants.

4 Transport Phenomena

Heat and mass transfer in gas-solid, gas-liquid, liquid-liquid, and other multiphase systems. Concurrent flow transport processes, boundary layer theory, turbulence at mobile interfaces, frequency response methods, diffusion studies, etc.
5 Polymer Science
Diffusion through modified membranes, radiation graft polymerization, emulsion polymerization, stress relationship in elastomers, physical properties of polymers, kinetics and thermodynamics of polymerization reactions, etc.

6 Extractive Metallurgy
Pyrometallurgical, hydrometallurgical and electrometallurgical processes are studied in detail with emphasis being given to such subjects as solvent extraction, ion exchange, leaching, inorganic chemistry, theoretical high temperature metallurgy.

Details of Graduate Courses
All courses are of one term duration and except for those listed under "Special Topics" are normally given every year.

600 Theory and Application of Transport Phenomena
Derivation of general transport equations for mass, heat and momentum. Application and simplification of general equation to analysis of simple transfer operations. Volume and time averaging of the general equations for applications to transport processes and turbulent flow systems. Deductive analysis of the general equations and boundary layer theory.

3 lectures, one term.

602 Behaviour and Properties of Particulate Material
Size analysis and description of particle. Behaviour and consequences of solid/solid and solid/fluid interactions, especially in dense systems.

3 lectures, one term.

624 Liquid-fluid Transfer Processes
An advanced survey of gas-liquid heat and mass transfer operations in flowing systems. Special emphasis will be placed on one or more of the following topics: transfer mechanisms at fluid-liquid interfaces, drop and bubble phenomena, cascade theory of separation processes, transfer processes in two-phase tube flow, packed column behaviour, mass and heat transfer during mixing, boiling and condensation phenomena.

3 lectures, one term.

634 Statistical Theory of Matter
Introduction to statistical methods, statistical description of systems of particles, statistical thermodynamics, techniques and results of statistical mechanics with applications, kinetic theory of transport, irreversible processes.

3 lectures, one term.

535 Selected Applications of the Statistical Theory of Matter
Elementary kinetic theory of transport processes, systems of interacting particles, transport theory using the relaxation time approximation, near exact formulation of transport theory, irreversible processes and fluctuations.

3 lectures, one term.

640 Chemical Reactor Analysis
Effects of mixing on chemical reactor performance, analysis of homogeneous and heterogeneous reactor stability and control, polymerization reactor analysis, optimal control of some chemical reactors.

3 lectures, one term.

642 Chemical Thermodynamics and Kinetics
Review of laws of thermodynamics, Gibbs equation, thermochemistry, chemical reaction equilibrium kinetics of homogeneous and heterogeneous systems, techniques for kinetic parameter determination.

3 lectures, one term.
systems, reaction systems, and other chemical engineering processes.
Topics cover the theory and applications of calculus of variations, linear
and nonlinear programming, search techniques, dynamic programming,
geometric programming, and maximum principle.
3 lectures, one term.

672 Advanced Mathematics in Chemical Engineering
Review of fundamental concepts and methods of mathematical analysis
with applications in Chemical Engineering. Topics will be selected from
Advanced Calculus, Vector Analysis, Tensor Analysis, Matrix Algebra
and Calculus, Ordinary and Partial Differential Equations and Integral
Equations, with particular reference to the unifying concepts of
functional analysis in Hilbert spaces.
Prerequisite: Permission of Instructor.
3 lectures, one term.

673 Advanced Mathematics in Engineering Research
An extension of the techniques of Ch.E. 672, including Banach spaces,
to problems in process analysis and control theory.
Prerequisite: Ch.E. 672.
3 lectures, one term.

680 Principles of Polymer Science
Introduction to the physical chemistry of high polymers, principles of
polymer synthesis, mechanisms and kinetics of polymerization reactions,
copolymerization theory, polymerization in homogeneous and
heterogeneous systems, chemical reactions of polymers. Theory and
experimental methods for the molecular characterization of polymers.
3 lectures, one term.

681 Polymer Synthesis and Characterization
The synthesis of polymers of theoretical and industrial importance by
ionic, free radical and condensation methods. Commercial and
laboratory synthesis of monomers. Copolymerization. Crosslinking
reactions. Polymerization kinetics and mechanisms. Stereoregulation of
polymer structure. Correlation of polymer tacticity, branching and
molecular weight distribution with the polymerization mechanism.
Recent methods of polymer characterization.
Prerequisite: Ch. E. 680.
3 lectures, one term.

683 Physical Properties of Polymers
Molecular and morphological structure of high polymers, molecular
interpretation of mechanical properties of solid polymers,
phenomenological viscoelasticity. Confirmation of polymeric chains.
Transition phenomena, thermodynamics of polymers and kinetic theory
of rubber elasticity. Rheology of polymer melts.
Prerequisite: Ch.E. 680.
3 lectures, one term.

684 Advanced Polymer Science
Selected advanced topics in the thermodynamics of polymer solutions,
kinetics of polymerization, kinetics and thermodynamics of
crystallization and melting, polymer degradation, transport phenomena
in polymers.
Prerequisite: Ch. E. 680.
3 lectures, one term.

686 Topics in Hydrometallurgy
General discussion of hydrometallurgical systems; ionic processes in
aqueous solutions, thermodynamics and kinetics of leaching,
precipitation and reduction processes; design problems encountered in
hydrometallurgical operations.
687 Topics in Theoretical High Temperature Metallurgy
A number of topics of importance in high-temperature metal extraction will be discussed. Among these will be defects and transport properties in solids, mechanisms of oxide reduction and metal oxidation, trends in thermodynamic properties of compounds, and aspects of the physical chemistry of melts and slags.
3 lectures, one term.

688 Topics in Inorganic Chemistry
Selected topics of current interest in inorganic research and in application of inorganic chemistry and hydrometallurgy.
3 lectures, one term.

589 Topics in Solvent Extraction and Ion Exchange
A discussion on the extraction and separation of metals by ion exchange and solvent extraction. This course will emphasize the main physico-chemical principles governing these processes. Selected industrial ion exchange and solvent extraction processes will be discussed to illustrate the application of basic principles in process design.
3 lectures, one term.

690 Principles of Biochemical Engineering
Aspects of mass-transfer, heat-transfer and fluid flow (including rheology) related to the design of biological process equipment (food and fermentation products; waste treatment). Fermentations. Sterilization techniques. Extraction and separation methods.
3 lectures, one term.

691 Advances in Biochemical Engineering
Design and control of continuous-flow processes for biological systems. Insolubilized enzymes. Exploration of new methods of producing materials for food and medicinal purposes and of treating effluents. 
Prerequisite: Permission of instructor.
3 lectures, one term.

Special Topics (Given only when justified by demand)

Group A - (Topics in Transport Phenomena)
705. Particle-Fluid Dynamics
707. Non-Newtonian Flow and Heat Transfer
715. Selected Topics in Heat Transfer
716. Heat Transfer in Two Phase System
724. Use of Travelling Waves and Pulses to Measure Physical Quantities
725. Gas-Liquid Mass Transfer Processes
749. Flow Through Porous Media

Group B - (Topics in Thermodynamics and Reaction Kinetics)
735. Surface Chemistry
741. Advanced Reactor Analysis
744. Advanced Chemical Kinetics
745. Physical Processes in Heterogeneous Catalysis
746. Kinetics of Consecutive and Chain Reactions
747. Kinetics of Biological Systems
748. Reactor Flow Models and Reactor Stability

Group C - (Topics in Control Theory and Applied Mathematics)
754. Mathematical Modelling of Chemical Processes
756. Control of Complex Processes
757. Optimization Problems in Chemical Processes
765. Basic Statistics in Engineering
766. Topics in Advanced Process Control
768. Advanced Statistics in Engineering

801. Oral Examination for the Ph.D. Degree
802. Research Proposal for the Ph.D. programme
803. Comprehensive Examination
805. Graduate Research Seminar. (To be presented before submission of a thesis.)
807. Engineering Report. (For students in the course-work option. Topic suggested by student or faculty.)
808. Research Thesis for the M.A.Sc. Degree
809. Research Thesis for the Ph.D. Degree
Department of Chemistry

Professor and Chairman of Department
L.W. Reeves, B.Sc., Ph.D., D.Sc (Bristol), F.C.I.C.

Adjunct Professor
R.H.F. Manske, M.Sc. (Queen’s), Ph.D., D.Sc (Manchester), D.Sc. (McMaster), F.C.I.C., F.R.S.C.

Professor
H.G. McLeod, M.A., Ph.D. (Toronto)

Professor
W.A.E. McBryde, M.A., (Toronto, Ph.D. (Virginia), F.C.I.C.

Professor (Chemistry and Physics and Dean of the Faculty of Science)

Professor (Chemistry)
A. Rudin, B.Sc. (Alberta), Ph.D. (Northwestern)

Professor
H.D. Shamba, M.Sc. (Delhi), Ph.D. (California)

Professor
W. Siebrand, B.Sc., M.Sc., Ph.D. (Amsterdam)

Professor
A.J. Carty, B.Sc., Ph.D. (Nottingham)

Professor
W.L. Elsdon, M.Sc. (Western), Ph.D. (McGill)

Professor
B.O. Fraser-Reid, M.Sc. (Queen’s), Ph.D. (Alberta)

Professor
T.E. Gough, B.Sc., Ph.D. (Leicester)

Professor
R.M. Guest, M.A. (Western), Ph.D. (McGill)

Professor
D.E. Irish, B.Sc. (Western), M.Sc. (McMaster), Ph.D. (Chicago)

Professor
F.W. Karasek, B.S. (Elmhurst), Ph.D. (Oregon)

Professor
J.L. Koppel, B.A., Ph.D. (Toronto)

Professor
J.G. Smith, B.A., M.A., Ph.D. (Toronto)

Professor
G.E. Toogood, B.Sc., Ph.D. (Nottingham)

Assistant Professor
A. Balasubramanian, M.Sc. (Madras), Ph.D. (Indian Institute of Science)

Assistant Professor
L.J. Brubacher, B.A. (Goshen College, Indiana), Ph.D. (Northwestern)

Assistant Professor
P.C. Chieh, B.Sc. (Nat Taiwan) M.Sc. (Nat. Tsing Hua), Ph.D. (British Columbia)

Assistant Professor
R.J. Friesen, M.Sc. (Manitoba)

Assistant Professor
F.R. McCourt, B.Sc., Ph.D. (British Columbia)

Assistant Professor
V.A. Snieckus, B.Sc. (Alberta), M.S. (California), Ph.D. (Oregon)

Assistant Professor
M. Tchir, B.Sc. (Alberta), Ph.D. (Western)

Teaching Post-doctorate Fellow
K.N. Shaw, B.Sc. (Wellington, N.Z.), Ph.D. (British Columbia)

Instructor
W.J. Byars, H.N.C. (Dundee Technical College)

Instructor
M.C. Michael (Miss), B.Sc. (Waterloo)

Instructor
D. Rees-Thomas, B.Sc. (Waterloo)

Instructor
M. Vatcher, H.N.C. (Bolton Technical College)

Undergraduate Course Descriptions

Details of the undergraduate programmes offered by the Faculty of Science are to be found on page 130.

Prerequisites for course are a reliable guide to the background necessary for the course. In lieu of the specific courses listed, an equivalent course may be accepted with permission of the instructor.
300-level courses are quoted in terms of the old numbers (e.g. 236 rather than 260*-261*). With consent of the instructor, prerequisites may be waived in exceptional cases.

11 General Chemistry
Stoichiometry, properties of gases, liquids and solutions, gas phase chemical equilibria, ionic equilibria in aqueous solutions, oxidation-reduction, chemical kinetics.
3 lectures, 1 tutorial, one term.
(For students registered in the Year I Engineering programme.)

22 Analytical Chemistry
Principles of quantitative analysis; precipitation, titration, separation, complex formation. Experiments in classical and modern methods of analysis, and problems on the necessary calculations.
1 lecture, 3 hours laboratory, one term.

26 Organic Chemistry 1
The basic chemistry of the important classes of aliphatic and aromatic compounds.
3 lectures, one term.

36 Organic Chemistry 2
An introduction to the important classes of heterocyclic compounds and natural products. A laboratory course on preparative organic chemistry and organic techniques accompanies the lectures.
Prerequisite: Chemistry 26.
3 lectures, 3 hours laboratory, alternate weeks, one term.

111* Contemporary Chemistry 1
Structure of matter; Matter and energy; Chemistry of the environment; Chemistry of materials; Chemical aspects of pollution.
Prerequisite: Grade 12 Chemistry
3 lectures+discussion meetings, fall term only.

112* Contemporary Chemistry 2
Chemical reactions - how far and how fast; Organic chemistry; Biochemistry; Nuclear chemistry.
Prerequisite: Chemistry 111* or Grade 13 Chemistry
3 lectures+discussion meetings, winter term only.

Chemistry 111*-112* are designed for students in Arts, Environmental Studies and some students in Mathematics and Science who are unlikely to take further courses in Chemistry; they will be accepted for degree credit but will not be accepted as prerequisites for any other chemistry courses, nor will credit be allowed for both Chemistry 111*-112* and 121*-122* or 142*.

121* Chemical Structure and Periodicity
An introduction to atomic structure and bonding. Periodic atomic properties. Chemical implications of periodicity.
Prerequisite: Grade 13 Chemistry, Math A.
3 lectures, 3 hours laboratory, fall term.

122* General Chemistry for the Physical Sciences
An integrated approach to the structure and reactivity of molecules. Basic chemical kinetics. Selected reactions of hydrocarbons.
Prerequisite: Chemistry 121*.
3 lectures, 3 hours laboratory, winter and spring terms.

142* General Chemistry for the Life Sciences
Equilibrium, energetics and mechanisms of reactions.
Prerequisite: Chemistry 121*.
3 lectures, 3 hours laboratory, winter term only.
b) The normal first-year pattern for most students will be to take 121* followed by 122* or 142*; however both 122* and 142* may be taken if desired.

200* Radiochemistry
Stability rules for atomic nuclei; modes of decay of radioisotopes; radiations and their detection methods; nuclear reactions applied to activation analysis; radiation induced chemical reactions; use of radioisotopes in science and industry as tracers and radiation sources.
Prerequisite: Chemistry 121*.122* or equivalent
2 lectures, 3 hours laboratory, one term.

209* Scientific Literature and Writing
This course is now offered as Science 209* and is described in the Science course listings.

210* Non-Aqueous Solvents and Non-Transition Metal Chemistry
Modern acid-base theory. Behaviour in specific non-aqueous systems. Application to the synthesis and reactivity of non-transition metal compounds. (Primarily for Honours Chemistry, Honours Applied Chemistry and Honours Biology and Chemistry.)
Prerequisite: Chemistry 121*.122*
2 lectures, 3 hours laboratory, fall term only.

211* Chemical Bonding in Inorganic Chemistry
Concepts of molecular orbital and valence bond theories, σ, π and δ bonding in complex polyatomic inorganic molecules. Relationship of bonding to stereochemistry and electronic structure in specific groups of compounds. (Primarily for Honours Chemistry, Honours Applied Chemistry and Honours Biology and Chemistry.)
Prerequisite: Chemistry 121*.122*
2 lectures, offered in winter and spring terms.

16* Introduction to Organic and Biochemistry
A general survey of the important principles and application of organic and biochemistry for Optometry students only.
3 lectures, winter term.

218* Development of Chemical Bonding and Structure
Prerequisite: Chemistry 211*
2 lectures, 1 tutorial, fall term.

19* Chemistry of Non-Transition Metals
Group trends in main group chemistry. Emphasis will be placed on correlation of structure with physical properties in various groups of compounds.
Prerequisite: Chemistry 218*
2 lectures, 1 tutorial, winter term.

220* Introductory Analytical Chemistry
The principles underlying quantitative chemical measurements, with experiments to develop confidence in personal laboratory techniques and to provide experience in comparing and choosing analytical methods. (Primarily for Honours Chemistry, Honours Applied Chemistry and Honours Biology and Chemistry.)
Prerequisite: Chemistry 121* and 122* or 142*
1 lecture, 6 hours laboratory, offered in fall and winter terms.

221* Analytical Chemistry of Multi-Component Systems
Applications of electroanalytical methods, spectroscopic methods, and analytical separations to the quantitative description of multi-component systems. (Primarily for Honours Chemistry, Honours Applied Chemistry and Honours Biology and Chemistry.)
Prerequisite: Chemistry 121* and 122* or 142*
1 lecture, 6 hours laboratory, offered in fall and winter terms.
2 lectures, offered in fall, winter and spring terms.

224 Chemical Spectroscopy
An introductory survey of the principles and applications of spectroscopic techniques used in the modern chemical laboratory. Topics will include electronic, vibrational and rotational spectroscopy, and magnetic resonance spectroscopy.
2 lectures per week, 2 terms. (full-year course).

226* Chemical Analysis 1
A variety of classical and modern methods will be discussed in principle, and applied in the laboratory.
Prerequisite: Chemistry 121* and 122* or 142*.
2 lectures, 6 hours laboratory, fall term only.

227* Chemical Analysis 2
The evolution of some modern analytical methods will be discussed in the lectures. The laboratory will deal with their application to contemporary problems in chemistry and other sciences.
Prerequisite: Chemistry 226* or 220*.
2 lectures, 6 hours laboratory, winter term only.

231 Chemical Bonding and Structure
Application of the concepts of chemical bonding to the stereochemistry, structure and properties of main group element compounds. Relationship of bonding to reactivity and electronic structure. Periodicity and periodic trends in group chemistry. Synthesis of selected groups of inorganic compounds.
Prerequisite: A first year Chemistry course, e.g. Chemistry 121*–122*.
2 lectures, for two terms (full-year course).

250* Introductory Thermodynamics
Laws 0,1,2,3 of Thermodynamics and their application to the properties of ideal systems; thermochemistry; spontaneity of chemical reactions and the criteria for chemical equilibrium; derivation of the phase rule and its application.
Prerequisites: Chemistry 121* and 122* or 142*; Mathematics 130
2 lectures, 1 tutorial, offered in fall and winter terms.

251* Application of Chemical Thermodynamics to Real Systems
Partial molal quantities; Gibbs chemical potential and non-ideal systems; chemical equilibrium; theory of electrolytes.
Prerequisites: Chemistry 250*
2 lectures, 1 tutorial, offered in fall, winter and spring terms.

252* Quantum Chemistry 1
Experimental basis of quantum mechanics and the limitations of classical mechanics; classical wave motion; the postulates of quantum mechanics and the Schrödinger equation; linear algebra, operators and matrix algebra; special solutions - the harmonic oscillator and the hydrogen atom.
Prerequisites: Chemistry 121* and 122* or 142*; Mathematics 130
2 lectures, 1 tutorial, offered in fall and winter terms.

253* Quantum Chemistry 2
Angular momentum, simple coupling schemes of angular momenta; term symbols; atomic spectroscopy of hydrogen and the hydrogen-like ions; selection rules; atomic spectroscopy of the helium atom; discussion of multi-electron atoms; fine and hyperfine structure; Zeeman effects in...
Department of Chemistry

2 lectures, 1 tutorial, offered in fall, winter and spring terms.

260* Organic Chemistry 1
The preparation and reactions of typical organic functional groups examined from the basis of the reaction mechanisms is presented. Spectroscopic correlations of these functional groups is introduced. Stereochemistry of organic molecules is discussed. (Primarily for Honours Chemistry, Honours Applied Chemistry and Honours Biology and Chemistry.)
Prerequisite: Chemistry 121*-122*
2 lectures, 1 tutorial, offered in fall and winter terms.

261* Organic Chemistry 2
The treatment of organic chemistry in Chemistry 261* is continued and extended to aromatic compounds. (Primarily for Honours Chemistry, Honours Applied Chemistry and Honours Biology and Chemistry.)
Prerequisite: Chemistry 260*
2 lectures, 1 tutorial, offered in fall, winter and spring terms.

266* Organic Chemistry 1
The properties, preparation, reactions and basic structural theory of the common classes of aliphatic compounds. Introduction to electrophilic and nucleophilic reaction mechanisms.
Prerequisite: Chemistry 121* and 122* or 142*
2 lectures, 1 tutorial, fall term.

267* Organic Chemistry 2
The properties, preparation, reactions and basic structural theory of the common classes of aromatic compounds. A continuation of organic reaction mechanisms. Introduction to the chemistry of carbohydrates, proteins, steroids, etc.
Prerequisite: Chemistry 266*
2 lectures, 3 hours laboratory, winter term.

(For students needing a full year of Organic Chemistry as a prerequisite to medicine, the sequence 266*-267* should be selected. For such students an additional 3 hours laboratory will be provided with 266* so that a full year laboratory may be taken.)

291* Laboratory
Selected experiments to accompany the lecture work of Year 2 Honours Chemistry (incl. Math and Physics options) and Honours Biology and Chemistry and term 2D Honours Applied Chemistry. Only open to such students.
9 hours laboratory, offered in winter and spring terms.

1* Applied Inorganic Chemistry
The physical principles of bonding and structure developed and applied to such industrial processes and materials as extractive metallurgy, synthesis of industrial chemicals; ceramics and alloys.
Prerequisite: Chemistry 201* or equivalent
3 lectures, 3 hours laboratory, one term.

302* Modern Organic Analysis
Application of wet chemical and instrumental methods in current use to the identification, determination and characterization of organic materials.
Prerequisites: Chemistry 202*, 206* or equivalent
2 lectures, 3 hours laboratory, one term.

303* Introductory Polymer Chemistry
Polymer nomenclature; effects of intermolecular forces on properties of polymers; molecular weight distributions and averages; step-growth
copolymers; ionic polymerization.

Prerequisites: Chemistry 205*, 206* or equivalent.
3 lectures, 3 hours laboratory, one term.

305* Applied Physical Chemistry

The application of reversible thermodynamics to chemical reactions. Kinetics of complex homogeneous and heterogeneous reactions. Chemical reactors. Phase equilibria applied to distillation and crystallization.

Prerequisites: Chemistry 205*, Math 31*.
3 lectures, 3 hours laboratory, one term.

306* Applied Organic Chemistry

Petroleum chemistry; the production of important industrial chemicals; synthesis of dyestuffs, pharmaceuticals, pesticides and surfactants.

Prerequisite: Chemistry 206* or equivalent
3 lectures, 3 hours laboratory, one term.

307* Introductory Biochemistry

Carbohydrates; proteins; nucleic acids; lipids; metabolism of these compounds.

Prerequisite: Chemistry 206* or equivalent
3 lectures, 3 hours laboratory, one term.

108* Instrumental Measurements

Introduction to the use of instruments to obtain accurate measurements of physical and chemical properties of materials.

Prerequisites: Chemistry 202*, 205* or equivalent
1 lecture, 3 hours laboratory, one term.

118* Instrumental Measurements

Extension of Chemistry 308 to dynamic measurements following the course of a chemical reaction or monitoring a continuous process.

Prerequisite: Chemistry 308*
1 lecture, 3 hours laboratory, one term.

325 Physical Chemistry

An introduction to the study of matter from the macroscopic and molecular point of view. Classical kinetic theory of gases, thermodynamics, electrochemistry, kinetics, molecular structure, surface phenomena, phase equilibria and macromolecules. A knowledge of calculus is assumed.

Prerequisites: Chemistry 121*-122* or equivalent and Mathematics 130.
2 lectures, 3 hours laboratory.

328 Chemical Measurements for Biologists

Basic methods of quantitative analysis and the proper use of instruments for extending and refining them, concentrating on problems of concern to biologists.

Prerequisite: Chemistry 121*-142*
2 lectures, 3 hours laboratory for both fall and winter terms.

331 Inorganic Chemistry 1

Systematic inorganic chemistry of the non-transition elements based on the principles established in Chemistry 231; introduction to nuclear-and radio-chemistry. The laboratory illustrates methods of synthesis and characterization of typical inorganic compounds.

Prerequisites: Chemistry 231
2 lectures, 3 hours laboratory.

335 Physical Chemistry 2

The thermodynamics of systems of variable composition including real gases and binary solutions of non-electrolytes. Electro-chemistry and the thermodynamics of electrolytic solutions.

Prerequisites: Chemistry 235 or 325; and Mathematics 236 or 31*.
336 Organic Chemistry 2 Correlation between electronic structure and chemical properties and reactivity; stereochemistry; synthetic methods, especially enolate and related condensations, and cyclo-addition reactions; carbohydrate and peptide chemistry.
Prerequisite: Chemistry 236 or equivalent
2 lectures; 3 hours laboratory.

337 Biochemistry 1 Carbohydrates, lipids, proteins, hormones, nucleic-acids, and vitamins. Metabolism of these groups of compounds. Physicochemical aspects of biochemistry.
Prerequisite: Chem. 236 or equivalent.
2 lectures. (For General students and Honours Biology, 3 hours laboratory.)

341 Inorganic and Nuclear Chemistry The chemistry of the transition elements. Introduction to nuclear and radiochemistry.
Prerequisite: Chemistry 241.
2 lectures, 3 hours laboratory (except for Honours Chemistry and Physics students).

344 Inorganic Chemistry Survey of transition metal chemistry including ligand field theory of coordination compounds and an introduction to organometallic chemistry. Some aspects of the descriptive chemistry of transition metal compounds.
Prerequisites: 2nd year course in chemical bonding, e.g. Chemistry 231 or Chemistry 211*
2 lectures for two terms.

355 Laboratory in Physical Chemistry A course of experiments relating to the following topics: Kinetics, thermodynamics, electrochemistry, phase equilibria, surface chemistry, spectroscopy, physical and chemical properties of organic and inorganic compounds.
Prerequisite or co-requisite: Chem. 335.
6 hours laboratory (this laboratory accompanies Chemistry 335).

400* Electrochemistry and Corrosion Electrolytic conductance and transport, thermodynamics of electrolytic cells. Reversible and irreversible electrode processes, metallic corrosion; study of selected industrial electrochemical processes.
Prerequisite: Chemistry 305*
3 lectures, 3 hours laboratory alternate weeks, one term.

403* Physical Chemistry of Polymers Polymerization reactions; effects of monomer structure, stereoregularity; polymer solutions; degradation and stabilization of polymers; network polymers and polymerization reactions; polymer elasticity.
Prerequisite: Chemistry 303*, 305* or equivalent
3 lectures, 3 hours laboratory, one term.

405* Surface Chemistry An introduction to the physical chemistry of surfaces. Properties of surfaces; quantitative description of a surface; interaction between phases at a surface. Thermodynamic treatment of surfaces; physical adsorption; chemisorption. Practical applications of surface chemistry in chemical industry.
Prerequisite: Chemistry 305*
3 lectures, one term.

407* Applied Biochemistry Vitamins and hormones; chemistry, production, and mechanism of action of drugs; industrial applications of enzymes and other biological catalysts.
Department of Chemistry

Prerequisite: Chemistry 307*
3 lectures, 3 hours laboratory, one term.

Prerequisite: Chemistry 318*.
1 lecture, 3 hours laboratory, one term.

410* Applied Chemistry Seminar 1 hour seminar, one term

412* Analysis of Materials Techniques of separation, determination and characterization of complex materials including ores, resistant alloys, ceramics, synthetic polymers, food and drug products and pesticides.
Prerequisite: Chemistry 318*.
2 lectures, 3 hours laboratory, one term.

413* Properties of Polymers Transitions in polymeric systems, crystallization and effects of crystallinity on polymer properties; types of mechanical behaviour; flow of thermoplastic melts; measurement of mechanical properties; effects of molecular structure, molecular weight and processing history on polymer properties.
Prerequisite: Chemistry 403* or equivalent.
3 lectures, 3 hours laboratory, one term.

415* Catalysis An introduction to homogeneous and heterogeneous catalysis; chemisorption and its relation to catalysis; geometrical and electronic factors. Industrial applications of catalysis. Problems in selection of catalysts.
Prerequisite: Chemistry 405*.
3 lectures, one term.

418* Instrumentation The laboratory time will be divided between analytical study of instrument modules, and synthesis of an instrument system to meet a typical industrial need.
Prerequisite: Chemistry 318*.
1 lecture, 3 hours laboratory, one term.

Prerequisite: Chemistry 305*.
2 lectures, one term.

429 Project Laboratory in Chemistry Students will be encouraged to submit a proposal for a project in any area of chemistry; alternatively, a project may be assigned.
9 hours laboratory, two terms (only for Year 4 Applied Chemistry students).

431 Inorganic Chemistry 2 Systematic inorganic chemistry of the transition elements; introduction to selected topics including ligand field theory, magnetochemistry; interpretation of electronic spectra. Organometallic chemistry; chemistry of metal carbonyls, and related compounds.
Prerequisite: Chemistry 331.
2 lectures.
Department of Chemistry

Prerequisite: Chemistry 335.
2 lectures, 1 hour problems.

436 Organic Chemistry 3 The use of spectroscopic techniques in organic chemistry; analysis of reaction mechanisms; free radical chemistry; a brief introduction to natural product chemistry.
Prerequisite: Chemistry 336.
2 lectures.

437 Biochemistry 2 Selected topics and techniques in modern biochemistry; energy transfer, transport across membranes, comparative aspects of metabolism, mechanism and kinetics of enzyme activity, structural macromolecules.
Prerequisite: Chemistry 337.
2 lectures, 3 hours laboratory.

439 Advanced Laboratory An introduction to research methods and techniques. The student will elect to concentrate this study in one of the following fields of chemistry, viz. analytical, inorganic, organic, physical or biochemistry. 9 hours per week for Honours Chemistry students, 6 hours for Honours Chemistry (Mathematics or Physics Option). 3 hours for Honours Chemistry and Physics students. Only available to such Honours students.

440 Polymer Chemistry Introductory concepts and definitions; polymer nomenclature; effects of intermolecular forces on polymer properties; molecular weight averages; step-growth polymerization; polymer constitution, configuration and conformation; radical chain-growth polymerization; vinyl copolymerization; cationic, anionic and coordinate polymerization.
Prerequisites: a full year background in both organic and physical chemistry (e.g. Chem. 236 and 235 or 325)
2 lectures.

Graduate Programme in Chemistry

For both the M.Sc. and Ph.D. programmes, a student is expected to combine a thesis embodying the results of some original research with course work. A major field of study should be chosen from the following areas: analytical, inorganic, organic, biochemistry, and physical chemistry. Course work will be appropriate to the area selected and a research director should be chosen from members of the department who are presently engaged in various fields of endeavour as listed.

Analytical Chemistry Chemical instrumentation based on analog modules and on direct digital control; complex ion systems useful in analysis; chromatography; mass spectroscopy; high resolution mass spectrometry, ion generation and fragmentation pattern studies; application of physical methods to separation of metallic constituents in aqueous solutions; analysis of rocks, minerals and meteorites.

Inorganic Chemistry Studies on inorganic complexes in solution; magnetic susceptibility measurements of metallic complexes; the chemistry of the lanthanides in non-aqueous solvents; isotopic exchange reactions; ion exchange kinetics and equilibria; nuclear chemistry.

Organic Chemistry Synthesis of organic substances by electrochemical techniques; abnormal Kolbe reaction of halogenocarboxylic acids; free radical chemistry in
Department of Chemistry

azo-compounds; studies on heterocyclic compounds; synthesis of natural products (especially alkaloids) and N-heteroaromatic substances; spectroscopic studies of molecular conformation synthesis and characterization of film-forming polymers; photochemistry; carbohydrate chemistry.

Biochemistry

Elucidation of structural basis of catalytic action; synthetic and degradative studies of enzymes, peptides and proteins; nature of materials excreted by algae; mechanisms of enzyme-catalyzed reactions.

Physical Chemistry

Studies of surfaces, surface reactions and catalysis; electrochemistry with emphasis on electroplating mechanisms and corrosion studies; spectroscopic studies of species in solution to determine their identity and contribution to the properties of the system; viscous and elastic properties of thermoplastics; influence of molecular structure and morphology on mechanical properties of polymers; N.M.R. studies of chemical systems; E.S.R. studies of radicals in solution—triple ions; crystal structure determination using diffraction methods; study of relationships between structure and physical properties; study of phase stability in metal structures; studies of mesomorphic phases; Overhauser effect; line shape studies by computer methods; nuclear magnetic relaxation studies;

Theoretical Chemistry

Transport phenomena (Senftleben and Senftleben-Beenakker effects); statistical and quantum theory; relaxation processes in gases; ab initio calculations on simple molecules; physical nature of the chemical bond.

Graduate Course Descriptions

Courses marked with an asterisk (*) are one-term courses; all others are full-year courses.

600* Radiochemistry

Nuclear Stability; radioactive law of decay, and mode of decay. Nuclear Models.

605* Physical Nature of the Chemical Bond

The one-electron and two-electron chemical bond as found in diatomic molecules. Covalency, electrovalency, electronegativity and their quantum chemical meaning. Methods for treating bonding in quantum chemistry.

610* Advanced Radiochemistry

Excited states of nuclei. Nuclear spectroscopy. Applications of radiochemistry.

615* Physical Chemistry of High Polymers

Selected topics in the field.

620 Resonance Spectroscopy

Nuclear and electron magnetic resonance spectroscopy; basic principles, derivation and solution of the Bloch Equations, first and second-order interpretation of nuclear magnetic resonance spectra. The application of these techniques and of double irradiation experiments to selected chemical problems.

25* Selected Topics in Quantum Chemistry

Projection operators, density matrices, natural spin orbital analysis, configuration interaction, correlation energy, geminals.
627* Selected Topics in Biochemistry
Chemistry of blood coagulation. Recent developments in immunochemistry.

630 X-ray Crystallography
Principles and practice of X-ray, neutron and electron diffraction. Interpretation of diffraction data for structure determinations of inorganic and organic compounds.

632 Chemical Analysis
An advanced treatment of classical analysis. The application of equilibria and kinetic considerations to the study of deviations from stoichiometric behaviour. The formation and nature of precipitates, non-aqueous solvent methods, analytical separations.

635* Thermodynamics
A rigorous treatment of chemical thermodynamics with emphasis on the complete thermodynamic description of a system.

636* Natural Products
Selected topics in the field of natural products; heterocyclic and alkaloid chemistry; steroids and terpenes, with emphasis on structural determination and biogenesis.

637* Recent Advances in Biochemistry
Chemiluminescence, bioluminescence, photosynthesis. Enzyme models.

638* Crystallography 1
Crystal lattices. Point group and space group symmetries. Principles of diffraction and space group determination. (This course is also listed as Physics 638).

639* Crystallography 2
X-ray optics and instrumentation. Methods of crystal structure determination: Fourier synthesis, the phase problem, refinement, crystallographic computing. (This course is also listed as Physics 639).

640* Group Theory and its Applications in Chemistry
Symmetry operations. Point groups. Reducible and irreducible representations. Character tables, Molecular vibrations.

641* Chemical Bonding in Inorganic Chemistry
Construction of hybrid orbitals. Molecular orbital theory. The Huckel method. Ligand field theory. Application to complex inorganic and organometallic molecules. Prerequisite: Chemistry 640* or its equivalent.

642 Chemical Instrumentation
Instrument components and optimum application; rudiments of design; electrical, spectral, migrational and other methods.

645* Molecular Quantum Mechanics
A course on the quantum theoretical elucidation of chemical and physical properties of molecules, quantum mechanical principles, quantum mechanical techniques, perturbation and variation methods, molecular orbital theory.

646* Theoretical Organic Chemistry
The stereochemistry and chemical reactivity of saturated and unsaturated 3-, 4-, 5-, 6- and 7-membered carbo cyclic systems, including the decalins and perhydrophenanthrenes. Elimination reactions. Aromaticity, including a study of valence bond isomers and the annulenes, and homoaromaticity. Reaction mechanism studies utilising isotope effects and transition state concepts. Woodward-Hoffman rules. Classical and nonclassical carbonium ion theories.

647* Regulatory Mechanisms in Biological Systems
Induction, repression and feedback. Inhibition of enzymes; allosteric proteins; regulation of RNA synthesis; chemistry and function of nucleic acids.
651* Physical Methods in Inorganic Chemistry
Optical, nuclear magnetic resonance, mossauber, nuclear quadrupole and mass spectroscopy and their uses in inorganic chemistry.

655* Chemical Kinetics
Statistical methods applied to the kinetic molecular theory and to the treatment of interacting systems. The kinetics of homogeneous reactions in gases with emphasis on unimolecular reactions, and of reactions in condensed phases.

656* Synthetic Methods of Organic Chemistry
A discussion of classical and newer concepts in the synthesis of organic compounds with emphasis placed on the fundamental behaviour patterns. An integration of experimental facts and modern theories is presented.

657* Topics in Physical Biochemistry
Thermodynamics of biological systems; ultracentrifugation; kinetics of enzyme catalyzed reactions; optical rotatory dispersion, etc.

661* Synthetic Methods in Inorganic Chemistry
An introduction to the synthetic techniques of inorganic and organometallic chemistry. Chromatography, inert atmospheres, techniques with non-aqueous solvents, high vacuum techniques, etc. The application of these methods to the synthesis of selected groups of inorganic compounds will be discussed.

662* Colloquia on Current Topics in Analytical Chemistry
Graduate students will each present for discussion short colloquia based on their reading of assigned topics. Participation in the discussions, as well as the actual presentation of papers, will be an integral part of the course. Admission to this course will be at the discretion of the Analytical faculty.

665* Molecular Spectroscopy
Rotational and vibrational spectra of diatomic and polyatomic molecules. Interpretation of infrared and Raman spectra. Force constant calculations. Applications. 
Prerequisite: Chemistry 640* or its equivalent.

666* Organic Spectroscopy
Introduction to ultraviolet, infrared, and resonance spectroscopy, with emphasis on applications to studies of organic molecules.

671* Equilibria in Coordination Complexes

676* Selected Topics in Organic Chemistry
Discussion of specialized topics related to the research interests of members of the Department.

681* Inorganic Reactions Mechanisms
Substitution, oxidation-reduction, isomerisation and racemisation reactions of coordination compounds in aqueous solutions. Experimental techniques and treatment of data.

685* Surface Chemistry and Catalysis
(This is a course which could be taken by non-physical chemists.)
Aspects of the Symmetry and point groups. The specification of chirality and prochirality. Stereoisomeric relationships of groups in molecular conformations and their effect on spectra. Correlation of configuration. Chiroptical properties of molecules and their application to structure determination.

Colloquia on Current Topics in Inorganic Chemistry
Graduate students will each present for discussion short colloquia based on their reading of assigned topics. Participation in the discussions, as well as the actual presentation of papers, will be an integral part of the course. Admission to this course will be at the discretion of the Inorganic faculty.

Semi-empirical methods in Quantum Chemistry
(This is a course which could be taken by non-physical chemists.)

Thesis.
Equilibrium and transport properties of electrolytes and their interpretation in terms of current theory.

Electrolyte Theory
Thermodynamics of the adsorbed phase. Surface energetic heterogeneity and methods for dealing with it. Statistical mechanics and quantum mechanics applied to surfaces and adsorption phenomena. The nature of forces involved in the adsorption process.

Theoretical Physical Chemistry of Surfaces and Catalysts
Undergraduate Course Descriptions

200 Systems 2 (Special Problems)  A series of problems designed to complement lecture material. The problems are related to the various divisions of Civil Engineering.


202 Mechanics of Deformable Solids 2  A general treatment of the behaviour of structural components from the study of stress and strain in solids. Topics include super-position, energy theorems, theories of failure, elastic and inelastic analysis of unsymmetrical bending, shear centre, torsion of cellular members, columns and stability and virtual work.


232 Systems 1 (Economics & Social Sciences)  (a) Demand and Supply, market places, marginal analysis, cost-benefit analysis engineering economy. (b) Introduction to the social sciences and series of guest lectures by outstanding men in sociology, psychology, engineering, philosophy, management.

241 Survey Camp  The fundamentals of plane measurement and route surveying. Chaining, levelling, traversing, triangulation and curve installation. Instrument correction.


321 Statistics Modern statistics and engineering; treatment of data, frequency distribution; theory of probability; Binomial, Poisson and Normal distributions; Central Limit Theorem; Normal Law of Errors; sampling distributions; statistical inference; regression theory.

322 Engineering Analysis Formulation and solution of various eigenvalue equilibrium and propagation problems in discrete and continuous systems. Topics include equations of mathematical physics, elementary matrix algebra, numerical methods, calculus of variations, and approximate methods.

350 Fluid Mechanics Physical properties of fluids and fundamental concepts of fluid flow. Dimensional analysis and similitude and their use in solving problems of fluid mechanics. Laws for conservation of mass, energy, momentum and entropy and their application to a variety of engineering problems such as flow in pipes and head loss analysis.


361 Urban Planning A systematic approach to urban planning. Goals, objectives and criteria, plan alternatives, optimization and plan implementation. Theories of urban growth and development. A group planning project.


371 Geology for Engineers An introductory course in geology with emphasis on topics related to civil engineering; mineralogy and petrology, structural geology,geomorphology (especially glacial geology). Aggregates: properties and occurrence. Field trips.


400 Systems 3 (Project) Design of civil engineering projects, building structures, bridges, highway and municipal engineering works. Emphasis is given to the interrelationship between practical design and the various sciences and disciplines covered in the undergraduate course of studies.

401 Structural Steel The design of structural elements in steel. Beams, tension and compression members, connections and plates.
402 Reinforced Concrete 1 Properties of concrete and reinforcing steel. Section design: ultimate strength design and working stress design. Design principles.

Prerequisite: CE 402

Prerequisite: CE 401.

451 Water Resources and Sanitary Engineering The physical, chemical and biological basis of water treatment and waste-water treatment and disposal. Principles of design and construction of facilities for the collection, treatment and distribution of water, and the collection, treatment and disposal of waste-waters. The lecture course is supplemented by a series of laboratory experiments related to the measurement of water quality and treatment process control.


471 Soil Engineering Subsoil investigation. A study of the present theories of soil mechanics and their use in soil engineering. Procedures for the analysis, design and construction of earth structures, shallow and deep foundations. Stability of slopes and earth dams are considered. This course is a prerequisite for further soils courses in fourth year.

481 Engineering Law General introduction to law and the Common Law legal systems; formation of contracts, effect of mistakes on contracts, interpretation of contracts, breach of contracts, legal remedies; scope and content of technical specifications; sale of goods; introduction to the Law of Agency; the Tort of Negligence, professional negligence; some aspects of restrictive trade practices; introduction to Patent Law.


500 Systems 4 (Project) An independent piece of engineering work, design or research, under the direction of a faculty member.

501 Approximate Analysis of Structures Simple alternative methods of structural engineering that provide independent checks on more complex analyses or designs are surveyed. Such methods are becoming necessary with the growing automation of structural computations. A deliberate development of understanding of structural behaviour ('structural intuition') is attempted. The role of approximation is discussed at all levels, ranging from accepted standard approximations in so-called exact structural mechanics to more intuitive proportioning of structures. Approximate equivalence of continuous and discrete systems: cantilever method, equivalent beams, plates and shells, trusses and grids. Finite element methods; Newmark's analysis and further simplifications. Moment balancing, load balancing and related methods of pragmatic design. Methods of negligible redundants: portal method, area method in shells.
502 Failure in Metal Assemblies

504 Structural Analysis 1
(a) Computing and Numerical Methods: Fortran review, JCL, information storage and retrieval, review of determinants and matrices, linear algebra, integration techniques, interpolation, errors, introduction to STRUDL.
(b) Structural analysis: Topology and determinancy, flexibility and stiffness methods applied to the analysis of beams, grids, space frames, etc.

505 Structural Analysis 2
(a) Computing and Numerical Methods: Eigenvalue problems, nonlinear equations, computer systems - ICES with particular emphasis on STRUDL II
(b) Structural Analysis: Stiffness methods applied to large problems finite element approximate methods.

506 Project Management

507 Advanced Analysis of Structures
Numerical methods in structural analysis for beams, members curved in space, plates, shells and space frameworks. Applications of topology. Matrix methods.

510 Advanced Mechanics of Deformable Solids

520 Computer Applications to Engineering Problems
Designed to give the student an appreciation of the capabilities of the digital computer and enable effective planning of large programmes to be accomplished. The use of functions, subroutines, programme libraries, object decks, overlay structures and load modules will be discussed using FORTRAN. Other systems such as ICES, STRUDL, CPS, WITS, ICETRAN and PL1. Use of tapes and other secondary storage is covered as is job control language and plotting facilities.

522 Engineering Analysis 2
Review of previous mathematical methods, ordinary and partial differential equations, transform methods, calculus of variations, approximate methods—Ritz, Galerkin and special topics.

530 Fundamentals of Experimental Mechanics and Engineering Measurements
system analysis, transfer function, noise/signal ratio. Typical measuring systems. Validity and accuracy of experimental results. Examples of engineering applications.

531 Introduction to Experimental Strength Analysis

540 Highway Engineering (Planning and Design)
Highway planning; methods, results. Classification needs, sufficiency ratings. Economics of location. Highway finance and administration. Geometric design; principles, methods.

541 Pavement Materials

542 Pavement Structural Design

543 Land Use Models
The objective of this course is to provide the student with experience in the calibration and use of one type of urban land use forecasting model. The emphasis will be on the application of the model to an urban area through the development of a computer model. The topics to be covered will include population and employment forecasting methods, a general review of all land use model types and a detailed treatment of the Lowry model.

546 Geometric Design of Highways
Design standards and geometric design of highway alignment, grade, sight distance and cross section by class of highway. Design of intersections and interchanges. Design of planned access facilities in rural and urban areas.

551 Engineering Aspects of Surficial Soils
Use of geologic and pedologic information and airphoto interpretation principles and techniques in the prediction of engineering properties of soils and the planning of engineering soil surveys.

560 Mechanical Behaviour of Materials
A review of crystalline and non-crystalline structures; elastic and inelastic properties, imperfection and plasticity in crystals; plastic deformation and creep; brittle, ductile and fatigue fracture. Plasticity in ceramics and polymers. Cyclic deformation.

572 Topics in Waste Treatment
This course deals specifically with methods for the treatment of municipal and industrial wastes and assumes that the student has some background in the area of Sanitary Engineering. The course will present two main topics: chemical and physical treatment of waste.
573 Hydraulic Considerations in Water Pollution

Concept of density stratified and temperature stratified fluid systems - hydraulics of stratified flows in open channels - internal waves and internal hydraulic jumps - diffusion in stratified flows - selective withdrawal of fluid from stratified reservoirs. Diffusion and pollution in estuaries - salinity intrusion into rivers - tidal effects on river pollution.

50 Engineering Aspects of Water Resources Planning

The structure of Water Resource agencies in Canada will be discussed. A simple computer hydrology simulation model will be developed. Economic functions pertaining to costs and benefits of water use will be discussed. A simplified water planning problem will be described. The class will be expected to develop a computer model to assist in evaluating alternative designs prescribed to overcome water resource problems.

Note Courses numbered within the 500 series are considered to be undergraduate courses but are intended to form a transition from the undergraduate to the graduate programme in certain areas of Civil Engineering. They serve two major functions:

1) to provide technical electives for the undergraduate so that he may specialize in a particular area.

2) to provide background information for the graduate student when such is lacking. Courses of this series may be credited toward a graduate degree.

Graduate and Research Programmes

Both co-operative and conventional graduate study leading to the degree of Master of Applied Science (M.A.Sc.) or Doctor of Philosophy (Ph.D.) can be undertaken in Civil Engineering. At present, there are five major areas of study in which specialization may be undertaken: Structural Engineering and Applied Mechanics, Soil Mechanics and Geotechnical Engineering, Water Resources and Sanitary Engineering, Transportation Planning and Engineering, and Hydraulics and Water Resources Systems Planning.

The following is the numbering scheme used for graduate courses in Civil Engineering:

- Structures: 600 - 609, 700 - 709
- Continuum Mechanics: 610 - 619, 710 - 719
- Applied Mathematics: 620 - 629, 720 - 729
- Experimental Mechanics: 630 - 639, 730 - 739
- Transportation: 640 - 649, 740 - 749
- Soil Mechanics: 650 - 659, 750 - 759
- Materials: 660 - 669, 760 - 769
- Sanitary Engineering: 670 - 679, 770 - 779
- Hydraulics & Water Resources: 680 - 689, 780 - 789

Courses in the 600 series are regular lecture courses normally available every calendar year. Courses in the 700 series provide flexibility and may be offered when there is sufficient demand and when faculty are available. To complement these courses in Civil Engineering, additional
mathematics, computer programming, urban and regional planning, economics, geography, hydrology, chemistry, sociology, operations research, earth sciences and biology.

Degree Programme Requirements

The minimum requirements for the Ph.D. degree are outlined elsewhere under Graduate Studies.

Minimum requirements for the Master's degree in Civil Engineering are satisfied when the candidate has successfully completed either

1. Eight one-term courses accepted for graduate credit by the department plus an engineering project report (CE 807) requiring a study in depth on a topic approved by the Department.
2. Four one-term courses accepted for graduate credit, plus a thesis (CE 808) embodying the results of his research on a topic approved by the Department.

Of courses accepted as part of the candidate's programme, at least one half must be graduate courses numbered in the 600 or 700 series. Undergraduate courses which are consistently accepted for graduate credit are numbered in the 500 series but other undergraduate courses which may be deemed appropriate in individual cases may be acceptable.

(Note: depending on his background and current performance, a candidate may be asked to take more that the minimum number of required courses).

In the case of a Master's programme involving an engineering project, two typewritten copies bound in standard Accopress binders are submitted by the candidate to the Department to be read and judged by two members of the faculty, one of whom is the Supervisor and the other appointed by him. When the project report has been accepted one copy is deposited in the Department and one is retained by the Supervisor.

In the case of a Master's programme involving a thesis the candidate is required to present a seminar (CE 805) on the thesis topic as part of this degree programme. The details for submission of a Master's thesis are outlined elsewhere under Graduate Studies. Master's theses will be read and judged by three readers, namely (a) the candidate's supervisor, (b) a faculty member appointed by the supervisor, and (c) a faculty member appointed by the department.

Current research in the five major areas of specialization include the following:

Structural Engineering and Applied Mechanics

Major subdivisions of study are applied mechanics, structural mechanics, concrete structures, properties of materials, experimental mechanics and stochastic systems. Current research includes studies in structural stability, static and dynamic response of structures, propagation of elastic disturbances in solids, elastic and inelastic continua, structural response to random excitation, nonlinear stochastic processes, hydroelasticity, analysis and design of reinforced and prestressed concrete structures, structural optimization, computer-aided design of structures, strength and safety of structures, strength of pressure vessels, plastic behaviour of shells, mechanisms of fatigue failure in materials, rheology, structural model mechanics, experimental stress analysis, modal analysis of contact problems, fluid flow, behaviour of plastics at elevated temperatures, theory and technique of designing experiments, and foundations of photoelasticity.
Transportation Planning and Engineering

The major areas of study are urban transportation planning, transportation systems analysis, highway planning and engineering, traffic engineering and air transport planning. Current research activities include investigations in transportation systems analysis, urban transportation analysis methods, urban land use models, economic analysis of transportation systems, inter-city air transportation of persons and goods and studies in bituminous materials.

Soil Mechanics and Geotechnical Engineering

Major subdivisions of study in this area are soil mechanics, foundation engineering geology. Current activities include studies on the yielding of soils, settlement of structures, model testing, seepage and engineering geology.

Water Resources and Sanitary Engineering

At the present time, research involves work on the kinetics of biological waste treatment (aerobic and anaerobic), specific industrial waste treatment problems, the use of coal for waste treatment, evaluation of the applicability of trickling filters for waste treatment in cold climates, scale-up in activated sludge, protein sparing in biological systems. Both laboratory-scale and pilot plant facilities are being used in these studies. Research is also being conducted in the areas of nutrient removal and solid-liquid separation. The Department has several well-equipped laboratories that are used for demonstrations, teaching and research. Biological and chemical plant units are used to study and evaluate new methods to improve water and waste quality.

Hydraulics and Water Resources Systems Planning

Current research in this area lies in the fields of open channel hydraulics, sediment transport, hydroelastic vibrations and water resources systems planning.

Graduate Course Descriptions

600 Theories of Design


101 Theory of Plates and Shells


102 Theory of Inelastic Structures


203 Theory of Inelastic Structures


694 Prestressed Concrete


609 Stability of Elastic Structures
Basic concepts of instability of a structural system, bifurcation, energy increment, snapthrough, methods of finding critical loads, post-buckling behaviour, buckling of imperfection sensitive structures, dynamic instability of nonconservative systems.

611 Mechanics of Continua
Mathematical preliminaries; coordinate transformation, introduction to tensors, tensor fields and transformations, integral theorems. Analysis of deformation; deformation tensors and rates of deformation tensors and their mechanical significance, convecting and rotating axes. Analysis of stress; definition of stresses and their physical significance, rates of stresses, objective stress-rates. Fundamental laws; conservation of mass, momentum and energy, thermodynamics of continuous media. Constitutive equations. Rheology.

621 Energy Methods in Applied Mechanics
An introduction to the variational principles of mechanics and their applications in engineering, virtual work, principles of minimum potential energy and complementary energy, approximate methods of solution.

627 Linear Stochastic Systems

629 Mathematical Methods in Applied Mechanics
The equations of applied mechanics and the methods of solution, equilibrium problems, eigenvalue problems, calculus of variations, approximate methods of solution, applications.

630 Engineering Photoelasticity

632 Foundation of Model Mechanics - Behaviour of Engineering Plastics
Creep indicators. Typical transfer functions. Examples of typical model studies of engineering problems.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>658 Soil Engineering (Case Histories)</td>
<td>A critical study by the consideration of case histories of the current procedures of design and construction of foundations, earth retaining structures and earth slopes.</td>
<td></td>
</tr>
<tr>
<td>671 Physical Processes of Sanitarly Engineering 1</td>
<td>Principles of mixing, aeration and gas transfer, solid-liquid separation, sludge handling, flow through porous media, flocculation.</td>
<td></td>
</tr>
<tr>
<td>672 Biological Waste Treatment</td>
<td>Principles and design of biological processes including activated sludge, trickling filters, stabilization ponds and sludge digestion.</td>
<td></td>
</tr>
<tr>
<td>674 Physical Processes of Sanitarly Engineering 2</td>
<td>Design applications of principles presented in CE 671. An integration of unit processes and operations into a composite design.</td>
<td></td>
</tr>
<tr>
<td>685 Operational Techniques in Water Resources Design</td>
<td>Operational hydrology, sensitivity analysis, stream assimilation functions.</td>
<td></td>
</tr>
</tbody>
</table>
Department of Civil Engineering


701 Advanced Topics in the Theory & Design of Structures
702 Structural Synthesis and Case Histories
703 Theory of Plates and Shells 2
704 Reinforced Concrete 3
710 Advanced Topics in Mechanics of Continua
715 Finite Element Method in Continuum Mechanics
716 Plasticity
717 Elasticity
723 Advanced Topics in Applied Mathematics
724 Mathematical Analysis of Stability of Elasto-Mechanical Systems
725 Nonlinear Dynamics
726 Advanced Analytical Mechanics
728 Nonlinear Systems with Random Inputs
729 Error Analysis of Numerical Methods in Applied Mechanics
730 Advanced Topics in Experimental Mechanics
731 Experimental Stress Analysis
733 Advanced Photoelasticity 1
734 Advanced Photoelasticity 2
735 Special Problems in Experimental Mechanics
740 Advanced Topics in Transportation Engineering
741 Advanced Pavement Design
742 Transportation Economics
745 Highway Planning
747 Traffic Engineering 1
748 Traffic Engineering 2
749 Airport Engineering and Planning
750 Earth Structures
751 Advanced Soil Mechanics
752 Advanced Topics in Soil Mechanics and Geotechnical Eng.
760 Advanced Topics in the Behaviour of Materials
761 Fatigue Behaviour of Materials
762 Cyclic Deformation Behaviour of Materials
770 Advanced Topics in Sanitary Engineering
776 Topics in Environmental Health Engineering
777 Biological Aspects of Water Pollution Control
778 Laboratory in Water Pollution Control
780 Advanced Topics in Hydraulics and Hydroelasticity
781 Fluid Elasticity
782 Hydraulic Transients
785 Evaluation of Water Resources Alternatives
786 Advanced Topics in Water Resource Systems
788 Sediment Transport
801 Oral examination of the Thesis for the Ph.D. degree
803 Comprehensive examination (as determined by the Department)
805 Graduate Research Seminar
807 Engineering Project
808 Research thesis for the M.A.Sc. degree
Department of Classics and Romance Languages

Professor and Chairman of the Department
R.L. Myers, B.A. (Western), M.A., Ph.D. (Johns Hopkins)

Professor A. Ages, B.A. (Carleton), M.A., Ph.D. (Ohio State)
Professor J.R. Finn, C.R., B.A. (Western), M.A. (Toronto), Ph.D. (Illinois)
Professor D.C. Mackenzie, B.A., M.A., Ph.D. (Princeton)
Professor J.C. McKeegney, B.A. (Western), M.A. (Oregon) Ph.D. (Washington), Diploma (Santander)
Professor D. Walter (Mrs.) B.A., M.A. (Queen's)

Associate Professor J.J. Biname, L'en Phil. rom., Agrégé (Brussels)
Associate Professor J.R. Dugan, B.A., M.A. (Toronto), Ph.D. (Yale)
Associate Professor E. Grey, B.A. (Texas Western), M.A. (Colorado), Ph. D. (Harvard)
Associate Professor P. Keresztes, M.A. (Toronto), Ph. D. (Graz)
Assistant Professor J. Dumont, Licence-És-Lettres L (Neuchatel)
Assistant Professor E. Evans, Laurea in pedagogia (Padua)
Assistant Professor C.M. Fernandez (Mrs.), Lic. en Arg. (Madrid), M.A. (Tulane)
Assistant Professor S.B.P. Haag, B.A., M.A. (Queen's) M. Phil. (Toronto)
Assistant Professor J. Lafrance (Miss), B. Paed., M.A., Ph.D. (Laval)
Assistant Professor R.L. Porter, B. A. (McMaster), M.A., Ph.D. (Princeton)
Assistant Professor B. Thalman (Mrs.), B.A. (DePauw), M.A., Ph.D. (Ohio State)
Assistant Professor W.D. Wilson, M.A., Ph. D. (Trinity College, Dublin)

Lecturer P. Forsyth (Mrs.), A.B. (Mount Holyoke), M.A. (Toronto)
Lecturer R.J. Fournier, B. A., M.A. (Western)
Lecturer M. Gold (Mrs.), M.A., D. Phil. (Oxford)
Lecturer P.J. Gold, M.A., B.Litt. (Oxford)
Lecturer (part-time) C.C. Abbott (Mrs.), B.A., M.A. (Ohio State)
Lecturer (part-time) H. S Fournier (Mrs.), R.A. (Toronto), M.A. Western
Lecturer (part-time) M. Mackenzie (Mrs.), B.A., M.A., Ph.D. (Rice)

General Remarks
1) The number of lectures per week shown after certain course descriptions is an attempt to indicate the "normal". The instructor will determine how often his particular class will meet.

2) In choosing his courses each year, the student should always bear in mind the requirements of the profession he intends to enter after graduation. The members of the department are at all times willing to advise the student if he so wishes.

3) Students entering their second year in September 1971 will require the following number of departmental courses in order to graduate with major or honours standing in French, Spanish or classics:
   a) Major in 3 year programme—6 courses
   b) Double honours programme—8 courses (except French and Political Science—7 courses)
   c) Single honours programme—10 courses

Undergraduate Courses

Classics

Classical and Mediaeval Civilization (Courses in Translation)

251* Near Eastern and Greek History
A survey of the civilizations of the Near East and of Greece, emphasizing their political, military, social and economic aspects. Three lectures. Fall term.
Department of Classics and Romance Languages

252* Roman History
A military, political, social, economic survey of Rome from earliest times to the Empire's fall.  
*Three lectures. Winter term.

255* Mediaeval Civilization
Study of mediaeval literature, art, architecture, music and other expressive forms. The periods from late antiquity to the High Middle Ages will be studied.  
*Three lectures. Fall term.

256* Mediaeval Civilization
Study of mediaeval literature, art, architecture, music and other expressive forms. The periods from the High Middle Ages to the Renaissance and Reformation will be studied.  
*Three lectures. Winter term.

265* Classical Verse in Translation 1
Greek and Roman Epic and Tragedy.  
Fall term.

266* Classical Verse in Translation 2
Comedy, Satire and other Verse forms.  
Winter Term.

150 Classical Art and Archaeology
A survey of art and architecture from the Aegean age through the Roman Empire.  

15* Problems in Greek History 1
A detailed study of a selection of problems in Greek History  
Prerequisite, Class Civ. 251. Fall term. Not offered in 1971-72.

16* Problems in Greek History 2
A detailed study of a selection of problems in Greek History.  

371* Myth and Religion
Deities, myths and sagas correlated with literature, religion and philosophy from the 6th century B.C. to the 4th century A.D.  
*Three lectures. Fall term.

372* Christianity and the Roman Empire
A study of the relationship between Christianity and the Roman Empire, from the earliest beginnings to the time when Christianity became the official religion of the state.  
*Three lectures. Winter term.

75* Problems in Roman History 1
A detailed study of a selection of problems in Roman History.  
Prerequisite, Class Civ. 252. Fall term. Not offered in 1971-72.

76* Problems in Roman History 2
A detailed study of a selection of problems in Roman History.  

385* Classical Prose in Translation 1
Greek History and Philosophy.  
Fall term.

386* Classical Prose in Translation 2
Roman History and Philosophy.  
Winter term.

495 Mediaeval Civilization
Senior Essay.  
Fall term.
Greek

100 Introductory Greek  
*Four lectures. Year course.*

190 Epic and Philosophy  
(to Plato). Homer *Iliad* 1, VI, IX; Plato, *Apology* and *Crito*: prose composition and sight translation.  
Prerequisite: Grade 13 Greek, Greek 100 or instructor's permission.  
*Four lectures. Year course.*

265* History and Historiography  
Selections from Herodotus.  
*Fall term.*

266* Tragedy  
Euripides, *Medea* and other selections.  
*Winter term.*

365* History and Historiography  
Selections from Thucydides.  
*Fall term. Not offered in 1971-72.*

366* Lyric and Elegiac Poetry  
Selections from Lyric and Elegiac Poets.  

375* Drama 1  
Selections from Aeschylus.  
*Fall term. Not offered in 1971-72.*

376* Drama 2  
Selections from Sophocles and Aristophanes.  

Note  
*All courses in Greek include prose composition assignments.*

Latin

100 Introductory Latin  
*Three lectures. Year course.*

190 Literature of the Republic  
Selections from Plautus, Catullus and Cicero.  
Prerequisite: Grade 13 Latin, Latin 100 or instructor's permission.  
*Three lectures. Year course.*

251* Language Study  
Composition, translation, basic grammar with intensive analysis of selected works.  
*Three lectures. Fall term.*

265* Letters  
Selections from the letters of Cicero and Pliny.  
*Fall term.*

266* Epic  
*Winter term.*

352* Language Study  
Composition, translation, basic grammar, with intensive analysis of selected works.  
*Three lectures. Winter term.*

365* History and Historiography  
Livy, 21, 22; *Res Gestae*.  
*Fall term.*
375* Lyric Poetry  Catullus and Horace.  
*Fall term.

376* Elegiac Poetry  Selections from Tibullus, Propertius and Ovid.  
*Winter term.

395* Mediaeval Latin Literature  From Gregory of Tours to Abelard. Selected readings in various genres such as drama and the Cambridge Songs.  
*Fall term.

396* Mediaeval Latin Literature  From the twelfth century to the Renaissance. Selected readings in various genres such as the chroniclers and the Goliardic Songs.  
*Winter term.

465* Philosophy  Lucretius, De Rerum Natura, 1, 3, 5 (selections); Cicero, De Officiis (Selections).  

466* Horace  Selections.  

475* Comedy  Plautus, Rudens; Terence, Phormio.  

76* Historiography and Literary Criticism  Tacitus. Annals 11-16 (selections); Quintilian 10  

85* Roman Life in the Empire 1  Juvenal; Petronius, Cena  
*Fall term.

96* Roman Life in the Empire 2  Tacitus, Agricola; Suetonius, Nero; Seneca, Apocolocyntosis.  
*Winter term.

490 Senior Seminar  On selected topics such as epigraphy, remains of old Latin, Roman law and society.  
*Year course. Not offered in 1971-72.

Romance Languages

French

100 French Language and Literature  The emphasis will be on oral and aural training. The language part of the course will include intensive oral training in the classroom as well as in the language laboratory, exercises in comprehension and conversation. Literature—weekly lectures and discussions on the texts being studied.  
Prerequisite: Grade 13 French or permission of the department.  
*Year course.

105* French Language 1  Intensive oral and aural training in the classroom as well as in the language laboratory, exercises in comprehension and conversation.  
Prerequisite: Grade 13 French or permission of the department

Note  This course is open only to non-Arts students in Co-operative programmes and will be offered only when enrolment is sufficient. Contact the department for further information.
106* French Language 2  
A continuation of French 105*.  
*Prerequisite: French 105* or permission of the department.

Note  
This course is open only to non-Arts students in Co-operative programmes and will be offered only when enrolment is sufficient. Contact the department for further information.

200 French Literature  
A survey in French of the major periods of French Literature  
*Full credit. One term.*

245* Literature of the Seventeenth Century  
A study of the major writers of 17th century France.  
*Winter term.*

246* Literature of the Eighteenth Century  
A study of the major writers of 18th century France.  
*Winter term.*

250 Intensive Language Training  
Intensive practice in oral structures and exercises toward skill in writing.  
A Follow-up of the language part of French 100.  
*Prerequisite: French 100.*  
*Three lectures. Year course.*

260 Classical Literature  
Offered in summer school and/or post-degree programme only.

265* Literature of the Nineteenth Century  
A study of the major writers of 19th century France.  
*Winter term.*

266* Literature of the Twentieth Century  
A study of the major writers of 20th century France.  
*Winter term.*

Note  
In the following series of courses, three areas will be included. These are indicated by the course numbers, which will fall into one of three ranges:  
310-319—18th century  
320-329—19th century  
330-339—20th century  
Courses in these ranges will vary from year to year, and numbers will be adjusted accordingly.

310* Revolutionary Texts of the Eighteenth Century  
Selected texts from Voltaire, Rousseau, Diderot, etc.  
*Fall term.*

320* Symbolist Poetry  
Particular attention will be given to Baudelaire, Rimbaud, Mallarmé, etc.  
*Fall term.*

321* Realism and Naturalism  
A study of Balzac, Zola, etc.  
*Winter term.*

330* The Novel in France, 1900-1939  
A study of selected texts.  
*Fall term.*

331* Twentieth Century French Literature of the Absurd.  
A study of selected texts by Camus, Sartre, Beckett, etc.; novel and drama.  
*Winter term.*

350 Advanced Instruction in Written French  
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Prerequisite</th>
<th>Term(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>360</td>
<td>French Literature of the enlightenment</td>
<td>Offered in summer school and/or post-degree programme only.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>365*</td>
<td>French Canadian Novel</td>
<td>A study of some representative novels of the 19th and 20th centuries. Prerequisite: a French literature course on the 200 level or instructor’s permission. Fall term.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>66*</td>
<td>French Canadian Poetry and Theatre</td>
<td>A survey of the Canadian works in poetry and drama. Prerequisite: a French literature course on the 200 level or instructor’s permission. Winter term.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>370</td>
<td>Romanticism, Realism and Symbolism in French Literature</td>
<td>To be offered in summer school and/or post-degree programme only.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>The Novel in French Canada</td>
<td>Special emphasis on contemporary novels. Year course.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25*</td>
<td>Mediaeval French Language and Literature</td>
<td>An introduction to the problems of mediaeval French language and readings from the major literary texts of the period. Fall term.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>435*</td>
<td>French Prose of the Renaissance</td>
<td>Readings in 16th century literature: Rabelais, and Montaigne, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>436*</td>
<td>French Poetry of the Renaissance</td>
<td>Readings in 16th century poetry: Marot, the Pléiade, the baroque poets, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>456*</td>
<td>Stylistics</td>
<td>An introduction to the problems of comparative French and English stylistics, with advanced grammar, composition, oral practice and corrective phonetics. This course is not a repetition of French 455*. Prerequisite: French 350. Winter term.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: In the following series of courses two areas will be included as of special interest to advanced students. These are indicated by course numbers which will fall into one of two ranges: 460-469—17th Century 470-479—Criticism, thematic studies, senior seminar

Courses in these ranges will vary from year to year, and numbers will be adjusted accordingly.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Term(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60*</td>
<td>The Comedy of Seventeenth Century France</td>
<td>Selected texts from Molière, Corneille, Racine, etc.</td>
<td>Fall term.</td>
</tr>
<tr>
<td>470*</td>
<td>Literary Criticism</td>
<td>A study of various critical methods and points of view in French literary criticism.</td>
<td>Fall term.</td>
</tr>
</tbody>
</table>
471* The Religious Impulse. Selected texts in French literature from the 17th to the 20th centuries. *Fall term.*


480 Modern French Literature. Offered in summer school and/or post degree programme only.

**Italian**

*The following courses are administered by St. Jerome's College:*

110J Introduction to Italian. An intensive study of the fundamentals of grammar and conversation. The language laboratory will be used.

*3 lectures and laboratory.*

*Year course.*

210J Intermediate Italian. Advanced study of grammar. Survey of the history of Italian literature with selected readings in prose and poetry. Intensive study of one

*Year course.*

230J Italian Culture. This course, given in English, aims at giving the student a well-balanced view of Italy and her culture, through the study of Geography, History, Religion, Literature, Art, Music and her contribution to the world and to North America in particular.

*3 lectures.*

*Year course.*

310J Italian Literature. Continued study of Italian literature with selected readings in and prose poetry. Study of one novel, "Il Piccolo Mondo". One semester devoted to the "Divina assessment of brain damage, basic interviewing Italian 210J.

*3 lectures.*

*Year course.*

**Spanish**

110 Introduction to Spanish. Intensive drill in the fundamentals of grammar and composition. The language laboratory will be used regularly.

*Five lectures.*

*Year course.*

190 Intermediate Spanish. For students with some knowledge of Spanish. The language laboratory will be used regularly. *Prerequisite: Spanish 110 or Grade 13 Spanish.*

*Four lectures. Conducted largely in Spanish.*

*Year course.*

210 Spanish Civilization. A study in English of the main historical and cultural currents in Spain and Spanish America. No knowledge of Spanish is required.

*3 lectures.*

*Year course.*
Department of Classics and Romance Languages

Prerequisite: Spanish 190.
Year course.

275* The Enlightenment in Spanish Literature
A study of the works of Luzán, Feijoo, Jovellanos, and Cadalso.
Fall term. Not offered in 1971-72.

276* Drama of the Nineteenth Century
A study in the development of the drama from the Duque de Rivas to Echegaray.

295* The Novel of the Nineteenth Century
A study of the literary currents of the past century such as the costumbrista movements, realism and naturalism.
Fall term.

296* Galdós
Intensive study of the novels and the theatrical works of Galdós.
Winter term.

315* Spanish Lyrics from Garcilosa to Góngora
Conceptism and Culteranism.
Fall term. Not offered in 1971-72.

316* The Theatre of the Golden Age
Dramatic theory and practice. The innovation of Lope

325* The Prose of the Golden Age
A study of the Quijote and other major works of Cervantes.
Fall term. Not offered in 1971-72.

326* The Picaresque Novel
Intensive study of the major picaresque novels from Lazarillo de Tormes to La Picara Justina.

350 Advanced Composition and Conversation
Writing of essays based on critical examination of selected plays and novels; discussion, in Spanish, of these works.
Prerequisite: Spanish 250.
Year course.

355* Survey of Spanish American Poetry
A study of the major poets from La Araucana to the beginning of the Modernista movement.
Fall term.

386* Modern Spanish American Poetry
A study of Spanish American poetry from the Modernista movement to the present.
Winter term.

395* Spanish American Prose
A critical study of Spanish American prose works from the Cortésletters to the works of Sarmiento.
Fall term.

396* Spanish American Prose
A critical study of masterpieces in prose from Sarmiento to the present.
Winter term.

415* The Generation of '98
A study of selected poetry and prose, including the philosophical essay.
Fall term. Not offered in 1971-72.

416* Drama and Poetry of the Generation of '98
Spanish poetry and drama from Antonio Machado to Juan Ramón Jiménez.
425* Twentieth Century Century Movements in Spanish Poetry  A study of poetical works from Garcia Lorca to Rafael Alberti.

Fall term. Not offered in 1971-72.

426* Contemporary Spanish Novel  The development of Spanish fiction from Cela to Sender.


440 Mediaeval Spanish Literature and Linguistics  Readings in texts from the beginning to the end of the fifteenth century. The jarchas, the Cid, Gonzalo de Berceo, Libro de Buen Amor, Romancero, and La Celestina.

Year course. Not offered in 1971-72.

450 Senior Spanish Composition and Conversation  This course will provide intensive practice in spoken Spanish on the advanced level.

Year course.

495* The Novel in Mexico  Principal stress will be placed on novels dealing with the Mexican Revolution.

Fall term. Not offered in 1971-72.

Graduate Programme

M. A. French

Entrance Requirements  A recognised Honours B. A. (or equivalent) with a minimum of a 'B' average in French.

Programme.

Course Route.  A minimum of four full courses or eight half courses is required. No more than one course grade below 66 (B-) will be permitted.

A candidate following the course route will be required, after successful completion of his courses, to sit four comprehensive examinations of his choice, selected from the following list of eight areas:

Old French language, Old French literature, 16th century, 17th century, 18th century, 19th century, 20th century and French Canadian literature.

The course route to the M. A. is usually considered to be terminal.

Thesis Route.  A minimum of two full courses or four half courses is required. No more than one course grade below 66 (B-) will be permitted.

A thesis of a minimum of about 20,000 words or 100 typewritten pages and involving original research will be written on a topic approved by the department under the direction of an advisor who is a member of department. To be accepted it must be approved by a minimum of one other reader appointed by the department.

This route is intended for students who are research oriented and who intend to continue studies towards a more advanced degree.

All graduate courses with the exception of the Thesis are one-term courses.

Individual courses will be assigned numbers falling into these ranges: consult the Department at the beginning of the fall term for specific courses and numbers.

600-609 Old French

610-612 Renaissance Literature
The Ontario Co-operative Programme in Latin American and Caribbean Studies

Reading courses will be assigned numbers consecutively in the 700 range as they occur. A limited number of these is available in Spanish on request.

M.A. Latin American Studies

The University of Waterloo has joined with McMaster University, Queen's University and the University of Guelph to offer mutually acceptable courses leading to the degree of M.A. in Latin American Studies. This is an interdisciplinary programme, in which courses will be offered by the Departments of Economics, Geography, Geology, History, Political Science, Romance Languages and Sociology-Anthropology in the participating universities.

For details of this programme, please write to the Chairman of the Department of Classics and Romance Languages or the Chairman of the Department of Sociology, University of Waterloo.

Gallery — Theatre of the Arts
Department of Earth Sciences

Professor and Chairman of the Department
Professor R.N. Farvolden, M.Sc. (Alberta), Ph.D. (Illinois)

Professor and President of the University
B.C. Matthews, B.S.A. (Toronto), A.M. (Missouri), Ph.D. (Cornell)

Associate Professor
E.C. Appleyard, B.Sc. (Western), M.Sc. (Queen's), Ph.D. (Cambridge)

C.R. Barnes, B.Sc. (Birmingham), Ph.D. (Ottawa)

J.A. Cherry, B.E. (Saskatchewan), M.S. (Cal., Berkeley), Ph.D. (Illinois)

P. Fritz, Dipl. Geol., Dr. Rer. Nat. (Technische Hochschule Stuttgart)

E.O. Frind, B.A.Sc., M.A.Sc., Ph.D. (Toronto)

D.E. Lawson, B.Sc., M.Sc. (New Brunswick)


D.L. Salter, B.Sc., Ph.D. (Southampton)

Sessional Faculty Appointment
O.L. White, B.Sc. (Melbourne), M.A.Sc. (Toronto), Ph.D. (Illinois)

Undergraduate Course Descriptions

Details of the undergraduate programmes offered by the Faculty of Science are to be found on page 130

Earth Sciences 130, or the consent of the instructor, is prerequisite for all later courses in Earth Sciences with the exception of Earth Sciences 368*. However, Science 100* (formerly Earth Sciences 100*) may be substituted for Earth Sciences 130 as prerequisite for Earth Sciences 232*, 238*, 240* and 334. All those majoring in Earth Sciences are required to take a two-week field camp at the end of second or third year. Earth Sciences students are encouraged to seek geological employment in the summers.

100* Geological Foundations of the Environment
This course is now offered as Science 100*. Consult the Science course listings for details.

130 Introductory Geology
An elementary introduction to rocks, minerals, and fossils, geological processes and their effects, structural geology, economic geology, and historical geology. Map study. Field trips.
2 lectures, 3 hours laboratory.

231* Mineralogy
2 lectures, 3 hours laboratory, full term.

232* Petrography
The classification and identification of sedimentary, igneous, and metamorphic rocks. The study of rocks in thin sections. Laboratory study of petrographic methods and problems.
2 lectures, 2 hours laboratory, winter term.

237* Field Geology
An introduction to surveying instruments and methods, drawing, cartography, and photogrammetry. Includes a two-week field camp at the end of second or third year.
4 hours laboratory, fall term.
Department of Earth Sciences

238* Historical Geology  The historical development of North America with a systematic review of the major geologic events of the Precambrian, and the Paleozoic, Mesozoic and Cenozoic eras. Laboratory study of stratigraphically important rocks and fossils; interpretation of geologic maps.

2 lectures, 2 hours laboratory, winter term.


2 lectures, 3 hours laboratory, fall term.


Prerequisite: Earth Sciences 231*.

2 lectures, 3 hours laboratory, winter term.


Prerequisite: Earth Sciences 231* 241*.

2 lectures, 3 hours laboratory.

334 Paleontology  The principles of paleontology, including the species concept and evolution. The morphology, taxonomy, evolution, paleoecology, and stratigraphic value of fossil animals and plants, with special reference to the invertebrates. Field trip and laboratory study of fossils and fossil assemblages.

2 lectures, 2 hours laboratory.


2 lectures, 3 hours laboratory.

340 Structural Geology  Primary and induced structures in igneous, sedimentary and metamorphic rocks. Diastrophic and non-diastrophic deformations; diapirs. The physical properties of rocks and the effect of stress on them. Theories of rock failure. The relationship between major and minor structures. Laboratory will deal with techniques of analysis of deformed rocks.

2 lectures, 2 hours laboratory.


Prerequisite: Mathematics 130

2 lectures, first term.

369* Geophysics 2  The geology of the ocean basins. Topics in physical oceanography. Physical properties of ocean water, heat budget of the world oceans. Oceanic circulations, Coriolis effects. Some idealized current regimes. (Identical to Physics 369*).
430 Economic Geology
Principles and processes governing the formation of metalliferous ore deposits, coal, petroleum and natural gas. The study of important examples primarily from Canada. Laboratory study will include instruction and practice in ore microscopy.
Prerequisite: Earth Sciences 231*-241+
2 lectures, 3 hours laboratory.

431 Geochemistry
A study of the origin and evolution of the Earth from a chemical standpoint. Fundamental chemical principles are reviewed and applied to the understanding of igneous, sedimentary and metamorphic rocks.
Prerequisite: Earth Sciences 330.
2 lectures, 3 hours laboratory.

432* Precambrian Geology
The geology, tectonics, stratigraphy and history of the Canadian Precambrian Shield. The Precambrian time scale and problems of geochronology. Life, climate and physical conditions in Precambrian time.
2 lectures, 2 hours laboratory, winter term.

434* Biostratigraphy
A study of selected fossil groups to illustrate the application of paleontological data in solving stratigraphic problems. Methods of differentiation and correlation of rock units on the basis of their fossil assemblages. Field trips.
2 lectures, 2 hours laboratory, fall term.

436 Honours Thesis
Each student will work under the direction of a member of the Department on a short research project. The results of this will be presented in thesis form and will be critically examined by members of this and, where pertinent, other departments.

437 Crustal Evolution
The origin and growth of the continents and ocean basins. The development of shields; geosynclinal evolution; orogeny and epeirogeny. Continental drift and sea-floor spreading; paleoclimatology and paleogeography.
2 lectures, 2 hours seminar alternate weeks.

438* Engineering Geology
The application of geology to civil engineering problems. Introductory soil and rock mechanics. Urban and environmental geology.
2 lectures, 1 hour problems, fall term.

439* Groundwater Geology
Groundwater hydrology. The location, exploitation, and conservation of groundwater resources.
2 lectures, 1 hour problems, winter term.

440* Quaternary Geology
Stratigraphy and history of the Quaternary Period with emphasis on glaciation. Laboratory studies on glacial deposits. Field trips. A previous course in geomorphology is recommended.
2 lectures, 3 hours laboratory, fall term.

445* Quantitative Geomorphic
Analysis of Geomorphic processes, quantitative description of landscape; analysis and interpretation of geomorphic measurements; application of techniques in quantitative geomorphology to environmental problems.
3 lectures, fall term.

455* Mathematical Geology
Introduction to mathematical geology and the theory of physical, analog, and digital models for the solution of problems. Short course in fortran computer programming.
**456* Statistical Methods** Application of statistical methods in analysis of data from investigations: design of experiments in Earth Sciences; evaluation of quantitative data. 3 lectures, winter term.

**Graduate and Research Programmes**

The Department of Earth Sciences offers graduate work leading to the M.Sc. degree. The emphasis in graduate work in this department is in the area of *Environmental Geology*, including the special fields of hydrogeology, Quaternary geology, geochemistry, isotope geology, engineering and urban geology.

The Department has a truck-mounted drill rig capable of hollow-stem augering and rotary drilling, and a driller, in order that raw data may be obtained for research in *Environmental Geology*. The geochemistry-isotope laboratory is designed particularly to support the *Environmental Geology* programme, but is available for other purposes.

There are also active research programmes and graduate courses in lower Paleozoic biostratigraphy, Precambrian geology, and sulfide mineralization. Faculty in allied fields co-operate to enable students to do interdisciplinary studies in Civil Engineering (soil mechanics, engineering geology, sediment transport, waste disposal), Biology (palynology, invertebrate ecology, physical limnology), Chemistry (silicate geochemistry), Geography, (geomorphology) and Anthropology (paleo-Indian archeology).

At present (1971-1972) the following are the fields in which research is in progress in the Department:

- **Geochemistry** Groundwater chemistry; chemical facies in groundwater flow systems; tracers in groundwater pollution; geochemistry of sulfide mineralization.

- **Hydrogeology** Subsurface waste disposal and groundwater pollution; groundwater flow systems in Southern Ontario; aquifer hydraulics and analytical techniques; groundwater resources evaluation.

- **Isotope Geology** Application of stable isotope composition in research in hydrogeology, sulfide mineralization, and carbonate deposition.

- **Lower Paleozoic Biostratigraphy** Conodont biostratigraphy, especially the Ordovician of Eastern and Arctic Canada; the ultrastructure of conodonts; stratigraphy, carbonate petrology and paleoecology of the Ordovician of Ontario and Quebec.

- **Mathematical Geology** Development and application of mathematical techniques, especially statistical and computer-based, to geological problems.

- **Mineralogy** Clay Mineralogy; X-ray diffraction identification techniques applied to clay minerals; clay mineralogy of Paleozoic, Cretaceous and Quaternary sediments. Mineralisation of Paleozoic dolomites.

- **Precambrian Geology** The occurrence of syn-orogenic alkaline rocks, especially those of eastern Ontario and a comparison with similar rocks of lower Paleozoic age in West Finnmark, Norway. The development of metasomatic nepheline gneisses from a variety of parental rocks as well as the differentiation and evolution of the igneous alkaline varieties. The tectonic setting and the syn-orogenic history of the alkaline rocks is being investigated involving a structural analysis of polyphase deformation of alkaline and
**Quaternary Geology**  Quaternary stratigraphy and paleontology; characteristics of glacial deposits, particularly of the last or Wisconsinan glaciation; bedrock topography, landslide geomorphology; applications of Quaternary geology to mineral resources, engineering and planning.

**Sedimentology**  The influence of environmental changes on modern lacustrine and fluvial sediments in southern Ontario; the origin and significance of primary structures in clastic sediments. Sedimentology of the Torridonian (Precambrian) rocks of north-west Scotland.

**Mineral Deposits**  Sulphide deposits associated with volcanic rocks. Hydrothermal alteration in the volcanic environment; the post-depositional history and metamorphism of sulphide deposits of volcanic origin.

**Graduate Courses**

All graduate courses are one term in length. Not all of the courses listed are given in any one year.

**601 Stratigraphic Paleontology**  Analysis of the factors controlling the distribution of organisms and fossils. Important zone fossils of invertebrates, vertebrates and plants will be studied with reference to their vertical and lateral distribution. Problems of migration, dispersion, and provincialism will be considered in detail.

**602 Paleontology**  Selected topics in paleontology will be studied in depth with emphasis on micro-paleontology and paleoecology.

**610 Sedimentology Recent sediments**  The origin of recent clastic and non-clastic sediments, the study of composition, structures, relationships, and environments towards an interpretation of ancient sedimentary rocks. The origin and significance of sedimentary structures, environmental associations, sedimentological models, hydrodynamics.

**611 Sedimentology Ancient Sediments**  The interpretation of ancient sedimentary rocks. Paleo-current and basin analysis, the geometry of sedimentary bodies, the meaning of facies, geochemical environment indicators. Pyroclastics and volcanic sediments.

**620 Metamorphic Petrology**  The interpretation of the mineralogy, textures, structures, and geochemical characteristics of metamorphic rocks related to their natural occurrence. Problems of the recognition, origin and development of metasomatic rocks.

**625 Structural Geology**  The mechanisms and styles of rock deformation and the application of experimental studies. Criteria for the interpretation of multiphase deformation including the principles, methods, and limitations of statistical analysis of fabric elements.

**630 Genesis of Metalliferous Ore Deposits**  The relationship of igneous and sedimentary processes to the concentration of metalliferous ore deposits. Emphasis will be placed on the theoretical aspects of the development of a sulphide phase during the crystallization of magma. The post-depositional history of ore deposits.

**631 Geochemistry**  Lecture—seminar in selected topics in Geochemistry.
632 Geology of Industrial Minerals
Geological aspects of locating, working and utilizing industrial minerals and constructional materials. Problems of quantity, quality and value of such deposits will be evaluated and will be specifically related to those deposits in southern Ontario. Mineral economics and urban geology will be considered. Field trips will be an important part of the practical work of the course.

635 Clay Mineralogy
Structure, classification, properties, and nomenclature of clay minerals. Genesis and environmental significance of clay minerals. Identification of clay minerals by X-ray diffractometry and other techniques.

639 Advanced Hydrogeology
Groundwater flow systems and their response to stress; groundwater as an engineering hazard; case histories in groundwater development.

640 Quaternary Geology
Selected topics in the study of the Quaternary, with emphasis on the direct and indirect effects of glaciation. The interdisciplinary aspects of the Quaternary.

641 Stable-Isotope Geology
Lecture—seminar course dealing with the natural distribution of the stable isotopes of H, C, O, N, and S. Special emphasis will be given to topics related to hydorgeology, sedimentology, and hydrothermal ore deposits.

645 Regional Geology of the Great Lakes
Selected topics dealing with the stratigraphy, sedimentology, paleontology, petrology, structure, and economic geology of the Great Lakes area will be covered. Special reference will be devoted to the development of the Michigan Basin, the metallic and industrial mineral resources of the region, the glacial history, formation of the Great Lakes and recent sedimentation, and regional groundwater problems.

651 Geohydrologic Response Systems
Physical and geochemical response of watersheds under natural and man-induced conditions. Emphasis on interactions between surface water, soil water, and groundwater systems as determined by field, laboratory, and theoretical studies.

90 Current Problems in Geology
Seminars will be held to cover major topics excluded from other available courses. Graduate students will be required to present for discussion short colloquia based on their reading of assigned topics. Participation in the discussions, as well as the actual presentation of papers, will be an integral part of the course.

691 Special Studies
Course credit may be given for specialization related to the research interest of a student and a member of the faculty, by special arrangement. Topics such as aquifer hydraulics, isotope geology, computer applications, and groundwater chemistry are among those available.

699 Thesis
Department of Economics

Professor S. Weintraub, Ph.D. (New York)
Chairman of the Department

Professor J.H. Hotson, B.A. (Colorado College), M.A., Ph.D. (Pennsylvania)
Professor V.C. Walsh, B.A., M.A., Ph.D. (Trinity College)

Visiting Professor J. Robinson, Ph.D. (Cambridge)

Associate Professor L.P. Fletcher, B.Comm. (Mount Allison), A.M., Ph.D. (Brown)
Associate Professor S.K. Ghosh, B.S., M.S. (Calcutta), M.A., Ph.D. (Wisconsin)
Associate Professor H. Habibagahi, B.Sc. M.Sc., Ph.D. (Purdue)
Associate Professor D.W. Katzner, B.A. (Oberlin), Ph.D. (Minnesota)
Associate Professor G. Lerner, B.Sc. (M.I.T.), M.A., Ph.D. (McGill)

Associate Professor J N.E. Lavigne, C.R., B.A. (Western), M.Comm. (Ottawa), M.B.A. (Detroit)
Associate Professor W.R. Needham, B.Comm. (Carleton, M.A., Ph.D. (Queen's)
Assistant Professor K.M.H. Bennett, B.A., M.A. (Queen's)
Assistant Professor S.G. Clarke, B.A., M.A. (Queen's)
Assistant Professor S.W. Kardasz, B.A. (Loyola)

Assistant Professor and Deputy Chairman R. R. Kerton, B.Comm. (Toronto), M.A. (Carleton), Ph.D. (Duke)
Assistant Professor F. Mueller, M.A. (Berlin)
Assistant Professor J.L. Pratschke, B.Com., M.Econ.Sc., Ph.D. (N.U. Ireland).

Lecturer (part time) W.M. Lawson, B.Sc. (McGill), M.B.A. (Western)
Lecturer (part time) J.D. Cianci, B.Ap.Sc., (University of New Brunswick)

Associated Faculty

Professor K.D. Mackenzie, A.B., Ph.D., (University of California at Berkeley),
Department of Management Sciences
Associate Professor D.W. Conrath, B.A., M.S., (Stanford), M.A., Ph.D. (University of California at Berkeley), Department of Management Sciences

1) The number of courses offered in a particular year will not necessarily include all of those listed below.
2) The number of hours or lectures shown after the course description is an attempt to indicate the "normal"; each instructor determines how often his particular class will meet.

Undergraduate Courses

Economics 101, 102 comprise the regular sequence of courses in introductory economics for students majoring in this field, and for other students who plan to do additional work in economics. Students proceeding to a General Arts degree with a major in Economics are required to take as part of their programme Economics 201*, 202* and 231*, 232*, or 203*, 204* and 205*, 206*.

101* Introduction to Economics The first half of the course includes the discussion of the central problems of every economic society, the functioning of a mixed capitalistic enterprise system, the economic role of government, the composition and pricing of national output, pricing of productive factors and income distribution.
3 lectures.

102* Introduction to Economics Subjects to be discussed in this half of the course include the determination of national income, the banking system and government
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
<th>Credit</th>
<th>Lecture Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>201*</td>
<td>Intermediate Price Theory 1</td>
<td>Theory of consumer demand; production theory; resource pricing and allocation under perfect and imperfect competition.</td>
<td>3 lectures.</td>
<td>3</td>
</tr>
<tr>
<td>202*</td>
<td>Intermediate Price Theory 2</td>
<td>Economic method; dynamic micro theory; distribution theory, general equilibrium; welfare economics.</td>
<td>3 lectures.</td>
<td>3</td>
</tr>
<tr>
<td>203</td>
<td>General Equilibrium Theory</td>
<td>Theory of individual and group demand for one and several commodities, theory of individual and group production and supply under various types of market structure. Economics 203* and 204* are similar to economics 201* and 202* but make greater use of mathematical techniques.</td>
<td>3 lectures.</td>
<td>3</td>
</tr>
<tr>
<td>204</td>
<td>General Equilibrium Theory</td>
<td>Theory of price formation; the transition to dynamics. Some aspects of welfare economics.</td>
<td>3 lectures.</td>
<td>3</td>
</tr>
<tr>
<td>205</td>
<td>Aggregate Economic Theory</td>
<td>Theory of capital and investment; theories of general equilibrium of employment, output, price and money; processes of adjustments to changes in parameters and relationships.</td>
<td>3 lectures.</td>
<td>3</td>
</tr>
<tr>
<td>206</td>
<td>Aggregate Economic Theory</td>
<td>Theories of business fluctuations; models of growth and technological change. Economics 205* and 206* are similar to economics 231* and 232* but make greater use of mathematical techniques.</td>
<td>3 lectures.</td>
<td>3</td>
</tr>
<tr>
<td>231*</td>
<td>National Income Determination</td>
<td>National income measurement, and the theory of money, income and employment.</td>
<td>3 lectures.</td>
<td>3</td>
</tr>
<tr>
<td>232*</td>
<td>Employment and Public Policy</td>
<td>Further exploration of the topics developed in Economics 231* within a Canadian setting.</td>
<td>3 lectures.</td>
<td>3</td>
</tr>
<tr>
<td>31*</td>
<td>Economic History of Canada</td>
<td>The economic development of Canada to 1914.</td>
<td>3 lectures.</td>
<td>3</td>
</tr>
<tr>
<td>32*</td>
<td>Economic History of Canada</td>
<td>Canadian economic development since 1914; regional and national economic problems and policies.</td>
<td>3 lectures.</td>
<td>3</td>
</tr>
<tr>
<td>256</td>
<td>Introduction to Accounting 1</td>
<td>Recording transactions; preparation and analysis of financial statements; accounting for inventories, fixed assets, liabilities, and shareholders' equity.</td>
<td>3 lectures, 2 hours laboratory.</td>
<td>2</td>
</tr>
<tr>
<td>257</td>
<td>Introduction to Accounting 2</td>
<td>Systems of Cost Accounting, analysis of cost variances; budgeting, break-even analysis, the problem of changing price levels.</td>
<td>3 lectures, 2 hours laboratory.</td>
<td>2</td>
</tr>
</tbody>
</table>
61* European Economic History
Selected topics in European economic development in the Medieval period. Emphasis is given to the nature and origin of the forces which gave rise to particular methods of economic organization and institutions and to the emergence of the market society.
2 lectures, 1 hour discussion.

62* European Economic History
Selected topics in European economic development in the modern period. Particular emphasis is placed on a comparative analysis of the economic development of the countries of Europe, particularly England, France and Germany.
2 lectures, 1 hour discussion.

300 Statistical Methods
Frequency distributions; measures of central tendency, dispersion, skewness and kurtosis; probability theory; tests of hypotheses; sampling techniques; time series analysis; aggregation and index numbers; the estimation and testing of economic relationships using regression and correlation techniques, elementary decision theory.
Prerequisite: Economics 101, 102. 3 lectures.

303* Economic Statistics
Estimation procedures; maximum likelihood methods—sampling distribution of estimates—Point and interval estimation—Properties of estimators—The nature of Statistical Decision problems or testing of hypotheses—Applications to Business problems.

304* Economic Statistics

320 North American Economic History
An advanced level treatment of the economic development of North America with particular emphasis given to various facets of the economic inter-relationships between Canada and the United States.
Prerequisite: Economics 201, 202. Lectures and seminars.

330 Public Finance
The economic rationale of governmental activity; budget systems and the elements of cost benefit analysis; the structure and economic effects of government revenues and expenditures; the role of fiscal policy in economic stabilization and growth.
Prerequisite: Economics 201, 202.

340 International Trade and Finance
The pure theory of international trade; balance-of-payments statistics; meaning and measurement of payments imbalances; exchange rate systems; commercial policy; international investment and foreign aid; problems and suggested modifications of the international monetary system.
Prerequisite: Economics 201, 202. 3 lectures.

356* Intermediate Accounting 1
The objective of this course is to provide an in depth analysis of accounting procedures and the rationale behind these procedures. A study is made of the reporting process, matching of costs and revenues, money value items, capital determination and presentation, and accounting for internal management.
Prerequisite: Economics 256, 257.

357* Intermediate Accounting 2
The objective of this course is to provide an in depth analysis of accounting procedures and the rationale behind these procedures. A study is made of the reporting process, matching of costs and revenues,
Department of Economics

Prerequisite: Economics 356.

358*/359* Cost Accounting
Prerequisite: Economics 257. (Not offered in 1971-72).

366*/367 Corporate Finance
The general problem of financing business activities; the financial organization and control of corporations, liquidations and reorganizations; the operation of capital markets.
Prerequisite: Economics 256.

370 Labour Economics
Theories of the labour movement; collective bargaining— institutions and models; wages and employment theory; economic demography; investment in man.
Prerequisite: Economics 201, 202, or 203, 204.

371*/374* Special Subjects
One or more half courses will be offered at different times as announced by the department.
Prerequisite: Consent of instructor.

380 Industrial Organization and Public Policy
An analysis of the characteristics of industrial structure, behaviour and performance with special reference to Canada. Antitrust policy in Canada, the United States, and other selected countries.
Prerequisite: Economics 201, 202, or 203, 204. 3 lectures.

385 Business Cycles
Study of changes in the levels of national output; theories of the business cycle; proposals for controlling economic fluctuations.
Prerequisite: Economics 231, 232 or 205, 206.

400 Advanced Economic Theory
An advanced treatment of selected topics in economics.
Prerequisite: Economics 201, 202, 231, 232, or 203, 204, 205, 206.

421* Welfare Economics
Concept of efficiency; Pareto, Scitovsky, Hicks, and Little criteria for increase in welfare; application of welfare economics to government expenditures and taxation, international economics, location of industry, and public utilities.
Prerequisite: Economics 201, 202 or equivalent. 3 lectures.

440 History of Economic Thought
A survey of the historical development of economic theory.
Prerequisite: Economics 201, 202, 231, 232, or equivalent.

450 Economics of Development
The problem of economic development; theories of growth; the significance for economic development of capital accumulation, technology, natural resources and population. Allocation of investment resources; the role of economic institutions; public policies to stimulate economic development.
Prerequisite: Economics 201, 202, 231, 232 or equivalent. 3 lectures.

460 Econometrics
Theory of estimation of parameters of economic models and tests thereof. Both aggregative and micro-economic models will be considered. Students will be assumed to have an adequate knowledge of elementary calculus and algebra but other mathematical techniques will be developed as they become necessary.
Prerequisite: Economics 201*/202*, 231*/232* 300, or equivalent.
465* Security Analysis and Investment Policy
This course is designed to relate corporate financing priorities and an individual's investment policy. The first part of the course includes a study of analytical techniques for the appraisal of corporate and government securities, security price movements, indentures, sources and interpretation of information and the technical character of security markets. The second part of the course studies the management of portfolios of individuals and institutional investors; the relation of investment policy to individual acquirement, and national securities policy.
Prerequisite: Economics 366, 367. 3 lectures. (Not offered in 1971-72.)

470 Mathematical Economics
Mathematical formulation of economic theory; solutions to systems of simultaneous difference and differential equations; an introduction to dynamic models; analysis of stability conditions; an introduction to linear and non-linear programming, input-output analysis, and game theory.
Prerequisite: Economics 201, 202, 231, or equivalent. 3 lectures.

475*-478 Special Subjects
A series of half courses to be offered at different times as announced by the department.

480 Comparative Economic Systems
An analytical comparison of resource-allocation methods, growth and development under socialist and capitalist systems.
Prerequisite: Economics 201, 202, 231 or permission of Instructor. 3 lectures.

491*/499 Special Studies
Research and reading courses under the direction of individual instructors.
Admission by consent of instructor.

Graduate Studies
Students interested in graduate studies in economics should contact the department for further information.

Required Courses

600* Price and Distribution Theory
Consumer behaviour and demand, product demand, production and costs, the firm in diverse market contexts, multiple product firms and multiple period analysis, and the theory of income distribution.

601* Income and Growth
Income and employment determination; some basic monetary theory; growth models in open and closed economies. Stabilization and growth policies.

602* History of Economic Thought
A survey from early writers through classical, neo-classical and contemporary schools. Students will be required to read the original texts.

603* The Canadian Economic System
A concrete study of Canadian development. Regional and national development, their history and related policies will be examined.

504* Mathematics and Statistics for Economists 1
A remedial course for students lacking adequate background in mathematical and statistical methods. Others may be exempted. Fall term. (No credit)
605* Mathematics and Statistics for Economists 2
As 604*, winter term (No credit)

606* Quantitative Methods
Testing of micro and macro theories involving consumption and production functions, input-output and forecasting models. Quantitative research methods will be stressed.

Elective Courses

610* Money and Banking
A general equilibrium approach to money, interest and asset structures, prices, and activity. Problems and policies of central banking, with special reference to Canadian experience.

611* Modern Research in Economic Theory
Topics to be announced. Intended as a forum for guest lecturers, and an opportunity for tutorial papers by students.

620* Econometrics
Probability and statistical distribution theory, hypothesis testing, estimation in regression models; demand, production, and cost functions, input-output relations, international trade elasticities, etc.

625* Introduction to Operations Research
Department of Management Sciences. Registration with approval of instructor.

630* Population and Labour
Labour market structure and operation. Theories of real wages, population, employment-unemployment, unions, inflation, Phillips curve. Policy aspects for perfect and imperfect markets; operational definitions and measurement problems.

640* International Economics
International trade theory, commercial policy, and trade for economic development; balance of payments, international capital movements, and foreign exchange, international financial systems. Canadian problems and policy issues.

650* Public Finance
The theory of public expenditure and taxation; criteria for public investment, and cost-benefit analysis. Fiscal policy for stabilization and growth. Canadian experiences and problems.

660* Managerial Economics
Selected from course offerings in the Department of Management Sciences. Registration approval required from instructor.

670* Applied Economics
A selection of important empirical issues will be posed to enlist student's interests for research and critical review. (Course content contingent on student enrolment, interest and available staff.)

680* Comparative Economic Development
A world view of advanced and lesser developed countries. An examination of differing economic systems, major policies, and measurable results.

699 M.A. Thesis

Courses listed in other graduate departments such as Mathematics, Philosophy, Political Science, Psychology, etc., may be selected with the approval of the Graduate Officer. Ordinarily no more than 1 unit may be offered from other fields in fulfillment of the M.A. degree.
Department of Electrical Engineering

Professor and Chairman

Professor

Professor

Professor

Professor
A.R.M. Noton, B.Sc. (Sheffield), B.Sc. (London), Ph.D. (Cambridge).

Professor and Associate Dean of Faculty

Professor and Associate Chairman
Professor and Associate Chairman
K.D. Srivastava, B.Sc., B.E. (Hons.) (Roorkee), Ph.D. (Glasgow).

(Graduate Studies)
J. Vlach, Dipl. Ing., CSc. (Technical University of Prague).

Professor

Professor

Associate Professor

Associate Professor

Associate Professor
J.D. Cross, B.Sc. (Cardiff), M.Sc., Ph.D. (Carleton).

Associate Professor
G.J. Dufault, B.A. (Ottawa), B.Sc. (Carleton).

Associate Professor

Associate Professor
J.A. Field, B.E. (Saskatchewan), M.A.Sc., Ph.D. (Toronto).

Associate Professor

Associate Professor
J.S. Keefer, B.A.Sc., M.A.Sc. (Toronto).

Associate Professor

Associate Professor
J.W. Mark, B.Sc. (Toronto), M.Sc., Ph.D. (McMaster).

Associate Professor
W.N. Meikle, B.A.Sc., M.A.Sc. (Toronto).

Associate Professor

Associate Professor
J. Reeve, B.Sc., M.Sc., Ph.D. (Manchester).

Associate Professor
D.J. Roulston, B.Sc. (Belfast), Ph.D. (Imperial College London).

Associate Professor and Associate Chairman (Undergraduate Studies)
R.G. van Heeswijk, Dipl. Ing. (Delft, Holland).

Associate Professor

Associate Professor

Assistant Professor
J.D. Aplevich, B.E. (Saskatchewan), Ph.D. (Imperial Coll. London).

Assistant Professor

Assistant Professor

Assistant Professor

Assistant Professor
W.D. Little, B.A.Sc., M.A.Sc., Ph.D. (University of B.C.).

Assistant Professor

Visiting Professor
R.I. Donocik, C.Sc., DrSc. (Technical University of Prague).


Visiting Associate Professor
G.S. Brayshaw, B.Sc. (Huddersfield), Ph.D. (London).

Fall Term, 1970.

Visiting Associate Professor
W.A. Brown, B.Eng., M.Eng. (Melbourne), Ph.D. (Queen's-Belfast).


Visiting Associate Professor
P.A. Chatterton, B.Sc. (Hons.), Ph.D. (Liverpool).


Laboratory Director
R.L. Wright, P.Eng.

Undergraduate Programme

Details of the undergraduate programme in Electrical Engineering may be found on pages 252-253.
Undergraduate Course Descriptions

10 Introduction to Electrical Engineering


Prerequisite: Physics II.
3 lectures, 3 hours alternate seminar and laboratory, one term.

12 Electrical Circuits


Prerequisites: Math 12, Math 21.
2 lectures, 3 hours laboratory every alternate week, 2 seminars, one term.

14 Electromagnetics


3 lectures, 2 seminars, 3 hours laboratory every alternate week, one term.

32 Electronic Instrumentation

Introduction to the principles of instrumentation: transducers, amplifiers and read-outs. Realization of these with emphasis on solid state electronic devices and circuits. The control of electric power with semiconductor devices.

Prerequisite: EE 14.
3 lectures, 3 hours laboratory alternate weeks, one term.

201 Seminar

General Seminar.

202 Seminar

General Seminar.

217 Electronic Computers and Numerical Analysis

Introduction to electronic computers; procedure oriented languages (FORTRAN); application of electronic computers to problem solving in engineering; systems of linear equations, determinants and matrices, eigenvalue problems, iterative procedures, relaxation methods; difference equations, numerical solution of ordinary differential equations.

Prerequisite: Math 22 or equivalent.
2 lectures, 2 seminars, one term.

233 Physical Electronics


2 lectures, 2 seminars, one term.

241 Electric Networks 1

Lumped circuits and Kirchhoff's laws; circuit elements and simple circuits; first order circuits; second order circuits; linear time invariant systems.

2 lectures, 2 seminars, one term.
2 lectures, 3 hours laboratory, 1 seminar, one term.

261 Electromechanics
Introduction to energy conversion with special emphasis on translational electromechanical energy converters. Physical magnetic and electrostatic circuits: statically and dynamically coupled circuits, reluctance torque.
Prerequisite: EE 241, EE 271 or equivalent.
2 lectures, 3 hours laboratory, 1 seminar, one term.

271 Electric and Magnetic Fields
Electrostatics: Coulomb's law, electric fields and potentials, electric flux and Gauss' law, electric energy, capacitors, dielectric material.
Magnetostatics: Ampere's law, magnetic field and force, Biot-Savart Law, magnetic flux and energy, coils and solenoids, magnetic materials.
Induced EMF: Faraday's law, Lenz's law, mutual and self-inductance, simple transformers, induced EMF on a moving system, simple electric motors and generators. Introduction to Maxwell's equations.
2 lectures, 3 hours laboratory alternate weeks, 1 seminar, one term.

301 Seminar
General Seminar.

302 Seminar
General Seminar.

316 Probability and Statistics
Sample spaces, events, relative frequency, basic notions of probability.
Conditional probability and independence, Bayes' theorem, random variables, continuous and discrete probability density function.
Cumulative distribution function, functions of a random variable, geometric interpretations of probability, marginal p.d.f.'s. Expectation, variance, conditional expectation, correlation coefficients, Chebyshev's inequality, regression of the mean, law of large numbers.
Prerequisite: Math 22 or equivalent.
2 lectures, 2 seminars, one term.

324 Principles of Digital Computers
Boolean algebra, number systems and data representation, flipflops and registers. Computer operation, control unit, instruction sequencing, arithmetic unit. Storage organization. Operating systems, compilers, assemblers. Multiprogramming, multiprocessing and time-sharing.
Prerequisite: EE 217 or equivalent.
2 lectures and 2 seminars, one term.

342 Electric Networks 2
Network graphs and Tellegen's theorem; general network analysis; reduction of network equations; Laplace transforms; network functions; network theorems; two ports.
Prerequisite: EE 241 or equivalent
2 lectures, 2 seminars, one term.

351 Electronics 1
Doped semiconductors, equilibrium conditions, transport mechanisms, derivation of p-n junction d.c. and a.c. characteristics, charge storage effects. The transistor; derivation of d.c. and a.c. terminal characteristics, equivalent circuits, temperature effects. Thermionic emission, vacuum diodes and triodes.
Prerequisite: Physics 15 or equivalent
2 lectures, 3 hours laboratory alternate weeks, 1 seminar, one term.

352 Electronics 2
Large signal amplifiers, biasing networks, single and multi-stage small signal amplifiers, high and low frequency cut-off effects, feedback amplifiers, stability, oscillators, noise in electronic circuits, modulation and detection systems.
2 lectures, 3 hours laboratory alternate weeks, 1 seminar, one term.

372 Electromagnetic Theory and Applications  Electromagnetic theory: Maxwell’s equations, plane electromagnetic waves; polarization; Poynting’s vector and power flow; field components and propagation in rectangular waveguides. Transmission lines; line parameters and telegrapher’s equations; sinusoidal analysis; terminated lines, transient analysis; Smith Chart and its applications.
Prerequisite: EE 271 or equivalent.
2 lectures, 3 hours laboratory alternate weeks, 1 seminar, one term.

380 Introduction to Systems and Control  State space representation for continuous and discrete systems. Mathematical modelling of systems and components. Block diagram and signal flow graph representation. Introduction to analog simulation; feedback systems, system stability; frequency response; Nyquist criterion.
2 lectures, 2 seminars, one term.

401 Seminar  General seminar.

402 Seminar  General seminar.

2 lectures, 1 seminar every week,
3 hours laboratory every 3rd week, one term.

2 lectures, 3 hours laboratory every third week, 1 seminar, one term.

427 Design of Discrete Signal Systems  The object of this course is to relate the realization of digital systems to device technology. Realization of logic elements; electronic and magnetic components, discrete and integrated circuits. Synchronization and control of digital signal networks. Communication processors, computational processes. Storage of numbers; registers, counters, delay lines, matrix and film memories. Input and output media, economics of tape, cards and remote keyboards. Recorded and display outputs.
Prerequisites: EE 324, EE 426, EE 434, or equivalents.
2 lectures, 3 hours laboratory every third week, 1 seminar, one term.

428 Communication Theory  Fourier series; Fourier Transforms; signal transmission through linear networks; Filter transfer functions; Power spectra and correlation; Input-output relations of power spectra; Signal distortion and bandwidth; Thermal noise in networks; Sources of receiver noise; Receiver noise calculations; Noise figure and noise temperature; Random signals; Filtering of random signals; Input and output correlation functions; Representation of narrow band noise.
429 Communication Theory 2  Digital communication systems; The sampling theorem; PCM, PAM and PPM; Quantization of signals; Modulation techniques including AM, FM, and SSB; Performance of these modulation systems in the presence of noise; Signal to noise ratios.  
Prerequisite: EE 428  
2 lectures, 2 seminars, one term.

Prerequisites: EE 271, EE 351 or equivalent.  
2 lectures, 2 seminars, one term.

Prerequisite: EE 351 or equivalent.  
2 lectures, 2 seminars, one term.

Prerequisite: EE 351 or equivalent.  
2 lectures, 2 seminars, one term.

453 General Electronic Circuits  Selected topics from: applications of electronic devices including tunnel diodes, thermistors, varactors, SCR's, photo-sensitive devices, Hall generators, FET's, zener diodes; modulators, mixers and detectors; analysis of non-linear electronic circuits; cascade differential, D.C., operational, feedback, narrow-band, broad-band, and high impedance amplifiers; frequency response and stability; noise; active filters; introduction to linear integrated circuits.  
Prerequisite: EE 352 or equivalent.  
2 lectures, 2 seminars, one term.

454 Pulse and Switching Circuits  Selected topics from the following: switching characteristics of semi-conductor devices, non-sinusoidal wave generation and shaping, voltage and current sweeps, binary circuits, NAND, NOR, AND, OR gates and compatibility requirements, digital integrated circuits, the blocking oscillator.  
Prerequisite: EE 351, 352 or equivalent.  
2 lectures, 3 hours laboratory every third week, 1 seminar, one term.

463 Introduction to Power Engineering  High power electronic devices and their applications in power engineering, e.g. converter circuits and control of electrical power apparatus. Topics from power system, high voltage and insulation engineering. Introduction to cryogenics and super-conductivity in power engineering.  
Prerequisite: EE 362 or equivalent.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Description</th>
<th>Prerequisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>464</td>
<td>Power Apparatus</td>
<td>Analogue and digital computer analysis of electrical machines. Introduction to the design of overhead lines and underground cables. Origin and nature of power system transients. Principles of circuit breaking. Utilization of electricity as a source of energy. Control of electrical power apparatus.</td>
<td>Prerequisite: EE 463. 2 lectures, 2 seminars, one term.</td>
<td>4</td>
</tr>
<tr>
<td>473</td>
<td>Microwave Engineering</td>
<td>Introduction to waveguides, simple waveguide discontinuity; periodic transmission systems, microwave scattering theory, ferrite components, klystrons, travelling-wave amplifiers, backward-wave oscillator, magnetron, solid-state microwave devices.</td>
<td>Prerequisite: EE 372 or equivalent, 2 lectures, 3 hours laboratory every third week, 1 seminar, one term.</td>
<td>4</td>
</tr>
<tr>
<td>474</td>
<td>Antenna and Propagation Engineering</td>
<td>An introduction to the theory of radiation and of antenna and propagation engineering. Linear antennas, linear arrays, aperture antennas, frequency independent antennas, measurement theory. Ground wave propagation, ionospheric propagation, plasmas.</td>
<td>Prerequisites: EE 372 or equivalent. 2 lectures, 2 seminars, one term.</td>
<td>4</td>
</tr>
<tr>
<td>481</td>
<td>Control Systems</td>
<td>Classification of systems into types 0, 1, 2; error coefficients. Stability of linear systems, analytical design techniques, compensation techniques, control system components.</td>
<td>Prerequisite: EE 380 or equivalent. 2 lectures, 2 seminars, one term.</td>
<td>4</td>
</tr>
<tr>
<td>499A, 499B</td>
<td>Project</td>
<td>An engineering assignment requiring the student to demonstrate initiative and assume responsibility. The student will select a project at the end of the 3B term from an approved list prepared by the Department. A short progress report at the end of the 4A term and a full report at the end of the 4B term are required. 4 hours, one or two terms.</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>543</td>
<td>Electric Networks 3</td>
<td>Real linear time-invariant systems; system (transfer) function; Fourier series: properties; Fourier transforms: properties, convolution; impulse response; causal systems; strictly stable systems; singularity functions; driving point functions; transfer functions; reactance functions, reactance networks, filters, minimum phase functions.</td>
<td>Prerequisite: EE 342 or equivalent. 2 lectures, 2 seminars, one term.</td>
<td>4</td>
</tr>
<tr>
<td>546</td>
<td>Algebra of Linear Systems 1</td>
<td>Continuous and discrete linear systems; linear transformations; matrix algebra; finite field theory, polynomials over finite fields, system eigenvalues and system decomposition.</td>
<td>Prerequisite: EE 380 or equivalent. 2 lectures, 2 seminars, one term.</td>
<td>4</td>
</tr>
<tr>
<td>565</td>
<td>Power Systems Engineering</td>
<td>Component systems. Per-unit systems. Fault networks. Transient stability. Load flow. Protection. Introduction to High-voltage direct-current transmission.</td>
<td>2 lectures, 2 seminars, one term.</td>
<td>4</td>
</tr>
</tbody>
</table>
Graduate and Research Programme

Graduate credit is measured in units. A one-term course at the graduate level counts as one unit. Two units are given to graduate courses extending over two terms (certain mathematics and science courses). Credit units required for specific programmes are discussed in separate sections for the M.A.Sc. and Ph.D. programmes below.

The normal academic load is four units per term for a full-time student. Five units may be taken with special permission only. Students involved in part-time employment at the University or otherwise, must take a reduced academic load.

A Faculty Advisor is appointed to supervise the programme of study of each graduate student. A new student must meet with his advisor prior to graduate course registration to arrange his course-work programme and discuss his research interests. The progress of the student will be reviewed at least once each term by the advisor. Any changes in either course-work or research programme must be specifically approved prior to registration in the subsequent term.

Master's Degree Programme

The objective of the Master's Degree programme (M.A.Sc.) in Electrical Engineering is to demonstrate individual accomplishment of a high professional and academic standard. The candidate, with the approval of his advisor, may elect to submit either a research thesis as a portion of the requirements, or an engineering project report of a professional calibre on a design or theoretical application problem.

The complete programme submitted for the M.A.Sc. degree must consist of at least five units of graduate credit plus a thesis, 808, or eight units of graduate credit plus a project, 807. The thesis, 808, counts as six units, and the project, 807, as two units.

The topic of the thesis and the choice of the required five units of graduate-course work are arranged by the student and his Faculty Advisor. Each student's programme is subject to approval by the Graduate Studies Committee of the Department. The student must remain registered without interruption in 808 until the thesis is submitted. The research work leading to the thesis must be performed under the direction of the Faculty Advisor, and is finally approved and accepted by at least two readers, including the Advisor.

The topic of the report and the eight units of graduate-course work are arranged by the student and his Faculty Advisor for approval by the Graduate Studies Committee. The work leading to the report must be performed under the direction of the Advisor and be acceptable to him. Credit may not be obtained for both 807 and 808.

The minimum period of registration for the Master's degree is three terms after an honours Bachelor's degree or equivalent. A programme of fourteen or more academic units is considered as a two-year programme. The two-year programme is appropriate for applicants with acceptable preparation who are changing their field of study, or entering an inter-disciplinary area.

At least half the minimum course requirements shall consist of graduate courses numbered 600 to 790. Advanced undergraduate courses in the 500-series may be accepted as part of the candidate's programme for one unit of credit each, together with other undergraduate courses which may be deemed appropriate in individual cases for credit as recommended by the Department.

The candidate must obtain an average grade of at least 66% (B) in the course-work portion of his approved study programme. At any time the candidate's performance is considered unsatisfactory, the candidate may be required to withdraw from the programme.
Department of Electrical Engineering

received a grade C (60-65%) or less, in more than one course in Electrical Engineering, or in more than a total of two course units.

The Department may recommend that credit be allowed for courses taken at other institutions. Up to two units for a research thesis student, and up to four units for a project student may be approved in special cases.

The Ph.D. Degree Programme

The primary objective of the Ph.D. programme is the accomplishment of independent and original research work and reporting thereon in a research thesis. The subsidiary requirements are completion of a suitable course-work programme, passing a comprehensive examination, and receiving a satisfactory review by an advisory committee.

Admission to the Ph.D. programme is based upon the student's academic record and evidence of ability to pursue independent research. At the time of admission, each Ph.D. student must have a Faculty Advisor who has endorsed the recommendation for admission. Normally, admission is made to a two year programme from the Master's degree. Once a candidate is formally registered for a research thesis, he must maintain such registration continuously until his thesis is submitted. The actual time required to satisfy all Ph.D. requirements is usually longer than two years, but normally four years is considered ample time. Extensions beyond five years must be approved by the Faculty Graduate Studies Committee.

The course-work associated with the Ph.D. programme is intended to provide a foundation for advanced learning in the chosen field of research. While there is no fixed requirement as to the number of credit units to be taken, the Advisor and the Advisory Committee for each student will consider the level and adequacy of each student's preparation in drawing up his specific programme.

The Comprehensive Examination

This examination, 803, is conducted by the Department for each candidate. It is normally held 8-12 months, but in any case no later than 18 months, after the initial registration for the Ph.D. degree. The examination has two main objectives: First, the Department is to be satisfied that the candidate has a broad knowledge of his field and adequate background preparation to pursue his research. The candidate may be questioned on his background preparation. Secondly, to identify an Advisory Committee who have examined and approved the candidate's thesis proposal, and are willing to assist the Advisor with the subsequent research programme.

Graduate Course Descriptions

620 Modulation Systems

Summary of principal modulation systems, unconventional modulation systems, effects on signals and noise, signal-to-noise ratio, bandwidth, effects of coding, evaluation of various signal processing techniques.

(Old number EE 615)

621 Electronic Computing Machines


(Old number EE 660)
processors, pipelines operation, determinancy of parallel subsystems. Memory systems and storage organization, information structures, hardware and algorithmic memory search systems. (Old number EE 661)

623 Hybrid Computer Simulation
Elements of Hybrid computer systems, error sources and propagation, comparison of simulation methods, generation and measurement of random signals, simulation of control systems, solution of functional equations and partial differential equations. (Old number EE 662)

624 Stochastic Processes

625 Information Transmission
Sequential sources, signal section, channel models, channel capacity; implementation of coded systems, encoding and decoding, sequential decoding; error rates in different systems; adaptive systems. (Old number EE 671)

626 Communication Systems Engineering
Consideration of the factors related to the design of communication systems; summary of the historical development of the art; system performance requirements; consideration of channel characteristics; modulation and reception techniques; comparisons of overall system configurations; criteria for optimum performance including reliability, costs, convenience, availability, and economic factors. (Old number EE 672)

630 Theory of Solids
Crystal structure: types of crystal bonding, crystal lattices, space groups, X-ray and electron diffraction. Lattice dynamics: lattice vibrations on a line, normal modes, phonons, acoustic and optic modes, vibrations of three dimensional lattices, lattice specific heat theory. Free electron model of metals: electrical conductivity and Ohm's law, thermal conductivity, quantum theory of particles in a box. Fermi distribution. Band theory of solids: Bloch theorem, Kronig-Penney models, holes, effective mass concept, motion of holes and electrons, Hall effect, Brillouin zones. (Old number EE 629)

632 Electrons and Phonons
Hamiltonian and dynamics of linear lattices, properties of creation and annihilation operators, second quantization Umklap process, electron-phonon interaction, interference condition, Bloch integral equation, conductivity of metals at high and low temperatures, the general variation principle, Bardeen's theory of metallic conductivity. Theory of mobility in semiconductors, deformation potential, lattice scattering, impurity scattering, impurity conduction, hot electrons. (Old number EE 620)

633 Semiconductor Device Characteristics
Resumé of physics of semi-conductors leading to d.c. and small signal a.c. characteristics of junction diodes. Discussion of depletion layer capacitance, diffusion capacitance, high level injection, charge storage and recovery, breakdown. Discussion of above effects in transistors, transit time, base width modulation, base resistance, drift transistor. Special attention will be paid to recent devices such as varactor diodes,
634 Classical, Quantum and Statistical Mechanics 1
Review of Newton's laws, generalized coordinates, Lagrange's equations, generalized momenta, Hamilton's equations, canonical transformations, Poisson brackets, phase space, Liouville's theorem. The development of quantum mechanics, quantization of energy, wave particle duality, wave mechanics, solutions of Schroedinger's equation for some simple systems. The hydrogen atom, angular momentum.
(Old number EE 627)

635 Classical, Quantum and Statistical Mechanics 2
The matrix formulation of quantum mechanics, spin, many particle systems, the Pauli principle. Perturbation theory for time independent systems, treatment of degeneracy, perturbation theory for time dependent systems, transition probabilities. Classical statistical mechanics, the concept of ensembles, the microcanonical, canonical and grand canonical ensembles. Quantum statistical mechanics, the density matrix, ensembles in quantum statistical mechanics, the partition function, the most probable distribution, Fermi-Dirac, Bose-Einstein and Maxwell-Boltzmann systems.
(Old number EE 628)

641 Advanced Network Theory
Topics from: Linear graph properties and state equation formulation; analytic and algebraic foundations of network theory; scattering matrix; degree and canonic forms; synthesis of passive n-ports.
(Old number EE 601)

642 Topics in Network Synthesis
(Old number EE 605)

647 Systems Theory: Algebra of Linear Systems
Functions of matrices, solutions of linear time-invariant systems, continuous and discrete; algebraic approach to transform theory; sampled data systems, digital filters; Kalman algebraic theory of linear systems.
(Old number EE 602)

648 Nonlinear Systems Theory
(Old number EE 631)

649 Function Space Methods in Systems Theory
Sets, metric spaces, Banach and Hilbert spaces. Transformations, dynamical systems. Linear functionals, adjoint transformations, canonical forms.
(Old number EE 638)

656 Linear Active Circuits
Analysis of active networks: network functions, active elements, sensitivity, realizability. Introduction to synthesis. Negative resistance, negative impedance converter, gyrator, operational amplifier as active elements.
(Old number EE 611)

657 Advanced Electronics
A continuation of EE 453 to include design technology and fabrication of integrated circuits. Introduction to monolithic bipolar and MOS circuits. Qualitative analysis of planar technology. Photoresist and oxide
dynamic logic circuits.

(Old number EE 612)

659 Electroacoustics
Electroacoustical systems analogies and transducers; selected topics from physical acoustics, speech, hearing, music, noise, communication of information, intelligibility, acoustics instrumentation and measurements, architectural acoustics, sound reproduction.

(Old number EE 619)

662 Power System Analysis

(Old number EE 652)

665 Advanced Electromechanics
Rotational transducers and energy relations; G matrix; power flow; transformations and power invariance; generalized theory applied to real machines; electrical transient performance, transient reactances, fault conditions, sustained small oscillations; excitation and transient performance of synchronous machines.

(Old number EE 650)

666 High-Voltage Engineering
Surge voltages, their origin and effects. Laboratory generation of high voltages. Measurements. Insulation coordination.

(Old number EE 651)

673 Microwave Engineering 1

(Old number EE 642)

674 Analysis and Computation of Electric and Magnetic Fields

(Old number EE 643)

675 Electromagnetic Engineering 1
Maxwell's equations, time-harmonic complex notation, general orthogonal coordinates. Wave theory; propagation, reflection, boundary conditions, lossy media. Polarization; polarization ratio, representation in terms of left and right circularly polarized waves. Plane, cylindrical, and spherical wave functions; waveguides, cavities, surface wave transmission. Radiation: Poynting's vector, sources of radiation. Antennas; linear antennas, arrays, impedance, gain, super-gain, pattern synthesis.

(Old number EE 644)

676 Electromagnetic Engineering 2
Diffraction theory; the induction, equivalence, and reciprocity theorems, reaction concept, image theory, Huggen's sources, method of stationary phase. Green's functions; method of images, spherical harmonics, eigenfunction expansions, multipoles, dyadic Green's functions. Coherence theory; mutual coherence function quasi-monochromatic sources; mutual coherence function quasi-monochromatic sources.

(Old number EE 644)
682 Advanced Control Systems
Numerical methods of dynamic and static optimization, sampled data feedback control systems, introduction to the stability of nonlinear systems, methods of system reduction.

683 System Identification
Stationary and nonstationary stochastic processes, ergodicity, correlation functions and spectral density, Gauss-Markov processes, linear and nonlinear recursive estimators—Kalman filter theory, maximum likelihood and least square estimation, identification and parameter estimation.

(Old number EE 636)

685 Optimal Control 1
Optimization problems through variational methods and mathematical programming, optimal control for discrete time and continuous time systems. Maximum principle with equality and inequality constraints, feedback control, linear systems with quadratic criterion including the stochastic case.

(Old number EE 637; also listed as Systems Design SD 685)

720 Topics in Communication Theory (Old number EE 770)
721 Topics in Information Theory (Old number EE 771)
722 Topics in Communication Systems (Old number EE 772)
727 Topics in Computing Machines
728 Topics in Digital Systems
729 Topics in Sequential Machines
730 Topics in Quantum Electronics (Old number EE 723)
733 Experimental Techniques for Solids (Old number EE 724)
734 Topics in the Theory of Solids (Old number EE 725)
735 Topics in the Theory of Electron Phonon Interactions

(Old number EE 726)

740 Advanced Topics in Network Theory
745 Advanced Topics in System Theory (Old number EE 703)
756 Advanced Topics in Solid State Electronics
757 Advanced Topics in Electronic Circuits
760 High Voltage D.C. Transmission (Old number EE 750)
761 Advanced Topics in Gaseous Discharges (Old number EE 751)
762 Topics in High Vacuum Technique (Old number EE 752)
763 Power Electronics and Control Devices (Old number EE 753)
764 Advanced Topics in High Voltage Engineering (Old number EE 754)
765 Power System Protection and Control (Old number EE 755)
766 Applications of Superconductivity to Power Apparatus
773 Radio Propagation Studies (Old number EE 741)
774 Microwave Engineering 2 (Old number EE 742)
775 Approximate Methods in Electromagnetic Theory

(Old number EE 743)

780 Advanced Topics in Control Theory (Old number EE 731)
785 Optimal Control 2 (also listed as SD 785) (Old number EE 732)
801 Oral Examinations for Ph.D.
803 Comprehensive Examination for Ph.D.
807 Engineering Project for the Master's Degree
808 Research Thesis for the Master's Degree
809 Research Thesis for the Ph.D. Degree
Department of English

Professor J. Gold, B.A. (Birmingham), Ph.D. (Wisconsin)

Chairman of the Department

Professor J. A. Cummings, A.B. (Washington), M.A. (Missouri), Ph.D. (Washington)

Professor J. C. Gray, B.A. (Washington State), M.A. (Connecticut), Ph.D. (Syracuse)

Professor G. R. Hibbard, B.A., M.A. (London)

Professor K. Ledbetter, A.B. (Central College, Mo.), M.A., Ph.D. (Illinois)

Professor C. F. MacRae, B.A. (Western), M.A. (McMaster), Ph.D. (Toronto)

Professor W. R. Martin, M.A., D.Litt. et Phil. (South Africa)

Professor, Director, Inter-Faculty W. U. Otter

B.A. (Washington and Lee), Ph.D. (Indiana)

Programme Board

Professor W. K. Thomas, M.A., Ph.D. (Toronto)

Associate Professor A. I. Dust, M.A. Ph.D. (Illinois)

Associate Professor H. E. Haworth (Mrs.) B.A. (Rollins), M.A., Ph.D. (Illinois)

Associate Professor B. N. Honeyford, B.A., Ph.D. (Toronto)

Associate Professor N. C. Hultin, B.A. (Concordia), M.A. (Chicago), Ph.D. (Johns Hopkins)

Associate Professor H. M. Logan, A.B. (Franklin and Marshall), Ph.D. (Pennsylvania)

Associate Professor P. Roland, B.F.A. (New Mexico), M.A. (Northern Illinois), Ph.D. (Southern Illinois)

Associate Professor J. S. Stone, M.A. (British Columbia)

Associate Professor R. H. Tuyin, M.A. (Utrecht and Oxon.)

Assistant Professor R. R. Dubinski, B.A., M.A. (Western), Ph.D. (Toronto)

Assistant Professor R. N. Gosselink, B.A. (Kansas), M.A., Ph.D. (Colorado)

Assistant Professor C. S. Hedges, B.A. (Northeastern, Okla.) M.F.A. (Art Inst of Chicago)

Assistant Professor J. P. Hinchcliffe, B.A. (British Columbia), M.A., Ph.D. (Toronto)

Assistant Professor W. R. Macnaughton, B.A. (Toronto), M.A., Ph.D. (Wisconsin)

Assistant Professor A. M. MacQuarrie, B.A. (Acadia), M.A. (Toronto)

Assistant Professor J. S. North, B.A., M.A. (British Columbia), Ph.D. (Alberta)

Assistant Professor E. F. Shields (Miss), B.A. (Chestnut Hill), M.A. (Villanova) Ph.D. (Illinois)

Assistant Professor J. Sister M. Leon, S.S.N.D. B.A. (Toronto, M.A. (Detroit)

Assistant Professor G. E. Slethaug, B.A. (Pacific Lutheran), M.A., Ph.D. (Nebraska)

Lecturer P. D. Beam, B.A. (Waterloo), M.A. (McMaster)

Lecturer M. J. Estok, B.A., M.A. (Saskatchewan)

Lecturer D. L. Hedges, B.A. (Northeastern, Okla.), M.A. (Arkansas)

Lecturer J. D. Keppel-Jones, B.A. (Natal), M.A. (Queen's)

Lecturer (part-time) M. R. Kerr (Mrs.), B.F.A. (Manitoba)

Lecturer D. Letson, B.A. (Waterloo), M.A. (McMaster)

Lecturer R. Lister (Mrs.), B.A., M.A. (Toronto)

Lecturer E. P. McCormack, M.A. (Glasgow)

Lecturer S. E. McMullin, B.A., M.A. (Carleton)

Lecturer M. G. Thysell (Mrs.), M.A. (Montana)

Lecturer K. J. R. Wylie, B.A. (British Columbia)

For programmes and courses in Drama, see Department of English, Division of Drama, Page 270

English Honours Programmes

Department of English

English General Programme

To fulfill the requirements for a general degree in English, a student must take six courses in English consisting of: 101 or equivalent, 251, two of 361*, 362*, 363*, and three approved English full course equivalents.

First year: English 101 and 102 are the recommended first-year courses. However, a first year student may—without formal permission from the Department—take courses from the following list instead of 101 and 102: English 105*,108*, 190*, 211-212*, 230*-231* and 240. All other English courses are open to first year students, but only with the permission of the Chairman of the English Department and the instructor of the course. Students may use only one full course equivalent in English from the 100-level to fulfill the minimum English requirements.

Upper years: English 251 is strongly recommended for second year. With the consent of the Department upper year courses may be taken at any time during the upper years without regard to course number or “level.” Restrictions: English 240, 335, and courses in theatre (designated “Drama” in the calendar) may not be included as approved English courses in fulfilling the minimum course requirements for an English Programme, but may be chosen as non-English electives.

Note 1 W.K. Thomas' Form and Substance is the the official style sheet for all undergraduate English courses.

Note 2 The “normal” number of lectures per week in each course is three; however, each instructor determines how often his particular class will meet.

Note 3 A dagger (†) following a course description indicates that the course is tentatively scheduled for the session 1971-72.

101 The Living Tradition An examination of examples of the greatest literature in English and its relation to the periods of its origin. Figures such as Chaucer, Shakespeare, Milton, Swift, Blake, Keats, Tennyson and T. S. Eliot will be examined. The precise list of readings will depend upon the individual instructor. The basic text will be the one-volume Norton Anthology of English Literature. Emphasis will be placed on student essays written in connection with the reading.

102 Poem, Play and Story A study of the forms that imaginative literature assumes. Examples of different kinds of literature will be explored in detail so as to discover how the shape of a literary work of art gives to its meaning. Students will for instance read ballad, lyric, and narrative poetry; classic tragedy and comedy and absurdist, existential and expressionist plays; novels and short stories.

105* The Modern Short Story and its Predecessors A study of the form and development of the short story, with particular attention to British and North American writers.†

108* Themes of Literature This course will present the student with some recurrent themes in the literature of various ages. The following themes will be offered in 1971-72: the hero, utopia and anti-utopia, literature and morality, the quest theme. For more details, see the English Department.

190* Shakespeare Several of Shakespeare's Comedies, Histories, and Tragedies will be
range of Shakespeare's themes and techniques. No previous work in Shakespeare is required.

211 The Novel 1 A study of the novel in English from its beginnings to the later 19th century.†

212 The Novel 2 A study of the novel in English from the later 19th century to the present.†

230* Poetry 1 A study of English poetry before 1800.†

231* Poetry 2 English poetry after 1800.†

236* Literature of Ideas 1 This course, which deals chiefly with the moral implications of political thought, is designed both to stimulate controversy and to improve the student's ability to express himself in clear, organized fashion. Students are required to write essays and seminar papers on the topics discussed. Students are required to conduct seminars on such topics as political realism, human rights versus civil rights, the difference between rebellion and revolution.†

237* Literature of Ideas 2 Similar to 236, but dealing with the moral implications of scientific and philosophical thought.†

240 The Use of English The use and abuse of present-day English as a spoken and written language. The search for criteria in evaluating different means of communication such as journalese, technical jargon, slang and colloquialisms. The bearing of structure, semantics, and imagery on clear expression and its practical application in effective writing. Open to Year 1 students.

251 The Theory and Practice of Criticism A study of the elements of criticism and their application to a variety of literary texts and contexts. Much of the work of this course consists of analysis and discussion of literary problems by the students themselves.†

261 Old English An introduction to the literature and language of pre-conquest England. The principal literary methods, themes, and types of English literature up to the 12th century constitute the material of study in this course.†

270 Middle English A study of Middle English literature with special emphasis on the works of Chaucer.†

281* Elizabethan Literature 1 (excluding drama) A study of the principal writers of prose and of lyric and narrative poetry in England during and immediately preceding the reign of Elizabeth 1. Native, classical, and Italianate influences are stressed in the erotic poetry of the period especially as manifested in the sonnet tradition and the mythological narrative poems of Marlowe and Shakespeare. Other writers represented are More, Wyatt, Surrey, Skelton, Gascoigne, Daniel, Lyly, Drayton, and Sidney.†

282* Elizabethan Literature 2 (excluding drama) A study of the rich and various literary achievements of the golden age of Elizabeth 1. Reserved to special attention is Spenser’s epic poem glorifying Elizabeth 1 and England—The Faerie Queene. English 281* is recommended.

290* American Literature A survey of major American authors from Edward Taylor to Stephen
312* Literature of the Commonwealth
A survey of Australian poetry and prose, with some consideration of the literatures, in English, from South Africa and the West Indies.†

313* Canadian Literature to 1920
A study of Canadian prose and verse to 1920, with particular attention to the poetry of the School of the Sixties and to the historical and idyllic novels of the 19th and early 20th centuries.†

314* Canadian Poetry Since 1920
Poetry in Canada from E. J. Pratt and A. J. M. Smith to Leonard Cohen.†

315* Canadian Prose Since 1920
The Canadian novel since the appearance of Morley Callaghan, with brief consideration of the essay, the short story, and drama during the period.†

320* Fictional Prose, Not Including the Novel
The mutations of prose style and form as seen in the “romance” writers such as Malory, Sidney, Bunyan, Swift; in the Novella and picaresque writers such as Nashe and Defoe; in the short story and novelette writers such as Poe, Conrad, and Faulkner.

321* Personal and Utilitarian Prose
The mutations of prose style and form as seen in writers of biography and autobiography such as Boswell, Franklin, Strachey; letter writers such as Chesterfield, Keats, Dickinson; essayists such as Bacon, Burton, Ruskin, Orwell; and writers of scientific, historical, and philosophical prose such as Browne, Darwin, Macaulay, and Trevelyan.

335 Creative Writing
Aimed at encouraging the student to develop his creative and critical potentials, the course consists of supervised practice, tutorials, and seminar discussions. Enrollment is limited and, in order to be accepted, an applicant must first submit a manuscript as evidence of his ability to profit from the course.†

338* Sociology of Literature
This course attempts to provide the student with an opportunity for exploring literature as a social phenomenon. Specific areas to be dealt with might include: 1) the relationship of the artist to his social structure; 2) the nature of the relationship of the work and its audience; 3) the attitudes toward the social structure implicit in the work of art.
In general the course is viewed as an attempt to combine both the scientific approach and the humanistic approach to literature. Here literature is viewed as including both belles lettres and popular culture. The course will be taught by someone in sociology and someone in literature in dialogue method.
Prerequisite: Sociology 101*/102* and a first year English course.

341* Early American Literature

3* The American “Renaissance”
A consideration of the so-called “American Renaissance”, with particular attention to the works of Hawthorne and Melville.

343* American Literature, 1865-1914
American prose of the late nineteenth century, with concentration on such major figures as Twain, James, and Crane.†
Prerequisite: English 290*, 341*, 342* or consent of instructor.

44* Recent American Literature
A survey of major American writers since World War 1, especially Frost, Eliot, Hemingway, and Faulkner.†
Prerequisite: One of English 290, 341*, 342*, or consent of instructor.
The Development of Drama to 1660

A study of the origins and development of English drama, with special concentration on 16th century and early 17th century non-Shakespearean drama.†

Shakespeare 1

A study of those plays of Shakespeare written up to 1600, including the early comedies, the histories, Romeo and Juliet and Julius Caesar.†

Shakespeare 2

A study of those plays of Shakespeare written after 1600, including the late comedies and the major tragedies.†

Drama from 1660

A study of the principal playwrights, plays, and movements in dramatic history from the re-opening of the theatres in 1660 to the present day.†

Selected Studies

Designed to provide a study in depth of problems and/or authors selected by the instructor.†

Prerequisite: consent of instructor.

The Augustan Age

An historical and critical study of the drama, poetry, novels, and other writings of the Restoration and 18th century.†

An Introduction to the History of English

The processes of linguistic change as exemplified in the development of the English language from its origins in Indo-European and Germanic through modern Canadian dialects and other forms of English in the twentieth century (British and American dialects, commonwealth dialects) forms the subject of this study. Traditional, structural and generative approaches to historical linguistics will be employed in this survey.†

Linguistics and English Grammar

An interpretation of linguistics and its application in the English classroom to the study of grammar and language. The course will provide an introduction to descriptive and historical linguistics and the principles of linguistic analysis. It will include an evaluation of English grammars ranging from the traditional to the structural and transformational-generative.†

The Romantic Movement

An historical and critical study of the principles and practice of the English Romantic authors from Blake to Keats, with primary emphasis on poetry.†

Literature of the Victorian Age

An historical and critical study with emphasis on the major poets (Browning, Tennyson, Arnold), novelists (Dickens, Thackeray, Eliot), and essayists (Newman, Ruskin, Mill, Huxley). Prominent topics are relative morality, the role of the artist, freedom of speech, the idea of a university, and the effect of economic and social reform upon the human condition. Provision will be made for students who wish to study other writers such as Hopkins, Swinburne, Carroll, Morris or Pater.†

Literature and History of the Victorian Age

A literary and historical survey of Victorian England through authors and works that have major significance in both fields. The student will be encouraged to use several approaches and forms of evaluation of this material. He will be obliged to register in English 456 or in History 456 and to direct and concentrate his studies accordingly.
Conrad, Joyce, and Lawrence.†

465 Contemporary Literature A study of the major trends in British and American literature from World War 2 to the present. Students may use 385R or 465 but not both to fulfill the minimum English course requirement.†

470 History of Literary Criticism A study in seminars of the literary criticism of the four great ancients and of English writers from the Elizabethans to the present day.†

495 Supervision of Senior Honours Essay.†

The following course is administered by St. Jerome's College:

480 J Senior Seminar Designed for fourth-year students in the Honours English or Combined Honours English programs, this course provides a study of the major works in those periods of English literature in which students have not taken courses. It also provides a study in depth of selected authors and topics. Individual syllabi are prescribed for each student, and the course is conducted on a seminar basis.†

The following courses are administered by Renison College:

240R Same description as English 240.†

385R Contemporary Literature A study of such writers as Graham Greene, Evelyn Waugh, Aldous Huxley, Henry Green, Kingsley Amis, Irwin Shaw, John O'Hara, Edward Albee and Harold Pinter. An examination of the anti-hero and the stream of consciousness from the psychoanalytical novel to the theatre of the absurd.†
Students may use 385R or 465, but not both, to fulfill the minimum English course requirement.

Graduate Courses

The Department of English offers courses leading to the degree of Master of Arts and to the degree of Master of Philosophy. The requirements for these degrees may be found in the departmental graduate brochure.

The Department will indicate, to the group of graduate students admitted for the coming year, which courses it stands ready to offer and will ask them to indicate their preference. In the light of these preferences the Department will then select those courses which in fact it will offer.

701 Studies in Methods of Research
701A* Introduction to the Methods of Graduate Research
701B* Studies in Bibliographic Method
701C Practical Criticism

705 Studies in Mediaeval Literature
705A* Beowulf
705B Studies in the Exeter Book
705C Chaucer
705D* Piers Plowman
705E* Mediaeval Drama

710A Shakespeare: Comedies
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>715</td>
<td>Studies in Renaissance Thought and Poetry</td>
</tr>
<tr>
<td>715A</td>
<td>Spenser</td>
</tr>
<tr>
<td>715B</td>
<td>Donne, Jonson, and their Followers</td>
</tr>
<tr>
<td>715C</td>
<td>Milton</td>
</tr>
<tr>
<td>20</td>
<td>Studies in the Restoration and Eighteenth Century</td>
</tr>
<tr>
<td>720A</td>
<td>Drama of the Restoration</td>
</tr>
<tr>
<td>720B</td>
<td>Neoclassical Satire</td>
</tr>
<tr>
<td>720C</td>
<td>The Periodical Essay in the Eighteenth Century</td>
</tr>
<tr>
<td>720D</td>
<td>Fielding</td>
</tr>
<tr>
<td>720E</td>
<td>Johnson and his Circle</td>
</tr>
<tr>
<td>720F</td>
<td>Sterne and Smollett</td>
</tr>
<tr>
<td>725</td>
<td>Studies in Romanticism</td>
</tr>
<tr>
<td>725A</td>
<td>Blake</td>
</tr>
<tr>
<td>725B</td>
<td>Wordsworth and Coleridge</td>
</tr>
<tr>
<td>725C</td>
<td>Shelley</td>
</tr>
<tr>
<td>725D</td>
<td>Keats</td>
</tr>
<tr>
<td>725E</td>
<td>Byron</td>
</tr>
<tr>
<td>725F</td>
<td>Jane Austen: Novelist</td>
</tr>
<tr>
<td>730</td>
<td>Studies in Victorian Literature</td>
</tr>
<tr>
<td>730A</td>
<td>Victorian Poetry</td>
</tr>
<tr>
<td>730B</td>
<td>Victorian Minor Poetry</td>
</tr>
<tr>
<td>730C</td>
<td>Expository Prose of the Victorian Age</td>
</tr>
<tr>
<td>730D</td>
<td>The Victorian Novel</td>
</tr>
<tr>
<td>735</td>
<td>Studies in Modern British Literature</td>
</tr>
<tr>
<td>735A</td>
<td>Yeats</td>
</tr>
<tr>
<td>735B</td>
<td>Lawrence</td>
</tr>
<tr>
<td>735C</td>
<td>Twentieth-Century British Novel</td>
</tr>
<tr>
<td>735D</td>
<td>Twentieth-Century British Poetry</td>
</tr>
<tr>
<td>735E</td>
<td>The Bloomsbury Group</td>
</tr>
<tr>
<td>750</td>
<td>Studies in Colonial American Literature</td>
</tr>
<tr>
<td>755</td>
<td>Melville</td>
</tr>
<tr>
<td>755B</td>
<td>American Transcendentalist</td>
</tr>
<tr>
<td>760</td>
<td>Studies in Twentieth Century American Literature</td>
</tr>
<tr>
<td>760A</td>
<td>Twentieth-Century American Fiction</td>
</tr>
<tr>
<td>760B</td>
<td>American Naturalists</td>
</tr>
<tr>
<td>760C</td>
<td>Contemporary American Fiction</td>
</tr>
<tr>
<td>760D</td>
<td>Twentieth-Century American Poetry</td>
</tr>
<tr>
<td>770</td>
<td>Studies in Canadian Literature</td>
</tr>
<tr>
<td>770A</td>
<td>Modern Canadian Poetry</td>
</tr>
<tr>
<td>770B</td>
<td>Studies in Canadian History and Letters</td>
</tr>
<tr>
<td>770C</td>
<td>Canadian Novelists</td>
</tr>
<tr>
<td>770D</td>
<td>Early Canadian Literature</td>
</tr>
<tr>
<td>775</td>
<td>Studies in Commonwealth Literature</td>
</tr>
<tr>
<td>775A</td>
<td>Studies in Australian Poetry</td>
</tr>
<tr>
<td>780</td>
<td>Studies in a Genre</td>
</tr>
<tr>
<td>780A</td>
<td>Satire</td>
</tr>
<tr>
<td>780B</td>
<td>Twentieth-Century Drama</td>
</tr>
<tr>
<td>785</td>
<td>Studies in Literary Theory</td>
</tr>
<tr>
<td>785A</td>
<td>Current Schools of Literary Criticism</td>
</tr>
<tr>
<td>799</td>
<td>Theses</td>
</tr>
<tr>
<td>799A</td>
<td>M.A. Thesis.</td>
</tr>
</tbody>
</table>
Department of English

For a more precise listing of graduate courses see the Graduate Brochure for 1971-1972

Drama Honours Programme

For Honours English Drama Programme see P. 21

Drama General Programme

To fulfill the requirements for a general degree in Drama, a student must take three full course equivalents in Drama consisting of 223*, 224*, 329, 429*, 430* and three full course equivalents in English consisting of 101, 361*, 362*, 363* and 364*.

First Year

English 101 and Drama 223* and 224* are the recommended first year courses. Other drama courses are open to first year students, but students planning to major in drama should check with the drama adviser before enrolling.

Note

The normal number of lectures per week in each course is three; however, each instructor determines how often his particular class will meet. Laboratory sessions and rehearsal periods may be added to any course at the discretion of the instructor.

223* Introduction to the Theatre

The role of theatre as a major art. Contribution of the playwright, actor, director, designer, and technician to the theatrical production. Analysis and interpretation of selected plays. Practical experience in production is available.

224* Introduction to the Theatre 2

An extension of the studies described in 223*.

Prerequisite: Drama 223*

225 Acting and Directing 1

An introduction to the basic techniques of acting and directing. Class experience in pantomime, improvisation, and characterization. Detailed preparation of scenes and one-act plays with emphasis on styles of acting. Laboratory and production participation required.

228* Design for the Theatre

The aesthetics and creation of performance environment; design as a theatrical medium.

Prerequisite: Consent of instructor

325 Acting and Directing 2

Analysis of production and performance problems from the actor's and director's point of view. Planning the interpretative concept of a production and supervising the production from casting to performance. Laboratory and production participation required.

Prerequisite: Drama 225 or consent of instructor.

26* Special Studies in Drama 1

Production participation and the study of selected problems of a major production.

Prerequisite: Drama 325 or consent of instructor.

27* Special Studies in Drama 2

Production participation and the study of selected problems of a major production.

Prerequisite: Drama 325 or consent of instructor.
328* Costume History  A survey of changing fashions in costumes from ancient to modern times with emphasis on design and construction techniques for the stage.

329 History of the Theatre  The theatre of Greece and Rome; Mediaeval and Renaissance theatre; Restoration and 18th Century theatre; 19th and 20th century theatre. The relation between a theatre and its literature.

425 Styles in Stage Production  Different methods of staging in the various type of theatre styles and forms. Practical work in the theatre based on plays representative of various periods.

428* Theatre Technology  Principles and techniques of the construction and handling of stage scenery; theory and practice of stage lighting. Laboratory and production participation required.  
Prerequisite: Drama 228 or consent of instructor.

429* Dramatic Criticism 1  A study of dramatic criticism from antiquity to the present, involving all aspects of dramatic performance.

403* Dramatic Criticism 2  Practice in analysis and criticism of all aspects of dramatic performances.  
Prerequisite: Drama 429*.

op Math Student on Work Term
Fine Arts

Assistant Professor
Co-ordinator
N.L. Patterson (Mrs.), B.A. (Washington)

Assistant Professor G
Lecturer
H. Martens (Miss), B.A., M.A. (Minnesota), Ph.D. (Columbia)

Lecturer (part-time)
B. Irland, B.A., (Illinois)
J. Kristof (Mrs.), B.A., M.A. (Chicago) Ph.D. (Columbia)
K. VanDop, B.A. (Waterloo)

Instructor
J. Uhde, M.A. (J.E. Purkyne Univ., Brno, Czechoslovakia)

Fine Arts General B.A.

To fulfill the requirements for a general degree in Fine Arts students must take 12 half courses in Fine Arts, including 110*, 111*, 120*, 121*. Of the eight remaining half courses at least four must be on the third year level. Courses in music and dance will be considered as electives and not as part of the regular Art programme in Fine Arts.

Students from any faculty may take courses in Fine Arts on an elective basis with the consent of their departments, or as a part of their regular programme where their departments so direct.

Undergraduate Courses

110* Introduction to World Art 1
A comparative survey of Western art, from prehistoric times to the Renaissance, emphasizing visual form as an expression of its historical and cultural context.
No prerequisites. Fall term.

111* Introduction to World Art 2
A comparative study of non-Western art, including the Orient, and the development of modern art from the Baroque to the Twentieth century, emphasizing visual form as an expression of its historical and cultural context.
Prerequisite: Fine Arts 110*. Winter term.

120* Fundamentals of Visual Art 1
An introduction to the fundamental principles and concepts of visual art, through a series of experimental studio problems in two and three dimensional materials and media.
Fall term.

121* Fundamentals of Visual Art 2
A series of studio projects designed to develop basic skills and apply the principles of visual dynamics in the various media of visual art.
Prerequisite: Fine Arts 120*. Winter term.

30* Introduction to Film Making 1—Film Forms
Basic introduction to the field of audio visual media: principle techniques and methods; creation of ideas, scriptwriting, documentary and poetic aspects of film, principles of editing and montage. Practical work in photography, slide-sound, 8 mm film, videotape. Photographic and sound material and processing at student expense. Basic experience in photography and possession of camera and/or sound equipment by student desirable. Lab fees.
Fall term.
31* Introduction to Film Making
2: Film Technique
Practical introduction to technique of 16 mm film. Scriptwriting, production planning and organization, calculation, camera techniques, sound techniques; documentary, studio, blimp techniques; mixing; theory of writing, direction, sound, camera, editing, finishing techniques. Production of short 16 mm films in group work.
Lab fees.
Prerequisite: Fine Arts 130*. Winter term.

140* History of Film 1
Silent Film
The historic development of world cinematography in its silent era (1895-1929), including a short mention of the prehistory of film (before 1895), covering the most important artistic movements, works by outstanding directors and their contribution to the film as an independent form of art. Regular screenings will accompany discussion of historic and aesthetic aspects of film.
Fall term.

141* History of Film 2:
Sound Film
A continuation of Fine Arts 140*: the extension of film history into the sound era (since 1929) including the most recent period.
Prerequisite: Fine Arts 140*. Winter term.

180* (Kinesiology 160*): History of Dance Since 1900
Consideration is given to the study of folk forms of dance and their eventual development to ethnic forms, theatre dance, and neo-classics dance. Particular attention is paid to the simultaneous development of classic dance forms of the nineteenth century.
Fall term.

181* (Kinesiology 161*): History of Dance Since 1900
The emergence of modern dance in North America is examined in detail. The conditions leading to this new dance form as well as past and future developments are analyzed.
Winter term.

210* Modern Art 1
A survey of the history of modern art, examining its origins in the eighteenth century and the romantic and realistic art of the nineteenth century, showing how the late nineteenth century developed the basic characteristics of the twentieth century art.
Prerequisite: Fine Arts 110*–111*. Fall term.

211* Modern Art 2
A survey of modern art examining the development of twentieth century art from the Post-Impressionists through the multiple trends of the present decade. Both movements and individual artists will be studied.
Prerequisite: Fine Arts 210*. Winter term.

212* Italian Renaissance Art 1
A survey of painting, sculpture, and architecture, especially in Florence and Siena, starting with Giotto and his contemporaries and covering innovations in perspective, anatomy, and iconography through the end of the 15th century.
Prerequisite Fine 110*/111*, or consent of instructor.
Fall term.

213* Italian Renaissance Art 2
Prerequisite Fine 212* or consent of instructor.
Winter Term.
Fine Arts

(both continental and colonial).

Fall Term

217* Primitive Art  A continuation of Fine Arts 216*.
Prerequisite: Fine Arts 216*.
Winter term.

218* Western Religious Art  An introductory survey of the visual art and architecture of Judaism and Christianity in the Common Era. The development and subsequent changes of style in places of worship and ceremonial objects and ornaments, and the changing forms of religious expression through visual art, will be studied.
Winter term.

220* Fundamentals of Painting 1  Exploration of painting problems in various media as vehicles for serious creative expression: the fundamentals of composition and painting techniques (paints, materials, and preparation of painting surfaces) will be presented through studio projects.
Prerequisite: Fine Arts 120*-121*. Fall term

221* Fundamentals of Painting 2  A continuation of Fine Arts 220* with an emphasis on independent problems.
Prerequisite: Fine Arts 220*. Winter term.

222* Fundamentals of Sculpture 1  Exploration of sculpture problems in various media as vehicles for serious creative expression: emphasis will be given to developing understanding and mastery of three dimensional forms and the preparation and handling of sculptural materials and tools.
Prerequisite: Fine Arts 120*-121. Fall term.

223* Fundamentals of Sculpture 2  A continuation of Fine Arts 222* with an emphasis on independent problems.
Prerequisite: Fine Arts 222*. Winter term.

224* Drawing 1 (General Drawing)  Students will make analytical and expressive drawings in a variety of media, in order to develop accurate observation and understanding of form.
Prerequisite: Fine Arts 120*-121*. Fall term.

225* Drawing 2 (Figure Drawing)  Students will make drawings from the nude and costumed figure in order to gain understanding of action and proportion in, and anatomical construction of, the human body.
Prerequisite: Fine Arts 222*. Winter term.

226* Introductory Printmaking  An introductory course in materials and methods of printmaking with emphasis on relief and intaglio techniques.
Prerequisite: Fine Arts 224*. Winter term.

227* Scientific Drawing  Through studio experience, students will learn techniques for making accurate scale drawing of biological subjects in line and value, using various media. Methods of preparing drawings for reproduction will be included.
No prerequisite. Winter term.

32* Documentary Film Making 1  A studio course in which students will produce 8 mm sound documentary films. This course emphasizes techniques and aesthetics of film production.

Improvisation, realism and documentation as methods of producing an artistic representation, abstraction and concretization, the relation between art and realism, "cinema verite", the realistic drama", etc., will be explored as specific dimensions of the film medium. *Lab fees.*

**Prerequisite:** Fine Arts 130*-131*. Fall term.

**33* Documentary Film Making 2**
A continuation of Fine Arts 232*. *Lab fees.*

**Prerequisite:** Fine Arts 323*. Winter term.

**270* Film Theory 1 (Anatomy of Film)**
A development of ideas gained in Fine Arts 140* and 141*. Provided with the basic historical knowledge, the student will analyse the aesthetic aspects of a cinematographic work (principles known as "film language").

Milestones of the history of film will be discussed from this point of view, and the principles of directing, shooting, and editing film will be discussed. Screenings of film will accompany the course.

**Prerequisites:** Fine Arts 140*-141* or Fine Arts 130*-131 or permission.

**Fall term.**

**271* Film Theory 2 (Film Aesthetics and Criticism)**
An extension of Fine Arts 270*. The main accent will be placed upon major theories of cinematography, such as those of Kracauer, Bulaz, and Eisenstein, and upon the development of the students' own judgement in the form of critical essays.

Some problems of television, as a new film medium, will also be discussed.

**Prerequisite:** Fine Arts 270*. Winter term.

**312* Renaissance Art Outside Italy 1**
A survey of painting, and related developments in sculpture and architecture, from the late Gothic period through the High Renaissance. Emphasis will be on the Flemish and German Schools.

**Prerequisite Fine Arts 110*/111* or consent of instructor.

**Fall term.**

**313* Renaissance Art Outside Italy 2**
Mannerism, Baroque, and Rococo in Northern Europe and Spain. The contributions of such masters as Brueghel, Rembrandt, Rubens, and Velasquez will be studied as well as the emergence of genre and landscape painting and the development of national schools.

**Prerequisite Fine Arts 312* or consent of instructor.

**Winter term.**

**316* Canadian Art**
An examination of Canadian art beginning with the aboriginal arts of Indians and Eskimos, extending through the imported European styles of settlers, especially from Britain and France, in the seventeenth, eighteenth, and nineteenth centuries, to the development of the nationalist styles of the early twentieth century, culminating in contemporary Canadian art.

*No Prerequisites.* Fall term.

**317* Canadian Art**
A continuation of Fine Arts 316*.

**Prerequisite Fine Arts 316*.**

**Winter term.**

**320* Advanced Painting 1**
Exploration and organization of colour in a three dimensional environment.

**Prerequisite Fine Arts 220*/221*. Fall term.
322* Advanced Sculpture 1 Exploration of sculpture problems, specifically the organization and integration of three dimensional objects in a real environment. 
*Prerequisite Fine Arts 320*. Winter term.

323* Advanced Sculpture 2 A continuation of Fine Arts 322* with emphasis on independent problems. 
*Prerequisite Fine Arts 322*. Winter term.

324* Advanced Drawing 1 The practice and study of various drawing techniques with emphasis on visual clarity and the creative process. 
*Prerequisite Fine Arts 224* or Fine Arts 225*. Fall term.

325* Advanced Drawing 2 A continuation of Fine Arts 324* with emphasis on independent problems. 
*Prerequisite Fine Arts 324*. Winter term.

326* Advanced Printmaking 1 The practice and study of various graphic techniques with emphasis on coloured intaglio, silk screen, and photographic processes. 
*Prerequisite Fine Arts 226*. Fall term.

327* Advanced Printmaking 2 A continuation of Fine Arts 326* with emphasis on independent problems. 
*Prerequisite Fine Arts 326*. Winter term.

328* Calligraphy 1 A study of the art of written forms, combining studio projects with slide lectures on the history of writing, illuminating, and lettering. Students will strive for mastery in various calligraphic forms including Uncial, Gothic, Fraktur, Italic, and Contemporary free scripts. 
*No prerequisites*. Fall term.

329* Calligraphy 2 Studio work in techniques of preparation of graphic material for reproduction, using illustration and typography as well as calligraphic forms, together with slide lectures on the history of printed forms. 
*Prerequisite Fine Arts 328*. Winter term.

390* Selected Subjects in Fine Arts Research and reading courses under the direction of individual instructors. 
*Admission by consent of the instructor. Fall term.*

391* Selected Subjects in Fine Arts Research and reading courses under the direction of individual instructors. 
*Admission by consent of instructor. Winter term.*

102*G/104*G Introduction to the Fine Arts An integrated study of works of art and musical compositions, and their relationship to the time period in which they were created. The emphasis is on actual experiences of the arts. 
*No prerequisites.*

150*G Introduction to Music 1 Examination, by means of listening and analysis, of various styles of music ranging from early Christian Chant to electronic and computer music. Compositions to be studied include major forms such as sonata, symphony, opera, mass, etc., as well as smaller forms such as lieder. 
*No prerequisites.*
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>151*G</td>
<td>Introduction to Music 2</td>
<td>Same as above.</td>
</tr>
<tr>
<td>250*G</td>
<td>The History of Music 1</td>
<td>From its earliest beginnings to 1750.</td>
</tr>
<tr>
<td>251*G</td>
<td>The History of Music 2</td>
<td>From 1750 to the present.</td>
</tr>
<tr>
<td>260*G</td>
<td>Choral Literature</td>
<td>Study of choral and ensemble music of all styles, sacred and secular, from the Middle Ages to the present. Laboratory sessions will consist of actual singing of choral works, leading to public performance. Prerequisite: 150*G or consent of instructor.</td>
</tr>
<tr>
<td>0*G</td>
<td>The Folk Music of Europe and North America</td>
<td>Countries to be discussed: British Isles, France, Germany, the Balkans and Eastern Europe, including the Ukraine and Russia; Canada and the USA through Library of Congress record albums, <em>Folkways</em> and other records, field recordings from Bulgaria, Yugoslavia, Czechoslovakia, Greece, Hungary, Rumania.</td>
</tr>
<tr>
<td>100*G</td>
<td>Stratford Festival Seminar</td>
<td>An interdisciplinary course intended for students interested in English, Music, Drama and Speech. The focus of the seminar is centered in the dramatic and musical productions at Stratford Festival theatres plus performances at the Shaw Festival Theatre at Niagara-on-the Lake and selected productions at Toronto and London, Ontario. Offered Summer only. Prerequisite: An introductory course in Music, Drama, or Speech, or consent of instructor.</td>
</tr>
<tr>
<td>11*G</td>
<td>Stratford Festival Seminar</td>
<td>Continuation of Fine Arts 300*G</td>
</tr>
<tr>
<td>350*G</td>
<td>Bach to Beethoven</td>
<td>The development of cantata, oratorio, mass and opera, concerto and symphony in the compositions of Bach, Haydn, Mozart, and Beethoven.</td>
</tr>
<tr>
<td>351*G</td>
<td>Music of the Romantic Period (1800 to 1900)</td>
<td>A study of the compositions of Wagner, Chopin, Schumann, Schubert, Wolf, and others. Particular attention is placed on the affinity between music and literature.</td>
</tr>
<tr>
<td>352*G</td>
<td>Music of the twentieth century</td>
<td>A study of representative musical compositions of the twentieth century and their relationship to social, literary and political movements. Prerequisites: Music 150<em>G and 151</em>G, or consent of the instructor.</td>
</tr>
</tbody>
</table>

*The following courses are administered by St. Jerome's College.*

*These courses will not be offered by St. Jerome's College during the academic year 1971/72.*

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0J</td>
<td>Studies in the Contemporary Cinema</td>
<td>Through film viewing and seminars, a close investigation of the work of three important European directors of the post-war period: Michaelangelo Antonioni, Ingmar Bergman, and Jean-Luc Godard. Film sessions and lecture-discussions. Prerequisite: Fine Arts 140*/141* (Film 100) or the instructor's consent.</td>
</tr>
<tr>
<td>340*J</td>
<td>Fellini</td>
<td>A study in detail of the director's work from <em>Luci del Varieta</em> to <em>Satyricon</em>, including his apprenticeship in neorealismo and his work in episodic films. Four hours weekly. Prerequisites: Film 100, Fine Arts 140*/141*, 240J, or the consent of the instructor.</td>
</tr>
</tbody>
</table>
344J The Cinema of Time  A study of the work of Alain Resnais and Jacques Demy, with special emphasis on their literary and cinematic origins. 
Prerequisites: Film 100, Fine Arts 140*/141*, 240J, or the instructor's consent.
Winter Term.
General Engineering

000 Tutorial
Students will meet with a faculty member designated as their class professor. Performance in problem assignments and conceptual difficulties with other courses will be discussed, along with interrelation of present coursework, later work and engineering practice.
1 hour per week, both terms. (Consultation periods with teaching assistants regarding specific course problems and if required at the initiative of the student or his class professor, will be available.)

061 History and Philosophy of Science
The nature of science; science and technology in Egypt and Babylon. The development of science in Greece; the Orphic mysteries and the Ionian philosophers. Plato and Aristotle; Archimedes. The Alexandrian school and the separation of science and philosophy. Technology under the Roman Empire. The mediaeval attitude toward science. The Renaissance. Copernicus and Galileo. Sir Isaac Newton. The physical and biological sciences during the 18th century. Developments during the 19th century in physics, chemistry, technology, geology, evolution, and the rise of modern genetics. The 20th century revolution in pure science and technology.
3 lectures, 1 hour tutorial.

062 Introduction to Human Communication Systems
Broadly, the processes involved in man-man, man-machine and mass communications will be discussed. Models of communication systems. The contributions and points of view of the various disciplines which make up the spectrum of communication studies today. Necessary fundamental concepts from these disciplines. Applications of the theories in fields relevant to the student.
3 hours per week, lectures and seminars.

101 Topics from Scientific Thought
A variety of topics selected from modern science are treated in the lectures at a conceptual level and then used as a base for discussion. Certain aspects of historical, philosophical and particularly social significance are included according to the inclinations of the students and discussion leaders.
1 hour lecture and 1 seminar per week.

102 Fundamentals of Social-Political Thought
This course is the same as Philosophy 125*. The central question of the course is: What reasons can I have for acting on the issues which will face me as a member of society? Such problems as divorce, democracy, socialism, the Bomb, and international politics will be critically discussed in the light of readings from both classical and contemporary philosophers.
2 hours per week (Engineering K divisions only).

103 Topics from the Arts and Humanities
The course will explore some of the major movements of thought which are still shaping modern affairs and modern consciousness - including Christianity, Marxism, Racism, Imperialism, Freudianism, Existentialism, and Humanism. Lectures, readings and seminars together should offer an entertaining and stimulating, if glancing, acquaintance
General Engineering

with a few of the major strands of the present intellectual environment.

1 lecture and 1 seminar per week.

111 Graphics
(A Term)  A course in the fundamentals of graphical projections of all types - orthographic, isometric, oblique and true perspective. Introduction to spatial co-ordinate plotting. Fundamentals of free hand sketching for communication of concept.
3 hours per week.

111 Graphics
(B Term)  The application of graphics to the solution of vector problems, both coplanar and non-coplanar. Graphic calculus, both integration and differentiation, design of all types of nomographs: design of special slide rules: continuation of free hand sketching.
3 hours per week.

113 Engineering Measurement
1 hour lecture, term project.

120 Engineering Synthesis
Principles of problem statement, analysis, and concept creation in the design process. Discussion of planning, the flow of information, physical, economic and financial feasibility, and concept selection as related to project design. Discussion of social and economic conditions affecting value and utility, and their relationship with the design process in the solution of engineering problems. The application of simulation, modelling and optimization to the above: three term projects.
2 hours lecture, 1 hour tutorial.

121 Digital Computation
Introduction to electronic digital computers, hardware and software organization; basic features of FORTRAN IV; examples of efficient numerical algorithms for basic scientific computations.
2 hour lecture, 2 hour tutorial, one term.

122 Electricity and Magnetism
Introduction to fundamentals of electromagnetics, circuits, wave motion and propagation. Electromagnetics: Coulomb's Law, electric field and potential, capacitor; resistivity and Ohm's Law; Ampere's Law, magnetic fields and forces, inductor. Circuits: series and parallel circuits, Kirchhoff's laws; ohmic dissipation of energy, stored energies in capacitors and inductors. Wave motion: graphical representation, rotating vectors, superposition. Wave propagation: (i) sound: velocity, wavelength, energy, frequency and resonance. (ii) optics: plane, concave and convex mirrors and lens; reflection and refraction; interference and diffraction, polarization; electricity and light.
3 hour lectures, 2 hours lab, 1 hour tutorial.
Department of Geography

Associate Professor and Chairman of the Department
R.M. Irving, B.A., M.A. (Toronto), Ph.D. (Minnesota)

Professor
A. Diem, B.A. (Wayne State), M.A. (Clark), Ph.D. (Michigan)

Professor
D.K. Erb, B.Sc. (Western), M.A. (Toronto), Ph.D. (McGill)

Professor
R.R. Krueger, B.A., M.A. (Western), Ph.D. (Indiana)

and Associate Dean (Graduate studies)

Professor and Dean of the division
P.H. Nash, B.A., M.A. (California); C.E. (Grenoble); M.C.P., M.P.A., Ph.D. (Harvard); A.I.P.

Professor
B.C. Matthews, B.S.A. (Toronto), A.M. (Missouri), Ph.D. (Cornell)

President of the University
R.E. Preston, B.A., M.A. (Washington), Ph.D. (Clark)

Professor
H.D. Steiner, M.Sc., Ph.D. (Zurich)

Visiting Professor
D.A. Gillmor, B.A., Ph.D. (Dublin)

Visiting Professor
A.B. Kesik, M.A., Ph.D. (UMCS - Lublin, Poland)

Associate Professor and Deputy Chairman
L.H. Russwurm, B.A., M.A. (Western), Ph.D. (Illinois)

Assistant Professor

Assistant Professor
C. Bryant, B.A., Ph.D. (London School of Economics)

Assistant Professor
R.A. Bullock, B.A., M.A. (Belfast), Ph.D. (London)

Assistant Professor
T.E. Bunting, B.A. (York), M.A. (Western)

Assistant Professor
B. Hyma, B.S. M.S. (Madras), M.A. (Econ.) (Sheffield)

Assistant Professor
G.R. McBoyle, B.Sc., Ph.D. (Aberdeen)

Assistant Professor
A.G. McLellan, B.Sc., Ph.D. (Glasgow)

Assistant Professor
W.B. Mitchell, B.A., M.A. (U.B.C.), Ph.D. (Liverpool)

Assistant Professor
E.R. Officer, B.A. (U.B.C.), M.A. (Wisconsin)

Assistant Professor
G.B. Priddle, B.A. (Western), M.A. (Clark)

Assistant Professor
K.E. Rawling, A.B. (Catawba)

Assistant Professor
D.F. Walker, B.Sc. (Econ.) (London), M.A. (Toronto)

Lecturer
E. Sommerville, B.Sc. (Glasgow)

Lecturer and Cartographer
A.E. Hildebrand, B.A. (Toronto)

†Divisional Appointments: Faculty members appointed also in other Schools or Departments in the Division of Environmental Studies.

Undergraduate Geography Courses

Note 1 All courses are open to any student from any Faculty or School of this University whenever prerequisites are met.

Note 2 The Department of Geography offers General and Honours degrees both in the Faculty of Arts (B.A.) and the Division of Environmental Studies (B.E.S.). Joint honours degrees with any other subject in the University may be arranged subject to departmental approval. Some examples of such programmes may be seen under the Faculty of Arts programmes section earlier in the calendar.

Note 3 The letter R designates courses given through Renison College.

101* Introduction to Human Geography
An introduction to some of the central problems, concepts and methods of contemporary geographic analysis of man's cultural environment. Two overriding themes are emphasized: the locational analysis theme which focuses on the spatial structure and dynamics of socio-economic systems and the man-land theme which focuses on the impact of man through time on the landscape.
An ecosystem approach to physical geography is employed which emphasizes that man's natural environment is an integrated system of which man is a part. A systems approach is used to study selected aspects of weather and climate, soils, biogeography, and landforms. Stress is placed on the flows of energy, water and matter and the resultant effects on the subsystems of the natural environment.

2 lectures. 2 hours lab--discussion.

An introduction to problems of population growth, resource development, cultural diversity, and of industrial and urban growth in developing areas of the world. Contemporary problems of economic, cultural and demographic differences will be examined in selected regions of Asia and Africa.

No prerequisite

The emergence of the "Third World" in international relationships. Background factors: the impact of occidental culture in colonial and post-colonial times; changes in technology, economic organization, rapid population growth, resource development problems, political unrest. The challenge to the wealthy, industrialised countries posed by the needs of the populations of Africa and Asia.

A discussion of some major environmental problems such as the population explosion, the impact of urbanization on man's environment, resource management, conservation, and pollution. How geographical theories and methods can be applied to the solution of these problems.

Note Geography 101*/102* remain the prerequisites for most second year courses in Geography; Geography 195* is intended mainly for non-geography students but may be taken as an elective by students in the first or second year of a Geography programme. Geography 195* is not a substitute for Geography 101* and is not a prerequisite for a number of advanced Geography courses. Students may not take both Geography 195* and Man-Environment 195*

Principles of plant and animal geography, biogeography, and ecology. This course is the same as Planning 200*, Man-Environment 200*, and Architecture 222*.

Prerequisite: Geography 102* or consent of instructor.

The study of energy and matter flows in the atmosphere and on the land, begun in Geography 102*, will be further developed. Specific topics of study will include global radiation balances, energy flux at the land-air interface, weather modification, urban climates, climate classification systems, the physical processes in the pollution of land, air and water, the dynamics and morphology of stream systems and glacial landform systems.

Prerequisite: Geography 102*

202* Some Basic Topics of Economic and Urban Geography
Locational analysis of settlement patterns and economic activity. The location theory approach to the problem of rational, spatial allocation of economic activity will be compared to the more all-inclusive viewpoint of resource management specialists.
Prerequisite: Geography 101*.
2 lectures, 1 hour seminar (fall term).

203* Some Basic Topics of Cultural and Regional Geography
The approach of the regional geographer will be illustrated by reference to one or more world regions. Political, social and historical processes will be studied as they affect man’s perception of his environment and the identification of culture regions.
Prerequisite: Geography 101* or consent of instructor
2 lectures, 2 hour lab. (winter term).

225R Urbanization in Newly Developing Countries
An analysis of the factors behind the rapid urbanization of selected areas in Asia, Africa and Latin America, with an examination of related problems of urban planning and development control policies.
No prerequisite
(fall term)

226R Population Growth and Resource Development in “Third World” Countries
A discussion of some major problems of population explosion, food supply and economic development faced by the Developing Countries of the World. Emphasis will be placed on case studies of selected countries like India, China, Indonesia, Egypt, Brazil, Ghana, Nigeria, etc.
No prerequisite
(winter term)

232* Geography of Population
No prerequisite.
3 lectures

251* Urban Areas in North America
An introduction to some basic concepts in urban geography with specific reference to processes and problems of urban development in North America, particularly in Canada.
No prerequisite
3 lectures (fall and winter terms)

260* Cartography
Geodetic, surveying and photogrammetric principles as related to mapping. Techniques and materials used in the compilation, design, production and reproduction of thematic maps.
Prerequisite: Geography 101*/102* or consent of instructor.
2 lectures, 2 hours lab. (fall and winter terms).

0* Introduction to Cartography and Air Photo Interpretation
Geometry and applications of different types of air photos and other forms of remote sensing in geographic research. Basic principles of topographic and thematic map production and reproduction.
Prerequisite: Geography 101*/102* or consent of instructor.
2 lectures, 2 hours lab. (fall and winter terms).

Note Not available to Honours Geography students.

1* Introduction to Quantitative Research Methods
An introduction to scientific method; descriptive and inferential statistics; computer programmes. This course is the same as Plan. 271* and M. Env. 271*
Prerequisite: Scientific reasoning in Environment.
Department of Geography

2 lectures, 1 hour practical (fall term).

275* Introductory Air Photo Interpretation
The techniques of air photo interpretation as applied primarily in the field of geography and resource inventory. Interpretation of land forms, geological features, soils, natural vegetation, drainage pattern, and rural and urban land use.
Prerequisite: Geography 101*/102*.
2 lectures, 2 hour lab. (fall and winter term)

300* Geomorphology
An evaluation of past and contemporary positions of this subdiscipline. The basic geomorphological processes will be critically examined in relation to climate, vegetation, soils, geology, and man. Emphasis will be placed on lectures and field work on the geomorphological problems of Southern Ontario.
Prerequisite: Geography 200*/201* or consent of instructor.
2 lectures, 2 hour lab. (fall term).

301* Climatology and Meteorology
Prerequisite: Geography 201* or consent of instructor.
2 lectures, 2 hours lab. (winter term).

307* Social Survey Techniques
Social research and the planning process; interview and self administered surveys; questionnaire design; profile data; sampling; data processing; non-survey data collection techniques; practical applications. This course is the same as Plan. 307*.
Prerequisite: Geography 271; may be taken in 2nd or 3rd year.
2 lectures, 1 hour practical or discussion (winter term).

310* Advanced Econ. Geog. 1 Resources Management
The general philosophy and approach to natural resource studies; development of a conceptual and operational framework; development of research designs; socio-economic research problems; research techniques; practical applications.
Prerequisite: Geography 202* or consent of instructor.
3 lectures (winter term).

311* Advanced Econ. Geog. 2 Manufacturing and Transportation
Studies in the geography of manufacturing and transportation: further development of theory and empirical studies of Canada and the United Kingdom.
Prerequisite: Geography 202* or consent of instructor.
3 lectures (fall term).

315* Agricultural Geography
An introduction to and analysis of agricultural concepts and systems.
Prerequisite: Geography 101*/102*.
(Fall term).

316* Multivariate Statistics
The theory and application of multivariate statistics, with particular emphasis upon use of the computer. Same as Plan 316*.
Prerequisite: Geography 271* or consent of instructor.
3 hours seminar and/or tutorial (fall term)

317* Nonparametric Statistics
The theory and application of nonparametric statistics, with particular emphasis upon social science problems. Same as Plan 317*.
Prerequisite: Geography 271* or consent of instructor.
318* Spatial Analysis  
Advanced quantitative analysis applied to spatial patterns and interactions. The course will focus on a selection of techniques from gravity models, linear programming, nearest neighbour analysis, Markov chain analysis, graph theory simulation and trend surface analysis. This course is the same as Plan 318*.  
Prerequisite: Geography 271* or consent of instructor.  
3 lectures (winter term).

319* Regional Planning Techniques  
Application of economic and social measurement techniques in regional planning; includes discussion of input-output analysis; regional accounting techniques; cost-benefit analysis; planning, programming and budgeting systems; the multiplier and accelerator concepts; and balance of payments. This course is the same as Plan 319*.  
Prerequisite: Geography 271* or consent of instructor.  
3 hours seminar and/or tutorial (fall term).

320 World Regional Geography  
This course studies in depth selected areas of the world's climatic regions, emphasizing characteristic problems of these regions as well as their physical, cultural and economic interrelationships. Among the many factors which are discussed are the utilization of natural resources, the effects of increasing population density, the occupation and utilization of urban and rural land, and the effects of man's tools, techniques, and institutions on the earth's surface.  
No Prerequisite.  
2 lectures, 2 hour lab. (year).

121* Regional Geography of The United States  
Selected topics and problems of the American Environment. Emphasis on the historical background of urbanization and on contemporary problems of the American City.  
No prerequisite (Mix of lecture and seminar sessions)

322* Geographical Study of Canada  
Selected problems in land utilization, urbanization, regional and resource development. Geographical basis of Canadian Regional analyses.  
Students with Grade 13 Geography are encouraged to take Geography 422* or another Regional course. Students may not take both Geography 322* and Planning 222*.  
No prerequisite.  
3 lectures (fall term)

323* Geographical Study of a Selected Region  
A geographical analysis of a selected region and its current problems. The region chosen in any given year will depend on the specialized knowledge of faculty available and student demand.  
No prerequisite.  
3 lectures.

324* Soviet Geography  
An introduction to the geography of the Soviet Union, with a focus on selected problems in urbanization, industrialization, resource use and regional economic development in a planned economy.  
No prerequisite.  
3 lectures (fall term).

325* Africa  
A study of the geography of modern Africa south of the Sahara in the context of changing attitudes to the continent on the part of the "developed" countries.  
No prerequisite.
Department of Geography

330* Cultural Geography  
Problems in the delimitation of cultural regions. A study of the diversity of man in his relations with his environment.  
Prerequisites: Geography 203* or consent of instructor.  
Mix of lecture and seminar sessions (full term).

331* Special Topics in Cultural Geography  
A detailed investigation of selected issues in man’s relations with the natural environment. The course will be run as a seminar, and the issues will be at least partially selected on the basis of the interests of participants.  
Prerequisite: Geography 330* or consent of instructor.  
Mix of lecture and seminar sessions (winter term).

332* Special Topics in The Geography of Population  
Detailed study of selected topics of population geography.  
Prerequisite: Geography 232* or consent of instructor.  
3 lectures (winter term).

341* Historical Geography of Canada 1  
The changing geographies of settlement and resource use from the Discoveries to the early nineteenth century.  
Prerequisite: Geography 203* or consent of instructor.  
3 lectures (fall term).

342* Historical Geography of Canada 2  
The changing geographies of settlement and resource use in the nineteenth and early twentieth centuries.  
Prerequisite: Geography 341* or consent of instructor.  
3 lectures (winter term).

345* Political Geography  
A study of differences from place to place in political phenomena. Subjects covered include the interrelationships of states and nations, centripetal and centrifugal “forces” within states, electoral geography, boundary and frontier problems, the location of capital cities, internal organization of states, external relations, and geopolitics.  
Prerequisite: Geography 203* or consent of instructor.  
3 lectures (winter term).

350* Advanced Urban Geography 1  
The external structure and function of urban centres and their role in the spatial economy. Study of the growth and support of urban centres and city systems, of the outward growth of cities, and of analytical techniques available for such studies are emphasized.  
Prerequisite: Geography 202* or 251* or consent of instructor.  
3 lectures (fall term).

351* Advanced Urban Geography 2  
An examination of theories, models and research procedures appropriate to the study of internal urban structure.  
Prerequisite: Geography 202* or 251* or consent of instructor.  
3 lectures (winter term).

357* Conservation and Resource Development  
History of the conservation movement; principles of conservation management and the development of resources. Analysis, use and planning of recreational resources. The course is the same as Planning 357*.  
Prerequisite: Honours Geography or Honours Planning students or consent of instructor.  
3 lectures (winter term).

381* The Nature of Geography  
The past traditions in geography. Modern trends in geographical research and teaching.
391* Field Research  One week field camp session during which a specific area will be analyzed from a geographic point of view. Students will be expected to undertake individual or group analysis of specific problems and must present the results in a written report. 
**Prerequisite:** Third Year Honours Geography students only or consent of instructor.
2 hours seminar (fall term).

400*-401* Special Topics in Geomorphology  Advanced studies in geomorphological mapping, glacial, fluvial and applied geomorphology. Selected problem areas will be subjected to field and laboratory investigation. Discussions will involve pertinent literature and theories and the role(s) of contemporary geomorphology. 
**Prerequisites:** Geography 275* and 300* or consent of instructor.
3 hours seminar and/or lab. (fall and winter terms).

403* Advanced Cartography  Advanced study of numerical map analysis and computer mapping techniques. 
**Prerequisite:** Geography 260*, 271* or consent of instructor.
2 hours seminar and/or tutorial (winter term).

410* Recreation Geography  The environmental implications of existing and potential recreational demands. Recreational travel, site capability, economic and ecological impact models will be considered as well as the normative behavioural aspects of amenity resources. 
**Prerequisite:** Geography 310*, or consent of instructor.
3 lectures (full term).

411* Resource Studies  Consideration of problems, theories, principles and methods of natural resource management with particular attention to air, land and water resource systems. 
**Prerequisite:** One of Geography 310*, 311* or consent of instructor
3 lectures (winter term).

412* Industrial Geography  Industrial location theory will be assessed through empirical analysis of the spatial organization of the workshop factory continuum at both the urban and regional scales. Some attention will also be given industrial location theory and problems in a planned economy. 
**Prerequisite:** Geog. 311* or consent of instructor.
3 lectures (fall term).

413* Behavioural Studies  Studies of the behaviour of individuals, groups and organizations in interaction with their environment, especially its spatial dimension. Emphasis will be placed on environmental perception, decision-making and theories of consumer and business behaviour. 
**Prerequisite:** One of Geography 310*, 311* or consent of instructor
3 lectures (winter term).

415* Special Topics in Urban Geography  A detailed study of selected aspects of urban geography. Possible topics are household activity systems, urban models, human and factorial ecology, commercial structure of cities, urban environmental perception. The impact on and the interrelation with the natural ecosystem. 
**Prerequisite:** Geography 350* and 351* or consent of instructor.
(fall term).
421 Europe and the Mediterranean

Detailed study of physical, cultural, economic, and political geography of non-communist Europe. Geographical aspects of the development of cities, problems of agriculture, changing industrial patterns, distribution of trade, regional disparities, and planning on the city, region and national level are covered with specific examples from the various countries.

No Prerequisite. (year).

422* Canada

Seminar on the geographical analysis of selected Canadian development problems. Emphasis will be on regional disparities, resources development, urban and rural problems.

Prerequisite: Geography 322* or equivalent.

(winter term).

423 Eastern Europe

Detailed study of physical, cultural, economic, and political geography of communist Europe. Geographical aspects of agricultural problems, industrialization, distribution of trade, economic planning, and relations with the Soviet Union and the West are covered.

No prerequisite. (year).

424* Soviet Geography

Advanced study of selected aspects of the geography of the Soviet Union. A degree of flexibility in the course will allow some emphasis in topics of particular interest to the students registered in it.

Prerequisite: Geography 324* or consent of instructor.

2 hours seminar (winter term).

425-432

In this group of courses other selected world regions will be analysed. The areas chosen will depend on faculty availability and student demand. e.g. Middle East, Latin America, U.S.A., Asia, Africa, Polar Lands & Oceania.

430 Field Research in Regional Geography

A detailed analysis of a selected region in Canada or the United States with major emphasis upon a field examination of the region (2-3 weeks duration) in spring.

Prerequisite: Fourth year Honours Geography students or consent of instructor.

2 hours seminar (winter term).

451* Soils Geography

An analysis of the factors affecting soil development and classification. Techniques of soil survey and land classification.

Prerequisite: Geography 200*/201* or consent of instructor.

2 hours seminar (fall term).

452* Problems of Rural Land Use

An analysis of the nature of rural land use problems, and a critical evaluation of the methods of rural land use planning.

Prerequisite: Consent of Instructor.

2 hours seminar (winter term).

470* Advanced Air Photo Interpretation 1

Advanced studies in air photo interpretation and its application in geographic studies, resources survey, terrain analysis and geomorphology. Basic photogrammetric techniques will be utilized where applicable.

Prerequisite: Geography 275* and 300* or consent of instructor.

3 hours seminar and/or lab. (fall term).

471* Advanced Air Photo Data gathering from air photos by interpretation and measurement with

imagery, multiband imagery). Spectral analysis, image quality, image processing.
Prerequisite: Geography 275* and 300* or consent of instructor.
3 hours seminar and/or lab. (winter term).

475* Special Readings and Seminar on Selected Topics
Prerequisite: Honours Geography students and consent of instructor
2 hours seminar and/or tutorial.

6 Special Readings and Seminar on Selected Topics
Prerequisite: Honours Geography students and consent of instructor.
2 hours seminar and/or tutorial.

180* Development of Geographic Thought
Historical development of the discipline of Geography; contributions of the German, French, British and American geographers in the nineteenth and twentieth centuries.
Prerequisite: Geography 200*/201*; 202*/203* or consent of instructor.
2 hours seminar (fall term).

481* Frontiers in Geography
New and resurgent developments in the various subfields of geography.
Current trends in the philosophy and methodology of geography. This seminar will be shared by the geography faculty.
Prerequisite: Geography 200*/201*; 202*/203* or consent of instructor.
2 hours seminar (winter term).

490 Senior Honours Research Essay
Prerequisite: Honours Geography students only.
2 hours seminar.

Graduate Courses in Geography

The Department offers courses leading to the M.A. and Ph.D. degrees. Detailed information about these programmes can be obtained by writing to the Graduate Officer, Department of Geography, Division of Environmental Studies.

600* Geomorphology 1
Glacial geomorphology and related applied studies.
Studies will concentrate on an examination of the phenomena attributed to glaciation and particularly the problems of geomorphological evolution in Southern Ontario. Also emphasized will be the role of geomorphology in contributing towards the solution of contemporary problems. (Fall)

601* Geomorphology 2
Climatic geomorphology and geomorphological techniques.
The role of climatic influence in geomorphology will be studied. Specific geomorphological processes, such as tropical and periglacial will be discussed. A study of geomorphological techniques will include mapping methods and laboratory analyses. (Winter)

1* Air Photo Interpretation and Remote Sensing 1
Advanced studies involving conventional air photo interpretation of the physical and cultural environment, use of stereo plotting instruments and map production. Applied research. (Fall)

1* Air Photo Interpretation and Remote Sensing 2
Advanced data sensing and processing techniques for urban and rural studies. Use of thermal infrared imagery, radar imagery, multiband photography and satellite photography. Technical problems in image quality and processing. (Winter)
604 Integrated Aerial Surveys
A thorough review of all technical and methodological aspects of aerial surveying, covering the following topics: Physical aspects (radiant energy, aerial photography, nonphotographic remote sensing), photogrammetry (elementary methods, restitution and assembly of models, orthophotography), image interpretation (basic terrain observables, interpretation procedures, image processing and pattern recognition), cartography (topographic and thematic maps, orthophoto maps, computer-generated maps). Lab work, seminars on integration and project presentations. The course is part of an inter-university programme and involves faculty from the Universities of Waterloo, Guelph and Toronto and McMaster University.

606* Advanced Cartography
Studies will involve map digitization, numerical map analysis and computer mapping techniques. The relation of map data to geographic information systems will be discussed. (Winter)

608* Climatology 1
Advanced study of selected aspects of climatology. Topics to be covered include urban climatology, air pollution and climatic change. (Fall)

609* Climatology 2
Advanced study of selected aspects of climatology. Topics to be covered include weather, climate, and health, the value of weather and climate and the human use of the atmosphere. (Winter)

610 Economic Geography
Advanced study of selected subfields of economic geography.

611 Industrial Geography
Advanced study of selected aspects of industrial geography. A degree of flexibility in the course will allow some emphasis on topics of particular interest to the students registered in it.

616* Multivariate Statistics
The theory and application of multivariate statistics in particular of regression and correlation analysis, factor analysis, discriminant analysis and grouping analysis, with special emphasis on the use of the computer. (Fall)

617* Nonparametric Statistics
The theory and application of nonparametric statistics, with particular emphasis upon social science problems. (Winter)

18* Spatial Analysis (cross-listed as Planning 618*)
Advanced quantitative analysis applied to spatial patterns and interactions. The course will focus on a selection of techniques from gravity models, linear programming, nearest neighbour analysis, Markov chain analysis, graph theory simulation and trend surface analysis. (Winter)

619* Regional Planning Techniques (cross-listed as Planning 619*)
Application of economic and social measurement techniques in regional planning; includes discussion of input-output analysis; regional accounting techniques; cost-benefit analysis; planning, programming and budgeting systems; the multiplier and accelerator concepts; and balance of payments. (Fall)

621 Europe and the
A study of the geographic features pertaining to urban and rural development problems in various regions of the world. One or two problem regions will be studied in depth each year.

621 Europe and the
of trade, regional and national level are covered with specific examples from the various countries.

623 Middle East  
624 Asia  
625 Africa  
626 Oceania  
627 Latin America  
628 United States of America  
629 Polar Lands

630 Canada  Seminar on the geographical analysis of selected Canadian development problems. Emphasis will be on regional disparities, resources development, urban and rural problems.

631 Eastern Europe  Detailed study of physical, cultural, economic, and political geography of communist Europe. Geographical aspects of agricultural problems, industrialization, distribution of trade, economic planning, and relations with the Soviet Union and the West are covered.

632 Soviet Union  Advanced study of selected aspects of the geography of the Soviet Union. A degree of flexibility in the course will allow some emphasis in topics of particular interest to the students registered in it.

633 Field Research in Regional Geography  A detailed analysis of selected region in Canada or the United States with major emphasis upon a field examination of the region (2-3 weeks duration) in the Winter.

634 Political Geography  A review of contrasting approaches to the field; recent theories and their integration; geopolitics; quantitative research in political geography.

650* Basic Research Concepts in Urban Geography  Methods, theory and concepts used in urban research with emphasis on the use of quantitative measures and computers. Detailed study of central place theory, economic base concepts, urban functions and classification and internal locational structure. (Fall)

651* Urban Systems and Urban Models  An urban systems approach emphasizing locational and interactional subsystems; an investigation of various types of urban models - both specific and general, quantitative and qualitative.

652* Urban Spatial Behaviour  The social geography of the city; human ecology, social area analysis, factorial ecology, household activity systems, intra-urban migration, special preferences of people. (Winter)

655* Analysis of Metropolitan Areas  An analysis of the structure, form, and function of metropolitan areas and their regional influence and impact. Study of metropolitan development models. (Winter)

656* Quality of the Urban Environment  An analysis of existing and proposed theories, concepts and practices that have utility in understanding, measuring and improving the qualitative aspect of the urban environment.

657 Agricultural Land Use Problems  Physical and human aspects of agricultural land use problems in Canada and other selected areas.
Department of Geography

662* Natural Resource Planning: Policies and Programmes (cross-listed as Planning 652*)
- International, national, and provincial resource planning policies and programmes; legislation dealing with resource allocation and planning: the structure and programmes of national and international agencies; Canadian federal-provincial resource development agreements. *(Fall)*

663* Recreational Resource Planning (cross-listed as Planning 653*)
- Forecasting recreational demands; methods of classifying recreational resources; methods of recreational resource, method of recreational resource inventory; principles of recreational land management and conservation. *(Winter)*

664* Ecological Foundations of Resource Use (cross-listed as Planning 654*)
- Principles of biogeography and environmental biology. Ecological principles in resource use and development. Case studies and projects. *(Fall)*

665* Resource Conservation and Development (cross-listed as Planning 655*)
- Appraisal of renewable natural resources with reference to demands and changing technology. Problems related to management and development of resources. Resource oriented regional case studies and projects. *(Winter)*

675* Special Readings and Seminar on Selected Topics in Geography
- Topic(s) to be negotiated on an individual basis with faculty members.

76 Special Readings and Seminar on Selected Topics in Geography
- Topic(s) to be negotiated on an individual basis with faculty members.

677 Problems in Resources Management
- Analysis of existing management concepts and practices. Study of proposed theories, concepts methods and techniques relevant to the management of resources.

680 Geographic Thought and Methodology
- An analysis of changing methods and philosophy of geographic research. Special attention is focussed on problem formulation, the design and evaluation of geographic research, and scholarly writing.

698 Course work M.A. research Paper

699 Thesis
Department of Germanic and Slavic Languages and Literatures

Professor J.W. Dyck, A.B. (Bethel), M.A. (Missouri), Ph.D. (Michigan)
Chairman of the Department

Professor E. Heier, B.A., M.A. (British Columbia), Ph.D. (Michigan)
Professor S. Höfert, B.A., M.A., Ph.D. (Toronto)
Professor I. Levitsky, A.B. (Rochester), M.A. (Buffalo), Ph.D. (Duke)
Visiting Professor H. Boeschenstein, Ph.D. (Rostock)
Visiting Professor H. Nicolai, Ph.D. (Hamburg)
Associate Professor M. Richter, Staatsexamen (Berlin and Bonn), M.A. (Toronto), Ph.D.
Deputy Chairman (Toronto)
Associate Professor W. Schlechtl, Diploma (Munich), M.A. (Ottawa), Ph.D. (Munich)
Assistant Professor A. Donskov, B.A., M.A. (British Columbia)
Assistant Professor G. Firmau (Mrs.), Staatsexamen (Berlin), Ph.D. (Yale)
Assistant Professor M. Kuxdorf, B.A., M.A. (Waterloo), Ph.D. (Alberta)
Assistant Professor J. Whiton, B.A., M.A., Ph.D. (Minnesota)
Assistant Professor A. Zweers, Doctorandus (Amsterdam), litt. Dr. (Groningen)
Lecturer F. Jakobsh, B.A., M.A. (Manitoba), Ph.D. (Waterloo)
Lecturer H.W. Pantehei, B.A. (Waterloo), M.A. (Cincinnati), Ph.D. (Waterloo)
Lecturer T. Sommer (Miss), B.A., M.A. (Waterloo)
Lecturer (Part-time) H. Marsden (Mrs.), B.A. (Randolph-Macon), M.A. (Waterloo)

Undergraduate Courses

German

Note 1 All courses with the exception of German 10 are one term (half) courses.
Note 2 Half courses are designed for the convenience of students (Engineering and other Co-operative) who are enrolled in term-programmes. Nevertheless, to obtain credit Arts students must follow up—though not necessarily in the same year—101 with 102 or 112; 111 with 112 or 102; 121 with 122; 201 with 202; 251 with 252; 271 with 272; 351 with 352; 451 with 452.
Note 3 Any other two term (half) courses constitute one full course.
Note 4 Except for German 10, all the following courses are Honours courses, but are also open to students enrolled in General programmes.

10 Reading and Translation
This course is designed to assist graduate students in acquiring a reading knowledge of German. Usage and structure of German scientific writings. Translation in fields of specialization.
Two terms. Lectures arranged.
Open to graduate students of all departments.

101* First Year German
(arts Oriented) For students with little or no knowledge of German.
(Not open to students with Ontario High School Grade 13 German or equivalent.) The basic elements of German grammar with an emphasis on oral practice and pronunciation. Language laboratory. Introduction to aspects of German culture and reading of appropriate graded texts.
Open to all university students.
One term. 4 hours.

102* First Year German
(arts Oriented) Course description as in German 101.
Prerequisite: German 101, or German 111, or equivalent.
111* First Year German  
(Science Oriented) For students with little or no knowledge of German.  
(Not open to students with Ontario High School Grade 13 German or  
equivalent.) The basic elements of German grammar with an emphasis  
on reading and translation of elementary scientific literature from  
various fields. The basic elements of German pronunciation.  
Introduction to aspects of German culture.  
Open to all university students.  
One term. 3 hours.

112* First Year German  
(Science Oriented) Course description as in German 111.  
Prerequisite: German 111, or German 101, or equivalent.

121* Introduction to German  
Literary Movements  
Reading and interpretation of selected works by major German authors.  
Oral practice, composition, grammar.  
One term. 3 hours (lectures and language lab.).  
Prerequisite: This course is normally for students with at least two years of  
high school German. Other students with equivalent knowledge of German  
should obtain the permission of the instructor.

122* Introduction to German  
Literary Movements  
Course description as in German 121.

201* Scientific German  
A review of the fundamentals of grammar is followed by a more  
advanced study of language structure and idiom. Readings and  
translation from contemporary scientific writing in the Physical Sciences  
with the aim of helping the student to acquire a greater vocabulary and  
to master the stylistic difficulties peculiar to technical writing. The  
reading material will be selected in accordance with the field of study of  
the individual student.  
One term. 3 lectures.  
Prerequisite: German 102, 112 or equivalent. Permission of instructor.

202* Intermediate Scientific  
German  
Course description as in 201.  
One term. 3 lectures.  
Prerequisite: German 201 or equivalent. Permission of instructor.

221* Development of the German  
Theatre  
A historical study of the major developments of German theatre from  
the beginnings to Storm and Stress.  
The development of dramatic criticism, acting and stage design will also  
be discussed. The production of a play of the time covered in this course  
is envisaged. This course is taught in English.  
One term. 3 lectures.  
Prerequisite: None.

222* Development of the German  
Theatre  
A historical study of the major developments of German theatre from  
The Classical period to the present.  
The development of dramatic criticism, acting and stage design will also  
be discussed. The production of a play of the time covered in this course  
is envisaged. This course is taught in English.  
One term. 3 lectures.  
Prerequisite: None.

251* Conversation, Composition,  
Grammar and Phonetics  
This course is conducted primarily in German and provides intensive  
practice in spoken German. Vocabulary building, comprehension,  
pronunciation, and intonation are stressed.  
One term. 3 hours (lectures and language lab.).
252* Conversation, Composition, Grammar and Phonetics

As 251.

One term. 3 hours (lectures and language lab).
Prerequisite: German 251 or equivalent.

261* German Classicism

Reading, interpretation, and critical analysis of representative works (Goethe, Schiller, Kleist, Hölderlin, etc.).

One term 3 lectures.
Prerequisite: German 102 or 122: permission of department chairman.

262* German Romanticism

Reading, interpretation, and critical analysis of representative works (Novalis, Brentano, Tieck, Eichendorff, etc.).

One term 3 lectures.
Prerequisite: German 102 or 122: permission of department chairman.

271* German Thought and Culture

A survey of cultural currents to the time of Enlightenment. Lectures will focus on major developments in literature, philosophy, religion, art, architecture, and music as seen against the historical background of the German speaking peoples. This course is taught in English.

One term. 3 lectures. Prerequisite: none.

Note

Arts students can take this course in their second or subsequent years, students of other faculties in any year (p. 13 for course requirements in the Faculty of Arts).

272* German Thought and Culture

A survey of cultural currents from Goethe to the present. Lectures will focus on major developments in literature, philosophy, religion, art, architecture, and music as seen against the historical background of the German speaking peoples. This course is taught in English.

One term. 3 lectures.

351* Intermediate Conversation and Composition

Written reports on prescribed themes and topics. Oral drill.

One term. 3 lectures (language lab).
Prerequisite: German 252 or equivalent.

352* Intermediate Conversation and Composition

As 351.

One term. 3 lectures.
Prerequisite: German 351.

361* Young Germany and Biedermeier

Reading, interpretation, and critical analysis of prescribed prose, drama and poetry.

One term. 3 lectures.
Prerequisite: German 102 or 122.

362* Poetic Realism

Reading, interpretation, and critical analysis of prescribed prose, drama and poetry.

One term. 3 lectures.
Prerequisite: German 102 or 122.

371* Modern German Literature

Reading and interpretation of prescribed works from early Naturalism to the Twenties.

One term. 3 lectures.
Prerequisite: German 102 or 122.

372* Modern German Literature

Reading and interpretation of prescribed works from the Twenties to the present.

One term. 3 lectures.
Department of Germanic and Slavic Languages and Literatures

381* Enlightenment  Reading, interpretation, and critical analysis of prescribed prose, drama and poetry (Brockes, Haller, Gellert, Klopstock, Lessing, Wieland, etc.)
One term. 3 lectures.
Prerequisite: German 102 or 122.

382* Storm and Stress  Reading, interpretation, and critical analysis of prescribed prose, drama and poetry (Herder, Goethe, Lenz, Klinger, Schiller, etc.).
One term. 3 lectures.
Prerequisite: German 102 or 122.

391* German Literature in Translation  A study of representative works of the major movements of German literature from the beginnings to the age of Goethe. This course is taught in English.
One term. 3 lectures.
Prerequisite: A course in any other literature, or permission of the instructor.

392* German Literature in Translation  A study of representative works of the major movements of German literature in the nineteenth and twentieth centuries. Modern authors such as Rilke, Brecht, Kafka, Thomas Mann, Duerrenmatt, and Grass will be dealt with.
This course is taught in English.
One term. 3 lectures.
Prerequisite: A course in any other literature, or permission of the instructor.

451* Advanced Conversation, Grammar and Composition  This course is conducted in German and provides intensive practice in spoken and written German on the advanced level.
One term. 3 lectures.
Prerequisite: German 352 or equivalent.

452* Advanced Conversation, Grammar and Composition  As 451.
Prerequisite: German 451.

61* Introduction to the History of the German Language with Readings in Middle High German  One term. 3 lectures.
Prerequisite: German 102 or 122.

462* Middle High German Literature  Reading and interpretation of prescribed works of the first “Blutzezeit” in German literature.(Walther von der Vogelweide, Reinmar der Alte, Heinrich von Morungen, Wolfram von Eschenbach, Gottfried von Strassburg, Nibelungenlied, etc.).
One term. 3 lectures.
Prerequisite: German 461.

471* German Poetry  A study of the main thoughts, themes, forms, and schools in German poetry from the beginnings to Goethe.
One term. 3 lectures.
Prerequisite: German 102 or 122.

472 German Poetry  A study of the main thoughts, themes, forms, and schools in German poetry from German Romanticism to the present.
One term. 3 lectures.
Prerequisite: German 102 or 122.

481* Renaissance/Humanism  Reading, interpretation, and critical analysis of prescribed texts (Tepl, Brant, Erasmus, Luther, Sachs, Ridderman, etc.)
Prerequisite: German 102 or 122.

482* Baroque Reading, interpretation, and critical analysis of prescribed texts (Opitz, Gryphius, Grimmelshausen, Reuter, Fleming, Hofmannswaldau, Angelus Silesius, Guenther, etc.).
One term, 3 lectures.
Prerequisite: German 102 or 122.

495*-498* Reading Course in Approved Topics One term each, 3 lectures.
Open to fourth year students only.

Russian

Note 1 All courses with the exception of Russian 10 are one term (half) courses.
Note 2 Half courses are designed for the convenience of students (Engineering and other Co-operative) who are enrolled in term-programmes. Nevertheless, to obtain credit Arts students must follow up—though not necessarily in the same year—101 with 102; 201 with 202; 251 with 252; 271 with 272; 351 with 352; 381 with 382; 451 with 452.
Note 3 Any other two term (half) courses constitute one full course.
Note 4 Except for Russian 10, all the following courses are Honours courses, but are also open to students enrolled in General programmes.

10 Reading and Translation This course is designed to assist graduate students in acquiring a reading knowledge of Russian. Usage and structure of Russian scientific writings. Translation in fields of specialization.
Two terms. Lectures arranged.
Open to graduate students of all departments.

101* First Year Russian For students with little or no knowledge of Russian.
A. Arts Students: The elements of Russian grammar, oral practice, and composition. Reading selected texts of major Russian authors. Open to all university students.
B. Science, Mathematics, and Engineering Students: Essential grammar, sentence structure. Reading and translation of scientific literature according to the students' fields of interest.
Open to all university students.
One term, 4 hours for A; 3 hours for B.

102* First Year Russian Course description as in Russian 101.
Prerequisite: Russian 101 or equivalent.

201* Scientific Russian A review of the fundamentals of grammar is followed by a more advanced study of the language structure and idiom. Readings and translation from contemporary scientific writing in the Physical Sciences with the aim of helping the student to acquire a greater vocabulary and to master the stylistic difficulties peculiar to technical writing. The reading material will be selected in accordance with the field of study of the individual student.
Prerequisite: Russian 102 or equivalent. Permission of instructor.
One term. 3 lectures.

202* Intermediate Scientific Russian Course description as 201.
Prerequisite: Russian 201 or equivalent. Permission of instructor.
One term. 3 lectures.
251* Conversation, Composition, Grammar and Phonetics
This course is conducted largely in Russian and provides intensive practice in spoken Russian. Vocabulary building, comprehension, pronunciation and intonation are stressed.
Prerequisite: Russian 102 or equivalent. Permission of instructor.
One term. 3 hours (lectures and language lab.).

252* Conversation, Composition, Grammar and Phonetics
As 251. Prerequisite: Russian 251 or equivalent.
One term. 3 hours (lectures and language lab.).

261* Introduction to Russian Literary Movements
Reading of representative works from Russian Classicism, Romanticism, 19th century Realism, and various periods of 20th century Russian literature.
Prerequisite: Russian 102 or permission of instructor.
One term. 3 lectures.

262* Introduction to Russian Literary Movements
As 261. Prerequisite: Russian 261.
One term. 3 lectures.

271* Russian Thought and Culture
A survey of cultural history from 862 to 1861. Lectures will focus on major developments in literature, religion, philosophy, art, architecture, and music as seen against the background of Russia's historical past. This course is taught in English.
Note
Arts students can take this course in their second or subsequent years, students of other faculties in any year (p. 13 for course requirements in the Faculty of Arts).

272* Russian Thought and Culture
A survey of cultural history from 1861 to the present. Lectures will focus on major developments in literature, philosophy, art, and music as seen against the background of Russia's historical past. Discussions will be devoted primarily to works of Russian literature. This course is taught in English.
One term, 2 lectures, 1 discussion.

351* Intermediate Conversation and Composition
Written reports on prescribed themes and topics. Oral drill and translation.
Prerequisite: Russian 252 or equivalent.
One term. 3 lectures.

352* Intermediate Conversation and Composition.
As 351.
Prerequisite: Russian 351.
One term. 3 lectures.

361* Russian Realism (Aksakov, Gogol, Goncharov, Turgenev, Tolstoy, Ostrovsky)
Reading, interpretation, and critical analysis of selected fiction and drama.
Prerequisite: Russian 101 and 102.
One term. 3 lectures.

362* Russian Realism (Chemyshevsky, Leskov, Dostoevsky, Saltykov-Shchedrin, Chekhov)
Reading, interpretation, and critical analysis of selected fiction and drama.
Prerequisite: Russian 101 and 102.
One term. 3 lectures.

71* The Golden Age of Russian Literature
Reading and interpretation of prescribed prose, drama and poetry from Lomonosov to Pushkin.
Prerequisite: Russian 101 and 102.
372* The Golden Age of Russian Literature
Reading and interpretation of prescribed prose, drama and poetry from Pushkin to the 1860’s.
Prerequisite: Russian 101 and 102.
One term. 3 lectures.

381* The Peoples of the Soviet Union
Especially emphasized will be the study of non-Slav peoples of the Caucasus and Central Asia, European Russia and Siberia. Czarist and Soviet policy towards national minorities, assimilation and integration problems in the light of linguistic divisions; development of literary languages. Some achievements of Soviet anthropology.
One term. 3 lectures.

382* The Peoples of the Soviet Union
As 381.
Prerequisite: Russian 381.
One term. 3 lectures.

391* Russian Literature in Translation
From Pushkin to Dostoevsky.
Prerequisite: At least one course in any other literature.
One term. 3 lectures.

392* Russian Literature in Translation
From Chekhov to Pasternak.
Prerequisite: At least one course in any other literature.
One term. 3 lectures.

451* Advanced Conversation, Grammar and Composition
This course is conducted in Russian and provides intensive practice in spoken and written Russian on the advanced level.
Prerequisite: Russian 352 or equivalent.
One term. 3 lectures.

452* Advanced Conversation, Grammar and Composition
As 451.
One term. 3 lectures.

461* Twentieth Century Russian Literature
(Gorky, Mayakovsky, Olesha, Kataev, Leonov, Zoshchenko) Reading, interpretation, and critical analysis of selected fiction and drama.
Prerequisite: Russian 101 and 102.
One term. 3 lectures.

462* Twentieth Century Russian Literature
(Sholokhov, A.N. Tolstoy, Fadeev, Pasternak, Solzhenitsyn, Kazakov) Reading, interpretation, and critical analysis of selected fiction and drama.
The course is conducted in Russian and provides intensive practice in spoken and written Russian on the advanced level.
Prerequisite: Russian 461.
One term. 3 lectures.

471* The Image of Russia and the Russians in Western Thought and Writings
This is a critical appraisal of the changing image of the Russian and Russia as presented by West European writers, poets and thinkers. Consideration will also be given to the image of western man in Russian literature.
One term. 3 lectures.

472* The Image of Russia and the Russians in Western Thought and Writings
As 471.
One term. 3 lectures.

481* Russian Poetry
A study of themes and forms of representative authors of Classicism, Romanticism (Lomonosov, Derzhavin, Pushkin, Lermontov, Nekrasov, Fet, Tiutchev, etc.).
Department of Germanic and Slavic Languages and Literatures

482* Russian Poetry
A study of themes and forms of representative authors from Symbolism to the present (Rilke, Esenin, Mayakovskiy, Akhmatova, etc.).
Prerequisite: Russian 101 and 102.
One term. 3 lectures.

495*-498* Reading Course in Approved Topics
Open to fourth year students only.
One term each. 3 lectures.

Ukrainian

101* Beginners' Ukrainian
Intensive language study. Basic grammar, reading, oral practice in language lab, translation, and writing exercises.
One term. 3 hours.
Open to undergraduate students of all departments; recommended to graduate students of Russian as a second Slavic language.

102* Intermediate Ukrainian
Reading from selected texts, oral practice, translation, grammar with the aim of helping to master pronunciation and syntax. Intensive exercises in composition.
One term. 3 hours.
Prerequisite: Ukrainian 101 or equivalent.

201* Introduction to Ukrainian Literature
The place of Ukrainian in the Slavic family of languages, review of grammar; reading of texts chosen from the works of Ukrainian authors.
( Skovoroda, Kotliarev'sky, Franko, L. Ukrainka, Ryl's'ky and others).
Prerequisite: Admission by consent of the instructor.
One term. 3 lectures.

202* Introduction to Ukrainian Literature
A critical survey of Ukrainian literature from Kotliarev'sky to the present.
Prerequisite: Ukrainian 201 or admission by consent of the instructor.
One term. 3 lectures.

301* Ukrainian Romanticism
Taras Shevchenko and his Time. Kharkov and Kiev as literary centers; the Brotherhood of SS. Cyril and Methodius; reading and critical interpretation of prescribed prose, drama, and poetry. (Shevchenko, Kostomariv, Kulish, and others.)
Prerequisite: Ukrainian 202 or admission by consent of the instructor.
One term. 3 lectures.

302* Ukrainian Romanticism
The literary revival in Western Ukraine. A critical study of the literary movement with special emphasis on the major authors (Shashkevych, Walylevych, Holavats'kyj and others).
Prerequisite: Ukrainian 301 or admission by consent of the instructor.
One term. 3 lectures.

Graduate Courses

German

600* German Literary Criticism. Research techniques, source material, bibliography.
601* Intellectual Foundations of German Classicism.
620* Studies of a Modern Author.
630* The German Novel.
631* The German Novelle.
640* Lessing.
641* Schiller.
650* Goethe.
651* Kleist.
660* The German Drama to 1889.
661* Twentieth Century German Drama.
670* Medieval German Literature.
671* History of the German Language.
680* Andreas Gryphius and his Time.
681* Heine and Young Germany.
690* Gothic.
691* Old High German.
692* The History of German Literary Criticism.
695*-698* Reading Course in Approved Topics.

All courses with the exception of the Thesis are one term courses.

Russian

600* Russian Literary Criticism. (Problems and methods.)
601* Pushkin or Lermontov.
610* Structure of Standard Russian.
630* Tolstoy.
631* Dostoevsky.
640* The Russian Drama.
650* Contemporary Russian Literature.
651* Early East Slavic Literature (the epics, the byliny, the chronicles).
660* Old Church Slavonic.
661* History of the Russian Language.
695*-698* Reading Course in Approved Topics.

All courses with the exception of the Thesis are one term course.
Department of History

Associate Professor, J.F.H. New, M.A. (Melbourne), Ph.D. (Toronto).
Chairman of the department

Professor R.W. Beachey, B.A. (Queen's), Ph.D. (Edinburgh).
Professor P.G. Cornell, E.D., M.A., Ph.D. (Toronto).

Professor G.M. Ostrander, B.A. (Columbia), M.A., Ph.D. (California-Berkeley).
Professor A.W. Rees, M.A. (Wales).

Adjunct Professor (Dep't of Religion and Culture; W.L.U.)

Associate Professor D.N. Baker, B.A. (U.B.C), A.M., Ph.D. (Stanford).
Associate Professor M.T. Cherniavsky, M.A. (Oxford).
Associate Professor A.D. Davies, B.A., Ph.D. (Washington).

Associate Professor (Classics and History)
Professor G. W. Klaassen, B.A. (McMaster), D. Phil. (Oxford).
Associate Professor W. Klaassen, B.A. (McMaster), D. Phil. (Oxford).
Associate Professor T. Lammers, M.A. (Cornell), A.B., MA., Ph.D. (Stanford).
Associate Professor R.C. MacGillivray, B.A. (Queen's), A.M., Ph.D. (Harvard).
Associate Professor E.P. Patterson, B.A. (Baylor), M.A. (Kansas), Ph.D. (Washington).

Assistant Professor J. A. Barbier, M.A., Ph.D. (Connecticut).
Assistant Professor K.R. Davis, B.A. (Toronto), M.A. (Wheaton), Ph.D. (Michigan).
Assistant Professor J. E. Dembski, M.A. (Toronto)
Assistant Professor P.J. Harrigan, B.A. (Detroit), A.M., Ph.D. (Michigan).
Assistant Professor L.A. Johnson, B.A. (Waterloo), M.A., M.Phil. (Toronto).
Assistant Professor A. Lentin, B.A., M.A., Ph.D. (Cambridge).
Assistant Professor J. P. Smith, M.A. (Toronto), Ph.D. (New Mexico).
Assistant Professor J. A. Wahl, C.R., B.A. (Western), M.A., Ph.D. (St. Louis).

Lecturer F.L. Barron, B.A., M.A., M.Phil. (Waterloo).
Lecturer Part-time L.W. Grady, B.A. (St. Elizabeth College), M.A. (McMaster), M.Phil. (Toronto)

Lecturer S.K. Johannesen, B.A. (Evangel College), M.A. (Missouri).
Lecturer K.M. McLaughlin, B.A. (Waterloo), M.A. (Dalhousie).

Liaison Librarian
Assistant J.M. Campbell, B.A. (Waterloo).

Bachelor of Arts

a) Students majoring in History should consult the General Programme requirements listed on page 15. They will normally choose an Introductory history course and three History courses from the Survey section of course listings in the Calendar. In addition, at least one course must be chosen in the third year from the Depth Study section (or from the Senior Seminars, if permitted) and taken as an Honours course as a prerequisite to graduation. The exact programme for each student will be determined at the time of registration.
programme described on page 33. The exact programme for each student will be worked out in consultation with a departmental advisor.

Master of Arts

In History there are two programmes leading to the degree of Master of Arts: three courses and a cognate essay normally; or in exceptional circumstances, and after approval from the prospective supervisor and Graduate Officer in consort, two courses and a thesis will be accepted. Subject to Departmental approval, one course may be selected from graduate offerings in another department. If, however, a candidate has not had a previous course in Historiography or an equivalent, one of the chosen courses must be in either the History & Theory of History or in variations of this course taught by the History and/or Philosophy Departments. A candidate who needs to take one of the historiography courses would not be recommended to select another course from another department. In addition, reading proficiency in one language other than English - usually, but by no means necessarily in French - must be tested before a candidate qualifies for the degree.

Master of Philosophy

The general requirements for the degree of Master of Philosophy as indicated on page 165 apply to the degree in History. The M. Phil. degree is an intermediate degree between the M.A. and Ph.D., and a degree of markedly higher quality than the M.A.

The M.Phil is designed for 3 main classes of students: those, who for lack of time or money, are unwilling to meet the demands of the Ph.D. programme; those who desire the advanced education of extra, diverse course work and some research of lower intensity than the doctorate; and those who wish to proceed with further education whom the department feels would benefit by further education, but whom the department does not select for the Ph.D. programme. It should be understood, however, that upward mobility into the Ph.D. programme will always be available to the student who displays outstanding ability. Courses taken for the M.Phil may be credited toward the Ph.D.

Normally the M.Phil, over and above the M.A., would require two more courses and a research thesis. The M.Phil candidate who has written an M.A. thesis is required to write a second thesis, unless the M.A. thesis was of exceptional calibre, in which case additional courses are required to ensure equity.

M. Phil thesis

The standard of the M.Phil thesis is to be judged relative to our requirements for the Ph.D. thesis. Normally the M.Phil thesis would be some-what less in length, scope and quality than the Ph.D.

Length M. Phil should run between 30,000 to 50,000 words excluding bibliography.

Scope Scope would be local in character, or limited in chronological span; or deal with interpretive problems of a secondary nature.

Quality Historiographers Ph.D. theses are expected to include aminiature historiography section, which will serve as an introduction to the subject and offer a critical discussion of the literature.
Relative to this standard, we would expect the M.Phil to be based on smaller bodies of evidence, to display somewhat less interpretive skill, and less perception, penetration and style than a doctoral thesis.

Note The M.Phil is a research thesis, and, like the doctoral dissertation, should be based on primary sources.

Doctor of Philosophy

The Department hopes to mount a Ph.D. programme in 1971-72 at the earliest, or in the following year, pending approval from the Provincial Government. If Provincial approval is forthcoming the requirements will be as follows:

Admissions Students will normally be admitted only after an M.A. or M.Phil. degree in which they have obtained an A or A- standing. Since we do not expect to be able to admit all students who apply for registration even with high standing, we will pay close attention to the scores of the few applicants who may have taken Graduate Record exams, to the candidates' transcripts and past records as a whole, to testimonials written on their behalf by former professors; and we may also require a preliminary personal interview.

Residence The University requires at least two years full-time residence after the M.A., or one year after the M.Phil. It is not, however, expected that many candidates will manage to complete their preparations and research wholly in that length of time.

Language Requirement Reading fluency in one language other than English will be required as a minimum. In many areas of study the department may ask for two or three languages. Since we regard languages as necessary basic tools for mastering the literature in a field as well as for the undertaking of research for a thesis, the degree of proficiency must be such that the candidate can read easily in the language(s) appropriate to his studies.

Thesis and Course Requirements Each candidate will be required to write a thesis of such originality and cogency that it should be publishable with minor revisions. An upper limit of 90,000 words, excluding bibliography, will be strictly enforced. As a preparative to the research and writing of the thesis candidates will be required to familiarize themselves thoroughly with the scholarly literature in one major field and three minor fields. One of these minor fields should be taken in a discipline other than history. A field is major in the sense that it would be the area where the widest reading and most intensive study would be expected; and this would be the area in which the thesis would be chosen. There will be written and oral exams in both major and minor fields of history, which must be passed to the satisfaction of the History Department before the candidate can proceed to the substantive research and writing of the thesis. All candidates will be expected to take reading courses and tutorials within the boundaries of the history fields. We require one of the minor history fields to be in an area clearly distinct from the major. By this provision, and by encouraging an outside minor field, we hope to avoid undue narrowness on the part of our candidates.

We propose that major fields and thesis choices be drawn from the following:

...
*European history, from the reformation era to the present;
Canadian and American history from European discovery and colonization to the present;
British history, late medieval, early modern and modern;
British Imperial History and indigenous peoples' responses;*

and we assume that a subject within any of the above categories may be selected as a minor field, or students may choose a minor from other areas that are taught at the graduate level by the History Department.

**Undergraduate Courses**

**Note 1** Courses offered by the History Department are divided into four basic categories, to allow for sequential development. The four categories are as follows:

- **100 level:** Introductory Courses (For General credit only)
- **200 level:** Survey Courses Group 1 (For General credit only)
  Group 2 (For General or Honours credit)
  Group 3 (For Honours History students only)
- **300 level:** Depth Courses (For Honours credit only)
- **400 level:** Senior Seminars (For Honours credit only and intended primarily for Honours students).

*General students are reminded that they must take at least one Depth Course - or Senior Seminar, if permitted - for Honours credit in order to complete their major.*

**Note 2** Half courses (meeting for one term only) are designated by an asterisk (*) after the course number.

**Note 3** Not all courses listed below are offered each year. In March of each year the Department will publish an updated list and expanded description of the courses it expects to offer during the following academic year.

**Note 4** Please note that many courses previously taught have been given new numbers.

**Introductory Courses**

101* Major Themes of Western Civilization
A study for freshmen of several distinct but related themes which have been of central importance in the evolution of Western Civilization. Students will be introduced to historical controversy, historical methodology, techniques of theme writing and research, and source analysis.

3 hours. Lectures and tutorial groups.

102* Major Themes of Western Civilization
A study for freshmen of several distinct but related themes which have been of central importance in the evolution of Western Civilization. Students will be introduced to historical controversy, historical methodology, techniques of theme writing and research, and source analysis.

3 hours. Lectures and tutorial groups.
Department of History

3 hours. Lectures and tutorial groups.

03* The Emergence of the Third World
Surveys the history of the social, political and economic changes which have led to the creation of new nations and the resurgence of old nations and peoples in Asia, Africa and the New World.
3 hours. Lectures and tutorial groups.

04* The Emergence of the Third World
Surveys the history of the social, political and economic changes which have led to the creation of new nations and the resurgence of old nations and peoples in Asia, Africa and the New World.
3 Hours. Lectures and tutorial groups.

10 An Introduction to Historical Method
This course is designated for able students with a special interest in history. The aim is to provide an introduction to the techniques of historical enquiry through the study of one period in some depth.
3 hours. 2 lectures, 1 hour discussion groups.

120 An Introduction to Western Intellectual History
This course is a foray into intellectual history which will explore some of the seminal visions of the human predicament and some of the solutions posed by thinkers of the Western world over the past 2,500 years. The work is tailored especially for students who want to be challenged intellectually and who are willing to opt for more, and more stimulating reading than is usual in introductory subjects. This is a course of continuous readings and discussions, meeting twice a week in small seminars. Written work will be required and a high level of participation in seminars, but no lectures.
3 hours of discussions

Survey Courses

Group 1 3 hours. No pre-requisite. The following courses may not be taken for Honours History credit.

201* Expansion of Europe from the 15th to the 18th Century
Surveys the major explorations, conquests and settlements of the Portuguese, Dutch, French and English empires. The eighteenth-century decline of the French, Spanish, and English empires in the new world is outlined.

202* Expansion of Europe in the 19th and 20th Centuries
Surveys European expansion especially in Africa and Asia and traces the rise of the nationalist-independence movements which culminate in the end of empire in the mid-twentieth century.

203* Twentieth Century History, 1900-39
Surveys the historical evolution of the present century to the beginning of World War 2, with emphasis on those issues which have posed the greatest problems and dilemmas in a rapidly changing world.

204* Twentieth Century History, 1939-70
Recent social, economic and political trends in Europe, Asia, Africa and the Americas will be set in a longer historical perspective.

211* British History to 1603
A survey of the main stages in the transition of Britain from a remote province of the Roman Empire to a prominent, independent state of post-Reformation Europe. Within the chronological framework, cultural and social as well as political and institutional developments will be examined.
212* British History since 1603
A survey of the shaping of British society and the British experience from the time of Shakespeare to the present: constitutional conflict and compromise, rise and fall of empire, industrial and urban revolution, world wars and welfare state.

213 British Empire and Commonwealth History
A topical survey rather than the usual chronological treatment, divided into halves on the broad themes "The British Influence" and "The Colonial Identity". In the first term there will be sections on the institutional framework, imperial biographies and the development of communications; in the second, sections on native peoples, colonial economics and the history of the commonwealth ideal.

223* Canadian History to 1867
An analysis of selected issues: New France, Atlantic outlook, Loyalism and the crisis of Empire, rebellion and reconstruction, regional loyalties and the strategy of Confederation.

227* The History of Selected Racial and Regional Minorities in North America
An examination of the formative years of the Afro-American, Indian and French-Canadian minorities in Canada and the United States.

228* The History of Selected Racial and Regional Minorities in North America
An examination of the emergence of minority assertiveness and the changing perception of majority-minority relationship.

255 Ancient Civilization
A survey of the social, political and economic history of Greece and Rome with an introduction to the civilization of the Ancient Near East.

260 Europe in Renaissance and Revolution
This course will focus on Europe in transition (1300-1600) and emphasize those political, intellectual, social and economic changes most significant to the emergence of modern Europe.

262 Europe in the Eighteenth Century
A survey of states and society in Europe before the French Revolution with special reference to France, Prussia and Russia and the impact on them of Enlightenment thought.

263* Europe in the Nineteenth century
A study of Europe from the French Revolution to approximately 1900 with particular emphasis on the social and intellectual forces that affected European society and the historical role of institutions in European society.

264* Europe in the Twentieth Century
The course will stress a close examination of those issues both domestic and international, which constitute the distinctive features and trends of twentieth century Europe.

281 South Asian History
Economic, social and political repercussions of contact with Europe since 1600. Emphasis will be on events in the Indian sub-continent.

282 East Asian History
A study of the development of East Asia from the Opium War (China) and the Meiji Restoration (Japan) to the present using various sources in English and Chinese.
285 Colonial Latin America
A social emphasis will be placed upon selected topics of the period 1492-1821 (discovery to the winning of independence). The course will be concerned primarily with the transfer and modification of Iberian civilization in America.

291* Ancient and Pre-Colonial Africa
A study of the political, social and economic history of the major states of sub-Saharan Africa from earliest times to the advent of Europeans. The course includes an examination of the Cushite, Sudanic, Forest, Swahili and Central African states.

292* Colonial and Independent Africa
A survey of sub-Saharan African history from the coming of the Europeans to the era of independence with emphasis on Ghana, Nigeria, Kenya, Uganda, Zambia and the former Southern Rhodesia. Special attention will be given to a comparison of colonial administration and the rise of nationalist-independence movements.

95* History of the United States to 1865
A survey of American society, politics and thought, and of the relations of the United States with the outside world from 1776 to 1865.

96* History of the United States since 1865
A survey of American society, politics and thought and of the relations of the United States with the outside world from 1865 to the present.

Group 3
3 hours. Lectures and seminars. The following courses have as a pre-requisite an Introductory history course or the permission of the instructor. They are for Honours History students only.

258 History of Medieval Europe
The political, cultural, economic and ecclesiastical development of Europe from 300 to 1300.

265* Canadian History 1
Selected topics in the period to 1867.

266* Canadian History 2
Selected topics in the period since 1867.

277 British Empire and Commonwealth History
A topical survey rather than the usual chronological treatment, divided into halves on the broad themes "The British Influence" and "The Colonial Identity". In the first term there will be sections on the evolution of the institutional framework, imperial biographies and the development of communications; in the second, sections on native peoples, colonial economics and the history of the commonwealth ideal.

Depth Courses

The following courses are open to students above the First Year level. They normally have a pre-requisite and may only be taken for Honours credit. General students taking these courses will therefore be expected to work at Honours standard.

350 Theory and Practice of Historical Writing
A course consisting of seminars on problems of historical enquiry and explanation, including individual guidance in the preparation of a research essay.
Pre-requisite: For third year honours students or permission of the instructor.

351* Special Subject
Seminars and public lectures in special fields. (Topics to be announced each year).
352* Special Subject
Seminars and public lectures in special fields.
(Topic to be announced each year).

Pre-requisite: permission of the instructor.

353 Medieval Church History
From 312-1449
3 hours, lectures and seminars.
Pre-requisite: an Introductory course or permission of the instructor.

355* Russian History 1613-1825
The course will focus on selected themes in the development of the Russian state and society from the beginning of Romanov rule to the middle of the nineteenth century.

3 hours, lectures and seminars.
Pre-requisite: an Introductory history course or permission of the instructor.

356* Russian History Since 1825
The course will focus on selected themes in Russia's development in the nineteenth and twentieth centuries, including the Soviet Period.

3 hours, lectures and seminars.
Pre-requisite: an Introductory history course or permission of the instructor.

357* German History 1648-1848
The course will cover in some depth selected topics of political, social and economic history of the Germanic lands from the Peace of Westphalia to the revolutions of 1848.

3 hours, lectures and seminars.
Pre-requisite: an Introductory history course or permission of the instructor.

358* German History 1848-1933
The course will cover briefly the Unification of Germany; the empire under William I and William II; the Revolution of 1918 and some aspects of the Weimar Republic to Hitler. German nationalism will be analysed in both courses.

3 hours, lectures and seminars.
Pre-requisite: History 357 or permission of the instructor.

359* French History 1760-1848
A study of France from the Ancien Regime to the revolution of 1848 with particular emphasis on the social and intellectual forces that affected French society and the historical role of institutions in French society.

3 hours, lectures and seminars.
Pre-requisite: an Introductory history course or permission of the instructor.

360* French History 1848-1960
A study of France from 1848 to the Fifth Republic with particular emphasis on the social and intellectual forces that affected French society and the historical role of institutions in French society.

3 hours, lectures and seminars.
Pre-requisite: an Introductory history course or permission of the instructor.

361 English History 1485-1660
A study of achievements and crises in the Tudor and early Stuart periods.

3 hours, lectures and seminars.
Pre-requisite: an Introductory history course or permission of the instructor.

362 English History Since 1660
A study of the development of the world's first industrialized state.

3 hours, lectures and seminars.
Pre-requisite: an Introductory history course or permission of the instructor.
363 Medieval English History  
A study of government, church and society.  
3 hours, lectures and seminars.  
Pre-requisite: an Introductory history course or permission of the instructor.

364 Iberian History  
History of Spain and Portugal from ancient times to the present. The course will deal primarily with the emergence of a medieval society and the persistence of such a society—despite developments elsewhere in Europe—to the present day.  
3 hours lectures and seminars  
Pre-requisite: An Introductory history course or permission of the instructor.

366 European Intellectual History  
Major themes in European thought and culture since the 17th century, with an emphasis on the emergence, transformation and decline of Enlightenment perspectives and the contemporary search for alternatives.  
3 hours, lectures and seminars  
Pre-requisite: an Introductory history course or permission of the instructor.

367R War and Revolution in the Twentieth Century  
The 1914-1918 War: Russian revolution: Peacemaking 1919: the Chinese nationalist revolution: fascism, nazism; Second World War; peacemaking 1945; the Chinese Communist revolution; the Korean war; international communism and the West; revolution in the “third” world.  
3 hours: lectures and seminars  
Pre-requisite: an Introductory history of permission of the instructor.

8 The International Relations of the European States, from the Congress of Vienna to the Cold War.  
A study of the international relations of the European states during the periods of European ascendancy, paramountcy and decline, with attention to the nature of the “state system”, the workings of the “balance of power”, the causes and nature of war, and the conditions of peace in modern times.  
3 hours, lectures and seminars  
Pre-requisite: an Introductory history course or permission of the instructor.

370 Comparative Studies in Imperialism and Colonization  
A comparison of colonial empires, mostly European, since the sixteenth century, in which a general study in the first term is followed by the examination of particular examples in the Caribbean region, Latin America and Southern Africa in the second term.  
3 hours, lectures and seminars.  
Pre-requisite: an Introductory history course or permission of the instructor.

372 East African History  
An examination of the historical development of East Africa from its partition among the European powers in the late nineteenth century to the present day. Special attention will be given to the nature of colonial administration, emergence of nationalism, and the basic problems faced by the territories of Uganda, Kenya, Tanzania and Zanzibar since attaining their independence.  
3 hours, lectures and seminars.  
Pre-requisite: an Introductory history course or permission of the instructor.

373R Contemporary History: Southern Africa  
South Africa: Problems of a pluralist society: the impact of British imperialism and of cosmopolitan finance capital: the rise of Afrikaner nationalism: origins and evolution of apartheid: the struggles of the
The independent African states of southern Africa - Lesotho (Basutoland), Botswana (Bechuanaland), Swaziland. Culture conflict in contemporary southern Africa.
3 hours lectures and seminars
Pre-requisite: An Introductory history course or permission of the instructor.

375 History of China
The continuation of Hist. 282. Particular attention will be devoted to responses to the technically sophisticated cultures of the West; modernization; reform and revolution; modifications of Communism and democracy; the development of the People's Republic.
3 hours, lectures and seminars.
Pre-requisite: an Introductory history course or permission of the instructor.

377 History of Modern India
Selected issues in the development of India since 1526, centering primarily on traditional Hindu society, the Muslim and Western impact on that society and the emergence of independent India.
3 hours, lectures and seminars.
Pre-requisite: an Introductory history course or permission of the instructor.

380* - Canada 1867-1914
This course will examine the development of a “national consensus” in British North America after Confederation. Continentalism, Imperialism, Bi-culturalism and Economic nationalism will be major themes.
3 hours. Lectures and seminars.
Prerequisite: a previous Canadian history course or permission of the instructor.

381* Canada since 1914
This course will examine Canada's emergence as a twentieth century nation. Emphasis will be placed on economic and social change, regional unrest, and the development of Canadian nationalism.
3 hours. Lectures and seminars.
Prerequisite: a previous Canadian history course or permission of the instructor.

82 Canadian Intellectual History
An historical analysis of Canadian culture, both nationally and regionally.
3 hours, lectures and seminars.
Prerequisite: a previous Canadian history course or permission of the instructor.

13* History of French Canada to 1867
The course will emphasize social and economic issues in the development of French Canada to Confederation.
3 hours, lectures and seminars.
Prerequisite: a previous Canadian history course or permission of the instructor.

384* History of French Canada Since 1867
The course will treat the emergence of modern Quebec, with special emphasis on social and economic issues.
3 hours, lectures and seminars.
Prerequisite: a previous Canadian history course or permission of the instructor.

386* Ontario History to Confederation
The course will examine the growth of Ontario from a pioneer settlement, with particular emphasis on economic, social, political and
Department of History

3 hours, lectures and seminars.
Prerequisite: a previous course in Canadian history, economics or politics, or permission of the instructor.

387* Ontario History Since Confederation
The course will examine the emergence of Ontario as an industrial giant and the development of its hegemony in Canada. An emphasis will be placed on the sources and methods of local historical research.
3 hours, lectures and seminars.
Prerequisite: a previous course in Canadian history, economics or politics, or permission of the instructor.

388 History of Canadian-American Relations
Mainly, but not exclusively the history of diplomatic relations. In addition, selected topics of a political, economic, social and cultural nature will be studied in comparative terms.
3 hours, lectures and seminars.
Prerequisite: a course in Canadian and/or U.S. History or permission of the instructor.

390 History of North American Indians
An examination of the main themes in the history of the Indians of Canada since 1600. Some attention will also be given to the Indians of the United States comparing their history with that of the Canadian Indians.
3 hours, lectures and seminars.
Prerequisite: an Introductory history course or permission of the instructor.

392 Colonial American History
The development of an American civilization with emphasis on colonial and Revolutionary origins. Selected topics in social and intellectual history will be explored in depth.
3 hours, lectures and seminars.
Prerequisite: an Introductory history course or permission of the instructor.

393 - Nineteenth Century United States History
Selected topics in intellectual and cultural history in depth.
3 hours. Lectures and seminars.
Prerequisite: an Introductory history course or permission of the Instructor.

394 Latin America, National Period
A special emphasis will be placed upon selected topics of the period 1821 to the present. The course will be concerned primarily with a conflict of old and new: the response of existing semi-feudal Iberian civilization to the demands of industrialization.
3 hours, lectures and seminars.
Prerequisite: History 285 or permission of the instructor.

395 History of Science
A survey of scientific developments in Western Civilization from its roots in the ancient world to the present, with emphasis on the scientific revolutions of the 17th and 20th centuries and on the relation of science to society, government, religion, industry and technology, and the arts.
3 hours, lectures and seminars.
Prerequisite: an Introductory history course or permission of the instructor.

397 The History of Public and Private Law to 1500
An historical study of the evolution of law and the legal approach. Topics in the history of Roman, Canon, and Common Law will be discussed to provide the student with an appreciation of law as it exists today.
3 hours, lectures and seminars.
399 Directed Studies in Special Topics
Study in a limited field under tutorial guidance. A high standard of written work will be expected.

Senior Seminars

(Students who have taken Hist. 350 should be at an advantage in Senior Seminars)

401 Senior Seminar in Medieval History
Prerequisite: History 258 (formerly 250) or equivalent.

405 Senior Seminar in the Intellectual History of Renaissance and Reformation
Prerequisite: History 260 or 361 or permission of the instructor.

406 Senior Seminar on Europe and Russia in the Eighteenth Century
Prerequisite: a previous course in early modern Europe or Russia or equivalent.

410 Senior Seminar in Early Modern English History
Senior students only.

411 Senior Seminar in English History from the Seventeenth to the Nineteenth Century.
Prerequisite: permission of the instructor.

412 Senior Seminar in Nineteenth and Twentieth Century British History.
Prerequisite: History 362 or permission of the instructor.

413 Senior Seminar in Modern French History
Prerequisite: permission of the instructor.

414 Senior Seminar in Modern European Intellectual History
Prerequisite: History 366 or permission of the instructor.

415 Senior Seminar in Modern German History
Prerequisite: normally History 357-58 (formerly 261-62) or equivalent.
(Open to qualified Third Year General Students.)

418 Senior Seminar in Russian History Since 1861
Prerequisite: a previous course in Russian history or permission of the instructor.

420 Senior Seminar in Canadian History
Prerequisite: a previous course in Canadian history.

421 Senior Seminar in Ontario History
Prerequisite: a previous course in Canadian history or permission of the instructor.

422 Senior Seminar in French Canadian History
Prerequisite: History 383-4 and a reading knowledge of French, or permission of the instructor.

423 Senior Seminar in Modern Quebec
424 Senior Seminar in Canadian Labour History
Prerequisite: a previous course in Canadian history.

425 Senior Seminar in Canadian Cultural History (to be announced)
Prerequisite: permission of the instructor.

426 Senior Seminar in Colonial American History
Prerequisite: permission of the instructor.

427 Senior Seminar in Nineteenth Century United States History
Prerequisite: permission of the instructor.

428 Senior Seminar in Modern American History
Prerequisite: permission of the instructor.

429 Senior Seminar in Latin American History
Prerequisite: permission of the instructor.

430 Senior Seminar in British Imperial and Colonial History
Prerequisite: History 277 or 370 or permission of the instructor.

435 Senior Seminar in the History of Native Response to Colonial Rule
Prerequisite: permission of the instructor.

440 Senior Seminar in Far East Asian History
Prerequisite: permission of the instructor.

442 Senior Seminar in Indian History
Prerequisite: History 377 or permission of the instructor.

452 Senior Seminar in the History of Science
Prerequisite: permission of the instructor.

453 Senior Seminar in Modern International Relations
Prerequisite: permission of the instructor.

456 Literature and History of the Victorian Age. A literary and historical survey of Victorian England through authors and works that have major significance in both fields. The student will be encouraged to use several approaches and forms of evaluation of this material. He will be obliged to register in English 456 or History 456 and direct and concentrate his study accordingly.

465 The History and Theory of Historical Writing
3 hours, lectures and seminars.
Senior students or permission of the instructor.

466* The History and Theory of Historical Writing
This half course will be offered in conjunction with a half course in the philosophy of history offered by the Philosophy Department.
3 hours. Lectures and seminars.
Prerequisite: Senior student or permission of the instructor.

491 Directed Studies in Special Topics
Senior students only.

Special Seminar - not for credit
This course is intended for students who wish to pursue an extended project of research and writing beyond the normal limits of a senior seminar. The course will include several faculty (and invited specialists) and will consist of the presentation and high level criticism of major papers.

Graduate Courses In History

565 The History and Theory of Historical Writing
566* Philosophy and History of Historical Writing.

Graduate Fields in History

600 The History and Theory of Historical Writing
    Prequisite: History 565 or equivalent.
601 Canadian History: The Conservative Tradition
602 Canadian History: The French Canadian Tradition
603 Canadian History: Labour History
604 Canadian History: Ontario History
605 Canadian History: Intellectual History
606 Canadian History: 19th Century
607 Canadian History: 20th Century.
608 Canadian History: Modern Quebec
610 British Imperial & Colonial History: The Caribbean.
611 African History
612 Indigenous Minorities
613 Latin American History
615 Early Modern English History
616 Modern English History: 17th to 19th Centuries
617 Modern British History: 19th & 20th Centuries.
619 Medieval History
620 Early Modern Europe: The Reformation Era.
621 18th Century Europe
622 Modern German History
623 Modern French History
624 Modern Russian History
625 Modern Central European History
626 Topics in Modern European Diplomatic History
627 Topics in Modern European Intellectual History
630 American Colonial History
631 United States History: 19th Century
632 United States History: 20th Century
640 Chinese history.
642 Modern India
691-4 Directed Studies in Specific Fields including specific Reformation studies, Ancient History and Historiography, and early Church History, among others.
695 Cognate Essay
699 Thesis
Department of Kinesiology

Associate Professor and Chairman of the department
N.J. Ashton, B.Sc. (P.E.) (McGill), M.S. (Michigan)

Professor and Dean of the School of Physical Education and Recreation

Assistant Professor
P. Davis, (Miss) B.P.H.E. (Toronto), M.Ed. (North Carolina)
W.A. Delahey, B.A. (B.P.H.E.) (Western)
H.J. Green, B.A., B.P.H.E. (Queen's) M.A. (Alberta)
D. Hayes, B.Sc., B.P.E., M.Sc. (Springfield)
M.E. Houston, B.Sc. (Toronto), Ph.D. (Waterloo)
P. King, B.P.E. (UNB), M.Sc., Ph.D. (Alberta)
J.C. Nash, B.A. (Western), M.S. (Illinois), Ph.D. (Ohio State)
R.W. Norman, B.A., B.P.E. (McMaster), M.Sc. (Alberta)
R.E. Priddle, (Mrs.), B.P.H.E. (Toronto)
J.P. Stothart, B.P.E., M.Sc. (Alberta), Ph.D. (Penn State)

Assistant Professor
C.A.W. Totzke, B.A. (Western)

Assistant Professor and Associate Chairman of the Department
W.N. Widmeyer, B.A. (Western), B.P.E. (McMaster), M.A. (California)

Assistant Professor
I. Williams, M.S., Ph.D. (Illinois)
G.H. Baycroft, B.P.E., M.Sc. (Alberta)
P.J. Bishop, B.Sc., B.P.E. (Waterloo), M.Sc. (Western Illinois)
R.D. Graham, B.A. (Western)
P. Hopkins, B.A. (Carleton), B.P.E. (Waterloo)
S. Kemp, (Miss), B.A. (Sir George Williams)
M. Lavelle, B.A. (Windsor), M.A. (Marquette)
R. McKillop, B.A., B.P.E. (Waterloo)
J. Simpson, B.P.H.R. (Toronto), M.A. (Illinois)

Course Descriptions

02* Introduction to Kinesiology
This course is designed to give the student an understanding of the field of study of Kinesiology. The study of human movement from mechanical, anatomical, sociological, psychological parameters will be discussed. Emphasis is placed on the relevance of such study to the applied fields of physical education, physical recreation and coaching.
2 hours lecture, 1 hour tutorial

103* Current Developments in Kinesiology and Recreation
An examination of current developments and problems in the fields of recreation, physical activity and sport in social and historical perspective. An attempt is made to analyze these situations and determine trends.
2 hours lecture, 1 hour tutorial

140* Introduction to Health 1
Emphasis is placed on the problems of youth. The course is designed to foster understanding and attitudes essential for making decisions related to present and future health practices.
3 lectures

141* Introduction to Health 2
An overview of marriage and family life. Also discussed are problems of environmental health and an examination of health agencies.
3 lectures
160* (180* Fine Arts) History of Dance to 1900  
Consideration is given to folk forms of dance and their eventual development to ethnic forms, theatre dance and neo-classic dance. Particular attention is paid to the simultaneous development of social folk and social ballroom dance with emphasis on the latter's development to the classic dance of the 19th century.  
3 lectures.

161* (181* Fine Arts) History of Dance Since 1900  
The emergence of modern dance in North America is examined in detail. The conditions leading to this new dance form, as well as past and future developments, are analyzed.  
3 lectures.

171* History of Sport and Physical Activity  
A cultural historical review of the development of sport and physical activity from the early Greek period to modern times. Special emphasis is placed on the development of sport in Canada since 1900 and the role of physical activity of all kinds in today's society.  
3 hours lecture.

185* Basic Skills  
(A programme of basic skills performance and analysis is conducted throughout terms 1 to 6 inclusive. Courses embraced by the description below are 185, 186, 285, 286, 385 and 386). Instruction and practice of the basic skills and the mechanical analysis of the following activities: aquatics, gymnastics, track and field, physical conditioning, low organizational games, square and folk dancing, basketball, soccer, judo, football (M), hockey (M), badminton, field hockey, volleyball, dance (W), lacrosse (M), wrestling (M), and skiing.  
Also included are the instruction and practice of the basic fundamentals of the following skills: archery, curling, fencing, golf, handball, paddleball, rugger, squash, tennis, skating and water polo.  
4 hours, terms 1 to 6 inclusive.

Skills Week  
Students will be given complete courses in canoeing, sailing, orienteering, and camping. Lectures in camp and waterfront administration will also be included.

200* Human Anatomy  
A study of the human anatomical systems and their integration. Particular emphasis is placed on the skeletal articular and muscular systems.  
3 lectures, 2 hours lab.

216* Organic Chemistry  
An introduction to organic chemistry.  
3 lectures.

217* Biochemistry  
Carbohydrates, lipids, proteins, hormones and vitamins. Metabolism of these groups of compounds in humans.  
3 lectures

222* Statistical Techniques Applied to Kinesiology  
An introduction to descriptive and inferential statistics and the interpretation of data. A major consideration of the course is the use of statistics in the solution of problems in Kinesiology.  
2 hours lecture, 2 hours laboratory.

240* Man Adapting  
An analysis of the physiochemical determinants of life essential for the understanding of man's nature. Views man from two points of view: an organic entity and a responding being.  
3 lectures
241* Epidemiology An investigation of the communicable and non-communicable diseases of man. The etiology, duration, and severity of selected diseases are studied, along with resistance and immunity: natural and artificial. 
3 lectures

260* Modern Dance Theories and Composition 1 (280* Fine Arts) An investigation of the communicable and non-communicable diseases of man. The etiology, duration, and severity of selected diseases are studied, along with resistance and immunity: natural and artificial. 
3 lectures

260* Modern Dance Theories and Composition 1 (280* Fine Arts) Historical survey and study and movement theories of late 19th and early 20th century - Delarte, Dalcroze, Wigman. Studio sessions involve the study of the elements of dance composition-space, time, dynamics. 
2 lectures, 2 hours studio

260* Modern Dance Theories and Composition 2 (281* Fine Arts) Historical survey and study and movement theories of late 19th and early 20th century - Delarte, Dalcroze, Wigman. Studio sessions involve the study of the elements of dance composition-space, time, dynamics. 
2 lectures, 2 hours studio

280* Administration A study of the principles underlying general administrative behaviour with an emphasis upon understanding the role and mechanics of decision making. Case study analysis and practical project work are utilized to foster the development of the student's administrative technique. 
3 lectures

285* Basic Skills See Kinesiology 185.

286* Basic Skills See Kinesiology 185.

281* Introduction to the Analysis of Human Movement Anatomical, neural and mechanical considerations of human physical activity are examined. 
3 lectures, 2 hours lab.

25* Basic Movement Education A study of the basic movements of the human and their relationship to sports and dance. To include basic locomotor movements, factors related to movement and creativity in movement. 
2 lectures, 2 hours lab.

330* Research Design An introduction to the basic principles of scientific inquiry in Kinesiology. A systematic treatment of the logic and practice of methods and techniques employed in research related to physical activity with an examination of design, sampling, data gathering and analysis. 
3 lectures.

5* Evaluation of Human Motor Performance Methods and procedures used in evaluating human physical performance are studied and practiced. Measurements of strength, motor performance, work capacity, reaction time and others, are included. 
3 lectures, 2 hours lab.

340* Care and Prevention of Athletic Injuries Prevention and correction of accidents in athletic activities. The use of proper personal and field equipment, support methods, conditioning exercises, the medical examination and therapeutic aids. 

345* Community Health A course designed to help students explore community and public health agencies. The course includes clinical experience for students with one or more agencies. 
3 lectures
355* Motor Learning  
An introduction to the theories of learning motor activity, individual differences, retention, transfer and other topics. Laboratory sessions enable the student to reproduce some of the standard experiments in this field.

360* Ballet History and Theory 1  
(380* Fine Arts)  
Historical survey, including the use of film of the development of ballet from the preclassic dance of the French courts to the beginning of the 20th century. Studio involves study of classic technique in R.A.D. Syllabus.

361* Ballet History and Theory 2  
(381* Fine Arts)  
Historical developments in the ballet since 1900 with particular reference to change in thematic content of significant choreographers and changing attitude toward the theatre.

385* Basic Skills  See Kinesiology 185.

386* Basic Skills  See Kinesiology 185.

400* Physiology of Physical Activity (Part 1)  
A study of the effects of physical activity on the muscular circulatory and respiratory systems and the mechanisms through which the body adapts to activity and environment.  
2 lectures, 1 hour lab.

401* Physiology of Exercise (Part 2)  
A study of the metabolic and environmental aspects of exercise, fatigue, training, and physical fitness. Work capacity in relation to age and sex will be examined.  
3 lectures, 1 hour lab.

405* Applied Kinesiology  
Principles of physiology and movement analysis as they apply to the development of maximal human motor performance are examined. Consideration is given to the effects of environmental, psychological and social factors on such developments. Intended for students not electing Kinesiology 401*, Physiology of Physical Activity, Part 2.

410* Growth, Development and Aging  
The changing capacities and interests of man are studied as he grows and develops. The contribution of physical activity and growth, and physical, psychological and sociological development is examined.  
3 lectures.

420* Kinesiological Determinants of Facility and Equipment Design  
A study of the interrelationship between the environment which man structures and human motor abilities. Currently available facilities and equipment will be studied as to suitability of design with reference to the size, strength, work capacity and other limitations of the user.  
3 hours lecture.

422* Administration of Facilities  
A study of the problems involved in the planning and maintenance of various athletic plants used by schools and recreation agencies and the selection and care of the equipment and supplies used with these facilities.  
3 lectures.

425* Kinesiology of Sport and Dance  
A detailed analysis, from a mechanical and anatomical perspective, of skilled and unskilled performance in dance and selected sports activities. Cinematography and electromyography laboratory sessions will be emphasized to investigate changes which occur during skill acquisition.
into central nervous system mechanisms involved in skilled movement.
3 lectures, 2 hours lab.

430* Research Project Each student will work under the direction of a member of the
department on an approved research topic in health education, physical
education or recreation. The results of the investigation will be presented
in thesis form.
1 hour lecture, 1 hour lab.

440* Marriage and Family The analysis of contemporary trends in Canadian family life. Topics
include mate selection, family planning, family life cycle, family
dissolution, and the impact of contemporary culture and values on the
modern family.

42* Adapted Physical Education The study of individual problems and their implications for the physical
educator. Body mechanic problems, orthopaedic disabilities, neurological
disabilities, psychologic disorders, heart disturbances and nutritional
problems will be discussed in depth.
2 lectures, 2 hours lab.

445* Seminar in Health A study of current issues pertaining to health and health education.
Topics include pertinent research in the field of health which have
significant value to the individual, family and community, as well as a
complete study of the problem areas in health education.
3 lectures.

50* Comparative Programmes in Physical Education and Recreation
A study of present physical education and recreation programmes of
major countries of the world. Also included will be the basic principles
involved in developing physical education and recreation programmes.
3 lectures.

452* Sport in Society An introduction to the sociology of sport. The course will consider sport
as a social institution and examine its Junction in society utilizing the
major frames of reference of the social sciences.
Prerequisite: Two term courses in the social sciences.

455* The Individual in Sport Situations An introduction to the social psychology of sport and physical activity,
including sport involvement and personality, attitude, and beliefs; the
team as a small group; and social influence and facilitation in sport
situations.
Prerequisite: Two term courses in psychology or social psychology.

470* Seminar in Kinesiology An examination of the current major issues in Kinesiology.
Included will be discussions of trends in applied kinesiology (e.g.
physical education).
3 hours.

480* Coaching Foundations A study of the basic principles and philosophies of coaching today.
An examination of the qualifications and responsibilities of the coach,
resource materials and problems pertinent to coaching.
3 lectures.

485 Advanced Skills Students will be required to study three skill activities in detail,
including advanced techniques, mechanical analysis and coaching
principles. Admission to courses will require above average ability in the
basic course. Courses offered will include aquatics, track and field,
Meeting in the Campus Centre
Department of Management Sciences

Activities and Scope

The Department of Management Sciences, Faculty of Engineering was established in 1969.

The two main activities of the department are complementary: (1) the pursuit of advanced research in selected field of the management sciences, and (2) the provision of post-graduate courses of instruction for people who want to achieve high professional qualifications. Active faculty engagement in advanced research as well as experience in professional practice is considered essential to the development of adequate courses of instruction. The boundaries between pure research, applied research and professional practice become indistinct when the aim is to discover imaginative new ways to solve complex management problems.

The scope of both research activities and courses of instruction is presently limited to the fields of expertise and special interests of the faculty. However, existing research and course offerings fall within the three major programme categories described below, and the aim of the new Department is to strengthen and develop these major fields of study.

The Programme in Operations Emphasis in Operations Research is placed on applications of Research mathematics to various types of operational management problems. The programme stresses basic concepts and methods of modelling rather than purely manipulative skills. Special qualifying pre-requisite studies in mathematics may be required of some applicants.

A candidate in this programme is required to do major studies in the field of Operations Research. He will also be required to do minor studies in the other fields specified. Courses may also be taken in other departments, and particular attention is drawn to those in the Departments of Applied Analysis and Computer Science, Combinatorics and Optimization, and Statistics in the Faculty of Mathematics.

The Programme in Applied Emphasis in Applied Economics is on the application of micro-economic theories to the modelling of economic activities of an enterprise or group of enterprises. The programme stresses the basic concepts of market behaviour, managerial economics, decision and value theories and
models, capital investment models, innovation processes and corporate
growth models, and the selection of pricing, promotion and product line
strategies.

A candidate in this programme is required to do major studies in the
field of Applied Economics. He will also be required to do minor studies
in the other fields specified.

The Programme in Organizational Emphasis in Organizational Behaviour Emphasis in Organizational Behaviour is placed on theories of
psychology and sociology as they pertain to an organizational system,
and on the modelling of communication processes and organization
structures. Studies include aspects of human behaviour such as
motivation, interpersonal relations, group interactions, communication,
perception, decision-making, and responses to organizational change and
managerial control. Studies may also include some aspects of
mathematical communication theories and systems theories as they relate
to models of organizations.

A candidate in this programme is required to do major studies in the
field of Organizational Behaviour. He will also be required to do minor
studies in the other fields specified. Courses may also be taken in other
departments, and particular attention is drawn to courses in the
Department of Psychology, Faculty of Arts.

Graduate and Research Programmes

Graduate credit is measured in units. A one-term course at the graduate
level counts as one unit. Equivalent credit may be given to students
transferring from other recognized universities for appropriate graduate
courses previously taken. Certain senior undergraduate courses at this
University may be taken for either partial or full graduate credit up to a
maximum of two units.

The normal academic load is four units per term for a fulltime
student. Five units may be taken with special permission only. Students
involved in part-time employment at the University or otherwise must
take a reduced academic load.

A Faculty Advisor is appointed to supervise the programme of study
of each graduate student. A new student must meet with his advisor
prior to graduate course registration to arrange and approve his
coursework programme and discuss his research interests. The progress
of the student will be reviewed at least once each term by the advisor.

Master's Degree Programmes The Master's Degree (M.A.Sc.) in Management Sciences is awarded
upon demonstration of individual accomplishment of a high professional
and academic standard. The candidate, with the approval of his advisor,
may elect to pursue either of the following programmes A or B.

Programme A. The candidate is required to take for credit a minimum of eight units of
graduate course work, no more than three of which may be prerequisite
type courses (MSS00-series). He is also required to prepare a project
report of professional calibre on an operational or theoretical problem,
under the supervision of a faculty advisor, to be submitted for credit
under MS807.

Programme B. The candidate is required to take for credit a minimum of four units of
course work, no more than one of which may be a prerequisite type
course (MS500-series). He is also required to prepare a research thesis of
professional calibre, under the supervision of a faculty advisor, to be
M.A.Sc. Qualifying Examination

In addition to the specific programme requirements above, all M.A.Sc. candidates will be required to demonstrate an understanding of the elements of courses MS507, MS508, and MS509. M.A.Sc. candidates will also be required to take a comprehensive qualifying examination that integrates the essential material of courses MS504 through MS509. This exam will be offered at the end of every term, and must be taken within one year of first registration.

Academic performance must be maintained at a high level, as specified in Faculty of Engineering and Department of Management Sciences regulations. It is expected that most students will require four or five terms (16 or 20 months) to complete an M.A.Sc. programme. The programmes are presently structured so that it is to a student's advantage (particularly in timetabling courses) to commence in the Fall Term.

The Ph.D. Degree Programme

The Ph.D. degree is awarded for accomplishment of independent and original research work and reporting thereon in a research thesis. The subsidiary requirements include passing preliminary Ph.D. examinations, passing a comprehensive Ph.D. examination, and receiving a satisfactory review by a supervising committee. All of these must be construed as contributing to the competent performance of the research objective.

Admission to the Ph.D. programme is based upon the student's academic record and evidence of ability to pursue independent research. No candidate will be admitted to the Ph.D. programme before a Faculty Advisor willing to supervise the candidate's research is appointed.

Minimum residence requirements for the Ph.D. degree are two academic years from the Master's degree level, or equivalent. The maximum time allowed is five consecutive years from the same level. The course work associated with the Ph.D. programme is intended to provide a foundation for advanced learning in the general field of study as well as for competent research performance in some specific area. While there is no fixed requirement as to the number of credit units to be taken, the Advisor and the supervisory committee for each candidate will consider the level and adequacy of each candidate's preparation in drawing up his specific programme.

Ph.D. Preliminary Exams

Each candidate will be required to pass a set of preliminary examinations approximately eight months after first registering. These prelims will cover approximately the same material covered in courses MS504 through MS509 listed below.

Ph.D. Comprehensive Exam

The form of this examination varies with the applicant's background and will be determined by the Department.

Course Descriptions

500-series courses are generally regarded as pre-requisites for all degree candidates who have not already gained knowledge from equivalent courses prior to registration.

MS502 Computer Programming
MS503 Computer Systems
MS504 Mathematical Foundations for Management Sciences
MS505 Probability Theory 1
MS506 Statistical Estimation and Inference
Department of Management Sciences

MS507 Operations Research Models and Modelling
MS508 Micro-Economics
MS509 Industrial Psychology

600-series courses are regularly scheduled full-credit graduate courses.

MS601 Approaches to Modelling and Measurement
MS620 Organization Theory 1
MS621 Mathematical Methods in Micro-Organizational Research
MS622 Social Psychology
MS623 Mathematical Methods in Organization Research
MS624 Motivation to Work
MS625 Organization Theory 2 (Macro-Organizations)
MS626 Organizational Communication and Structure
MS633 Production Planning and Inventory Control 1
MS634 Seminar on Operations Research Literature
MS635 Theory and Techniques of Optimization 1
MS636 Theory and Techniques of Optimization 2
MS640 Strategies of Research and Development 1
MS642 Strategies of Research and Development 2
MS650 Probability Theory 2
MS651 Applications of Probability Models in O.R. and Economics
MS652 Statistical Inference and Decision Theory
MS653 Statistical Decision Theory
MS654 Industrial Experimentation for Engineer
MS655 Statistical Quality Control and Reliability
MS663 Managerial Economics
MS682 Network Methods
MS683 Markov Models and Dynamic Programming
MS688 Graph Theory and Applications
MS689 Decision Theory

700-series courses are irregularly scheduled as demands arise.

MS700 Special Directed Readings
MS710 Seminar in Marketing
MS720 Seminar in Organizational Behaviour
MS730 Seminar in Operations Research
MS740 Seminar in Research and Development
MS750 Seminar in Probability/Statistics
MS760 Seminar in Economics
MS770 Seminar in Finance
MS780 Seminar in Mathematical Programming
MS790 Seminar in Public Sector Modelling

800-series numbers apply to general graduate degree requirements.

MS801 Oral Examination for the Ph.D.
MS803 Comprehensive Examination for the Ph.D.
MS806 Preliminary Examinations
MS807 Management Sciences M.A.Sc. Project
MS808 Research Thesis for the M.A.Sc.
MS809 Research Thesis for the Ph.D.

Further Information Course descriptions are available on request. A brochure outlining general programmes and qualifications of the faculty of the Department of Management Sciences is available on request.
Department of Man-Environment Studies

Professor and Chairman  
G.R. Francis, B.A. (Toronto), B.A. (McGill), M.A. (British Columbia), Ph.D. (Michigan)

Professor, and  
P.H. Nash, B.A., M.A. (California; C.E. (Grenoble); M.C.P., M.P.A.,
†Dean of the Division  
Ph.D. (Harvard); A.I.P.
†Associate Professor  
J.T. Horton, B.A. (Wheaton), M.A. (Northwestern)
†Associate Professor  
W. Shalinsky, B.A., B.S.W (McGill), M.Sc., D.S.W. (Western Reserve)
Assistant Professor  
G.S. Davies, B.P.E., B.Sc., M.Sc. (British Columbia), Ph.D. (California)
Assistant Professor  
C.E. De'ath, B.A. (Auckland), ASOPA Cert. (Sydney), M.Ed., Ph.D. (Pittsburgh)
Assistant Professor  
D.W. Fischer, B.S. (Trinity), M.S. (Michigan State) Ph.D. (Colorado State)
†Assistant Professor  
S.K. Gupta, B.Sc., M.Sc. (Punjab), M.A., Ph.D. (Toronto)
Assistant Professor  
R.F. Keith, B.S.A. (Guelph), M.A., Ph.D. (Michigan State)
†Assistant Professor  
E.M. Pallett, B.A.Sc., M. Music (Oregon) Ph.D. (Michigan State)
Assistant Professor  
T.McL. Semple, B.A. (Western Ontario), M.A., Ph.D. (Waterloo)
†Assistant Professor  
J.B. Theberge, B.Sc.A. (Guelph), M.Sc. (Toronto)
Assistant Professor  
D.L. Wahlsten, B.S. (Alma College), Ph.D. (California)
†Lecturer  
S.C. Lerner, B.A. (Ohio State), M.A. (Columbia)

†Divisional Appointments: Faculty members appointed also in other Schools or Departments in the Division of Environmental Studies.

Course Descriptions

110* Environmental Perception  
Analysis of the nature of man's percepts, images, and meanings of environmental phenomena. Changing attitudes towards environment; consideration of differences in human perception caused by cultural, personality, age, social, economic, and ethnic factors.
3 lectures (Winter term)

120* Biological Perspectives  
Selected topics in biology will be studied in the context of some current problems facing mankind. Specifically, relevant aspects of genetics, evolution, embryology, reproductive physiology, and brain function will be applied to the problems of foreign substances in the body (pollution and drugs), the population explosion (birth control), and biological warfare. Critical evaluation of current research will be stressed.
Prerequisite: Honours Man-Environment or consent of Instructor
3 lectures (Fall term)

121* Psychological Perspectives  
Basic mechanisms and processes. Sensory mechanisms; perceptual processes; intellect, personality and creativity. Discussion of the effect of the environment on psychological models of man; psychoanalytic models, radical behaviourism, cognitive model, humanistic models.
Prerequisite: Honours Man-Environment or consent of Instructor
3 lectures (Winter term)

130* Aspects of Canadian Society  
Background material on the structure and functioning of the Canadian governmental, economic and social system as a context within which various man-environment issues can be understood; introduction to decision-making and organization theory for examining social processes affecting the analyses and solution of man-environment problems; selected issues considered.
Prerequisite: Honours Man-Environment or consent of Instructor
31* Aspects of Canadian Society  
Prerequisite: M-ENV 130*  
2 3 hours (Winter term)

50* Man-Environment Research  
Sources of man-environment information and research questions. Library research. Field research. Survey techniques. Participation observation techniques. Elementary structured and unstructured non-experimental research design. Basic measurement techniques as these relate to the collection and analysis of qualitative data.  
Prerequisite: Honours Man-Environment or consent of Instructor  
3 hours (Winter term)

190* Core Seminar 1  
A problem and issue-oriented seminar stressing interdisciplinary treatment of environmental problems, including discussions, special small group projects and field work as appropriate; exploration of ways in which individuals can learn about and become sensitive to their various social and physical environments.  
Prerequisite: Honours Man-Environment students or consent of Instructor  
3 hours (Fall term)

191* Core Seminar 2  
Prerequisite: M-ENV 190*  
3 hours (Winter term)

195* Overview of Man-Environment Problems  
A series of lectures covering major topics of the "environmental crisis" as seen in terms of the interrelationships of man with his social, man-made physical, and more natural environments. Topics will include population growth, environmental pollution, the conservation and management of natural resources, and environmental problems of urban areas.  
3 hours (Winter term)

Similar to and alternates with GEOG 195*. Not open to students who have taken GEOG 195*. Architecture students to take ARCH 122* which covers similar topics.

200* Ecology and Environment  
Introduction to main concepts and principles of ecology; cycling of elements, energetics and structural organization of major ecological systems; population dynamics; impact of natural resource management practices and urban and industrial development on environment.  
2 lectures, 2 hour lab. (Fall term)

Cross-listed as Planning 200*, Geography 200* and Architecture 222*, but offered to separate sections as necessary.

201* Introduction to Applied Ecology  
A course in the principles of ecology which stresses the impact of the environment and man on populations. Important ecological processes, pollution, conflicts of interest. The ecology of invasions and biological control. An introduction to systems analysis in ecology.  
No prerequisite. Primarily for students in faculties other than Environmental Studies. Not open to students who have taken M-ENV 200*, GEOG 200*, PLAN 200*, or ARCH 222*.  
2 lectures and three Saturday field trips (Winter term)

220* Man and Resource Use  
Review of the main physical, organizational and institutional factors governing Man's decisions to use natural resources. Appraisal of such resources as land, water, food, forests, wildlife, minerals, energy, oceans and air with special attention to contemporary conflicts of use, and main issues in resource policy and management. Reference to global and regional contexts.  
Prerequisite: M-ENV 130*  
3 hours (Winter term)
30* Aspects of Canadian Society 3
A problem and issue-oriented course dealing with topics related to specific environmental problems in the Canadian setting; a continuation of M-ENV 130*-131*.
Prerequisite: Honours Man-Environment students, or consent of Instructor.
3 hours (Winter term)

31* Aspects of Canadian Society 4
Prerequisite: M-ENV 230*
3 hours (Winter term)

240* Small Groups in the Environment
Selected elements of small group dynamics such as goal-setting, interpersonal relations, group development, change and influence in and by groups and communication. Different kinds of groups will be examined, and role of small group decision-making in organizational and social change will be discussed. Class participation as a small group process.
3 hours (Fall term)

241* Social Change Processes.
An analysis of major theories of social change, the sources and patterns of change and change processes, with emphasis on the environmental context.
3 hours (Winter term)

271* Quantitative Techniques for Environmental Problems 1
An introduction to the philosophy of science, scientific method, and statistical techniques. Experimental design considerations and computer concepts will be stressed. Some programming and statistical significance tests will be introduced.
Prerequisite: Honours Man-Environment students or consent of Instructor
3 hours (Winter term)

272* Quantitative Techniques for Environmental Problems 2
Prerequisite: M-ENV 250* or consent of Instructor
3 hours (Winter term)
Cross-listed as Planning 272* and Geography 272*

275* Special Readings
Prerequisite: Consent of the instructor
2 hours or equivalent

280* Environmental Problems Workshop
Each term, one or two major problems involving analysis and solution of a specific environmental problem will be dealt with by student groups composed of various specialities. Emphasis will be placed on the teamwork involved in defining the problem components, obtaining the necessary data for thorough analysis, and incorporating the analysis into formulation and evaluation of alternative solutions to the problem.
Offered at second, third and fourth year levels. Open to a maximum of 40 students, with a maximum of 10 from each of Man-Environment, Geography, Planning and Architecture.
(Fall term)

281* Environmental Problems Workshop
See M-ENV 280*
(Winter term)

290* Core Seminar 3
A problem and issue-oriented seminar or workshop; special emphasis on interdisciplinary treatment of environmental problems.
Prerequisite: Honours Man-Environment students or consent of Instructor
Department of Man-Environment Studies

291* Core Seminar 4  
**Prerequisite: M-ENV 290**
3 hours (Winter term)

310* Psychological Man  
The psychological correlates of the differing environments in which man develops and continues adult life. The emphasis will be on individual differences assessed by empirical techniques and objective criteria derived from the physical and cultural environment.
3 hours (Fall term)

320* Environmental Economics  
Principal economic forces that affect the environment. Examination of macro and micro concepts of economic welfare including scarcity, leisure, externalities, growth and property. Introduction to social benefit-cost analysis as applied to environmental problems.
3 hours (Fall term)

335* Management of Environmental Resources  
Major problems and issues in the management of resources. Synthesis of ecological, economic, and institutional aspects. Guiding concepts of management such as sustained yields, multiple purpose, joint product development. Integrating resource management with social and economic development policies and programmes.
2 hours (Winter term)

340* Government, Politics and Environmental Programmes  
Examination of the processes whereby political, social and economic goals are incorporated into environmental programmes. Study of selected government agencies having regulatory powers for environmental management, and discussion of some decision problems confronting them.
2 hours seminar (Fall term)

350* Community Action on Environmental Problems  
This course will focus on the citizen's role in the solution of environmental problems. The work of various community groups will be examined and evaluated. Students will take part in one group project to experience the process at first hand.
2 hours (Fall term)

351* Organization and Environment Change  
Analysis of organizations, both public and private, as a vehicle for instituting change in the contemporary environment. Goal formation, policy decisions and effects of change on society.
2 hours seminar (Winter term)
Not offered in 1971-72

356* Introductory Ekistics  
**Basic Principles**  
3 hours seminar (Fall term)

58* Environmental Pollution and Its Control  
A general overview course on environmental pollution, its causes and effects, human and technical aspects. Topics will cover air, water and soil pollution from waste products; biological, economic, political and legal aspects; technical and social control measures.  
*No prerequisite.*
3 hours (Winter term)

360* Science, Technology, Art and Environment  
Comparisons among science, technology and the creative arts in terms of their influence on the nature of Man's environments. Interactions among science, technology and the visual arts.
3 hours (Winter term)
362* Environments of the Future
Techniques of forecasting and projection of components of the environments of the future. Technological forecasting, environmental impacts. Social and economic forecasting. Scenario and Delphic approach to the consideration of alternative futures.
3 hours (Fall term)

366* Advanced Ekistics
Systems of Human Settlement
The nature of settlements as an interacting system. Functions of urban subsystems. Theories of urban regional development. Simulation and other analysis techniques. Critical review of ekistic concepts and methods, with special emphasis on policy synthesis, programmes and plans.
3 hours seminar (Winter term)

375* Special Reading, or Seminar on Selected Topic
Prerequisite: Consent of the Instructor
2 hours or equivalent

380* Environmental Problems Workshop
See M-ENV 280*
(Fall term)

381* Environmental Problems Workshop
See M-ENV 280*
(Winter term)

390* Seminar-Workshop
A series of seminars and workshop periods to integrate the work of the students in other courses. Emphasis is on team and individual approach to environmental problems in several areas. Field work when appropriate.
Prerequisite: Honours Man-Environment students or consent of Instructor.
4 hours (Fall term)

391* Seminar-Workshop
A continuation M-ENV 390*
Prerequisite: Honours Man-Environment students or consent of Instructor.
4 hours (Winter term)

410* Environmental Education
Study of the factors influencing environmental perception in the traditional educational system. Innovative curricula and practices for enhancing environmental learning in the context of the primary and secondary classroom structure. Environmental education for adults; a consideration of the use of the media, extension courses etc.
2 hours and 2 hours workshop (Fall term)
Not offered in 1971-72

420* Seminar on Urban Environment
Modern cities as a migratory and rapid growth phenomenon. Related technological and social problems especially insofar as these concern planners and migrant groups. Inter-, infra- and extra-city linkages.
2 hour seminar (Winter term)
Not offered in 1971-72

430* Natural Environment and International Development
Economic benefits and ecological costs of resource development projects in developing countries. Comparison of different development strategies and their environmental effects.
2 hour seminar (Fall term)
Not offered in 1971-72

431* Comparative Environmental Systems
Comparison of capitalist and socialist States' approaches to environmental concerns. Examination of ideological factors and their effects.
2 hours seminar (Winter term)
Not offered in 1971-72

40* Communication Systems and the Human Environment
A study of processes of communication and communication systems in the context of human environments. A communication focus will be utilized in analyses of urban and rural environments, of institutional and organizational environments, of processes of innovation and planned change.
2 hours seminar (Fall term)
Not offered in 1971-72

450* Environmental Policy: Generalists and Specialists
Role of generalists and specialists in society. Current policy problems examined from these viewpoints. Recent changes in public attitudes, legislation, agencies and functions in terms of the relative importance of these roles.
2 hours (Winter term)
Not offered in 1971-72

460* Series. Special Topics Relating to Environment
This series is to provide an opportunity for students to study particular problems selected from areas of special interest and experience of individual faculty members. The topics will change from time to time. Those available for 1971-72 are:

461* Perceptions of Environmental Control (T. Semple)

462* Coastal Environment Studies (D. Fischer)

463* Minority Groups and Their Social Environment (C. De'ATH)

464* International Organizations and Environmental Problems (G. Francis)

465* Poverty in Canada (W. Shalinsky)

466* Ecology and Resource Management (G. Davies)

467* Public Behaviour and Environmental Design (M. Pallett)

468* Communication and Innovation (R. Keith)
Prerequisite for the 460 series: Consent of Instructor
2 hours

5* Special Readings or Seminar on Selected Topics
Prerequisite: Consent of Instructor
2 hours or equivalent. (Fall and Winter)

76 Special Readings or Seminar on Selected Topics
Prerequisite: Consent of Instructor
2 hours or equivalent

480* Environmental Problems Workshop
See M-ENV 280*
(Fall term)
Not offered in 1971-72
481* Environmental Problems
Workshop  See M-ENV 280*
(Winter term)
Not offered in 1971-72

490* Seminar-Workshop  A series of seminars and workshop periods over which the student will be expected to develop and present an analysis of a major environmental problem in the form of a thesis essay. Group or individual work as appropriate.
Prerequisite: Honours Man-Environment students or consent of Instructor.
4 hours (Fall term)
Not offered in 1971-72

491* Seminar-Workshop  A continuation of M-ENVY 490*
Prerequisite: Honours Man-Environment students or consent of Instructor
4 hours (Winter term)
Not offered in 1971-72
Faculty of Mathematics

Department of Applied Analysis and Computer Science

Associate Professor
D. D. Cowan, B. A. Sc. (Toronto), Ph.D. (Waterloo)

Chairman of the Department

Distinguished Professor
J. Aczel, Ph.D. (Budapest), Habil. D.Sc. (Hung. Academy of Science)
(On Sabbatical leave, 1971-1972)

Professor
J.A. Brzozowski, M.A.Sc. (Toronto), Ph.D. (Princeton)

Professor
P.C. Fischer, M.B.A. (Michigan), Ph.D., (M.I.T.), F.S.A.

Professor (Applied Mathematics, and Applied Analysis and Computer Science)
C. Froese Fischer (Mrs.), M.A. (UBC), Ph.D. (Cantab.)

Professor and Director of Computing Centre
J.W. Graham, M.A. (Toronto)

Professor
H. Haruki, Ph.D. (Osaka)

Professor (Applied Mathematics, and Applied Analysis and Computer Science)
M.A. McKieman, M.A. (Loyola), Ph.D. (I.I.T.)

Professor
T. Pietrzykowski, M.A. (Warsaw), Ph.D. (Polish Academy of Sciences)

Associate Professor
W.M. Gentleman, B.Sc. (McGill), Ph.D. (Princeton)

Associate Professor
P.L. Kannapan, B.Sc. (Annamalai), Ph.D. (Washington)

Associate Professor and Associate Dean of Graduate Studies
J.D. Lawson, B.A.Sc. (Toronto), Ph.D. (Waterloo)

Associate Professor

Associate Professor of the Department
E.A. Ashcroft, B.A. (Cantab.), Ph.D. (Imperial College)

Assistant Professor
J.A. Baker, M.A. (Saskatchewan), Ph.D. (Waterloo)

Assistant Professor
P.C. Brillinger, B.A. (McMaster), M.A. (Waterloo)

Assistant Professor and Director of First Year Studies in the Faculty of Mathematics
C.E. Kohn, B.Eng.Sc. (Western Ontario), M.Sc. (Birmingham)

Director of Computing Centre
C.E. Kohn, B.Eng.Sc. (Western Ontario), M.Sc. (Birmingham)

Assistant Professor
D.J. Cohen, M.Sc. (Technion-Haifa), Ph.D. (Waterloo)

Assistant Professor
R.S. Cohen (Mrs.), M.Sc. (Technion-Haifa), Ph.D. (Ottawa)

Assistant Professor
K. Culik, M.Sc., R.N. Dr. (Charles University, Prague). Ph.D. (Czechoslovakian Academy of Science)

Assistant Professor and Associate Director of Computing Centre
J.G. Linders, M.A.Sc. (Toronto), Ph.D. (Imperial College)

Assistant Professor
D.E. Morgan, B.S. (Rose Polytechnic Institute), M.S. (Michigan)

Assistant Professor
R.B. Roden, M.A. (Toronto), Ph.D. (Cantab.)

Assistant Professor
R.V.M. Zahar, M.A. (U.B.C.), Ph.D. (Purdue)

Assistant Professor (part-time)
J.H. Vellinga, B.A. (Western), M.A. (Waterloo)

Lecturer
M. Beaupre, B.Sc. (Ottawa)

Lecturer
V.A. Dyck, M.Math. (Waterloo)

Lecturer
D.A. Gordon, B.Sc. (Manitoba), M.Math. (Waterloo)

Lecturer
R. Shinghal, B.E. (Burdwan, India), M. Tech. (Kanpur, India), M.Phil. (Waterloo)

Lecturer (part-time)
T.C. Wilson, M.Sc. (Chicago)

Research Assistant
S. Aczel (Mrs.), M.A. (Szeged)

Instructor (Statistics, and Applied Analysis and Computer Science)
J.E. Gentleman (Mrs.), B.S. Math., M.S. Stat. (Chicago)

Post-Doctorate Fellow
R. Benesch, M.Sc. (Alberta), Ph.D. (Queen's)

Post-Doctorate Fellow
A. Gabrielian, Ph.D. (M.I.T.)

Post-Doctorate Fellow
H.S. Shank, M.Sc. (Chicago), Ph.D. (Cornell)
Faculty of Mathematics

Post-Doctorate Fellow
A. Zajtz, Ph.D. Habilitation (Jagiellonian University, Krakow, Poland)

Department of Applied Mathematics

Professor
D.G. Wertheim, B.A. (McMaster), Ph.D. (Toronto)

Chairman of the Department
Professor
E.T. Davis, M.Sc. (Wales), Dottore in Matematica (Rome), Ph.D., D.Sc. (London) (McMaster), Ph.D. (Toronto)

Professor (Applied Analysis and Computer Science, and Applied Mathematics)
C. Froese Fischer (Mrs.), M.A. (U.B.C.), Ph.D. (Cantab.)

Professor
B. Forte, Ph.D. (Pisa), Habil. D.Sc. (Rome)

Professor (Applied Analysis and Computer Science, and Applied Mathematics)
M.A. McKiernan, M.A. (Loyola), Ph.D. (I I T)

Associate Professor
C.F.A. Beaumont, B.A. (McMaster), M.A. (Toronto)

Associate Dean of the Faculty of Mathematics

Associate Professor
J. Cizek, R.N.Dr. (Charles University, Prague), C.Sc. (Inst. Phys. Chem., Czechoslovakian Academy of Sciences, Prague)

Associate Professor
J. Froese, B.A. (Manitoba), M.A. (Queen's), Ph.D. (U.B.C.)

Associate Professor

Associate Professor
G.J. Lastman, M.A. (U.B.C.), Ph.D. (Texas)

Associate Professor
D. Lovelock, Ph.D. (Natal, Durban)

Associate Professor
I.J. McGee, B.A.Sc. (Toronto), M.Sc. (Waterloo), Ph.D. (Yale)

Associate Professor
J. Paldus, R.N.Dr. Fac. of Math. and Physics (Charles University, Prague), C.Sc. (Inst. of Phys. Chem., Czechoslovakian Academy of Sciences, Prague)

Associate Professor
P.J. Ponzo, M.A. (Toronto), Ph.D. (Illinois)

Associate Professor
R.A. Wentzell, B.Sc. (Acadia), Ph.D. (Western) (On Sabbatical Leave, 1971-1972)

Assistant Professor
Z. Dvorcek, M.S. (Charles University, Prague), Ph.D. (Czechoslovakian Academy of Sciences, Prague), R.N.Dr. (Charles University, Prague)

Assistant Professor
S.P. Lipshitz, B.Sc. Hons. (Natal), M.Sc. (South Africa), Ph.D. (Witwatersrand)

Assistant Professor
R.G. McLenaghan, M.Sc. (Queen's), Ph.D. (Cambridge)

Assistant Professor
M.E. Snyder (Mrs.), B.Sc. (Western), M.Sc. (Waterloo)

Assistant Professor
J. Wainwright, B.Sc. (Natal), Ph.D. (U. South Africa)

Lecturer (part-time)
D.I. MacLeod, M.A. (Waterloo)

Lecturer (part-time)
B.J. Marshman (Mrs.), M.Sc. (Waterloo)

Lecturer (part-time)
D.W. Trim, M.Sc. (Waterloo)

Instructor
V.M Bobetic, M.A. (Zagreb, Yugoslavia)

Research Associate
T.N.E. Skinner, M.Sc. (Natal)

Adjunct Professor
D.J. Henderson, B.A. (U.B.C.), Ph.D. (Utah), F. Inst.P.

Adjunct Professor
H. Rund, Ph.D. (Cape Town), Habilitation (Freiburg)

Department of Combinatorics and Optimization

Professor
G. Berman, M.A., Ph.D. (Toronto)

Chairman of the Department

Distinguished Professor
W.T. Tutte, Ph.D. (Cantab.), F.R.S.C.

Professor
H.F. Davis, Ph.D. M.I.T.

Professor
J. Edmonds, B.A. (Geo. Washington), M.S. (Maryland)
### Faculty of Mathematics

**Professor** K.D. Fryer, B.A. (Western), Ph.D. (Toronto)

**Professor** R.C. Mullin, B.A. (Western), Ph.D. (Waterloo)

**Professor** C.J.A. Nash-Williams, Ph.D. (Cantab.), F.R.S.E.

**Professor** R.C. Read, M.A. (Cambridge), Ph.D. (London)

**Associate Professor** C.E. Haff, B.S. (Stanford), Ph.D. (Waterloo)

**Associate Professor** D.H. Younger, Ph.D. (Columbia)

**Assistant Professor** J.A. Bondy, D. Phil. (Oxon.)

**Assistant Professor** R.N. Burns, B.Sc. (Toronto), Ph.D. (Waterloo)

**Assistant Professor** R. P. Gupta, M.Sc. (AGRA University), Ph.D. (Indian Statistical Institute)

**Assistant Professor** R.A. Honsberger, B.A. (Toronto), M.A. (Waterloo)

**Assistant Professor** U.S.R. Murty, M.A. (Osmania), Ph.D. (Indian Statistical Institute)

**Assistant Professor** R.A. Honsberger, B.A. (Toronto), M.A. (Waterloo)

**Assistant Professor** E. Anderson, B.A. (McMaster)

**Administrative Assistant**

**Lecturer** R.G. Dunkley, B.A. (Western)

**Lecturer** G.B. Faulkner, B.A.Sc. (Toronto), M.Sc. (Waterloo)

**Lecturer** W.I. Miller, B.A. (Queen’s)

**Instructor** P. Schellenberg, M.A. (Waterloo)

**Instructor** P. Zima, M.Sc. Physics (Charles University, Prague)

**Instructor (part-time)** A.W. Colijn, M.Sc. (Alberta.)

**Instructor (part-time)** T.A. Jenkyns, B.Sc. (Alberta)

**Assistant Professor** M.E Thomson (Mrs.), B.Sc. (Toronto), Ph.D (Illinois)

**Post-Doctorate Fellow** V. Chvatal, M.A. (Charles University, Prague), Ph.D. (Waterloo)

**Post-Doctorate Fellow** J.K. Vranch, Ph.D. (Waterloo)

**Post-Doctorate Fellow** T.R.S. Walsh, M.Sc. (Toronto)

**Post-Doctorate Fellow** J.A. Zimmer, M.A. (Nebraska), Ph.D. (Waterloo)

### Department of Pure Mathematics

**Professor** W. Benz, Staatsexamen (Mathematics, Physics), Ph.D. (Mainz), Habilitation (Mainz)

**Professor** H.H. Crapo, A.B. (Michigan), Ph.D. (M.I.T.)

**Professor** G.E. Cross, M.A. (Dalhousie), Ph.D. (U.B.C.)

**Dean of Graduate studies**

**Professor** D.Z. Djokovic, Ph.D. (Beograd)

**Professor** R.A. Staal, Ph.D. (Toronto)

**Professor** D.B. Sumner, M.Sc. (Cantab.), D. Phil. (Witwatersrand)


**Associate Professor** Y. Chen, M.Ph. (Frankfurt), Ph.D. (Bochum)

**Associate Professor** G. Dankert, Dipl. Math. (T. U. Hannover), Ph. D. (Cologne)

**Associate Professor** P. Hoffman, B.A. (Toronto), Ph.D. (Manchester)

**Associate Professor** M.A. Kcr-Lawson, B.A. (Toronto), S.M. (Chicago), Ph.D. (McMaster)

**Associate Chairman of the Department**

**Associate Professor** F.C.Y. Tang, B.Sc. (Hong Kong), M. S. (South Carolina), Ph.D. (Illinois)


**Assistant Professor** J.G. Anderson, M.Sc. (Durham), Ph.D. (Newcastle upon Tyne)

**Assistant Professor** S. Burris, Ph.D. (Oklahoma)

**Assistant Professor** L.J. Cummings, Ph.D. (U.B.C.)
Faculty of Mathematics

Assistant Professor D. Higgs, B.Sc. Hons. (Witwatersrand), M.A. (Cantab.), Ph.D. (McMaster)
Assistant Professor J. Malzan, Ph.D. (Toronto)
Assistant Professor E.M. Moskal, B.A. (Toronto), Ph.D. (Illinois)
Assistant Professor (St. Jerome's and Pure Mathematics) D. Mowat, Ph.D. (Waterloo)
Assistant Professor K.A. Rowe, B.A. (Toronto), M.S. (Wisconsin), Ph.D. (Illinois)
Instructor R.C. Wilton, M. Math. (Waterloo)
Post-Doctorate Fellow J.M. Brown, Ph.D. (S.I.T.)
Post-Doctorate Fellow L.J. Dickey, M.A. (Arizona), Ph.D. (Wisconsin)

Department of Statistics

Professor A. Sprott, Ph.D. (Toronto)
Chairman of the Department
Associate Professor W.F. Forbes, Ph.D. D.Sc. (London)
Dean of the Faculty of Mathematics
Associate Chairman of the Department
Professor V.P. Godambe, M.Sc. (Bombay), Ph.D. (London)
Professor (Philosophy and Statistics) J.S. Minas, B.A. (Wayne), Ph.D. (Illinois)
Professor (Psychology and Statistics) M.D. Vogel-Sprott, B.A. (McMaster), Ph.D. (Toronto)
Associate Professor G.W. Bennett, Ph.D. (Adelaide)
Associate Professor J.G. Kalbfleisch, B.Sc. (Toronto), Ph.D. (Waterloo)
Associate Professor K. R. Shah, M.A. (Bombay), Ph.D. (Indian Statistical Institute)
Associate Professor (Psychology and Statistics) R.V. Thysell B.S. (Montana), Ph.D. (Iowa)
Assistant Professor M.A. Bennett, B.A. (Nottingham), F.S.A., F.C.I.A.
Assistant Professor W.H. Cherry, Ph.D. (Melbourne)
Assistant Professor R.L. Prentice, B.Sc. (Waterloo), Ph.D. (Toronto)
Assistant Professor W.S. Rickert, Ph.D. (Waterloo)
Assistant Professor J.C. Robinson, M.A.Sc., P. Eng., Ph.D. (Waterloo)
Assistant Professor M. E. Thompson (Mrs.), B.Sc. (Toronto), Ph.D. (Illinois)
Assistant Professor J.B. Whitney, M.A. (Western), Ph.D. (Toronto)
Assistant Professor J.C. Young, B.A.Sc. (Toronto), M.Sc. (Waterloo), Ph.D. (Edinburgh)
Assistant Professor (part-time) R.C. Frecker, B.Sc. (Memorial), M.D. (Dalhousie)
Assistant Professor (part-time) J.D. Kalbfleisch, Ph.D. (Waterloo)
Lecturer H.A.J. Allen, M.A. (Toronto)
Lecturer D.E. Clow, B.Math. (Waterloo)
Lecturer C.C. Springer, M.Sc. (McGill)
Administrative Assistant
Lecturer V. Taht, M.A. (Toronto)
Lecturer (part-time) J. Holt, M.A. (Toronto), Ph.D. (Waterloo)
Instructor (Applied Analysis and Computer Science, and Statistics)
Research Assistant E. Paldus, M.U.Dr. (Charles University, Prague)
Adjunct Professor P. Robinson, Dipl. Math. Stat. (Cantab.), Ph.D. (Cape Town)
Adjunct Professor M. Zelen, B.S. (City College, New York), M.A. (North Carolina), Ph.D. (American University, Washington, D.C.)
Visiting Professors with Faculty of Mathematics (1970-1971)

<table>
<thead>
<tr>
<th>Name</th>
<th>On Leave From</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. Erdős</td>
<td>Mathematical Institute of the Hungarian Academy of Sciences, and Division of Budapest, Hungary</td>
<td>Combinatorics and Optimization, Mathematical Research</td>
</tr>
<tr>
<td>J.J. Florentin</td>
<td>Imperial College, London, England</td>
<td>Applied Analysis and Computer Science, and Division of Mathematical Research</td>
</tr>
<tr>
<td>D.R. Fulkerson</td>
<td>Rand Corporation, Santa Monica, California</td>
<td>Combinatorics and Optimization, and Division of Mathematical Research</td>
</tr>
<tr>
<td>F. Harary</td>
<td>University of Michigan, Ann Arbor, Michigan</td>
<td>Combinatorics and Optimization and Division of Mathematical Research</td>
</tr>
<tr>
<td>E.L. Johnson</td>
<td>IBM Research, Yorktown Heights, New York, Institute of Mathematics, Braunschweig, West Germany</td>
<td>Combinatorics and Optimization, Division of Mathematical Research</td>
</tr>
<tr>
<td>H. H. Kaires</td>
<td>University of Zagreb, Zagreb, Yugoslavia</td>
<td>Statistics, and Division of Mathematical Research</td>
</tr>
<tr>
<td>S. Kurepa</td>
<td>Ruhr University, Bochum, West Germany</td>
<td>Pure Mathematics, and Division of Mathematical Research</td>
</tr>
<tr>
<td>W. Leisner</td>
<td>University of Stockholm, Stockholm, Sweden</td>
<td>Mathematical Research</td>
</tr>
<tr>
<td>A. Lundberg</td>
<td>University of Stockholm, Stockholm, Sweden</td>
<td>Division of Mathematical Research</td>
</tr>
<tr>
<td>H. Schneeweiss</td>
<td>University of Saarbrücken, Saarbrücken, West Germany</td>
<td>Statistics, and Division of Mathematical Research</td>
</tr>
<tr>
<td>I. Vincze</td>
<td>Mathematical Institute of the Hungarian Academy of Sciences, Budapest, Hungary</td>
<td>(Statistics and Division of Mathematical Research)</td>
</tr>
</tbody>
</table>

Division of Mathematical Research

The Division of Mathematical Research is a trans-departmental organization within the Faculty of Mathematics which is responsible for the management and coordination of research activities in the field of mathematics. It oversees various research programs and initiatives, providing support and resources to faculty and students engaged in mathematical research. The Division collaborates with other departments and institutions to foster interdisciplinary research and promote the advancement of mathematical knowledge. Its mission is to create a dynamic and supportive environment that encourages innovation, collaboration, and excellence in mathematical research.
related activities. It arranges a regular programme of Colloquium lectures and research seminars, and brings mathematicians from other academic institutions in many parts of the world to the University as Visiting Professors. The Division has an organizing Committee of senior Faculty members, and Research Sections concerned with certain particular mathematical fields. At present there are six such Research Sections, namely, Theory of Computing, Combinatorics, Functional Equations, Statistics and Biometry, Differential Geometry and Relativity, Quantum Theory. Each of these holds research seminars weekly. These Research Sections cover only a relatively small part of the range of the Division's research interests, which extend widely over the field of Mathematics.

The following Research Seminars of the Division of Mathematical Research should be borne in mind by graduate students in shaping their schedules:

- Research Seminar in Theory of Computing
- Research Seminar in Functional Equations
- Research Seminar in Combinatorics
- Research Seminar in Statistics and Biometry
- Research Seminar in Differential Geometry and Relativity
- Research Seminar in Quantum Theory

Undergraduate Course Descriptions

**Note** The number of hours or lectures shown after the course description is an attempt to indicate the "normal"; each instructor determines how often his particular class will meet.

**12 Calculus 1** Functions and limits, the derivative, Differentiation formulae, Applications to tangents, rates, extrema. Antiderivatives. The definite integral, fundamental theorem of integral calculus. Applications to area, volume, moments, fluid pressure, work, potential. Transcendental functions. Techniques of integration. Parametric and polar equations with applications. Mean value theorem. Introduction to partial derivatives. Introduction to differential equation with applications. Students will work selected problems under supervision.

2 hours lectures, 1½ hours problems.

**21 Algebra and Vector Geometry** Mathematical induction, Determinants, vectors and solid geometry, matrices, complex numbers, polynomial equations, linear transformations, infinite series.

2 hours lectures, 1½ hours problems.

**22 Calculus 2** Partial differentiation, the gradient, multiple integrals with applications, line and surface integrals, divergence and curl, Theorems of Green and Stokes. Applications to physical problems.

3 hours lectures, one term.

**23 Introduction to Computer Programming** Concept and properties of an algorithm, language and notation for describing algorithms. An analysis of computational problems and development of algorithms for their solution. An introduction to the Fortran 4 programming language for use in implementing algorithms on the computer.

2 hours lectures, 1 hour problems, one term.
3 hours lectures.

32 Numerical Analysis A survey of numerical procedures with emphasis upon computer implementation using the Fortran 4 programming language. In particular the following topics are covered: interpolation, curve fitting, solution of non-linear equations, numerical integration, numerical solution of Ordinary Differential Equations, matrix algebra and solution of systems of linear equations, and problems in the solution of partial differential equations.
Prerequisite: Mathematics 23 or equivalent.
2 hours lectures, 2 hours problems, one term.

33 Differential Calculus Real numbers, sequences, limits, continuity. The derivative. General Theorem of Mean Value. Functions of several variables. Implicit functions, Jacobians, Power series with complex terms, the Taylor series for functions of several variables, constrained extrema. The elementary functions for a complex variable.
Prerequisite: Math. 22, 31.
3 lectures, one term.

Prerequisites: Math. 21, 31.
3 lectures, one term.

2 hours lectures, 2 hours problems.

3 lectures, one term.

44 Complex Variable Cauchy-Riemann equations, the Cauchy integral theorems, conformal mapping. the Taylor and Laurent series, contour integration.
2 lectures, 1 hour problems, one term.

3 lectures, 2 hours problems, one term.

Note 1 The following two courses, Mathematics 81 and 82, have been designed primarily for elementary school teachers taking a degree at the University of Waterloo.

Note 2 These two courses should be open only to persons who have not completed Grade 13 Mathematics and/or equivalent and are not to be counted as credits towards a B.Math. degree.
Faculty of Mathematics

81 An Introduction to Functions, Analytic Geometry, and Calculus
2 hours lectures

82 Introduction to Algebra
2 hours lectures

100 Fundamental Concepts of Mathematics
A mathematics course in the liberal arts tradition. A selection of mathematical topics in a context of history, philosophy and applications. The growth of the number system: rational, real, complex, hyper-complex and infinite numbers, vectors and matrices; paradoxes and applications. The limit concept, including an introduction to Calculus; Newton and the influence of Newtonian physics. Abstraction, symbolic logic and recent trends in mathematics education. Little is assumed in the way of previous knowledge, but the student should have some affinity for mathematics. The course is library-oriented rather than textbook-oriented and the student is encouraged to find and pursue some interest of his own, subject to approval.
3 lectures

119 Algebra and Geometry
Functions and permutations, Elementary number theory. Real and complex number systems. Polynomial functions. Linear geometry and algebra in 2 and 3 space.
3 hours lectures, 1 hour tutorial.

Note M 119 is not a course for Honours Mathematics students.

120 Calculus
3 hours lectures, 1 hour tutorial.

Note M 120 is not a course for Honours Mathematics students.

125 Algebra, Geometry, and Calculus for Optometry Students
A conventional course for freshman Calculus but with more time spent on concepts of algebra and analytic geometry intimately connected with the Calculus.
4 hours/week.

129 Algebra and Geometry
Functions and permutations. Elementary number theory. Real and complex number systems. Polynomial functions. Linear geometry and algebra in 2 and 3 space. Algebraic systems.
3 hours lectures, 1 hour tutorial.

130 Calculus
Functions and limits. The derivative. Differentiation of algebraic functions. Applications to tangents, rates, minima and maxima.
Partial differentiation.
3 hours lectures, 1 hour tutorial.

131 Algebra and Solid Geometry
2 lectures, 1 hour problems.

132 Introduction to Computer Science
A thorough introduction to algorithms, stored-programme computers and programming languages. Concept and properties of an algorithm, language and notation for describing algorithms. Analysis of computational problems and development of algorithms for their solution. A procedure-oriented language (FORTRAN IV) and machine and assembly languages are used to implement algorithms on the computer. Introductory ideas from Boolean Algebra switching theory and hardware design.
2 hours lectures, 2 hours problems
Prerequisite: Grade 13 Mathematics recommended

201 (a) Applications of Mathematics to the Physical Sciences
Mathematics 201 (a and b) is the first of three courses (201, 301, 401), designed to show the interplay between mathematics and science; each course is a study of the application of mathematical ideas and techniques to the sciences and the influence of physical problems on the formulation of mathematical concepts.

In Mathematics 201 (a) calculus is applied to an examination of the basic concepts of Newtonian mechanics, planetary motion, rocket flight and related topics; vectors, tensors and groups are given added meaning through a discussion of various physical laws and crystalline structure.
2 hours lectures, Fall term.
Prerequisite: M. 130, Phys. 131 or equivalents.

Note Math. 201, 301, 401, 402 may not be counted as Mathematics credits but may be counted as elective credits.

201 (b) Applications of Mathematics to the Physical Sciences
The concepts of probability and statistics are exemplified in discussions of some of the following topics:
Kinetic theory of gases, Maxwell's distribution of velocities, statistical meaning of entropy, random numbers and random walk, Brownian motion, Monte Carlo method, design and evaluation of experiments, Markov chains and notion of information.
2 hours lectures, Winter term.
Prerequisite: Phys. 131 or equivalent.

217 Advanced Calculus
Differential calculus of functions of several variables. Multiple integrals. Line and Surface integrals; Green's Theorem, Divergence Theorem, Stokes' Theorem. Infinite Series.
3 hours lectures.

Note M 217 is not a course for Honours Mathematics students.

219 Linear Algebra
3 hours lectures

Note M 219 is not a course for Honours Mathematics students.
Faculty of Mathematics

228 Introduction to Pure Mathematics
Examples and results in modern geometry, number theory, and algebra. Logical foundations of Mathematics (Hilbert’s proof theory and Brouwer’s intuitionism).
2 hours lectures.

229 Linear Algebra
3 hours lectures.

233 Probability and Statistics
An introduction to probability theory and statistics, with emphasis on their applications to practical problems, and on the logical principles involved. Several of the examples to be discussed require use of the computer. Topics from probability theory include the laws of probability; discrete and continuous random variables; expectation; and the central limit theorem. Topics from statistics include the use of relative likelihood in estimation; sufficiency; exact and approximate tests of significance, tests of fit, contingency tables.
3 hours lectures.
Prerequisite: M 130, M 132

234 Introduction to Applied Mathematics

234 (a) Differential Equations
First order equations; second order equations with constant coefficients. Applications to problems in the physical sciences. Solution of differential equations by series.
2 hours lectures, one term.
Requisite: M237 (may be taken concurrently).

234 (b) Introduction to Mechanics
2 hours lectures, one term.
Prerequisites: First year Physics or Consent of Instructor. M 234 (a) or M 236 or M 31

Note Math 234 (a) and M 236 may not both be taken for credit.

235 (a) Actuarial Mathematics
The theory of rates of interest and discount, annuities and sinking funds; application to financial problems, including the determination of mortgage payments and the price and yield of bonds.
2 hours lectures, Fall Term

235 (b) Basic Life Insurance Mathematics
Applications of probability to problems of life and death. The determination of single and annual premiums for assurances and annuities. Reserves. Company expenses and their incorporation into premium and cash value calculations.
2 hours lectures, Winter term.

236 Elementary Differential Equations
2 lectures.

Note M 236 is not a course for Honours Mathematics Students
237 Advanced Calculus
3 hours lectures.
Prerequisite: M 130

239 (a) An Introduction to Combinatorics
2 hours lectures.

239 (b) An Introduction to Optimization
2 hours lectures.

10 (a) Numerical Applications in Computer Science
An introduction to Numerical Procedures with emphasis upon computer implementation using the FORTRAN IV programming language. In particular, the following topics are introduced: concept of numerical errors, interpolation, curve fitting, solution of non-linear equations, numerical integration, matrix operations and solution of systems of linear equations, numerical solution of ordinary differential equations.
2 hours lectures, one term.
Prerequisites: M 132, and M 120 or M 130, and M 119 or M 129
There is a special section for Non-Mathematics students.
Prerequisites: Mathematics 130 Mathematics 132

10 (b) Non-Numeric Applications in Computer Science
Introduction to: Number Systems, symbol manipulation, Boolean Algebra, concept of a list and elementary list processing techniques, sorting and searching algorithms, basic techniques of compilation.
2 hours lectures, one term.
Prerequisite: Mathematics 132 or equivalent.

243 Statistics for the Sciences
The topics of Mathematics 233 with particular emphasis on the analysis and interpretation of experimental data and the design of experiments in the Sciences. The more difficult mathematical techniques associated with these problems will be omitted and many examples from Physics, Chemistry, Biology and other natural Sciences will be considered.
2 hours lectures. 1 hour laboratory.

300 Discovery and Invention in Mathematics
The art technique of problem solving from the point of view of discovery and invention (heuristic); induction, analogy, pattern generalization, analysis, similarity and plausible reasoning. Problems will be selected from various areas of mathematics including Geometry (Euclid to Hilbert), Algebraic Structure (Groups in Algebra and Geometry), Set theory (point sets, Boolean Algebra) and Logic.
2 hours lectures.

301 (a) Applications of Mathematics to the Physical Sciences
See the preamble to Mathematics 201. Partial differential equations are applied to classical wave problems.
2 hours lectures. Fall term.
Prerequisites: M 201 and M 237 or equivalent.

301 (b) Applications of Mathematics to the Physical Sciences
Vector and tensor analysis are related to problems in continuum mechanics.
2 hours lectures, Winter term.
307 Combinatorial Geometry
Introductory problems and a brief survey; convex sets; covering problems; graphs; addition of figures; maxima and minima problems; curves of constant breadth \( \mathcal{A} \)-curves; equidecomposable figures.
2 hours lectures.

312 (a) Elements of Real Variable Theory
Metric properties of \( \mathbb{R}^n \), functions from \( \mathbb{R}^n \) to \( \mathbb{R} \); differentials; Riemann integrals; and one of (a) an introduction to the Lebesgue integral; (b) an introduction to metric spaces; (c) orthogonal systems.
3 hours lectures.

Note Emphasis will be on applications rather than theory.
Note M 312 (a) is not a course for Honours Mathematics students.

312 (b) An Introduction to Complex Variable Theory
Complex numbers; continuity, differentiability, analyticity of functions; the Cauchy-Riemann equations; solutions of Laplace's equation; conformal mapping by elementary functions, and applications; the Cauchy and allied theorems; Taylor and Laurent expansions; uniform convergence and power series; the residue calculus, and applications.
3 hours lectures.

Note Emphasis will be on applications rather than theory.
Note M 312 (b) is not a course for Honours Mathematics students.

319 Abstract Algebra
Groups; permutation groups. Lagrange's theorem, normal sub-groups, homomorphisms. Fields. Rings and ideals. Integral domains.
2 hours lectures.

Note Emphasis will be on applications rather than theory.
Note M 319 is not a course for Honours Mathematics students.

329 Abstract Algebra
2 hours lectures.

330 (a) Projective Geometry
Projective spaces over fields, collineations and correlations, quadric curves and surfaces. References to non-euclidean geometries.
3 hours lectures, one term.
Prerequisite: M 229

330 (b) Geometry of the Complex Numbers
The plane of complex numbers. The group of circle preserving mappings and its subgroups. Connections with non-euclidean geometries. Other number systems and their geometries. (Laguerre, Minkowski).
3 hours lectures, one term.
Prerequisite: M 229

330 (c) Euclidean Geometry
Concurrent lines, collinear points, the Euler line, the Simson line, the nine point circle. Cross ratio, projection, Harmonic range, the quadrilateral and the quadrangle. Properties of circles.
3 hours lectures, one term.

332 (a) Elements of Real Variable Theory
Metric properties of \( \mathbb{R}^n \), to \( \mathbb{R} \); differentials; Riemann integrals; and one of
(b) an introduction to metric spaces;
(c) orthogonal systems.
3 hours lectures.

332 (b) An Introduction to Complex Variable Theory
Complex numbers; continuity, differentiability, analyticity of functions; the Cauchy Riemann equations; solutions of Laplace's equation; conformal mapping by elementary functions, and applications; the Cauchy and allied theorems; Taylor and Laurent expansions; uniform convergence and power series; the residue calculus, and applications.
3 hours lectures.

334 (a) Numerical Algebra
2 hours lectures, 2 hours problems, one term.
Prerequisite: M 240 (a). Also recommended are M 219 or 229 and M 217 or 237.

34 (b) Numerical Approximation
2 hours lectures, 2 hours problems, one term.
Prerequisite: Math. 240 (a). Also recommended are M 219 or 229 and M 217 or 237.

335 (a) Finite Differences
A course in the calculus of finite differences, to include: summation, differences of zero, numerical integration, relation between integration and summation.
2 hours lectures.

335 (b) Graduation of Tables
Applications of finite differences to actuarial problems in graduation of statistical tables.
2 hours lectures.

336 Life Contingencies
336 (a) An advanced course on problems with single lives.
3 lectures, one term.
336 (b) An advanced course on problems with multiple lives; population and multiple decrement theory.
3 lectures, one term.

338 Mathematical Statistics
Derivation and applications of statistical theory for normally distributed measurements. Part (a) may be taken separately for half credit.

338 (a) Continuous random variables; moments and moment generating function; distribution of t, chi-squared, and F, and their applications. Simple analysis of variance and regression.
2 hours lectures.
Prerequisites: M 233, M 237.

338 (b) The multivariate normal distribution, its properties and uses; quadratic forms and Cochran's theorem; regression and auto-regression with k independent variables.
2 hours lectures.
Prerequisites: M 238 (a), M 239.
340 Computer Systems
A discussion of the hardware and software required in a computer system. Overlapped channels, interrupt facilities, memory protection, buffers, input-output control systems, macro-programming, monitor systems. Relocation schemes, multi-programming, multi-processing, dynamic memory allocation, time-sharing. Special purpose computer systems and simulation of computer systems. Peripheral equipment. Introduction to the theory of sequential machines and the logical design of computers.
2 hours lectures.
Prerequisite: Math. 240 (b) or Consent of Instructor

341 Algebra
Fundamentals of group, ring, and field theory.
3 hours lectures.
Corequisite: M 229

342 Real Analysis 1
Theory of functions of real variables. The notions of compactness, connectedness, and uniformity are used in a study of continuity, differentiation, and integration.
2 hours lectures.
Prerequisite: M 237

343 Complex Analysis 1
Analysis of complex numbers; fundamental theorems of holomorphic functions; meromorphic functions.
2 hours lectures.
Prerequisite: M 237

344 Topology (a)
Intuitive set theory, metric spaces, point set topology.
3 hours lectures, one term.
Consent of Instructor

345 Topics in Pure Mathematics for Combinatorial Mathematicians
Elementary introduction to cardinal and ordinal numbers; convexity and its applications to optimization; introduction to the main concepts of projective geometry, metric and topological spaces.
2 hours lectures.

351 Introduction to Graph Theory and Combinatorial Analysis (a)
Graphs, connectivity, bipartite graphs, factors, Menger's Theorem, directed graphs, planar graphs and duality, with applications.
(b) Theory of enumeration, generating functions, Ramsey's Theorem and applications, systems of distinct representatives, Latin Squares, and Balanced Incomplete Block Designs, with applications.
2 hours lectures.

352 Mathematical Operations Research
(A) Fundamentals
Classical optimization; linear programming; dynamic programming; probability models, reliability optimization.
2 hours lectures.

(b) Network Programming
Network and matrix methods for special linear problems.
2 hours lectures.

360 (a) Tensor Analysis
2 hours lectures, Fall term.
360 (b) Differential Geometry  
The metric tensor, and elementary differential geometry of surfaces, introduction to Riemannian geometry; Riemannian curvature, Gaussian curvature and Einstein curvature tensors. Spaces of affine connection and Finsler spaces with application to electromagnetic theory.  
2 hours lectures, Winter term.  
Prerequisites: M 237, Consent of Instructor

361 (a) Calculus of Variations  
Euler-Lagrange Equations, Legendre and Jacobi condition, the E-function. Fields of extremals and sufficient conditions; Hilbert's invariant integral. Parameter invariant single and multiple integral problems; Hamilton-Jacobi theory. Introduction to optimal control problems; introduction to direct methods and partial differential equations.  
2 hours lectures, Fall term.  
Prerequisites: M 237, Consent of Instructor.

361 (b) Mechanics 2  
2 hours lectures, Winter term.  
Prerequisites: M 237, Consent of Instructor.

363 Differential Equations  
2 hours lectures.  
Prerequisites: M 237, M 234 or equivalent M 332 (real variables) or equivalent (may be taken concurrently).

399 Reading in Mathematics

401 Applications of Mathematics to the Physical Sciences  
See the preamble to Mathematics 201. The concepts and techniques of group theory, special functions and theory of distributions are illustrated by the problems of quantum physics.  
2 hours lectures, 2 terms.  
Prerequisite: Consent of Instructors.

402 Topics in Mathematical Aspects of Chemistry, Biology, and the Medical Sciences  
Subjects will be selected from areas such as introductory wave mechanics, spectroscopy, molecular biology, and mathematical models of disease processes.  
2 hours lectures.

406 Linear Algebra 2  
Continuation of linear algebra. Main topics: representations of endomorphisms, structures of bilinear forms, multilinear products.  
2 hours lectures.  
Prerequisite: M 341 or M 239

407 Algebraic Geometry  
An introduction to the theory of algebraic varieties. Special topics such as the Theorem of Riemann-Roch.  
2 hours lectures.  
Prerequisite: M 341 or M 329

408 Mathematical Logic  
First order languages and theories. A treatment of at least one of the following: set theory, model theory, undecidability.  
2 hours lectures.

409 Foundations of Geometry  
An axiomatic treatment of geometry. Geometrical structures, such as projective, affine, and topological geometries.
410 Ring Theory  Continuation of the theory of rings and modules.
2 hours lectures.
Prerequisite: M 341 or M 329

411 Group Theory  Continuation of group theory.
2 hours lectures.
Corequisite: M 341 or M 329

412 Field Theory  Field extensions and Galois theory.
2 hours lectures.
Prerequisite: M 341 or M 329

2 hours lectures.
Prerequisites: M 363 (may be taken concurrently)
Consent of Instructor

2 hours lectures.

418 Computer Oriented Graph Theory  A general survey of those problems in graph theory that are amenable to the use of computing techniques. Algorithms for testing graphs for given properties, e.g. planarity, isomorphism. Algorithms for constructing graphs with given properties, or finding all subgraphs of a given kind, e.g. spanning trees, circuits. Combinatorial algorithms, etc. The emphasis of the course will be on the algorithms, rather than the details of computation; but students will be expected to implement these algorithms on the computer.
2 hours lectures.

419 Applications of Graph Theory  A course on Graph Theory with applications to psychology, electrical engineering, operational research, chemistry, and perhaps other topics.
4 hours/week

420 Combinatorial Methods and Probability Models  Combinatorial techniques applied to a variety of optimization problems including inventory control, replacement, discrete dynamic programming, and scheduling.
2 hours lectures.

2 hours lectures.
Corequisite: M 341 or M 329

426 Topology  Continuation of general topology; selected topics from other branches of topology.
2 hours lectures.
428 Lattice Theory  Ordered sets, lattices, and Galois connections. Applications in algebra, geometry and logic.
2 hours lectures.
Consent of Instructor

2 hours lectures.

2 hours lectures.
Corequisite: M 330 (a) (Projective Geometry)

432 Complex Analysis II  Further properties of holomorphic and meromorphic functions. Riemann surfaces.
2 hours lectures.
Prerequisite: M 343 or M 332 (b)

433 Real Analysis II  An introduction to integration and measure theory with emphasis on the real line.
2 hours lectures.
Prerequisite: M. 342 or M. 332 (a)

2 hours lectures.
Prerequisite: M 363 or equivalent, or Consent of Instructor

435 Laboratory  Numerical problems arising in actuarial science and statistics.
2 hours laboratory.

436 Introduction to Logic  An introduction to the logic of sentences and predicates with some emphasis on familiar algebraic structures. At first informal, then leading to a formal axiomatic treatment with proofs of consistency and completeness.
2 hours lectures.
Prerequisite: Consent of Instructor.

7 (a) Measurement of Mortality  Methods of analysis of data to produce raw rates for mortality and other tables.
2 hours lectures, 1 term.

(b) Risk Theory  Individual and collective risk theory. Ruin theory. Stop loss reinsurance premiums, Monte Carlo methods.
2 hours lectures, one term.

438 Statistical Inference  Several approaches to the controversial problems of statistical inference are compared. Likelihood, fiducial probability, Bayes' theorem, confidence intervals. Sufficiency and ancillarity. Consistency and efficiency of estimates. Information. Maximum likelihood and large sample theory.
2 hours lectures
Prerequisite: M 338 (a)

439 Theory of Experimental Design  The logic of experimental design with reference to randomization, experimental and sampling errors. Construction and analysis of factorial designs.
440 Probability Classical probability and introduction to stochastic processes with applications such as branching processes, epidemics, etc.  
2 hours lectures.

2 lectures.  
Consent of Instructor

2 hours lectures, Winter Term  
Prerequisite: M 360 (a) Consent of Instructor

443 Electromagnetism Applications of the Maxwell equations. Reflection and refraction. Introduction to wave guides and antennae.  
2 lectures, Fall term.  
Consent of Instructor

2 lectures, Winter term.  
Consent of Instructor

2 hours lectures.  
Consent of Instructor

446 History of Mathematics The development of Mathematics from ancient to modern times, including study of prominent mathematicians and their works. Problems will be worked using both modern and historical approaches.  
2 lectures.

447 Statistical Mechanics Applications of probability theory to theoretical Physics.  
2 lectures, Fall term.

448 Differential Geometry Differentiable manifolds, Tensor and Grassman algebras, Riemannian manifolds.  
2 hours lectures.  
Prerequisite: M 229, M 237

449 Experimental Design Similar to Mathematics 439 but with more accent on the logic and methods than on the mathematics. Primarily for students in the Sciences.  
2 hours lectures.

2 hours lectures.
451 Non-Linear Optimization

(a) Classical Methods
Discrete functions; continuous functions of n variables. Quadratic forms; convex functions. Equality constraints; Lagrange multipliers and generalizations. Inequality constraints: Kuhn-Tucker theorem.
2 hours lectures.

(b) Sequential Optimization
Gradient methods; recent sequential optimization methods; direct search methods; application to the solution of equation and non-linear regression analysis.
2 hours lectures.

452 Linear Programming: (Theory, Applications, and Related Topics)

2 hours lectures.

2 hours lectures.

453 Queueing Theory
2 hours lectures.

454 Game Theory
2 hours lectures.

455 Mathematical Programming
An introduction to the methods and applications of integer programming, non-linear programming and dynamic programming.
2 hours lectures.

456 Combinatorial Methods in Operations Research

(a) Combinatorial Systems
Representations by networks; simulation; recurrence relations; Markov processes, application to queueing theory, random walks, renewal theory, activity scheduling, etc.
2 hours lectures.

(b) Boolean Methods
Boolean algebras; pseudo Boolean programming; applications to switching circuits; selection problems; graph theory; integer programming, etc.
2 hours lectures.

457 Applied Combinatorial Mathematics
This is a relatively nonspecialized course on modern applied algebra. Emphasis is on the combinatorial foundations of applied mathematics.
2 hours lectures.
458 Graph Theory  A general survey of a number of topics in graph theory. Likely topics include: Eulerian and Hamiltonian lines in finite and infinite graphs, Menger's Theorem, trees, directed graphs, enumerative results in graph theory, reconstruction of graphs from subgraphs, colouring of graphs, graphs and the Four Colour Problem, planarity and thickness of graphs, graphs and matroids, applications of matrices to graph theory.
2 hours lectures.

460 Combinatorics The existence and construction of projective geometries, orthogonal Latin squares, room designs, balanced incomplete block designs and other combinatorial configurations. Results on the football pool problem.
2 hours lectures.

2 hours lectures, one term.
Prerequisites: M 332 (complex variables) M 332 (real variables) or equivalents.

461 (b) Actuarial Laboratory A tutorial course for the advanced actuarial student.
2 hours lectures, one term.

462 (a) Measure and Integration The theory of measure and the Lebesgue integral.
2 hours lectures, Fall term

462 (b) Fourier Series and Orthogonal Functions Linear spaces, orthogonal functions, Fourier series, Legendre and Bessel functions, harmonic analysis.
2 hours lectures, Winter term.

2 hours lectures, Fall term.
Consent of Instructor

464 Topics in Mathematical Physics A selection of topics given by members of the Applied Mathematics Department. Topics covered in previous years have included continuum mechanics (elasticity, fluid mechanics), electromagnetic theory, statistical mechanics.
2 hours lectures, two terms.
Consent of Instructor

465 Stochastic Processes An introduction to the basic theory of stochastic process, with applications to biology and operations research. Definition of stochastic process, waiting times. Random walk, Poisson process, Markov chains, Brownian motion. Applications to queueing theory, storage problems, population growth models; Monte Carlo methods; stochastic optimization problems.
2 hours lectures, Fall and Winter terms.
Prerequisite: Math. 233, 243, or 51.

466 (a) statistical Data Analysis Summary Statistics (mean, median, midmean, hinge, trimean, etc.). Transformation of data (to increase symmetry, remove strays, equalize spread). Residuals (from various measures of centrality, plottings, etc.) Outliers (effect on summary statistics and residuals, identification and removal). Plotting techniques (dot plots, histograms, stem-and-leaf box
Prerequisite: (1) A course in Fortran Programming or equivalent. (2) Mathematics 338

470 (a) Ordinary Differential Equations and Integral Equations

Initial value problems: existence and uniqueness of solutions, one step methods, multistep methods, stability, error analysis.
Boundary value problems: shooting and discretization methods, implementation problems especially for non-linear equations.
Integral equations: correspondence to ODE initial value and boundary value problems, solution techniques.
2 hours lectures, one term.
Prerequisite: M 334 (b) or Consent of Instructor

470 (b) Partial Differential Equations

Discretization methods for PDE's, convergence and stability, grid and characteristic methods for hyperbolic equations; iterative methods of solution for parabolic and elliptic equations, rate of convergence estimates,
2 hours lectures, one term.
Prerequisite: Math. 334 (a) or Consent of Instructor.

471 (a) Switching Circuits

2 hours lectures, Fall term.
Prerequisites: M 132 and 329, or Consent of Instructor

471 (b) Computer System Organization and Logic Design

Part 1. Logic Design: Brief review of basic switching theory; Number systems; logic circuits; storage elements; standard computer subsystems; overall logical design of a conventional processor; automated design of processors— computer compilers.
Part 2. System Organization. Definition of total system requirements for batch processing, time-sharing, real-time processing and other applications; hardware-software tradeoffs and the impact of large-scale integration; unorthodox hardware organizations evaluation of solutions. Some attention will be paid to design for reliability and fault diagnosis as additional system requirements.
2 hours lectures, Winter term.
Prerequisite: M 471 (a) or Consent of Instructor

472a Introduction to Automata Theory

2 hours lectures, Fall term.
Prerequisite: M 132 and 329, or Consent of Instructor

472b Introduction to Turing Machines and Computability Theory

2 hours lectures, Winter term.
Prerequisite: M 472 (a) or 436, or Consent of Instructor
473 (a) Programming Languages and Data Structures 1
2 hours lectures, one term.
Prerequisite: Math. 240 (b) or Consent of Instructor.

473 (b) Programming Language and Data Structures 2.
2 hours lectures, one term.
Prerequisite: Math 473 (a) or Consent of Instructor.

480 Functional Equations
Cauchy's, Pexider's and similar equations. Equations for polynomials and for trigonometric functions. Reduction to differential equations. General methods and theorems. Iteration. Applications. Further topics, as Equations for functions of several variables, or Equations for analytic functions, or Equations on algebraic structures.
2 hours lectures.

499 Reading in Mathematics

Graduate and Research Programmes


The University of Waterloo has at present five computer systems available to Mathematics faculty and graduate students. These are: an IBM System/360 Model 75, and IBM System/360 Model 44, an IBM/360 Model 50, an IBM 1710, an IBM 1620 and peripheral equipment which includes an IBM 2250 Graphic Display and a CALCOMP plotter.

The IBM 1620 computer is available to undergraduate students at all times. The IBM 1710 is used by undergraduates, graduates, faculty and staff. The System/360 Model 75 is run on a closed shop basis but all members of the University can get programmes processed within a reasonably short period of time. The System/360 Model 44 is used in process control applications and provides the University with a centralized process control facility. The System 360 Model 50 is used by undergraduates, graduates and faculty for development of software in Computer Science as well as a facility for handling the conversational language APL.

Extensive financial assistance is available through National Research Council Scholarships and Bursaries and Province of Ontario Graduate Fellowships. In addition, the Faculty of Mathematics offers a number of Teaching Fellowships and some Research Assistantships. For details, correspondence should be addressed to the Graduate Office of the Faculty or Department Chairmen.

Candidates for the degrees of M.Math., M.Phil. and Ph.D. are accepted under the general regulations set forth in the section of the
M.Math. degree are encouraged to present theses. Those proceeding by course work must submit a substantial essay in addition to their programme of courses.

Applied Analysis and Computer Science
Faculty members of the Department of Applied Analysis and Computer Science are currently engaged in a varied and extensive research programme including:

Programming: Software developed at the University of Waterloo is currently being used by Computing Centres throughout the world. In particular, its well-known WATFOR and WATFIV compilers are currently being used by over 350 System/360 installations. Several installations are using a similar compiler developed in 1965 for 7040-7044 Series machines. Many other topics are being studied including coroutine systems, symbol manipulation, and design of programming languages, both general purpose and also with particular emphasis on software implementation.

Machine Organization and Fault Diagnosis: Current research includes the development of software aids to fault diagnosis, the investigation of unorthodox machine organization from the viewpoints of fault diagnosis and system availability, and the self-diagnosis problem for digital processors. Also under study are system problems arising from time sharing such as the problem of testing software, and computer networks. Computer-Aided Design: The improvement of design techniques through the use of digital computers and associated devices such as visual display units is presently under study.

Formal Languages, Automata and Switching Theory: Among the problems being investigated are the algebraic theory of languages and structure theory of sequential machines.

Computability Theory: Topics currently being studied are Turing machines, complexity classifications of computable functions, abstract models of digital computers and hierarchies of classes of recursive functions.

Artificial Intelligence: One of the problems presently being studied is computer-assisted theorem proving.

Numerical Analysis: Algorithms for two-point boundary problems, stiff systems of differential equations, atomic structure equations, unilateral matrix equations, optimization problems, and linear algebra techniques are presently under investigation.

Functional Equations: Besides basic research, the fields investigated include fundamental applications in nomography, information theory, theory of complex variables, algebraic structures, geometry and generalized functions in general spaces.

Combinatorics and Optimization, Mathematical Operations Research, Graph Theory, Statistics and Decision Theory: Research in these areas is being conducted by members of other departments in the Faculty of Mathematics.

Applied Mathematics
Research in the department is being carried out in a number of areas related either directly or indirectly to problems in Mathematical Physics. These areas include Linear and Nonlinear Differential Equations, Special Theory of Differential Operators, Optimal Control Theory, Boundary Layer Problems in Fluid Dynamics and Particle Physics. A Relativity group is being formed within the department with interests in General Relativity, Differential Geometry and the Calculus of Variations. The department also has a very active Quantum Theory Group whose research involves the Quantum Theory of Crystals and Surfaces.
Faculty of Mathematics

The department sponsors a number of seminars, invited talks by outstanding people in the various fields and visiting Professors. Graduate students are encouraged to become involved in these programmes.

Combinatorics and Optimization

Research currently being pursued in the Department of Combinatorics and Optimization includes work in graph theory, chromatic polynomials, colouring problems and enumeration, design theory, matroid theory, well-quasi-ordered sets, directed graphs and relations, Boolean algebra and its applications to Optimization, applications of linear programming and convex polyhedra to Combinatorics and Optimization, extremal problems in graphs, minimax theorems, algorithms and computer analysis in Combinatorics and Optimization, theory of formal languages, and mathematics of elementary particle physics. Research and teaching in Optimization emphasize the underlying mathematical theory, and especially applications of Combinatorics. The department is developing a computerized reference retrieval system for graph theory, which may be extended to cover other areas of Combinatorics and Optimization.

The following graduate courses are offered by the Department of Combinatorics and Optimization: 780, 782, 785, 788, 789, 791, 792, 793, 798, 969, 971, 973, 981, 982.

Pure Mathematics

There are several research activities in the department. These include work in Geometry (Foundations of Geometry, Combinatorial Geometry, Special Geometries including Geometries over Algebras and Finite Geometries, Topology), work in Algebraic Structures (General Algebraic Systems, Linear Algebra, Lattice Theory, Group Theory) and work in Logic and Foundations, moreover some aspects of Analysis and Number Theory.

The departments of Philosophy and Pure Mathematics have inaugurated a joint graduate programme for students interested in the foundations of mathematics and related problems.

There is a weekly meeting of a Research Seminar on "Geometrical and Algebraical Structures", where original mathematical investigations by students and professors are presented.

Statistics

Research in the Department of Statistics centres on the controversial problem of formulating exact statistical inferences in many diverse situations using generalizations of the approach introduced by the late Sir Ronald Fisher in his foundation of the theory of fiducial inference, the theory of the likelihood function and the theory of estimation in general. The extensive computing facilities available at the University of Waterloo have given rise to investigations into the uses of computers to obtain exact results on the basis of these theories in situations previously treated by asymptotic methods, and also research into exact tests in multivariate analysis.

Related to this research, there is active interest in problems of experimental design, with particular reference to incomplete block designs, multivariate analysis, estimation theory, mathematical genetics and stochastic processes as applied, for example, to biometrical problems, such as the analysis of environmental factors contributing to diseases processes and aging.

Members of the department are also interested in problems in combinatorial mathematics, such as the construction of balanced incomplete block designs, which arise in the design of experiments. Other combinatorial questions under consideration include edge-chromatic graphs and the Ramsey numbers.
Increasing contact with the Department of Psychology and with work in the Physical Sciences, undertaken as part of the above-mentioned biometrical studies, provides a variety of new problems and also gives advanced students a valuable opportunity to apply lecture material to useful practical situations. An arrangement with the Statistics Unit of the Department of Agriculture in Ottawa provides potential summer employment for advanced undergraduates and at the same time, a further opportunity for practical experience.

Courses

Note: An asterisk (*) indicates courses given in 1970-1971 academic year. Other graduate courses may be given from time to time as demand warrants.

500 Survey of Algebra and its Applications.*
510 Survey of Numerical Analysis.
511 Computer Programming.*
700 Mathematical Logic.*
702 Transfinite Arithmetic.
703 Axiomatic Set Theory.
705 Recursive Function Theory.*
707 Algebraic Theory of Numbers.
715 Seminar in Logic and Foundations.*
716 Seminar in Number Theory.*
718 Topics in Logic and Foundations.*
719 Topics in Number Theory.
720 Universal Algebra.*
724 Groupoids and Quasigroups.
727 Infinite Groups.
728 Representation Theory.
731 Homological Algebra.
736 Seminar in Group Theory.
738 Topics on General Algebraic Systems.*
739 Topics in Group Theory.
740 Rings and Ideals.*
742 Multilinear Algebra.*
745 Galois Theory.
749 Topics on Rings and Fields.
764 Differential Geometry.
766 Differential Manifolds.
768 Topological and Lie Groups.
770 Algebraic Topology.*
776 Seminar in Homotopy Theory.*
778 Special Topics in Geometry.*
779 Topics in Topological Structures.*
780 Combinatorial Analysis.*
782 Combinatorial Graph Theory.*
783 Analytic Graph Theory.
784 Linear Graphs.
785 Planar Graphs.
786 Extrema in Graphs.
787 Directed Graphs.*
788 Combinatorics.*
789 Matroid Theory.*
793 Boolean Methods in Combinatorics and Optimization.*
Faculty of Mathematics

796 Seminar in Graph Theory.
797 Topics in Graph Theory.
798 Seminar in Combinatorial Analysis.*
799 Topics in Combinatorial Analysis.
810 Harmonic Analysis.
811 Orthogonal Series.
813 Functions of a Complex Variable (Analytic Function Theory)
815 Special Functions.
817 Abstract Measure Theory.*
819 Functional Analysis.
820 Linear Operators.
828 Topics in Classical Analysis.
829 Topics in Functional Analysis.*
830 Potential Theory.
832 Ordinary Differential Equations.*
834 Introduction to Partial Differential Equations.
835 Hyperbolic Partial Differential Equations.
836 Elliptic Partial Differential Equations.
837 Parabolic Partial Differential Equations.
848 Topics in Potential Theory.
849 Topics in Differential Equations.
850 Functional Equations for Functions of One Variable.*
851 Functional Equations in Several Variables.
852 Functional Equations for Analytic Functions.
855 Integral Equations.
858 Seminar on Functional Equations.*
859 Topics on Functional Equations.
860 Calculus of Variations.
861 Analytic Theory of Geometric Objects.
862 Vector and Tensor Analysis.
864 Integral Transforms.*
865 Calculus of Operators.
867 Theory of Approximation.
869 Survey of Numerical Analysis.
870 Numerical Solution of Ordinary Differential Equations.*
871 Numerical Methods in Linear Algebra.*
872 Numerical Solutions of Partial Differential Equations.*
873 Problems in Numerical Integration.
876 Seminar in Numerical Analysis.*
878 Topics in Applied Analysis.
879 Topics in Numerical Analysis.
881 Introduction to Switching and Automata Theory.*
885 Time-Sharing Systems.*
886 Computer Systems.*
890 Computer Programming.*
891 The Theory and Construction of Compilers.*
892 Data Structures 1 and 2.*
893 Data Structures 3.*
894 Finite Automata.*
895 Design of Sequential Machines.
896 Algebraic Structure of Sequential Machines.
897 Formal Languages.*
898 Computability Theory.*
899 Statistical Information Theory.
900 Measurement of Information.
902 Artificial Intelligence.*
905 Seminar in Computer Science.*
908 Seminar in Computer Science.*
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>908</td>
<td>Fault Diagnosis of Digital Systems.</td>
</tr>
<tr>
<td>909</td>
<td>Topics in Information Theory.</td>
</tr>
<tr>
<td>910</td>
<td>Introduction to Random Variables.</td>
</tr>
<tr>
<td>911</td>
<td>Theory of Probability.*</td>
</tr>
<tr>
<td>912</td>
<td>Stochastic Processes.*</td>
</tr>
<tr>
<td>918</td>
<td>Seminar in Probability Theory.</td>
</tr>
<tr>
<td>919</td>
<td>Topics in Probability Theory.*</td>
</tr>
<tr>
<td>925</td>
<td>Mathematical Genetics.</td>
</tr>
<tr>
<td>927</td>
<td>Topics in Probability and Biometry.</td>
</tr>
<tr>
<td>929</td>
<td>Topics in Biometrical Statistics.*</td>
</tr>
<tr>
<td>930</td>
<td>Foundations of Statistics.*</td>
</tr>
<tr>
<td>931</td>
<td>Estimation and Hypothesis Testing.*</td>
</tr>
<tr>
<td>932</td>
<td>Advanced Statistics.*</td>
</tr>
<tr>
<td>934</td>
<td>Applied Statistics.*</td>
</tr>
<tr>
<td>938</td>
<td>Seminar in Statistics.</td>
</tr>
<tr>
<td>939</td>
<td>Topics in Statistics.</td>
</tr>
<tr>
<td>950</td>
<td>Complex Variable Techniques in Physical Problems.</td>
</tr>
<tr>
<td>951</td>
<td>Group Theory in Physical Problems.</td>
</tr>
<tr>
<td>954</td>
<td>Continuum Mechanics.</td>
</tr>
<tr>
<td>955</td>
<td>Fluid Mechanics.</td>
</tr>
<tr>
<td>957</td>
<td>Mathematical Electrodynamics.</td>
</tr>
<tr>
<td>958</td>
<td>Quantum Molecular Physics.*</td>
</tr>
<tr>
<td>959</td>
<td>Quantum Mechanics.</td>
</tr>
<tr>
<td>960</td>
<td>Elementary Particles.</td>
</tr>
<tr>
<td>961</td>
<td>Mathematical Theory of Relativity.*</td>
</tr>
<tr>
<td>963</td>
<td>Statistical Mechanics.</td>
</tr>
<tr>
<td>965</td>
<td>Quantum Surface Physics.*</td>
</tr>
<tr>
<td>966</td>
<td>Control Theory.*</td>
</tr>
<tr>
<td>967</td>
<td>Quantum Crystal Physics.</td>
</tr>
<tr>
<td>969</td>
<td>Topics in Applied Mathematics.</td>
</tr>
<tr>
<td>970</td>
<td>Mathematical Optimization.</td>
</tr>
<tr>
<td>971</td>
<td>Directed Graphs and Applications.*</td>
</tr>
<tr>
<td>972</td>
<td>Mathematical Programming.*</td>
</tr>
<tr>
<td>973</td>
<td>Network Programming.</td>
</tr>
<tr>
<td>975</td>
<td>Mathematical Operations Research.</td>
</tr>
<tr>
<td>976</td>
<td>Seminar in Mathematical Operations Research</td>
</tr>
<tr>
<td>978</td>
<td>Seminar in Combinatorics and Optimization.*</td>
</tr>
<tr>
<td>979</td>
<td>Topics in Optimization.</td>
</tr>
<tr>
<td>981</td>
<td>Game Theory.*</td>
</tr>
<tr>
<td>990</td>
<td>Data Processing for Behavioural Scientists.</td>
</tr>
<tr>
<td>992</td>
<td>Mathematical Methods for Science and Engineering.*</td>
</tr>
<tr>
<td>994</td>
<td>Numerical Methods and Programming.</td>
</tr>
<tr>
<td>995</td>
<td>Seminar in Mathematics Education.</td>
</tr>
<tr>
<td>996</td>
<td>Topics in Mathematical Education.</td>
</tr>
<tr>
<td>999</td>
<td>Topics in the History of Mathematics.</td>
</tr>
</tbody>
</table>

M690 Literature and Research Studies.
M692 M.Phil. Comprehensive Examination
M693 Ph.D. Comprehensive Examination
M694 Language Requirement
M695 M.Math. Essay
M696 M.Math. Thesis
M697 M.Phil. Thesis
M699 Ph.D. Thesis
<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Institution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associate Professor Chairman of the Department</td>
<td>E. Brundrett</td>
<td>B.S.A. (O.A.C), B.A.Sc., M.A.Sc. Ph.D. (Toronto)</td>
</tr>
<tr>
<td>Professor</td>
<td>S. A. Alpay</td>
<td>Dipl. Ing., Dr. Ing. (Berlin)</td>
</tr>
<tr>
<td>Professor</td>
<td>T.A. Brzustowski</td>
<td>B.A.Sc. (Toronto), A.M., Ph.D. (Princeton)</td>
</tr>
<tr>
<td>Professor Associate Chairman</td>
<td>D.J. Burns</td>
<td>B.S., Ph.D. (Bristol)</td>
</tr>
<tr>
<td>Graduate Studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professor</td>
<td>G.T. Csanady</td>
<td>Dipl. Ing. (Munich), Ph.D. (New South Wales)</td>
</tr>
<tr>
<td>Professor</td>
<td>H.L. Evans</td>
<td>B.Sc., M.Sc. (Wales), D.I.C., Ph.D. (London)</td>
</tr>
<tr>
<td>Professor</td>
<td>G.F. Pearce</td>
<td>B.A.Sc. (British Columbia) M.A.Sc. (Toronto)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>G.M. Bragg</td>
<td>B.A.Sc. (Toronto), Ph.D. (Cambridge)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>M.B. Danard</td>
<td>B.A.Sc. (British Columbia), M.A. (Toronto) Ph.D. (Chicago)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>R.N. Dubey</td>
<td>B.Sc. (Hons) (Patna), B.Sc. (Eng.) (Bihar) Ph.D. (Waterloo)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>D.C. Ferguson</td>
<td>B.A.Sc. (Toronto)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>D. French</td>
<td>B.Sc., C. Eng.</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>A.M. Hale</td>
<td>B.Sc., M.A. (New Brunswick), B.A.Sc. (Toronto) M.A.Sc., Ph.D. (Waterloo)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>C.E. Hermance</td>
<td>B.E. (Yale), M.A., M.S.E., Ph.D. (Princeton)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>J.H.G. Howard</td>
<td>B.Sc. (Queen’s), M.Sc., Ph.D. (Birmingham)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>W.M. Mansour</td>
<td>B.Sc. (Cairo), M.A.Sc., Ph.D. (Toronto)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>H.R. Martin</td>
<td>B.Sc., M.Sc. (Queen’s Belfast) Ph.D. (Nottingham)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>W.B. Nicoll</td>
<td>S.M. (M.I.T.), Engineer (Stanford) Ph.D. (London)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>P. Niessen</td>
<td>B.Sc. (McMaster), M.A.Sc., Ph.D. (Toronto)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>K.R. Piekarski</td>
<td>Dipl. Ing. (London) Ph.D. (Cambridge)</td>
</tr>
<tr>
<td>Visiting Associate Professor</td>
<td>A. Plumtree</td>
<td>B.Sc., Ph.D. (Nottingham)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>R.F. Scrutton</td>
<td>B.Sc., M.Sc. (Melbourne)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>R. Skarecky</td>
<td>Ing. (Prague), C.Sc. (Brno)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>D.M.R. Taplin</td>
<td>B.Sc. (Aston), D.Phil (Oxford)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>M.M. Yovanovich</td>
<td>B.Sc. (Queen’s), M.S. (Buf.), M.E., Sc.D. (MIT)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>K.G.T. Hollands</td>
<td>B.A.Sc. (Toronto), Ph.D. (McGill)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>H.W. Kerr</td>
<td>B.A.Sc., Ph.D. (Toronto)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>J.T. Kessel</td>
<td>N.T. Dipl. Tech. (Witwatersrand), B.Ed (Cape Town)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>T.A. Ledwell</td>
<td>B.Eng., M.Eng. (Nov Scotia,) Ph.D. (Waterloo)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>W.K. Luk</td>
<td>D.I.C. (London), (Dipl of Hong Kong Tech. College), Ph.D. (Waterloo)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>J. Moss</td>
<td>B.Sc. (Western), Ph.D. (McMaster)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>R.J. Pick</td>
<td>B.A.Sc. (British Columbia), M.S. (Imperial College, London), Ph.D. (Waterloo)</td>
</tr>
<tr>
<td>Visiting Assistant Professor</td>
<td>R. Sowerby</td>
<td>B.Sc. (Imperial, London), M.Sc. (U.M.I.S.T., Ph.D. (U.M.I.S.T)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>A.B. Strong</td>
<td>B.A.Sc. (Waterloo), M.Sc. (Imperial College, London), Ph.D. (Waterloo)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>H.F. Sullivan</td>
<td>B.A.Sc. (Waterloo), A.M., Ph.D. (Princeton)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>T.M.L. Wigley</td>
<td>B.Sc., (Hons. Math. &amp; Phys.), Ph.D. (Adelaide)</td>
</tr>
<tr>
<td>Research Associate</td>
<td>J.M. Stuart</td>
<td>B.Sc. (Brown)</td>
</tr>
<tr>
<td>Lecturer</td>
<td>K.G. Adams</td>
<td>B.Sc. (Queen’s), M.A.Sc. (Waterloo)</td>
</tr>
<tr>
<td>Lecturer</td>
<td>G.C. Andrews</td>
<td>B.A.Sc. M.A.Sc. (British Columbia)</td>
</tr>
<tr>
<td>Lecturer</td>
<td>J.D. Malcolm</td>
<td>B.A.Sc., M.A.Sc. (Waterloo)</td>
</tr>
<tr>
<td>Special Lecturer</td>
<td>C.J. Beingessner</td>
<td>B.Sc., M.A.Sc., Ph.D. (Toronto)</td>
</tr>
<tr>
<td>Special Lecturer</td>
<td>R.G.R. Lawrence</td>
<td>Q.C</td>
</tr>
<tr>
<td>Special Lecturer</td>
<td>U.H. Mohaupt</td>
<td>B.A.Sc. (Waterloo)</td>
</tr>
</tbody>
</table>
Undergraduate Programmes

Details of the undergraduate programme in Mechanical Engineering are to be found on page 62. All courses extend over one term only, and consist of 3 hours of lectures per week unless otherwise specified. The hours of the core courses are listed on page 62.

In general, the only prerequisites are the core courses, unless otherwise specified.

Undergraduate Course Descriptions

1 Advanced Calculus

Infinite series: Tests for absolute, conditional, uniform convergence; power series; series expansions; differentiation and integration. Partial differentiation: total derivatives; estimation of errors; chain rule; geometry; maxima and minima; Taylor series; Jacobians. Multiple integration: areas, centroids, moments of inertia, centres of gravity. Vector analysis: gradient, divergence, curl, Laplacian; integral theorems.

2 Statistics for Engineers


Ordinary Differential Equations


4 Numerical Analysis

A survey of numerical procedures with emphasis upon computer implementation using the Fortran 4 programming language. In particular, the following topics are covered: Interpolation, curve fitting, solution of non-linear equations, numerical integration, numerical solution of Ordinary Differential Equations, matrix algebra and solution of systems of linear equations, and problems in the solution of partial differential equations.

10 System Dynamics

Generalized and unified dynamic concepts, physical laws governing dynamic systems. Laplace transform review and the transfer functions. Mathematical models and block diagrams for physical systems. Dynamics of first and second order systems due to deterministic inputs. Analogies among mechanical, electrical, fluid and thermal systems. Linear flow graph and Mason's rule. Analog computer simulation. Stability from the pole zero configuration.

12 Dynamics

15 Structure and Properties of Materials 1
Interatomic bonding, crystal and amorphous structures, structural defects, phase equilibria, diffusion, non-equilibrium transformations, corrosion.

16 Modern Physics

19 Mechanics of Deformable Solids 1

20 Mechanics of Deformable Solids
A general treatment of the behaviour of structural components from the study of stress and strain in solids. Topics include super-position, energy theorems, theories of failure, elastic and inelastic analysis of unsymmetrical bending, shear centre, torsion of circular members, columns and stability, and virtual work.

21 Kinematics and Dynamics of Machines

22 Mechanical Design

30 Structure and Properties of Materials 2
Elasticity, anelasticity plasticity, fracture, creep, fatigue, strengthening mechanisms, electrical, magnetic and optical properties.

32 Physical Metallurgy 2

33 Experimental Materials Science
This course is designed to acquaint students with experimental techniques in Materials Science. For the initial part, the students will be required to perform assigned experiments which demonstrate common physical phenomena. For the remainder of the course, each student will work on a small experimental project.

41 Manufacturing Science 1

42 Manufacturing Science 3


46 Manufacturing Science 7  Introduction to polymer processing for mechanical engineers. Elements of polymer science; plastics as a design material. Screw extrusion; elements of non-Newtonian flow and viscometry. Injection moulding. Parameters of polymer conversion operations and their estimation.


49 Metrology  Theory and practice of high precision mechanic measurements under strict control conditions—super micrometry; measurements by comparators; profilometry; surface profilography; environmental effects on measurements accuracy; theodolite techniques in the measurements of large structures; collimator applications in machine installation. Tolerances and quality control.


51 Fluid Mechanics 1  Physical properties of fluids and fundamental concepts in fluid mechanics. Hydrostatics. Conservation laws for mass, momentum and energy. Flow similarity and dimensional analysis as applied to engineering problems in fluid mechanics. Laminar and turbulent flow. Engineering applications such as flow measurement, flow in pipes and fluid forces on moving bodies.

52 Air Conditioning.  Thermodynamic properties of moist air; psychrometric charts; humidity measurements; direct water contact processes; heating and cooling of moist air by extended surface coils; solar radiation; heating and cooling of loads on buildings; effects of the thermal environment; air conditioning calculations; air flow in and around buildings, diffusers.

Prerequisites: ME 54

53 Heat Transfer 1  Introduction to heat transfer mechanisms. The formulation and solution of steady and transient heat conduction. Radiant heat transfer including
Department of Mechanical Engineering

54 Thermodynamics 2  Emphasis on applications of thermodynamics to flow processes, real fluids, evaluation of state functions of real fluids. Thermodynamic analysis of selected devices.

55 Refrigeration Engineering  Methods of refrigeration, refrigerants and their thermodynamic properties, vapour compression systems; actual cycles, simple and complex; survey of refrigeration applications such as preservation of food by quick freeze and long term deep freeze techniques; cooling load calculations; calculation of thermal capacities of components such as evaporators, compressors and condensors; refrigerant controls; piping and accessories; defrost methods; miscellaneous processes, cryogenics.  
Prerequisite: ME 54

56 Heat Transfer 2  Forced and free laminar and turbulent convection heat transfer in internal and external flows. Special topics selected from current applications.

58 Internal Combustion Engines  Reciprocating SI and CI engines, gas turbines, jets, rockets.  
Prerequisite: M.E. 54.

59 Energy Conversion  Steam power plants (conventional and nuclear), batteries, fuel cells, solar cells, thermionic conversion, thermoelectric conversion, MHD generators.  
Prerequisite: M.E. 54.


64 Industrial Fluid Mechanics  Flow in ducts, furnaces, heat exchangers, scrubbers, reactors, etc.; gas cleaning by removal of gaseous and particulate constituents; gas handling equipment; atmospheric dispersion of pollutants; wind loading on buildings and structures; wind tunnel modelling.


82 Mechanical Engineering Projects  Engineering assignments requiring the student to demonstrate initiative and assume responsibility. Student activity is guided and co-ordinated by faculty supervisor. In selecting projects, particular account is taken of the students' field of specialization. Projects, in general, involve technical disciplines beyond the strictly mechanical engineering field.  
9 hours laboratory.

90 Engineering Physics  Physical optics; waves as energy carriers, interference and diffraction.
radiation by atoms and molecules. Nuclear physics; nuclear structure, binding energy, nuclear reactions. Solid state physics; statistical distribution laws, molecular binding, band theory.

100 Introductory Survey of Law
The rights and responsibilities of the engineer as a citizen of Ontario and Canada under the law; brief history of Canadian law differentiating between Civil and Criminal Law, the rights and duties of citizens and police, a review of Domestic Law, Real Estate Law, Landlord and Tenant Law. The law as it may pertain to the engineer in his profession, brief reviews of the Law of Contracts, Patents, Trade marks, industrial design, and copy-right, Bills of Exchange, Company Law, incorporation of companies, Common and Preferred shares, the Law of Master and Servant, surveying law, Constitutional Law, Private International Law, and other topics.

200 Introduction to Mechanical Engineering 1
Discussion of structure of Mechanical Engineering curriculum, operation of Department, Faculty, University, technical societies.
1 hour, non-credit.

300 Introduction to Mechanical Engineering 2
Technical specialties in Mechanical Engineering, discussion of options in Mechanical Engineering curriculum, seminars on technical topics in the various options.
1 hour, non-credit.

400 Introduction to Mechanical Engineering 3
Research frontiers in Mechanical Engineering, specific discussion of research done at Waterloo, seminars by members of research groups.
1 hour, non-credit.

1 Partial Differential Equations

502 Functions of Complex Variables

503 Advanced Vectors, Tensors and Matrices
Advanced topics in vector analysis and matrix algebra. Cartesian tensors for engineers. Curvilinear coordinates. Introduction to general tensors.

504 Numerical Analysis 2
Advanced numerical techniques specifically designed to solve engineering problems in heat transfer, solid and fluid mechanics and systems dynamics.

523 Mechanical Design 2
Principles of optimum design of machine elements; minimum cost, minimum weight, maximum power, etc. Statistical considerations in factors of safety and tolerances. Effect of manufacturing errors on product performance. Introduction to value engineering and reliability. Prerequisite: M.E. 22.

524 Advanced Dynamics
A second course in engineering dynamics, inertia tensor and Euler's
Department of Mechanical Engineering

525 Mechanical Vibrations in Machines

527 Mechanics of Deformable Solids 3

528 Experimental Mechanics
Experimental methods of static and dynamic stress analysis; strain gauges, brittle coatings, photo-elasticity, moire fringes, analogues. Selected related topics: flaw detection, vibration measurement, use of statistical methods, error analysis and curve fitting.

531 Physical Metallurgy 1

534 Properties of Polymers

537 Ceramics
The crystallography of ionic and co-valent compounds. A study of the mechanical properties of single crystals and polycrystals. Properties of special ceramic materials.

544 Manufacturing Science 5

548 Numerical Control of Machine Tools 1

549 Analysis of Design of Machine Tools
This subject presents to the students both static and dynamic problems associated with machine tools and their effect on the accuracy and efficiency of manufacture.


Factors affecting the stiffness of machine tool structures, effects of relative stiffness on accuracy, friction characteristics of slideways. Hydrostatic bearings.
555 Thermodynamics 3  Chemical equilibrium, multiconstituent fluid phases, additional topics in statistical thermodynamics, introduction to thermodynamics of irreversible processes.

557 Combustion 1  Phenomenological description of flames of various types, flashback, blow off, inflammability limits, premixed flames, diffusion flames, burner design, flame holding, laminar flame theory, quasisteady droplet burning theory.


562 Control Theory 2  Introduction to nonlinear system: phase plane and describing functions. State space analysis. Introduction to systems with random inputs. Auto and cross-correlations, and the optimum filter theory.


564 Dynamics of Biomedical Systems  Sensors and instrumentation used in monitoring body parameters. Response of the body to various actions. Transfer functions and reaction times. Characteristics of blood flow. Mathematical models of pulmonary, cardiovascular and optical systems. Use of computers in modelling and data analysis. Application of automatic control principles to artificial limbs and other aids. Use of fluidics and fluid power devices to aid body functions.


566 Turbulent Flow 1  Reynolds stresses, intensity and scale of turbulence. The "law of the wall", logarithmic velocity profile and velocity defect laws, effects of roughness. Pressure loss in pipes and conduits. Jets and wakes.
567 Aerodynamics of Flight
Kinematics and dynamics of fluid flow; vorticity and circulation; vortex dynamics; theorems of Kelvin and Helmholtz and Biot-Savart law. Potential theory with circulation; Kutta-Joukowski theorem. Theory of infinite wing; effects of angle of attack, camber and profile shape on lift. Thin airfoil theory; aerodynamic devices for improving performance. Finite subsonic wing; downwash and induced drag. Stability and control of airplanes. Theory of supersonic wing; aerodynamic problems of supersonic flight.

568 Acoustics

570 Geophysical Fluid Dynamics 1
Hydrodynamic equations of motion on a rotating earth, Geostrophic balance in the atmosphere and oceans, vertical variation of wind and pressure fields in the atmosphere, mechanisms of pressure change, vorticity equation.

571 Air Pollution 1
Nature and sources of air pollution, chemical and biological aspects, effects on health and environment. Physical aspects of the atmosphere, thermodynamics, vertical variation of wind and temperature, stability, convection, atmospheric turbulence, diffusion equations, plumes, thermals, jets in stratified flow, radioactive plumes, particulate dispersion, instrumentation (micrometeorological), air pollution control techniques and equipment monitoring instrumentation.

572 Ocean Engineering
This course will deal with a number of topics from the broad spectrum of engineering problems in the aquatic environment. Subjects discussed may include: structures (open, solid, floating, submerged), vehicles (surface, substructure, bottom) and shore processes. Treatment of the phenomena and the particular properties of the medium which make its solution of engineering problems in this area more challenging will be treated (mainly) from the descriptive point of view. Usually a seminar and/or essay will be an important part of the course work-load.

567 Control System Design
A study of available components, their specifications, use and limitations. A number of industrial design projects will be carried out by limited numbers of students. Guest speakers from industry are invited to this course.

Graduate and Research Programmes

To be admitted to graduate studies in the Department of Mechanical Engineering, an applicant must have an excellent academic record from a recognized university, and must possess maturity and self-motivation. Furthermore, since close technical contact with a faculty member is an essential part of graduate education in engineering, no applicant can be admitted unless a faculty supervisor who specializes in the applicant's desired area of research offers him a place in his research group. It is therefore important that the applicant indicate clearly in his application the area of research in which he wishes to be engaged. Active fields of research in which students may at present be accepted are listed and described in the calendar, and the departmental brochure. It must be borne in mind that a number of fields of research are not currently open for graduate students. This restriction is subject to change from year to year.
new topics are added frequently as the sphere of interest of the department expands.

A. Master's Degree

The core of the Master's degree is a thesis whose content shall indicate a high level of scholarly research by the student into a topic related to his faculty supervisor's area of research. Pursuit of the thesis will involve the student in an experimental or theoretical research programme or possibly a combination of both. Wherever possible the faculty member will attempt to arrange financial assistance for the student from his research grants, with such awards being made by the beginning of April. It is therefore essential that applications be completed by March 1 at the latest.

Candidates registered for an M.A.Sc. degree will be requested to give advance notice of their intention to submit a thesis, approximately three months before the estimated date of submission. At this time an assessor will be appointed to aid the candidate's supervisor in evaluating the thesis. In most cases the assessor would be a member of the mechanical engineering department, except where some interdisciplinary research is involved.

The requirements for the award of a Master's degree are: a) that the candidate obtains a pass in all prescribed subjects, comprising at least four one-semester courses of which two or more must be graduate courses, with an average of 66% or better; b) that his thesis be accepted. In certain special cases the thesis requirement may be satisfied by four additional one-semester courses and a research project of limited scope, requiring a formal report.

B. The Doctor of Philosophy Degree

This degree is awarded after the candidate has satisfied his examining committee that his thesis is a substantial original contribution to knowledge and has also demonstrated a high degree of competence in areas of knowledge related to his specialization. The candidate will, to this latter end, take lectures and sit for examinations in a number of courses offered at the graduate level, according to a program of studies approved by his supervising committee. Approximately at the end of his first year of residence as a Ph.D. candidate a comprehensive oral examination is administered by his supervising committee.

The mechanics of thesis topics selection is very much as described above. Students continuing for a Ph.D., after obtaining the M.A.Sc. at Waterloo, may often continue to work in the same area of specialization.

In order to be admitted to graduate study as a Ph.D. candidate an applicant must have demonstrated his ability to do original research in the course of his Master's degree work. For this reason, should a graduate with a Master's degree obtained without producing a research thesis desire to enter our Ph.D. programme, he would have to satisfy the Department that he is able to carry out independent research.

The examining committee consists of the supervisor and four other members appointed on the advice of the supervisor. One of these is appointed from outside the university, another one from outside the department (often from Mathematics or Physics).

Comprehensive Examination

The comprehensive examination should be conducted about one year, but in any case not later than 18 months, after the student has been admitted to the Ph.D. programme. In preparation for this examination the candidate will submit a written research proposal of between 2000 and 4000 words describing his problem and outlining his proposed method of attack. This proposal must be circulated to the members of the supervising committee not less than six weeks in advance.
supervisor, should examine: (a) The adequacy of the course of study being undertaken, (b) The performance of the student during his first year both in the course-work and in his research studies, (c) The proposal for a research programme as presented by the student and (d) His competence in being able to complete the work to the satisfaction of the committee. The main decision to be reached is whether the candidate should proceed with the work, but advice about taking additional graduate courses or about changing the emphasis in his research work may also be given.

Examination of the Thesis

Regulations governing the submission and examination of the Ph.D. thesis are found in the section on “Graduate Studies” in the first part of the Calendar.

Graduate Course Descriptions

All courses listed consist of three lectures per week for one term, unless otherwise specified. Courses numbered in the 600's are given regularly. Courses numbered in the 700's are given only by special arrangement.

605 Kinematics 2

611 Mechanics of Continua
Mathematical preliminaries; co-ordinate transformations, introduction to tensors, tensor fields and transformations, integral theorems. Analysis of deformation; deformation tensors and rates of deformation tensors and their mechanical significance, convecting and rotating axes. Analysis of stress; definition of stresses and their physical significance, rates of stresses, objective stress rates. Fundamental laws, conservation of mass, momentum and energy, thermodynamics of a continuous media. Constitutive equations. Rheology.

622 Mechanical Design 4
Analysis of redundant mechanical systems, rings, frames, compound beams. Stiffness, flexibility and elastic stability considerations. Lightweight design. Design equations and computer techniques in analytical design.

626 Creep, Fatigue and Brittle Fracture
Review of test and design procedures. Creep under combined stress, creep buckling, thermal and high strain fatigue, fatigue life distributions, cumulative damage, fracture mechanics, analysis of fatigue crack propagation and brittle fracture, transition temperature and brittle crack arrest.

630 Dynamics and Control of Non-Linear Systems
631 Fluid Control Actuating Systems

633 Fluid Control Dynamics

636 Materials Science Seminars
The student will be responsible for the formal presentation of two seminars and will be obliged to attend all the seminars given in this course.

638 Physical Examination of Materials

640 Thermodynamics of Solids
This course will deal with the atomistic and thermodynamic interpretation of the fundamental properties of solids such as diffusion, solidification, surface properties and equilibrium in multicomponent systems.

641 Mechanical Metallurgy
Stress-strain relationships in tension, compression and shear. Elastic, anelastic and plastic properties of single crystals and polycrystalline aggregates. Fracture, Applications to materials testing.

643 Manufacturing Science 2
The classical theory of plasticity, with particular reference to forming processes. Elements of tensors, stress, strain, yield and flow; strain-hardening, anisotropy. Extremum principles, field theory, limit analysis. Impact and instability effects. Limiting conditions in forming operations. Time rate and temperature effects. Approximate technological theories; residual stresses.

647 Manufacturing Science 8

648 Numerical Control of Machine Tools 2

649 Theory of Machining
Strain distributions in orthogonal chip formation; temperatures in chip formation; dynamic plasticity; tool wear and machinability; mechanics of chip formation, stresses, chip curl, bluntness and cutting forces; mechanics of scraping and grinding, design of surgical instruments; machining of brittle materials.

655 Combustion
Structure and physics of monatomic and polyatomic molecules.
calculation of thermodynamic properties of molecules, bond energies and heats of formation, elements of kinetic theory of gases, elementary chemical kinetics, ionization and relaxation effects in gases, radiation from flames.

656 Combustion 3 The theoretical description of common combustion processes such as laminar and turbulent premixed and diffusion flames, modelling of combustion processes, theory of ignition solids and liquids, combustion instability, combustion in jet engines, liquid propellant rockets, solid propellant rockets.

662 Laminar Flow Use of tensor notation. Navier-Stokes and continuity equations, some exact solutions. Two dimensional boundary layer theory, laminar flow along flat walls and in “equilibrium” layers (Falkner-Skan equation) some approximate methods for non-equilibrium layers. Equations of motion with buoyancy term, energy equation, Reynolds analogy. The origin of turbulence, Orr-Sommerfeld equation. Tollmein Schlichting waves.


666 Wave Phenomena in Fluid Flow Fundamental properties of “wave-like” motions in fluids, tidal waves in one-dimensional channels. Surface waves in deep water, phase velocity, dispersion relationship, group velocity. The equations of acoustics, “near field” and “far field” problems, ray theory. Wave propagation in 1-2 and 3 dimensions, in layered and in moving media. Gravity waves in stratified fluids. Second and higher order interactions, radiation stress.

667 Boundary Layer Theory Review of elementary boundary layer theory in laminar and turbulent flow. The development of turbulent boundary layers in arbitrary pressure gradients, application to internal and external flows. Boundary layers on axisymmetric bodies, three-dimensional or “skewed” boundary layers. Heat and mass transfer through boundary layers, effect of material properties on boundary layer behaviour.

668 Geophysical Fluid Dynamics 2 Steady horizontal motion in infinite fluids and in closed basins. Westward intensification, coastal jets in stratified fluids. Turbulent Ekman layers. Seiches in closed basins, internal waves in stratified fluids. Rossby waves. Motion under unstable stratification, the Rayleigh problem, Benard cells, turbulent thermals and plumes.

669 Numerical Studies in Geophysical Fluid Dynamics Numerical methods, time integration of hydrodynamical equations of motion on a rotating earth, numerical weather prediction, computation of selected other physical processes in the atmosphere (e.g. long-wave radiation)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>720</td>
<td>Evaluation of Mechanical Systems and Design</td>
<td>The testing and evaluation of mechanical systems. Product characteristics, reliability and long-life design. Hazards and safety consideration. Shock and vibration, environmental testing, Value engineering.</td>
</tr>
<tr>
<td>734</td>
<td>Seminar in Fluid Control Systems</td>
<td>Study, investigation and discussion under the supervision of a faculty member, of current literature and research papers in fluid control systems presented in recent conferences and meetings.</td>
</tr>
<tr>
<td>737</td>
<td>Phase Transformations</td>
<td>Phase diagrams, homogenous and heterogenous nucleation, diffusion, phase changes in metals and alloys. Diffusional growth processes, diffusional and shear transformations.</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>738</td>
<td><strong>Composite Materials</strong></td>
<td>Fibrous, lamellar and particle reinforced composites. The effect of combinations of brittle and ductile phases on the mode of deformation of an aggregate. The reinforcing mechanism of continuous and discontinuous fibres. Fracture and energy absorbing characteristics of composite materials.</td>
</tr>
<tr>
<td>739</td>
<td><strong>Dislocation Theory</strong></td>
<td>Simple and extended dislocations. Stress, strain and energy associated with single dislocations. Forces on and between dislocations. Dislocation-dislocation interactions, cross slip and multiplication. Interactions with point defects. Applications in grain-boundary theory, plasticity, recovery recrystallization and fracture.</td>
</tr>
<tr>
<td>740</td>
<td><strong>Thermodynamics of Solids</strong></td>
<td>Atomistic and thermodynamic interpretation of the fundamental properties of solids such as diffusion, solidification, surface properties and equilibrium in multicomponent systems.</td>
</tr>
<tr>
<td>752</td>
<td><strong>Convective Heat Transfer</strong></td>
<td>Derivation of the general energy equation. Parameters required for determination of heat transfer in laminar and turbulent flows. Fully numerical solutions, exact solutions, and approximate solutions for internal and external flows. Problems involving frictional heating, property variations and mass injection at the wall will be considered. If interest is indicated special topics such as heat transfer by boiling, condensation and evaporation will be discussed.</td>
</tr>
</tbody>
</table>
754 Approximate Methods in Non-Linear Analysis

This course constitutes an introduction to methods of obtaining approximate, analytical solutions to various typical, non-linear, ordinary and partial differential equations. Methods to be discussed include integral approximations, several types of weighted residual techniques, and asymptotic methods, including matched “inner” and “outer” expansions. Examples will be obtained primarily from electrical, chemical and aero-thermodynamic processes.

761 Internal Aerodynamics of Turbomachines

Fundamental relationships for internal fluid flow with reference to stationary and rotating co-ordinate systems; vorticity and circulation; compressible inviscid flow with swirl within axisymmetric passages; some effects of viscosity and turbulence. One-, two- and three-dimensional analysis methods for compressible flow in turbomachines; flow in diffusers; secondary flows in stationary and rotating passages; some characteristics of three-dimensional turbulent boundary layers.

762 Turbulent Diffusion in the Natural Environment

Statistical quantities of interest in turbulent diffusion: Eulerian and Lagrangian probability distributions, averages, correlations, spectra. Specific prediction models for atmospheric and oceanic mixing processes: diffusion in a homogeneous field and in a boundary layer. Effects of density stratification, buoyant movements.

763 Micrometeorology

Energy balances at the earth-atmosphere boundary, wind flow and turbulent heat and mass transfer over homogeneous surfaces, wind flow around obstacles, atmospheric pollution, local weather modification.

764 Dynamical and Physical Meteorology

Thermodynamics of moist air, formation of precipitation, solar and terrestrial radiation, energy equations, scale analysis of equations of motion, geostrophic adjustment, available potential energy, the general circulation, barotropic and baroclinic instability.

765 Flow of Inhomogeneous and Rotating Fluid


801 Oral examination of the thesis for the Ph.D.
803 Comprehensive Examination
807 Engineering Project
808 Research Thesis for the M.A.Sc.
809 Research Thesis for the Ph.D.

The major areas of current research in the Department of Mechanical Engineering are:
- Materials Science
- Manufacturing Science
- Solid Body Mechanics & Mechanical Design
- Natural Fluid Dynamics
- Combustion
- Turbulent Flow in Boundary Layers and Ducts
- Turbomachinery
- Fluid Control Systems
- Bio-Engineering
Department of Mechanical Engineering

Descriptions of the active projects in each area and a listing of publications resulting from them may be found in the brochure "Research in Engineering" published by the Faculty of Engineering.
School of Optometry

Professor and Director of the School

Professor
C.W. Bobier, B.A. (Toronto), M.Sc. (Ohio), O.D. (College of Optometry of Ontario)
W.S. Long, B.A. (Toronto) O.D. (College of Optometry of Ontario)
W.M. Lyle, M.Sc., Ph.D. (Indiana), O.D. (College of Optometry of Ontario)
M.E. Woodruff, M.Sc., Ph.D. (Indiana), O.D. (College of Optometry of Ont)

Professor C.W. Bobier, B.A. (Toronto), MSc. (Ohio), O.D. (College of Optometry of Ontario)
Professor W.S. Long, B.A. (Toronto) O.D. (College of Optometry of Ontario)
Professor W.M. Lyle, M.Sc., Ph.D. (Indiana), O.D. (College of Optometry of Ontario)
Professor M.E. Woodruff, M.Sc., Ph.D. (Indiana), O.D. (College of Optometry of Ontario)

Associate Professor T.P. Grosvenor, B.Sc., Ph.D. (Ohio State)
Associate Professor J.D. Moreland, B.A. (London U.), Ph.D. (Imp. Coll.)
Assistant Professor A. Remole, B.F.A. (Manitoba), M.Sc., Ph.D. (Indiana), O.D. (College of Optometry of Ontario)
Assistant Professor T.D. Williams, M.Sc., Ph.D. (Indiana), O.D. (College of Optometry, Ont)
Assistant Professor G.C.S. Woo, M.Sc., Ph.D. (Indiana), O.D. (College of Optometry of Ontario)

Adjunct Professor Irving Baker, O.D. (College of Optometry of Ontario)
Adjunct Professor M.G. Fernando, M.B., B.S. (Ceylon), Ph.D. (Singapore)
Adjunct Professor D.H. Lamont, B.A. (Toronto), Q.C.
Adjunct Professor Marvin Lunskey, M.Sc. (Indiana), O.D. (College of Optometry of Ontario)
Adjunct Professor A. Nichols, B.A., Ph.D. (McGill)
Adjunct Professor B.B. Sparks, M.D. (Toronto)
Adjunct Professor G.W. Wyszecki, Dip. Ing., Dr. Ing. (Tech. Univ., Berlin)
Clinical Associate S. Albright, Dip. Opt. (College of Optometry of Ontario)
Clinical Associate W.R. Andrews, O.D. (College of Optometry of Ontario)
Clinical Associate R.R. Bock, O.D. (College of Optometry of Ontario)
Clinical Associate E.L. Buchner, O.D. (College of Optometry of Ontario)
Clinical Associate M.G.E. Callender, B.Sc. (S.G.W.U.), O.D. (College of Optometry of Ontario)
Clinical Associate D.R. Gilhooey, B.Sc. (Saskatchewan), O.D. (College of Optometry of Ontario)
Clinical Associate L. Gold, Dip. Opt. (College of Optometry of Ontario)
Clinical Associate Garry Grant, O.D. (College of Optometry of Ontario)
Clinical Associate Ronald R. Hansford, O.D. (College of Optometry of Ontario)
Clinical Associate D.R. Larkworthy, Dip. Opt. (College of Optometry of Ontario)
Clinical Associate A. MacKinnon, O.D. (College of Optometry of Ontario)
Clinical Associate M.S. Munn. Dip. Opt (College of Optometry of Ontario)
Clinical Associate Harvey Naftolin, O.D. (College of Optometry of Ontario)
Clinical Associate R.D. Pellowe, O.D. (College of Optometry of Ontario)
Clinical Associate John D. Price, O.D. (College of Optometry of Ontario)
Clinical Associate Howard C. Thompson, B.A. (Toronto), O.D. (College of Optometry of Ontario)
Clinical Associate Ronald B. Watson, O.D. (College of Optometry of Ontario)
Laboratory Assistant Alan J. Baldock, O.D. (College of Optometry of Ontario)
Laboratory Assistant Lorne S. Joyce, O.D. (College of Optometry of Ontario)
Laboratory Assistant Robert Coles, O.D. (College of Optometry of Ontario)
Laboratory Assistant J.D. Pollock, O.D. (College of Optometry of Ontario)
Ophthalmic Technician James Moir
Ophthalmic Technician Harley Thompson
Laboratory Technician Douglas Gregory
Laboratory Technician Michael Kirby
Course Descriptions

Students in other disciplines may register for Optometry courses upon the approval of the Director of the School of Optometry.

200* History and Orientation
A brief history of the profession; a review of the development of visual science; a consideration of legal and organizational development of optometry; the role of professional associations. The scope and nature of optometrical practice and the relationship of the profession to other professions and the community.
2 lectures, Fall Term.

211* Physiological Optics
The eye as an optical instrument. The refracting mechanism; accommodation, pupil action and lid action; the passage of light in the eye; stray light in the eye; analysis of the retinal stimulus pattern.
3 lectures, 2 hours laboratory, Winter term.
Prerequisite: Physics 236.

214 Anatomy of the Eye and Associated Structures
The gross, microscopic and ultra structure of ocular tissues will be examined in detail. Extensive dissection of various eyes will be completed. Bone and other supportive structure will be studied in the laboratory with emphasis directed toward application of anatomical knowledge to related courses in pathology and clinical optometry. Embryology and Comparative Anatomy are included.
5 lectures, 4 hours laboratory, Winter term. (Full Course).
Prerequisite: Biology 201, Optometry 211*.

216* Advanced Geometrical Optics
An extension of geometrical optics given in Physics 236 dealing with the optics of surfaces, prism, thin and thick lens systems including the eye, aberrations of such systems and their correction; optical and ophthalmic instruments.
3 lectures, 3 hours laboratory, Winter term.
Prerequisite: Physics 236.

301* Physiological Optics
Ocular motility: description and analysis of eye movements, measurement of eye movements, the innervational systems of the extraocular and intraocular musculature.
3 lectures, 3 hours laboratory
Prerequisite: Optometry 211*

302* Clinical Optometry
Lectures on clinical techniques for examination of the optical properties of the eye. Included will be:—measurement of the visual acuity, theory and practise of retinoscopy, ophthalmoscopy, keratometry, subjective sight testing, measurement of amplitude of accommodation, and calculation of reading addition. A laboratory course in which these techniques will be demonstrated and practised will run concurrently.
3 lectures, 3 hours laboratory, Fall term.
Prerequisite: Optometry 211*

305* General Pathology
A study of the basic disease processes including inflammation, degeneration, neoplasia. The properties of pathogenic microorganisms and the specific diseases with which they are associated. Resistance, immunity, hypersensitivity. Diseases caused by physical agents other than microorganisms. Principal diseases affecting each organ system.
3 lectures, 1 hour tutorial, Fall Term.
Prerequisites: Biology 201, Optometry 214
306* Optometrical Optics
The history and manufacture of optical glass, ophthalmic lens surfacing and design, classification and performance of single vision ophthalmic lenses, prismatic effects, transposition, absorptive lenses and lens coating, problems and solutions in fitting ophthalmic lenses to the eyes. The laboratory course deals with processing all types of ophthalmic material, as well as optical bench experiments.
3 lectures, 2 hours laboratory. Fall term
Prerequisite: Optometry 216*

311* Physiological Optics
The visual process: retinal structure; photopigments; photoreception; electrophysiology of the retina and higher centres.
3 lectures, 3 hours laboratory
Prerequisite: Optometry 301

312* Clinical Optometry
Clinical techniques for the examination of the binocular relations of the non-strabismic patient, with particular emphasis on the study of the relationship between accommodation and convergence; techniques of phorometry, prism vergence tests, relative accommodation tests, dynamic retinoscopy, and monocular and binocular cross cylinder tests.
3 lectures, 3 hours laboratory. Winter term.
Prerequisite: Optometry 302*

315* General Pathology
A continuation of 305*
3 lectures, 1 hour tutorial. Winter term.
Prerequisite: Optometry 305*

316* Optometrical Optics
A continuation of 306*, dealing with problems peculiar to bifocal and multifocal lenses. Aberrations of thin lenses and the design of lenses for ophthalmic use.
3 lectures, 2 hour laboratory. Winter term.
Prerequisite: Optometry 306*

401* Physiological Optics
Psychophysics of vision: light and dark adaptation; spatial and temporal light discrimination; normal and defective colour vision.
3 lectures, 3 hours laboratory
Prerequisites: Optometry 301*, 311*

402* Clinical Optometry
The sequence of testing in the clinical examination will be outlined. Stress will be on case history, tests of the integrity of the visual system, tests of the refractive properties, and tests of binocular relations. The integration of these tests into a satisfactory clinical analysis and modes of treatment will constitute a large part of the course.
3 lectures, 1 hour laboratory. Fall term.
Prerequisites: Optometry 302*, 312*

404* Physiology of the Visual Systems
Vascular supply; physiology of the cornea and lids; formation, supply and drainage of the ocular fluids; intraocular pressure, metabolism of cornea, lens, vitreous and retina; effects of drugs producing miosis, mydriasis, cycloplegia, spasm of accommodation and anaesthesia of the ocular surfaces; neurophysiology of the retina, sensory and motor pathways and the brain centres of the visual system.
2 lectures, 2 hours laboratory. Fall term
Prerequisite: Optometry 214

405* Ocular Pathology
A detailed study of the diseases which involve the eye and related structures with emphasis on early recognition. Symptomatology, differential diagnosis. Evidence of systemic diseases as manifestations.
School of Optometry

2 lectures, 1 hour tutorial, Fall term.
Prerequisites: Optometry 305*, 315*

406* Optometrical Optics
The lecture course will deal with the problems involved in the selecting, preparing and fitting ophthalmic materials. Consideration of optical, cosmetic and comfort requirements. The laboratory course will give the student experience in working with lenses and frames as he prepares ophthalmic materials for clinic patients.
1 lecture, 2 hours laboratory, Fall term.
Prerequisites: Optometry 306*, 316*

408* Optometry Clinic
The student is assigned to the Visual Analysis Clinic and under the direct supervision of optometrists of the clinic staff, carries out routine clinical investigations of patients who attend the public clinic.
6 hours clinic, Fall term.
Prerequisite: Permission of Clinic Director.

409* Light and Illumination
Light sources, transmitting and reflecting surfaces; principles of radiometry and photometry; illumination and related factors involved in the control of the visual environment.
2 lectures, 2 hours laboratory, Fall term.

411* Physiological Optics
Binocular vision and perception: The binocular system; binocular integration and interaction; effects of disparate stimulation; perceived size, shape, direction, distance, motion, illusions.
3 lectures, 3 hours laboratory,
Prerequisite: Optometry 401

412* Clinical Optometry
A continuation of 402*. The detection of strabismus and techniques for testing the sensory and motor characteristics of the strabismic patient. The aim will be to allow the student to evaluate the likelihood of achieving a cure by non-surgical means. The techniques of orthoptics and visual training by which a rehabilitation of vision can be attempted will be described and demonstrated.
2 lectures, 2 hours laboratory, Winter term.
Prerequisites: Optometry 302*, 312*, 402*

414* Physiology of the Visual Systems
A continuation of 404*
2 lectures, 2 hours laboratory, Winter term.
Prerequisite: Optometry 404*

415* Ocular Pathology
A continuation of 405*.
2 lectures, 1 hour tutorial, Winter term
Prerequisite: Optometry 405*

416* Optometrical Optics
A continuation of 406*.
1 lecture, 2 hours laboratory, Winter term.
Prerequisite: Optometry 406*

417* Optometrical Specialties
A series of lectures and laboratories on the handling of patients in specialized areas of optometric practice. These include contact lens fitting, the fitting of aids for subnormal vision, and the correction of aniseikonia.
3 lectures, 2 hours laboratory, Winter term.
Prerequisites: Optometry 401*, 402*, 408*
**School of Optometry**

Prerequisite: Optometry 408*

### 428* Summer Clinic
Each student is required to complete 60 hours of clinical practice during the summer term. Times will be arranged by the student with the approval of the clinic staff.

*Prerequisite: Permission of Clinic Director.*

### 500* Optometrical Jurisprudence and Praxis
Lectures on laws governing the practice of Optometry in Canada and laws relating to the rights and responsibilities of the optometrist in his relations with his patients; the establishment and management of optometric practice; economics, taxes, insurance, accounting, office design, mode of practice, professional organization and societies.

2 lectures, Fall term.

### 501* Physiological Optics
Assignments will include preparing for seminars on topics of interest, reviews, library and laboratory researches by individuals or small groups. Consideration will be given to the individual student's special interests. Students who have demonstrated a particular interest in and aptitude for physiological optics and who are interested in research in this area may elect this course as an alternative to Psychology 355*-357*.

3 hours, Fall term.

*Prerequisites: Optometry 401*, 411*

### 502* Advanced Clinical Optometry
The lecture portion of this course will deal with special techniques of clinical optometry for examination of refractive properties and binocular relations; techniques of binocular refraction, prism adaptation; seminars and the presentation of clinical case reports by the student for defense and criticism will constitute a part of the course.

3 lectures, Fall term.

*Prerequisites: Optometry 302*, 312*, 402*, 412*

### 504* Pharmacology
Neurohumoral theory, responses to drugs, sterile techniques, disinfectants. Drugs used in contact lens practice, drugs used topically on the eye, drugs used as diagnostic aids. Side effects of all drugs on the eye and vision.

2 lectures, Fall term.

*Prerequisites: Optometry 404*, 405*, 415*

### 508* Optometry Clinic
The clinic is the culmination of the optometry student's educational career. Emphasis will be placed on vision care to patients of all ages and walks of life. The clinical intern performs the total work of an optometrist under the supervision and counsel of clinical faculty. Specialty clinics will be operated within the clinic organization to obtain facility of application of appropriate skill in pathology detection, orthoptics and vision training, contact lens application, the detection and rehabilitation of perpetual-motor problems, the problems associated with the low-vision patient.

22 hours clinic, Fall term.

*Prerequisite: Permission of Clinic Director.*

### 509* Public Health Optometry
The role of optometry in providing vision care to society and the community. Optometrical services to industry, in schools, the role of vision in the safe operation of highway vehicles and airplanes as well as the role of optometry in private and government programs of vision care and health insurance. Epidemiology.

2 lectures, 2 hours laboratory, Fall term.
School of Optometry

510* Optometrical Jurisprudence and Praxis
A continuation of 500*.
2 lectures. Winter term.
Prerequisite: Optometry 500

511* Physiological Optics
A continuation of 501*
3 hours. Winter term.
Prerequisite: Optometry 501.

512* Advanced Clinical Optometry
A continuation of 502*.
3 lectures. Winter term.
Prerequisite: Optometry 502*

514* Genetics For Optometrists
A brief review of Mendelian genetics, and the molecular basis of modern genetics. Inherited conditions of particular interest, e.g., colour vision, albinism, aniridia, refractive error, retinoblastoma, etc. Genetic counseling, and the detection of carriers.
2 lectures. Winter term.
Prerequisites: Optometry 405*, 415*.

518* Optometry Clinic
A continuation of 508*.
22 hours clinic. Winter term.
Prerequisite: Optometry 508*

519* Public Health Optometry
A continuation of 509*.
2 lectures, 2 hours laboratory. Winter term.

Graduate and Research Programmes

The School of Optometry offers graduate work leading to the M.Sc. degree in Physiological Optics. All graduate courses are one term in length.

Definition and Scope
Physiological Optics is, broadly speaking, the scientific study of vision and the eye. Specifically, it is the branch of science concerned with vision and its physical, physiological and psychological ramifications. Thus Physiological Optics is multidisciplinary since it interrelates anatomy, physics, biochemistry, physiology and psychology in the creation of new knowledge and understanding of ocular functions and visual processes.

Admission Standards
This programme is open to the graduates, with at least a B average, from Schools of Optometry with undergraduate programmes equivalent to the Optometry programme at University of Waterloo. Students who have completed B.Sc. in other areas with at least B standing will be considered for admission only after successful completion of one or more qualifying years. The “qualifying programme” would be planned in consultation with the faculty in the School of Optometry, and designed to remove deficiencies in the background of students so that they would have academic qualifications equivalent to honours graduates in Optometry before entering the M.Sc. programme.

Research in Progress
The effects of pupil size on space perception as manifest in changes in the Pulfrich Phenomenon and the horopter are being studied.
Changes in the time characteristics of eye movements as related to eye movement exercises are being investigated.
Clinical research in contact lenses, and their effects on the eyes and in vision aids for the partially sighted.

Physical properties of ophthalmic lenses, surface quality, focal properties, design, absorptive properties.

A study of children with Down's syndrome (mongolism) is being conducted. These children are being assessed as to the prevalence of ocular defects and their dermatoglyphic patterns are being obtained at the same time. The chromosomal abnormality seems to be associated with specific changes in the patterns of the lines and ridges on their fingers which correlate well with their karyotype. The accompanying ocular defects are being tabulated and will be compared on a statistical basis with the reported prevalence of each defect in normal children.

Research on drug induced vision effects which tend to impair driving performance.

Effects of intermittent stimulation on border enhancement.

Effects of wave length on subjective intermittence patterns.

Improved instrument for wide-angle ophthalmoscopy.

Interrelations between fixation patterns and visual acuity in amblyopia.

A comparison of the amount and kinds of corneal astigmatism present in Amerind children in Northern Saskatchewan with similar measurements on other Amerinds, Caucasians and Maori children.

Data on the refractive state of the eye, corneal curvature, corneal astigmatism, ocular astigmatism, corrected and uncorrected visual acuity of Amerind children from the James Bay Zone is presently under assessment and comparison with samples of other child populations.

Children between birth and the fifth year of life are being examined as part of a continuing longitudinal study of ocular refractive trends during this life period. This is a continuation of a cross sectional study of the same age group.

A search for the effects of high altitude parachute jumping on the eye is being conducted on two subjects.

A qualitative and quantitative study of lacrimal proteins and cations in the presence of pollutants and extraocular foreign bodies is under way. Initial studies indicate that larger numbers of fractions can be segregated and identified than has been the case heretofore. The application of these findings to contact lens wear is a concomitant part of the study.

Evaluation of the efficiency and economy of methods for vision screening of populations of varying ages.

Census of ocular problems of the institutionalized aged.

The effect of contact lenses on lacrimal fluids.

The assessment of the effects of soft-contact lenses on ocular tissues and fluids.

Biophysics of colour vision: a large trichromatic colorimeter is being constructed for fundamental research.

Graduate Courses

10* Vegetative Physiology of the Visual System

Glandular and secretory mechanisms of the eye, intraocular fluid dynamics. Physiological and physical properties of the cornea, crystalline lens, and vitreous.

*One term, 3 lectures*
School of Optometry

601* Optical Characteristics of the Eye
The refractive state of the eye and its variables; transmittance, absorption, scattering by the ocular media; pupil size, aberrations, diffraction limitations, resolution, and contrast transfer functions.
*One term, 3 lectures*

602* Ocular Motility
Kinematics of eye movements, specification of the direction of regard, neurology of oculomotor functions, oculomotor systems and types of eye movements, the pathologies of oculomotor systems and their effects.
*One term, 3 lectures*

603* Accommodation and Convergence
Mechanism of accommodation; stimulus to accommodation; time and amplitude characteristics of the response; synkinesis of accommodation and convergence, ACA ratio, the zone of clear single binocular vision.
*One term, 3 lectures*

604* Visual Perception of Space
Oculocentric and egocentric directionalization; monocular clues for depth perception; distance and size relationships; real and apparent motion; the theoretical and nonius horopter and the apparent fronto-parallel plane; stereopsis; aniseikonia; Pulfrich effects; alley experiments and the geometry of visual space.
*One term, 3 lectures*

605* Psychophysics of Colour Vision
Normal and defective spectral sensitivity, colour discrimination and colour matching functions. Colour perception in the peripheral retina and by small fields. Chromatic adaptation. The Stiles-Crawford, Bezold-Brücke and colour contrast effects. Colour vision in animals. Theories of colour vision.
*One term, 3 lectures*

606* Radiation and the Visual Stimulus
Measurement and specification of light; radiometric and photometric relationships; spectrophotometry and the colour-metric (CIE) specification of visual stimuli; radiation limits of the visual system.
*One term, 3 lectures*

607* Physiology of the Visual Process
Anatomy and neurophysiology of the retina, lateral geniculate body and cortex; photochemistry of vision, electrophysiology of the visual system.
*One term, 3 lectures*

608* Special Topics in Physiological Optics
Topics in the fields of specialization of the faculty may be studied by special arrangement with the faculty member, the student, and his committee.
*One term, 3 lectures*

609* Current Problems in Physiological Optics
Seminars covering major topics not presently included in available courses. Graduate students will make presentations on readings or research. Participation in discussions will be an integral part of the course.
*Credit to be arranged*

699 Thesis
*Credit to be arranged*
Department of Philosophy

Associate Professor and Chairman

of the Department
Professor L. Armour, B.A. (British Columbia), Ph.D. (London)
Professor L.L. Haworth, B.A. (Rollins), M.A., Ph.D. (Illinois)
Professor J.S. Minas, B.A. (Wayne), Ph.D. (Illinois)
Professor P. Seligman, B.A., Ph.D. (London)
Professor J.W. Tucker, B.Sc., B.A., Ph.D. (London)
Associate Professor E.J. Ashworth (Miss), B.A., M.A. (Cambridge), Ph.D. (Bryn Mawr)
Associate Professor R.A. George, M.A., Ph.D. (Michigan State)
Associate Professor B.P. Hendley, B.A. (Marquette), M.A., Ph.D. (Yale)
Associate Professor J.R. Horne, B.A., M.A. (Western Ontario), B.Th. (Huron) Ph.D. (Columbia)
Associate Professor A.C. Minas (Mrs.), B.A. (Radcliffe), M.A., Ph.D. (Harvard)
Associate Professor D.D. Roberts, B.A. (Roosevelt), M.A., Ph.D. (Illinois)
Associate Professor J.W. Van Evra, B.A. (Valparaiso), M.A., Ph.D. (Michigan State)
Assistant Professor J W. Abbott, B.A. (Kenyon), Ph.D. (Ohio State)
Assistant Professor J F. Centore, B.Sc. (Canisius), M.A. (Maryland), Ph.D. (St. John's)
Assistant Professor J D. DeMarco, B.Sc. (Stonehill, Mass.), M.A., Ph.D. (St. John's, N.Y.)
Assistant Professor R.H. Holmes, B.A., M.A. (Montana), Ph.D. (Washington)
Assistant Professor J. Huertas-Jourda, B.A. (Florida), M.A., Ph.D. (New York)
Assistant Professor J. Wubnig (Miss), B.A. (Swarthmore), M.A., Ph.D. (Yale)
Lecturer J G.T. Campbell, B.A. (Western Ontario), Ph.L. (Laval)
Lecturer M.F. McDonald, B.A. (Toronto), M.A. (Pittsburgh)

Note 1 Unless otherwise noted in the course listing, all courses offered by the Department may be taken by any student in the University, subject only to his meeting the specific prerequisites listed in the individual course descriptions.

Note 2 Some of the advanced courses (those numbered 300 or above) will not be available every year. Each Spring, the Department will publish a list of the courses to be offered for the following academic year. This list will include descriptions of courses whose content is not specified below and names of instructors for each course.

Note 3 The attention of all first-year students is called to the fact that several courses in addition to Philosophy 100 or 101 are open to them, any full courses or two half courses of which can be used to satisfy part of the University requirement under group A(i). These are the courses numbered 125, 135, 140, and 221/222, 240, and 280/281. Of these, the courses numbered 221/222, 240, and 280/281 are especially recommended for the student contemplating further study in Philosophy. (See recommended Honours Programmes, page 30.)

Note 4 The number of hours shown after the courses merely indicates the weight of courses relative to one another and does not determine the number of hours the course meets. The number of class meetings per week is determined by the instructor. Half courses (courses which meet for one term only) are designated by an asterisk (*) after the course number.

Note 5 Courses suffixed with 'J' are administered by St. Jerome's College; those suffixed with a 'P' are administered by St. Paul's College.
Department of Philosophy

Note to Honours Philosophy Students

The attention of students in Honours Philosophy programmes is drawn to the following list of recommended electives: Classical Civilization 251, Classical Civilization 260, History 260, English 350 and Political Science 320.

Note

Any of the following courses is especially recommended for the consideration of Honours students who intend to pursue graduate studies in Philosophy: Philosophy 340, 350, 363, 455, 465, and one of either 380*-389* or 480*-489*.

Undergraduate Courses

Note Concerning Introductory Courses

Normally all first year courses provide opportunity for weekly discussions in small groups.

100 Introduction to Philosophy

A broad selection of the main problems in philosophy will be considered. For example: How can we know whether anything is right or wrong? How can we know about things we cannot directly observe? Can we know whether there is a God? Is mind in any sense distinct from matter? Original texts of both classical and contemporary thinkers are employed. No prerequisite. 3 hours.

101 Introduction to Philosophy

As 100, but the course will be taught by a variety of instructors and a six-week detailed treatment of one philosophical problem will take place at the end of the second term. For this purpose the class will divide into a number of small sections, each in the charge of one of the original instructors. Each instructor will explore in depth a selected problem and students will be given some choice of sections. No prerequisite. 3 hours.

110 Problems

An introduction to philosophical thinking through an examination of problems that concern the student. The course will begin with a general discussion of problematic aspects of contemporary life. We will then focus in on specific topics and consider them in light of relevant philosophical approaches. Readings to be used will depend on the topics emerging from the discussion. No prerequisite. 3 hours.

135* Fundamentals of Social and Political Philosophy

The central question of the course is: What reasons can I have for acting on the issues which will face me as a member of society? Such problems as divorce, democracy, socialism, the Bomb, and international politics will be critically discussed in the light of readings from both classical and contemporary philosophers. No prerequisite. 3 hours.

135* Fundamentals of the Philosophy of Religion

A philosophical consideration of problematic aspects of religious belief. Topics to be discussed will include: attempts to prove the existence of God, the problem of evil, faith and reason, religious experience, and religious language. Classical and contemporary readings will be used. No prerequisite.
140* Fundamentals of Logic
Basic types of reasoning will be analyzed. The reasons for using symbols in logic will be explored, and some simple systems considered. Attention will also be devoted to informal arguments and scientific method.
No prerequisite.
3 hours.

150* Knowledge and Reality
Discussion of the nature of reality. Rival theories concerning mind, matter, freedom, the existence of God, and the place of experience and reason in human knowledge.
No prerequisite.
3 hours.

221* Ethics 1
The classic literature of ethics will be analyzed, and the principal problems brought to light.
No prerequisite.
3 hours.

222* Ethics 2
Contemporary theories will be explored, and recent philosophical methods applied in the discussion of the principal problems of ethical theory.
Prerequisite: Philosophy 221* or consent of instructor.
3 hours.

23 Mural and Social Philosophy
An examination of theories for evaluating personal conduct and political, social, and economic systems and policies. Such concepts as right and wrong, justice, individual rights, and the ends of political organization form the principal subject-matter of the course. Both classical and contemporary readings are employed.
Prerequisite: Philosophy 100 or equivalent, or Honours status in any Social Science department, or consent of instructor.
3 hours.

235* Philosophy and Mysticism
A critical examination of mystical writings, with regard to the nature of the experience reported, their typology, and their implications for epistemology, ethics, and philosophy of religion.
Prerequisite: Consent of instructor.
2 hours.

240 Logic
A systematic development of the propositional calculus and of the first-order functional calculus. Some attention will be devoted to extensions to, and interpretations of, such formal systems.
Prerequisite: None for second-year students and above; consent of instructor for others.
3 hours.

280* History of Ancient Philosophy 1
From the beginnings to Plato.
Prerequisite: Consent of instructor for students not taking philosophy as their main subject.
3 hours.

281* History of Ancient Philosophy 2
From Aristotle to the close of classical antiquity.
Prerequisite: Philosophy 280*.
3 hours.

282* History of Modern Philosophy 1
Earlier period beginning with Descartes.
Prerequisite: One full or two half Philosophy courses, preferably
283* History of Modern Philosophy 2 Later Period including Kant.

Prerequisite: Philosophy 282*.
3 hours.

311* Philosophy of Education 1 A philosophical analysis of classical and contemporary Theories of education, with a view to formulating a clear workable concept of education, its aims and methods.

Prerequisite: One full or two half Philosophy courses, or consent of instructor.
3 hours.

312* Philosophy of Education 2 Critical evaluation of selected problems of education in an attempt to relate theory to practice. Recent studies, such as the Hall-Dennis Report, will be among those considered.

Prerequisite: Philosophy 311*, or consent of instructor.
3 hours.

311-324* Studies in Ethics Various half courses dealing with special topics; one or more of these will be offered each year as announced by the Department.

Prerequisite: Philosophy 221* 222*.
3 hours.

325* Political Philosophy 1 Philosophical analysis of central concepts in political theory and its relation to moral and metaphysical problems of various periods.

Prerequisite: One full or two half Philosophy courses.
3 hours.

326* Political Philosophy 2 A detailed discussion of contemporary theories.

Prerequisite: Philosophy 325*, or consent of instructor.
3 hours.

327* Philosophy of Law Analysis of legal notions; the bearing of philosophical systems on theories of law. Historical and contemporary examples will be used.

Prerequisite: One full or two half Philosophy courses.
3 hours.

331 Aesthetics Philosophical consideration of works of art and the problems of beauty using selected readings to enable the student to recognize and formulate his own views in a philosophic manner.

Prerequisite: One full or two half Philosophy courses.
3 hours.

335* Philosophy of Religion A critical examination of the methods and substantive arguments found in selected theories of education, with a view to formulating a clear workable concept of education, its aims and methods.

Prerequisite: One full or two half Philosophy courses, or consent of instructor.
3 hours.

340 Logical Theory A rigorous development of the propositional and predicate calculus in a general framework in terms of which various alternative calculi may be examined. Particular attention is given to such concepts as completeness, consistency, extensionality, modality, etc., from both formal and philosophical points of view. Intended primarily for those interested in the philosophical issues connected with logic.

Prerequisite: Philosophy 140*, or (preferably) Philosophy 240, or consent
341* Decision and Value Theory  A systematic study of the basic concepts in decision-making theories and their associated value theories. Special emphasis will be devoted to the definition and measurement of utility functions and to the various criteria employed in models of decision-making under uncertainty and under risk. Extensive use will be made of literature from Economics, Political Science, Psychology, and Mathematical Statistics.  
Prerequisite: Consent of instructor.  
3 hours.

350 Epistemology  A systematic course in the analysis of human knowledge. Phenomenalism and various kinds of realism will be considered, as well as other main topics such as the a priori, our knowledge of other minds, and our knowledge of abstract entities.  
Prerequisite: One full or two half courses in Philosophy. Students not taking Philosophy as their main subject should consult the instructor.  
3 hours.

358* Introduction to the Philosophy of Science  A discussion of various methodological and substantive topics common to many sciences. These topics include the logical structure of scientific laws, the nature of scientific theories, and the structure of scientific explanation.  
Prerequisite: One full or two half courses in Philosophy, or consent of instructor.  
3 hours.

359* Philosophy of the Formal Sciences  A study of philosophical problems concerning mathematics. Topics discussed include formalism, intuitionism, logicism, the mathematical paradoxes, and other topics in foundations and metamathematics.  
Prerequisite: Philosophy 358* or consent of instructor.  
3 hours.

362* Philosophy of Social Science  Problems about the fundamental methods and aims of the social sciences generally, and problems specific to Psychology, Sociology, Political Science, etc., and their relations to one another will be considered.  
Prerequisite: Some previous work in a social science or in Philosophy.  
3 hours.

363 Analytic Philosophy  Contemporary philosophical literature is employed in the exploration of both formal and "ordinary language" analysis. This course should be especially useful for persons contemplating graduate study in Philosophy.  
Prerequisite: Consent of instructor, or Honours status in Philosophy.  
3 hours.

365*-366* Oriental Philosophy  Studies of a selected area of non-western Philosophy (e.g. Indian or Chinese). Parallels will be drawn between modes of Eastern thinking and European conceptions with emphasis on essential differences as well as similarities.  
Prerequisite: Consent of instructor.  
3 hours.

370*-372* Special Subjects  One or more half courses will be offered at different times as announced by the Department.  
Prerequisite: Consent of instructor.  
3 hours.

380*-389* Studies in the History of Philosophy  Various half courses dealing with a particular philosopher, a selected work or period; one course of these will be offered each year.
Department of Philosophy

Prerequisite: Philosophy 280*/281* and 282*/283*.
3 hours.

390* Medieval Philosophy 1 The early period to the 13th century. Among those considered will be: Augustine, Boethius, Anselm, and Abailard.
Prerequisite: Philosophy 280*/281*.
3 hours.

391* Medieval Philosophy 2 The later period, from the 13th century. Among those considered will be: Bonaventure, Aquinas, Scotus, and Ockham.
Prerequisite: Philosophy 390*.
3 hours.

398(a-b)* Directed Reading in Special Areas

9 Tutorial for Honours Students Students wishing to enrol in 399 should consult the Department.

401* Philosophical Literature The study of specific philosophic problems as illustrated in appropriate literary works. Choice of selections will be determined by their relevance to the philosophical theme or themes under consideration. Themes such as free will and determinism, the nature of the universe, the problem of knowledge, the nature of justice, the state and the individual, the nature of man, and the problem of beauty may be studied singly or in combination.
Prerequisite - Third or Fourth Year Standing or consent of instructor.
3 hours.

425* Philosophy of the City Analysis and evaluation of the philosophical points of view that underlie current criticism of urban life and prevalent schemes for its reconstruction.
Prerequisite: One half Philosophy course.
3 hours.

35*-439* Studies in Philosophy of Religion A study of a particular philosopher or problem. The topic will be announced in advance each year.
Prerequisite: Consent of instructor.
3 hours.

440*-444* Studies in Logic Various half courses dealing with specific topics; one or more of these will be offered each year as announced by the Department.
Prerequisite: Philosophy 240 or Mathematics 436.
3 hours.

446* - Philosophy of History Consideration of various possible views about the ultimate nature of history and historical knowledge. Offered in sequence with History 466*.
Prerequisite - One full course equivalent in Philosophy, or consent of instructor.
3 hours.

455 Metaphysics Theories of reality, historical and contemporary, with emphasis on metaphysical problems in the light of recent studies.
Prerequisite: Two full courses (or equivalent) in Philosophy.
3 hours.

465 Existential Philosophy A study of the thought of such authors as Kierkegaard, Nietzsche, Heidegger, Sartre, Levinas, and others.
3 hours.
Prerequisite: Consent of instructor.
3 hours.

470 Phenomenology
A critical examination of the issues and methods of phenomenology. The basic writings of phenomenologists such as Husserl and Merleau-Ponty will be the main texts. Such a critique will include the attempt to understand the uses and ramifications of phenomenological methods through the working out of particular analyses.
Prerequisite: One full or two half courses in Philosophy, or consent of instructor.
3 hours.

471*-473 Problems
One or more half courses will be offered at different times, as announced by the Department.
Prerequisite: Consent of instructor.
3 hours.

480*-489 Advanced Studies in the History of Philosophy
Various half courses dealing with a particular philosopher, a selected work or period; one or more of these will be offered each year as announced by the Department.
Prerequisite: Consent of instructor.
3 hours.

498(a-b)* Directed Reading in Special Areas

499 Tutorial and Honours Essay
Students wishing to enrol in 499 should consult the Department.

The following courses are administered by St. Jerome's College.

Note 1 Any student registered in the University through St. Jerome's College may achieve a general (three year) degree in philosophy by successfully completing the over-all Arts requirements and including in his programme the equivalent of any six full courses in philosophy, of which at least five must be above the 100 level.

Note 2 Presently, a student registered in the University through St. Jerome's College and wishing to acquire an honours (four year) degree in philosophy should consult the College department for details.

100J Invitation to Philosophize
An attempt to see philosophy as the heart of a liberal arts education. Also, there will be discussion of the nature of philosophy relative to other disciplines. Is philosophy a science? How is philosophy different from theology? etc. A discussion of the different views of philosophy as illustrated by their handling of the traditional areas of nature, man, and God. Questions such as what is right and what is wrong? Is seeing believing? Does man have a soul distinct from matter? etc., will be asked.
3 hours.
(1971-72 A section of the above will be offered Saturday morning.)

200J* Intentional Logic
This course regards logic as a tool in guiding our penetration of various substantive issues in philosophy. It will systematically cover the common logical fallacies, term logic, propositional logic, some logical paradoxes, syllogistic (categorical and compound) logic, variations on the syllogism, and reasoning by example, induction, etc. The differences between intentional logic and other traditional logic will be examined.
205J* General Science of Nature
An examination through conceptual analysis and historical reference of the explanatory principles underlying the material world. Various main doctrines (e.g. pythagoreanism, atomism, hylomorphism) will be compared and contrasted. Germane discoveries in physics (espically the work of Planck, Einstein, de Broglie, Heisenberg) and chemistry will be brought in.

No Prerequisite.
3 hours, half course. Fall term.

206J* Special Problems in the Philosophy of Nature
This course will take up various key topics with respect to the constitution and operation of the natural universe. Issues such as the definition of change, space and place, time, purpose in nature, the infinity of the universe, anti-matter, action-at-a-distance, etc., will be discussed.

No prerequisite.
3 hours, half course. Winter term.

210J* Philosophy of Man
A discussion of the peculiarities of living creatures; what it means to be alive. The various main types of living things compared and contrasted. The place of man in nature, his intellectual and volitional powers, his evolution, the nature of love, and the possibility of life after death will be discussed. The latest relevant discoveries in biology, psychology, and anthropology, as well as the insights of existentialism and phenomenology will be utilized.

No prerequisite.
3 hours, half course. Winter term.

18J* Philosophy of Human Acts
A normative approach, employing several of the classic Western traditions of rational thought, to general ethics. The various schools of ethical thought will be discussed.

No prerequisite.
3 hours, half course. Fall term.

219J* Practical Ethics
This course will discuss the applications of general ethics to the more specific areas of human endeavour, e.g., family, government, warfare, work, recreation, education and religion.

No prerequisite.
3 hours, half course. Winter term.

30J* The Western Philosophical Tradition (to 1600)
An intensive overview of the major recurring themes in Western intellectual history from both an historical and a philosophical viewpoint.

Prerequisite: Second year standing.
3 hours, half course. Fall term.

31J* The Western Philosophical Tradition (1600-present)
A continuation of 300J*

Prerequisite: Second year standing.
3 hours, half course. Winter term.

13J Contemporary Philosophical Problems in Art
An examination and discussion of some problems, espically in the areas of music, painting, and poetry, with which today's artist as well as his audience are confronted. Information Theory, computerized techniques, mass art, "Pop Art," the psychology of creative invention, art as an expression of reality, the morality of art, the responsibility of the artist, etc., will be discussed.

No prerequisite.
3 hours, half course. Winter term.
Prerequisite: One other philosophy course or consent of instructor. 3 hours.

349J Philosophy of Human Cognition
The problems of human knowledge have been in the foreground of philosophical discussions for three centuries. This course will cover such topics as the principles of all human knowledge, types and degrees of probability and certitude, Realism and Idealism, the problem of universal predication, various meanings of truth, criteria of truth, historiography.
Prerequisite: One other philosophy course or consent of instructor. 3 hours.
(Not offered in 1971-72)

395J Special Topics/Directed Readings
A series of readings and/or seminars on one or two topics or thinkers, with periodic reports and discussions.
Prerequisite: Consent of instructor. 3 hours.

450J Philosophy of Being
An advanced course for the serious student, delving into the notions of reality, being, essence, existence, analogy, etc. The existence and nature of God, as far as can be determined without any kind of revelation, will be examined. The techniques of linguistic analysis to be employed. Also, the very possibility of any kind of metaphysics will be thoroughly discussed.
Prerequisite: Third year standing or consent of instructor. 3 hours.

495J Special Topics/Directed Readings
A series of readings and/or seminars on one or two topics or thinkers, with periodic reports and discussions.
Prerequisite: Consent of instructor. 3 hours.
(Not offered in 1971-72)

Graduate Courses

610*-619* Seminar in the Study of a Recent Philosopher
Names at present contemplated from which a choice may be made should the demand be sufficient: Bradley, Collingwood, Heidegger, McTaggart, Peirce, Price, Russell, Ryle, Sartre, Wittgenstein.

621*-622* Seminar in Ethics
625*-626* Seminar in Political Philosophy
630*-631* Seminar in Aesthetics
635*-636* Seminar in Philosophy of Religion

640 General Logic 1
A rigorous development of the propositional calculus on both matrix and axiomatic bases in a general framework in terms of which various alternative calculi may be examined; particular attention is given to such concepts as completeness, consistency, decidability, modality, extensionality, deducibility, etc., from both formal and philosophical points of view. An axiomatic development of unrestricted first order predicate calculus, including the theory of identity and theories of description.
Prerequisite: Philosophy 140*, or (preferably) Philosophy 240, or consent of instructor. 3 hours.
Department of Philosophy

641 General Logic 2 A continuation of Philosophy 640. An examination of the completeness of the first order predicate calculus, the development of the second order predicate calculus, general quantification theory, and explorations of a variety of special problems in the philosophy of logic.
*Prerequisite: Philosophy 640, or consent of instructor.*

650*-651* Seminar in Epistemology  
655*-656* Seminar in Metaphysics  
660*-662* Seminar in Philosophy of the Sciences  
670*-679* Specially Directed Studies  
680*-689* Seminar in the History of Philosophy

6*(a)-(c) Directed Research for M.A. Candidates  
Non-thesis M.A. students must take these three half-courses, which involve the writing of research papers, as part of their requirement for the degree.

698(a)-(n) Qualification Area Tutorials for Ph.D. Candidates  
Ph.D. candidates who have completed their regular course requirements select, with Departmental approval, four of these courses from the Department’s list of areas. Satisfactory completion of the four fulfills the Comprehensive Examination requirement in Philosophy.

a. Aesthetics  
b. Epistemology  
c. Ethics  
d. Existential Philosophy and/or Phenomenology  
e. History of Philosophy  
f. Logic  
g. Metaphysics  
h. Philosophy of Religion  
i. Philosophy of Science  
j. Social and Political Philosophy  
k. Studies in a Philosopher  
l. Studies in a Philosophical Movement  
m. Special Topics 1  
n. Special Topics 2

699(a)-(c) Thesis
Department of Physics

Professor and Chairman of the Department

Professor
R.A. Aziz, R.A., M.A., Ph.D. (Toronto)
G.A. Bakos, B.A. (Trnava), M.A. (Bratislava), M.A., Ph.D. (Toronto)

Professor and Associate Dean of the Faculty of Science
F.W. Boswell, B.A., M.A., Ph.D. (Toronto)

Professor
D.E. Brodie, B.Sc., M.Sc., Ph.D. (McMaster)
J.A. Cowan, B.Sc. (Manitoba), M.A., Ph.D. (Toronto)
I.R. Dagg, B.Sc. (Manitoba), M.S. (Penn State), Ph.D. (Toronto)
J. Grindlay, B.Sc. (Glasgow), D.Phil. (Oxon)

Professor (Chemistry and Physics)

Professor (Chemistry and Physics) and Dean of the Faculty of Science
F.W. Boswell, B.A., M.A., Ph.D. (Toronto)

Professor
D.E. Brodie, B.Sc., M.Sc., Ph.D. (McMaster)
J.A. Cowan, B.Sc. (Manitoba), M.A., Ph.D. (Toronto)
I.R. Dagg, B.Sc. (Manitoba), M.S. (Penn State), Ph.D. (Toronto)
J. Grindlay, B.Sc. (Glasgow), D.Phil. (Oxon)

Professor (Chemistry and Physics)

Professor and Academic Vice-President
H.E. Petch, B.Sc. (McMaster), M.Sc., Ph.D. (U.B.C.) FRSC

Professor
G.E. Reesor, B.A., M.A. (McMaster), Ph.D. (Toronto)
R.A. Snyder, B.Sc., Ph.D. (Western)
S.F. Wang, B.E. (Port Arthur, China), D.Sc. (Nagoya)

Adjunct Professor
J.A. Barker, D.Sc. (Melbourne), F.A.A.S.
D.J. Henderson, B.A. (U.B.C.), Ph.D. (Utah), F.Inst.P.

Associate Professor
A. Anderson, M.A., D.Phil. (Oxon)
P.C. Eastman, B.Sc., M.Sc. (McMaster), Ph.D. (U.B.C.)
H.K. Ellenton, B.Sc. (Western), M.A. (Toronto)
J.A.V. Fairbrother, B.Sc. (London), Ph.D. (Reading)
N.R. Isenor, B.Sc. (Acadia), M.Sc., Ph.D. (McMaster)
J.D. Leslie, B.A.Sc. (Toronto), M.S., Ph.D. (Illinois)
C.C. Lim, B.A. (DePauw), M.A. (Nebraska), Ph.D. (Toronto)
R.A. Moore, B.Sc., M.Sc. (McMaster), Ph.D. (Alberta)
H.M. Morrison, B.Sc., Ph.D. (Edinburgh)
J.L. Ord, B.A.Sc. (Toronto), M.S., Ph.D. (Illinois)
M.M. Pintar, B.Sc., M.Sc., Ph.D. (Ljubljana)
A.D. Singh Nagi, B.A., B.Sc. (Panjab), Ph.D. (Delhi)
H.J.T. Smith, B.Sc., Ph.D. (London)
B.H. Torrie, B.A.Sc. (Toronto), Ph.D. (McMaster)
K.A. Woolner, B.Sc. (London)
J.K. Brandon, B.Sc., Ph.D. (McMaster) M.A. (Cantab.)
J.M. Corbett, B.A.Sc. (Toronto), M.Sc., Ph.D. (Waterloo)
A.E. Dixon, B.Sc. (Mt. Allison), M.Sc. (Dalhousie), Ph.D. (McMaster)
M.P. FitzGerald, B.Sc., M.Sc. (Toronto), Ph.D. (Case)
H.E. Frey, B.S., M.S., Ph.D. (Penn State)
D. Hemming, B.Sc., Ph.D. (Bristol)
J. Kruuv, B.A.Sc., M.Sc. (Waterloo), Ph.D. (Western)
T.K. Mitra, B.Sc., M.Sc. (Calcutta), Ph.D. (Liverpool)
D.L. Roberts, A.B. (Bowdoin College), Ph.D. (Case)
J. Vanderkooy, B.Eng., Ph.D. (McMaster)
A.B. Haner, B.Sc., M.Sc. (Waterloo)
D.S. McVicar, B.Sc. (Waterloo)
L.J. Young, B.Sc. (Waterloo)

Undergraduate Course Descriptions

Note 1 Details of the undergraduate programmes offered by the Faculty of Science are to be found on page 130.
Note 3 Prerequisites are given as a guide to the student and may be waived with the consent of the instructor.

11 Mechanics and Wave Motion Vectors, rectilinear motion, plane motion, dynamics of particles, work and energy, linear momentum, rotational motion, statics, angular momentum, harmonic motion, gravitation, wave motion, sound waves. For students registered in the Year 1 Engineering Programme. 3 lectures, 1 hour tutorial, fall term.

101* General Physics Electric fields and potential, D.C. circuits, magnetic fields, A.C. generators and circuits, elementary electronics. The thin lens equations, diffraction, resolution of optical instruments, the eye, camera, telescope and microscope, coherent light, colour, polarization, birefringence and photometry. 3 lectures, fall term.


Note The one-year sequence Physics 101*-102* is not normally followed by upper year Physics courses and is intended for students registered in the Year 1 Science programme who intend to proceed in Biology, Biology and Chemistry, or Earth Sciences. (It may be used as a prerequisite for Physics 301*-302*)

103* Mechanics in Human Movement A special physics course for Kinesiology students. 3 lectures, 2 hours laboratory, fall term.

121* Introductory Physics 1 Introduction to mechanics, motion of particles, conservation of energy and momentum, rotational motion. Prerequisite: Mathematics A. 3 lectures, 3 hours laboratory or 2 hours tutorial, fall term.

122* Introductory Physics 2 This course is a continuation of Physics 121*. Vibrations, waves, gravitation, heat and thermodynamics, properties of materials. Prerequisite: Physics 121* 3 lectures, 3 hours laboratory or 2 hours tutorial, offered in winter and spring term.

Note The one-year sequence Physics 121*-122* is intended for students registered in the Year 1 Science programme or the Year 1 Mathematics programme, and gives adequate preparation for upper year Physics courses.

137* Descriptive Astronomy This course is now offered under the Science course listings as Science 237* or 238*. See page 456 for details.

162* Mechanics, Wave Motion and Heat 1 Vectors, rectilinear motion, plane motion, dynamics of particles, work and energy, linear momentum, rotational motion, angular momentum, statics, additional enrichment topics such as special relativity. Prerequisites: At least a 75% average in Grade 13 Physics and Math A. 3 lectures, 3 hours laboratory or 2 hours tutorial, fall term.
163* Mechanics, Wave Motion and Heat 2
This course is a continuation of Physics 162*. Harmonic motion, gravitation, wave motion, sound waves, temperature, heat, first and second laws of thermodynamics, kinetic theory of gases, additional enrichment topics such as quantum concepts.
Prerequisite: Physics 162*.
3 lectures, 3 hours laboratory or 2 hours tutorial, offered in winter and spring term.

Note
The one-year sequence Physics 162*-163* is an enriched version of the Physics 121*-122* sequence intended for students registered in the Year 1 Science programme or the Year 1 Mathematics programme, and is normally followed by upper year Physics courses.

222* Electricity and Magnetism 1
Electrostatics, D.C. circuits, magnetic fields.
Prerequisite: Physics 121* and 122* or equivalent; Mathematics 130.
2 lectures, 3 hours laboratory and 2 hours problems on alternate weeks, fall term.

223* Electricity and Magnetism 2
Electromagnetic induction, A.C. circuits, electrical measurements, introductory electronics.
Prerequisite: Physics 222*.
2 lectures, 3 hours laboratory and 2 hours problems on alternate weeks, winter term.

226* Optics 1
Reflection and refraction at plane and curved surfaces, thin and thick lenses, optical instruments.
Prerequisites: Physics 121* and 122* or equivalent, and Mathematics 130.
2 lectures, 3 hours laboratory on alternate weeks, fall term.

227* Optics 2
The wave nature of light, interference, diffraction, slits and gratings, resolution, polarization, photometry.
Prerequisite: Physics 226*.
2 lectures, 3 hours laboratory on alternate weeks, winter term.

236* Optics
Prerequisites: Physics 121* and 122* or equivalent, and Mathematics 125 or 130
This course is intended primarily for students registered in the Optometry programme.
3 lectures, 3 hours laboratory on alternate weeks, fall term.

237 Astronomy 1
This is a two term course consisting of the courses Physics 250* and 251* for Correspondence and Summer School students only.
3 lectures.

243* Electricity and Magnetism
Electrostatics, D.C. circuits, magnetic fields, electromagnetic induction,
Department of Physics

Mathematics 130.
3 lectures, 3 hours laboratory alternate weeks, offered in fall and spring terms.

244 Quantum Physics
Background of quantum physics: special relativity, Bohr atom, wave-particle properties, uncertainty and wave packets. Introduction to quantum mechanics: equation for travelling wave, Schrödinger equation, solutions with potentials, correspondence principle, brief description of transitions and radiation processes. Kinetic theory, basic statistical mechanics, Boltzmann distribution, elementary X-ray diffraction. (Not for General Students.)
2 lectures, for 2 terms.

250* The Solar System
Aspects of the sky; motions of the earth; the earth and moon; the planets; the sun; gravitational astronomy; comets, meteors and meteorites.
Prerequisites: A first year physics course and Mathematics 130, or consent of instructor.
3 lectures, fall term.

251* The Stellar System
The stars, stellar motions; clusters; the structure of the Milky Way; exterior systems; cosmogony; radio astronomy.
Prerequisite: A first year physics course and Mathematics 130, or consent of instructor.
3 lectures, offered in winter and spring terms.

252* Electricity and Magnetism 1
Electrostatic fields, potential, steady currents, magnetic fields.
Prerequisites: Physics 121* and 122* or 162* and 163*; Mathematics 130.
Corequisite: Mathematics 237.
2 lectures, 1 hour of problems, offered in fall and winter terms.
Recommended for students registered in Honours programmes.

2 L* Electricity and Magnetism
1 Laboratory.
3 hours, alternate weeks, 0.25 course credit. (0.50 lecture hour credit)

253* Electricity and Magnetism 2
Induced electromotive forces, magnetic properties of materials, time-varying current, electromagnetic waves.
Prerequisites: Physics 252*, Mathematics 31*.
2 lectures, 1 hour of problems, offered in fall, winter and spring terms.
Recommended for students registered in Honours programmes.

3 L* Electricity and Magnetism
2 Laboratory.
3 hours, alternate weeks, 0.25 course credit. (0.50 lecture hour credit)

255* Quantum Physics
Background of quantum physics: special relativity, Bohr atom, wave-particle properties, uncertainty and wave packets. Introduction to quantum mechanics: equation for travelling wave, Schrödinger equation, solutions with potentials, correspondence principle, brief description of transitions and radiation processes.
Prerequisites: Physics 121* and 122* or Physics 162* and 163* and Mathematics 130.
3 lectures, offered in fall, winter and spring terms.
Recommended for students registered in Honours programmes.

256* Optics
Reflection and refraction at plane and curved surfaces using the matrix method; thin and thick lenses, optical instruments. The wave nature of
Prerequisites: Physics 121* and 122* or 162* and 163*, Mathematics 130
3 lectures, offered in fall and winter terms.
Recommended for students registered in Honours programmes.

256 L* Optics Laboratory. For students taking Physics 256*.
3 hours, alternate weeks, 0.25 course credit. (0.50 lecture hour credit)

259 Structure of Solids 1 Electronic structure of atoms and atomic bonding, crystal structure and
space lattices, symmetry, crystal geometry, stereographic projections,
theory of X-ray diffraction, X-ray methods, crystal formation, crystal
defects, physical properties of crystals.
Prerequisites: Physics 121* and 122* or 162* and 163*, Mathematics 130.
3 lectures, offered in fall, winter and spring terms.

259 L* Structure of Solids 1 For students taking Physics 259*.
Laboratory. 3 hours, alternate weeks, 0.25 course credit. (0.50 lecture hour credit)

270* Laboratory Further selected experiments in electricity and magnetism, optics, X-ray
diffraction, and astronomy.
3 hours laboratory, offered in fall and winter terms, 0.50 course credit
(1.00 lecture hour credit)

271* Laboratory A continuation of Physics 270*.
3 hours laboratory, offered in fall, winter and spring terms, 0.50 course
credit (1.00 lecture hour credit)

01* Physical Instrumentation for
Biologists 1 Ultra-centrifugation, spectroscopy, microscopy, use of radioactive tracers.
Prerequisite: a first year physics course, Mathematics 130.
2 lectures, fall term.

02* Physical Instrumentation for
Biologists 2 Detection and measurement of ionizing radiation, read-out devices,
transducers and other techniques.
Prerequisite: Physics 301*
2 lectures, winter term.

24* Atomic and Nuclear Physics
1 Fundamentals of modern physics, special theory of relativity,
quantization of electromagnetic radiation, wave properties of particles,
the hydrogen atom, atomic and X-ray spectra.
Prerequisites: Physics 222*, 223*, 226* and 227*.
3 lectures, offered in fall and spring terms.
Recommended for students registered in General programmes.

25* Atomic and Nuclear Physics
2 Nuclear structure, nuclear reactions, molecular and solid state physics.
Prerequisite: Physics 324*
3 lectures, winter term.
Recommended for students registered in General programmes.

335 Thermodynamics, Statistical
physics Thermodynamic systems, equations of of state, the laws of
thermodynamics, with applications - Change of phase. Kinetic theory of
an ideal gas, distributions of molecular velocities, transport phenomena.
Maxwell-Boltzman statistics, quantum statistics, fluctuations.
3 lectures.

337* Astronomy 2 This is a two-term course consisting of Physics 350* and Physics 351*
for Correspondence and Summer School students only.

350* Astrophysics 1 Atomic and molecular astrophysics, star

351* Astrophysics 2 Astrophysical plasma physics, radiation

401
Department of Physics

equations. Line broadening effects. Radiation transfer theory. Sources of opacity. The spectra of the sun and stars.
Prerequisites: Students should be in third or fourth year of Science, Mathematics or Engineering, or obtain consent of instructor.
Offered in the fall term of odd-numbered years to third and fourth year students. 3 lectures.

351* Astrophysics 2 Physical properties of the stars. Stellar distance determination.
Distribution of the stars in space. The solar motion. Galactic rotation. Stellar dynamics. Characteristics and structure of our galaxy and external systems.
Prerequisites: Students should be in third or fourth year of Science, Mathematics or Engineering, or obtain consent of instructor.
A one-term course offered in winter and spring terms of even-numbered years to third and fourth year students. 3 lectures.

Note Physics 450*, Astrophysics 3, and Physics 451*, Astrophysics 4, are also open to third and fourth year students.

352* Electronics 1 A survey of tubes, transistors and solid state devices. Basic A.C. circuit theory. power supplies. equivalent circuits. amplifiers and feedback.
Prerequisites: Physics 222*-223* or equivalent and Mathematics 31*
3 lectures offered in fall, winter and spring terms.

52 L* Electronics 1 Laboratory. For all students taking Physics 352*.
3 hours, alternate weeks, 0.25 course credit (0.50 lecture hour credit).

353* Electronics 2 Applications of feedback to oscillators, operational amplifiers, analogue computers and multi-vibrators. Introduction to digital circuits.
Prerequisite: Physics 352*
2 lectures, winter term.

353 L* Electronics 2 Laboratory For students taking Physics 353*.
3 hours, alternate weeks, 0.25 course credit (0.50 lecture hour credit).

Prerequisite: Physics 255*
2 lectures per week, fall term.

Prerequisite: Physics 255*.
3 lectures, winter term.

358* Thermodynamics Thermodynamic systems, equations of state, the laws of thermodynamics with applications. Change of phase.
Prerequisites: Mathematics 237 and Physics 162* and 163*.
3 lectures, offered in fall and spring terms.

359* Statistical Mechanics Basic theory; ideal, classical and quantum gas. Occupation numbers. Effects of statistical applications to metals, perfect crystals, radiation...
360* Intermediate Laboratory
Selected experiments in mechanics, heat, sound, optics, spectroscopy, X-ray, atomic physics, electricity, magnetism, and electronics.
6 hours laboratory, offered in fall, winter and spring terms. 1.00 course credit (2.00 lecture hours credit)

362* Classical Mechanics 1
Prerequisites: Physics 162* and 163*. Mathematics 130, 237 and 31*.
3 lectures, offered in fall and spring terms.

363* Classical Mechanics 2
Prerequisites: Physics 362* or Mathematics 234.
3 lectures, winter term.

364* Physical Mathematics 1
Vector and tensor analysis with applications.
Prerequisites: Mathematics 237 and 31*.
3 lectures, offered in fall and spring terms.

365* Physical Mathematics 2
The partial differential equations of mathematical physics.
Prerequisite: Physics 364*.
3 lectures, winter term.

368* Geophysics 1
Introductory topics on the physics of the earth. Seismology and the earth's interior. Thermal history of the earth, gravity and isostasy. Origin of the continents and continental drift. (Identical to Earth Sciences 368*.)
Prerequisite: Mathematics 130.
2 lectures, fall term.

369* Geophysics 2
The geology of the ocean basins. Topics in physical oceanography. Physical properties of ocean water, heat budget of the world oceans. Oceanic circulations. Coriolis effects. Some idealized current regimes. (Identical to Earth Sciences 369*)
Prerequisite: Physics 368*.
2 lectures, winter term.

371* Intermediate Laboratory
Further experiments in mechanics, heat, sound, optics, spectroscopy, X-ray, atomic physics, electricity, magnetism and electronics.
6 hours laboratory, winter term 1.00 course credit (2.00 lecture credit)

380* Molecular Biophysics
Energy production, transport and release in cells; structure of large molecules and their replication, genetic code, control of intracellular processes.
Prerequisites: Mathematics 31*, Physics 252* and 253* or consent of instructor
First year Chemistry.
3 lectures, fall term.

381* Cell Biophysics
Structure and behaviour of cell membranes, diffusion problems, selective ion transport, electrical activity and nerve conduction, cilia and flagella, muscle cells, sensory receptor cells. synthesis of cell components and cell division.
Prerequisite: Physics 380*
Prerequisite: Physics 362*, 363*, 364* and 365*.  
2 lectures and 1 tutorial hour for two terms, fall and winter.

Prerequisite: Physics 259*  
3 lectures, winter term.

433 Advanced Laboratory  An experimental research project. This course is designed for students in the Honours Physics Programme and in the Co-operative Applied Physics Programme, and enrolment may be limited to twenty-five students.  
6 hours laboratory, for two terms, fall and winter, 1.00 courses credit (2.00 lecture hours credit)

434 Introductory Quantum Mechanics  Applications of wave mechanics; the harmonic oscillator, the hydrogen atom. Angular momentum. Scattering. Perturbation theory. Transitions. The multi-electron atom.  
Prerequisite: Physics 255* and 355*.  
2 lectures and 1 tutorial hour for two terms, fall and winter.

Prerequisite: Physics 259*  
3 lectures, fall term.

Prerequisite: Physics 364* and 365*.  
2 lectures and 1 tutorial hour for two terms, fall and winter.

437* Topics in Theoretical Physics  Selected subjects for advanced study by theoretically inclined students; topics in relativistic, quantum, and statistical physics.  
3 hours per week, second term.

438 Geophysics 3  A more advanced discussion of seismology and the internal constitution of the Earth, mechanical properties of the Earth's interior, figure of the Earth and its gravitational field, temperature and thermal history of the Earth, internal magnetic field of the Earth and its electrical properties at depth, the rotation of the Earth and its geophysical effects.  
2 lectures, for two terms, fall and winter.

441 Electromagnetic Theory  A generalized treatment of the basic laws of electricity and magnetism; mathematical techniques for the problems of electrostatics; solutions of Maxwell's equation in free space and the study of plane waves; theory of waveguides and introduction to radiation.  
2 lectures and 1 tutorial hour for two terms, fall and winter.

442* Structure of Solids  A survey with emphasis on the physical properties and behaviour of metals and alloys. Elastic and plastic deformations of crystals. Solidification, structure of alloys, free energy of alloy systems.
**443* Classical Field Theory**
An introduction, with applications in the areas of elasticity and hydrodynamics. (The electromagnetic field is discussed in Physics 441.) Topics covered are—the conservation laws; field equations; boundary conditions. Equations of state, invariance, material symmetry. Methods of solution; application to fluid and elastic systems with simple geometries.
3 lectures, fall term.

**444* Nuclear Physics**
Elements of nuclear structure and systematics. Alpha emission, beta decay, gamma emission, two-body systems and nuclear forces, nuclear reactions. Neutron physics. Sub-nuclear particles.
3 lectures, winter term.

**445* Modern Optics**
Coherence, interference and optical resonators; quantum optics, amplification and lasers.
3 lectures, fall term.

**449* Radio Astronomy**
Radio telescopes. Radio sources including the sun. H 2 regions. H 1 regions. The galactic center; pulsars; quasars; other extra-galactic sources; cosmological implications.
Prerequisite: Same as Physics 350*.
Offered in the fall term of even-numbered years to third and fourth year students.
3 lectures.

**450* Astrophysics 3**
Prerequisites: Same as Physics 350*.
Offered in the fall term of even-numbered years to third and fourth year students.
3 lectures.

**451* Astrophysics 4**
The structure of stellar interiors; nuclear reactions and energy sources in the stars of the main sequence; early evolution of stars from the main sequence. Lifetimes of the stars.
Prerequisites: Same of Physics 350*.
Offered in the winter and spring terms of odd-numbered years to third and fourth year students.
3 lectures.

**480* Radiation Biophysics**
The effect of radiation of various kinds on cells and tissues; exposure calculations, mechanism of damage, repair theories, genetic effects, target theory; isotopic tracers in biophysical research.
Prerequisites: Physics 222*-223* and Mathematics 236 or equivalent, or consent of instructor
3 lectures per week, fall term.

**481* Biophysics of Organ Systems**
Special senses, biological transducers, information handling in the central nervous system, theories of muscle contraction; physics of homeostasis, interactions with the environment, circulation of blood, temperature regulation, respiration, and transport problems.
Prerequisites: Physics 222*-223* and Mathematics 236 or equivalent, or consent of instructor.
3 lectures, winter term.
Graduate Studies and Research Programmes

See page 164 for general information

There are at present several major areas of study in the Department in which graduate students may specialize. These include:

**Astrophysics** Stellar evolution in galactic clusters, radial velocities and spectral analysis, galactic structure.


**Geophysics** Physical limnology of the Great Lakes.

**Laser Research** Solid state injection lasers, laser-produced plasmas.

**Low Temperature Physics** Experimental studies of condensed inert gases, liquid helium, ultrasonics.

**Metal Physics** Diffusion, secondary electron emission. Electronic properties (Fermi surfaces, cyclotron resonance). Electron tunnelling in superconductors.

**Microwave Research** Dielectric constant measurements. Field induced absorptions, microwave spectrometry.

**Magnetic Resonance and Neutron Diffraction** Physical properties of non-metallic solids, especially ferroelectrics.

**Spectroscopy** Raman and Brillouin scattering, infra-red absorption

**Physics of Lattice Defects** Layer structures, properties of vacancies and impurities.

**Thin Film Physics** Epitaxial, anodic oxide, and semi-conducting films, active thin film devices.

**Theoretical Physics** Theory of liquids, the elastic dielectric, electronic states in crystals and molecules, colour centers, phonon dispersion curves, polymers, super-conductivity, liquid helium. Lattice dynamics of molecular crystals.

**Metal and Alloy Crystal Structures** Crystal structure determination using diffraction methods. Study of relationships between structure and physical properties. Study of phase stability in metal structures.

Details regarding these programmes and the faculty members engaged in them are to be found in a booklet prepared by the Department of Physics. The booklet also discusses admission procedures, programmes of study, teaching and research facilities and equipment, and is sent to every potential graduate student who applies for admission. New areas of research are usually added each year.
Graduate Course Descriptions.

All graduate courses are three lectures per week for one term. Those indicated (†) are available every year, others are given when required.

†620 Quantum Mechanics 1 A second course in the subject involving a re-examination of the principles of wave and matrix mechanics and applications to more complicated systems.
*Prerequisite: Physics 434 or equivalent.
*Fall term.

*Prerequisite: Physics 620, winter term.

622 Group Theory and Quantum Mechanics Introduction to group theory; groups, representations of groups, character tables. Group theory and quantum mechanics, the permutation and rotation groups. Applications of the theory to atomic spectra, the theory of angular momentum. Molecular symmetry and solid state physics.

623 Advanced Quantum Mechanics Dirac theory; the single particle description of relativistic quantum mechanics; bound state and scattering problems, the need for a many-particle (field) approach. Classical relativistic field theory. The radiation field, the electron field. Interaction of these fields. The S-matrix; Compton scattering, Coulomb scattering. The magnetic moment of the electron, the Lamb shift. Renormalization.

627 Atomic Spectra The fine and hyperfine structure of one-electron and many-electron atoms, the Zeeman and Stark effects.

628 Molecular Spectra Vibrational and rotational spectra of simple molecules; symmetry considerations and selection rules; spectra of condensed phases; brief survey of instruments and techniques of microwave, infrared and Raman spectroscopy.


† Advanced Classical Mechanics Review of elementary mechanics, Lagrangian formulation, variational principles, Hamiltonian formulation; rigid, body kinematics and dynamics, special relativity, transformation theory, Hamilton-Jacobi theory.

†635 Electromagnetic Theory Solutions to Maxwell’s Equations, Radiation Theory; normal modes; multiple expansion; Kirchhoff diffraction theory; radiating point charge; optical theorem. Special relativity; transformation laws for Maxwell’s Equation; line broadening. Dispersion; Kramer-Kronig Relations. Hamiltonian formulation of Maxwell’s Equations. Magnetohydrodynamics.
*Prerequisite: Physics 441 or equivalent.

636 Electromagnetic Theory Selected Topics.
<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>638* Crystallography 1.</td>
<td>Crystal lattices. Point group and space group symmetries. Principles of diffraction and space group determination. <em>(This course is also listed as Chemistry 638</em>).</td>
</tr>
<tr>
<td>639* Crystallography 2.</td>
<td>X-ray optics and instrumentation. Methods of crystal structure determination: Fourier synthesis, the phase problem, refinement, crystallographic computing. <em>(This course is also listed as Chemistry 639</em>).</td>
</tr>
<tr>
<td>640 Stability and Properties of Metallic Phases and Crystal Structures</td>
<td>The influence of temperature, pressure, electron concentration, geometrical and chemical bond constraints, etc., on entropy and enthalpy and therefore on phase and structural stability. The electron theory of metals, influence of E vs. k relationships on structural stability, role and interactions of d and f electrons in metals and alloys; influence on properties.</td>
</tr>
<tr>
<td>642 Electron Microscopy and Electron Diffraction</td>
<td>Introduction to electron optics and the electron microscope, kinematical and dynamical theories of electron diffraction by perfect crystals and by crystals containing lattice imperfections, limited area-electron-diffraction, dark-field microscopy, interpretations of electron-diffraction patterns and diffraction-contrast effects in electron microscope images, selected experimental methods in electron microscopy.</td>
</tr>
<tr>
<td>645 Statistical Mechanics</td>
<td>Review of essential classical and quantum mechanics; microcanonical, canonical and grand canonical ensembles; quantum statistical mechanics, theory of the density matrix; fluctuations, noise, irreversible thermodynamics; transport theory; application to gases, liquids, solids.</td>
</tr>
<tr>
<td>646 Advanced Statistical Mechanics</td>
<td>Applications of the principles of statistical mechanics to classical and quantum many-body systems.</td>
</tr>
<tr>
<td>647 Low Temperature Physics</td>
<td>Production and measurement of very low temperatures. Low temperature materials and techniques. Thermal, magnetic and electrical properties of matter at very low temperatures. Superconductivity. Liquid helium.</td>
</tr>
<tr>
<td>648 Solid State Physics 1</td>
<td>Waves in lattices. Static elastic, thermal, dielectric and magnetic properties of solids. Fermi surface. <em>Prerequisite: Physics 435 or equivalent.</em></td>
</tr>
<tr>
<td>651 Imperfections in Crystals</td>
<td>Perfect and imperfect crystals, general properties and origins of point defects and dislocations, stacking faults, interactions of imperfections, influence of lattice imperfections on physical properties and their role in deformation of crystals and phase transformations, experimental detection and observation of imperfections.</td>
</tr>
<tr>
<td>653 Inert Gas Solids</td>
<td>Theory of crystal lattices; quantum mechanical basis, interatomic potential, stability, dynamic of cubic close packed lattices.</td>
</tr>
</tbody>
</table>
properties.

4 Advanced Quantum Theory of Solids

455 Optical Properties of Semiconductors

456 Magnetism

457 Principles of Magnetic Resonance

458 Crystal Physics

459 Green's Function Method

460 Selected Topics in Physics

41 Advanced Nuclear Magnetic Resonance of Solids

462 Superconductivity

463 Quantum Optics

465 Cellular Biophysics

Biophysics of Organ Systems

468 Molecular Biophysics

469 Radiation Biophysics

Application of quantum field theory to phonons and electrons, many-body techniques, electron-phonon interactions, and selected topics.

Reflection and refraction of electromagnetic waves at dielectric and conducting interfaces. Dispersion, absorption processes, photo effects, magneto-optical effects, emission of radiation.

Introduction to the theory of magnetic phenomena in metals and non-metals. Relevant experimental work will also be discussed.


The phenomenological theory of the elastic, dielectric and thermal properties of crystals. Classical field theory—linear and non-linear; field equations and boundary conditions; equations of state; material symmetry. Thermodynamics; thermodynamic identities; phase transitions. Applications to the ferroelectric crystals.

Review of essential quantum field theory; zero and finite temperature; Green's functions. Applications to Fermi liquids, electron-phonon problem, superconductivity and magnetic impurities.

General theory of magnetic resonance absorption; method of Kubo and Tomita; dynamical theory of nuclear induction; shape of absorption lines for crystals. Magnetic interactions of nuclei with electrons, electric quadrupole effects.

Macroscopic properties and phenomenological theories. Electron-phonon interaction, Cooper pairs and BCS theory. Applications of BCS theory especially to electron tunnelling.

Theory of optical coherence; quantum electronic processes and devices.

The physics of cellular structure and function; membrane theories, diffusion and active transport, bioelectric phenomena; intracellular motion, thermodynamics; selected topics of current interest and seminar.

Specialized cells and organs; the nerve impulse and its propagation, muscle contraction, sensory transducers, the central nervous system; haemodynamics, the red blood corpuscle, homeostasis; selected topics of current interest and seminar.

Physical methods of determining macromolecular structure; energetics, intramolecular and intermolecular forces, information storage, DNA and RNA, recognition and rejection of foreign molecules.

Physical properties and biological effects of different kinds of radiation; action of radiation on molecules.
Special Topics in Biophysics

This course is designed to give students, especially those taking a degree based on course work alone, a survey of research going on in Biophysics today. It will involve reading in the current periodical literature, essays and student seminars describing work being done in specific fields, a search of the literature associated with a research area of interest to the student, and faculty lectures on selected topics.

Special Topics in Biophysics 2

Selected subjects for advanced study.

Biophysics Laboratory

Students who will not present a thesis as part of their M.Sc. programme are encouraged to take this course. They will be expected to become a part of each in turn of the various research projects currently under way in the laboratory for long enough to become familiar with the purpose of the project and with the techniques involved. They will then be asked to undertake and write up a small research project under the supervision of one of the project leaders in the Biophysics laboratory.

Biophysics of Nervous Systems

Neurons; nerve conduction; sensory transducers; coding, processing and storage of information; control of muscles and other effector organs. Some knowledge of molecular and cellular biophysics is assumed.

Advanced Radiation Biophysics

Radiation problems with tissue cultures and related topics.

General Relativity and Cosmology


Galactic Structure


Celestial Mechanics 1


Celestial Mechanics 2


Astrophysics

The fundamental astronomical data; the techniques to obtain it and the shortcomings present. The classification systems. Wide and narrow band photometric systems. The intrinsic properties of stars, colours, luminosities, masses, radii, temperatures. Variable stars. Distance indicators. Interstellar reddening. Related topics.
684 Stellar Spectroscopy
Theory and practice of astronomical spectroscopy. Identification, line
and band intensity measurements. Classification of normal and peculiar
spectra. The interpretation of spectra of observed astronomical sources.
Spectral classification systems at high and low dispersions.

15 Selected Topics in Astronomy

686 Selected Topics in
Astrophysics

687 Stellar Atmospheres
Theory of the stellar photosphere and the continuous spectra of stars.
The formation of absorption and emission lines in stellar spectra.
Determination of ionic abundances, surface pressure, surface temperature
from spectra. The spectra of planetary and interstellar nebulae.
Computation of model atmospheres.

688 Stellar Interiors and
Evolution
The theory of stellar interiors and nucleogenesis. Chemical synthesis in
stars. Evolution of stars from the pre-main sequence stage to the white
dwarf stage. The influence of mass and chemical abundance of the
structure and evolution of stars. Instability in evolving models.
Computation of stellar models.

698 M.Sc. Thesis

699 Ph.D. Thesis
Department of Political Science

Professor and Chairman of the Department
T.H. Qualter, B.A. (New Zealand), Ph.D. (London)

Professor
J.E. Kersell, B.A., M.A., (Queen’s), Ph.D. (London)

Associate Professor
S. Andracki, LL.M. (Poznan), M.Sc. (London), Ph.D. (McGill)

Associate Professor and Deputy Chairman of the Department
L.K.D. Kristof, B.A. (Reed), M.A., Ph.D. (Chicago)

Associate Professor
J.S. Andracki, LL.M. (Poznan), MSc. (London), Ph.D. (McGill)

Associate Professor
A.D. Nelson, A.B., A.M., Ph.D. (Chicago)

Associate Professor
R.G. Stevens, A.M., Ph.D. (Chicago)

Associate Professor
J.M. Wilson, B.A., M.A. (Toronto)

Assistant Professor
R.V. Edington, B.A. (San Francisco State), M.A., Ph.D. (Washington)

Assistant Professor
C.H. Grant, B.A., M.A. (Leicester), Ph.D. (Edinburgh)

Associate Professor
R.J.C. Freeze, B.A., Ph.D. (Leicester)

Assistant Professor
R.P. Woolstencroft, B.A. (Alberta)

Assistant Professor
R.J.C. Preece, B.A., Ph.D. (Leicester)

Lecturer
J.E.-C. Surich, B.A., M.A. (Waterloo)

Undergraduate Programmes

The Department of Political Science offers a series of undergraduate programmes designed to meet the needs of students with varying interests. Requirements for each programme are restricted to the completion of a specified number of courses in different fields of the discipline before graduation. For these purposes Political Science courses above the 100 level are numbered according to the field within which they fall. The key to this scheme is the second digit of the course number, as follows:

2 - theory and methodology
3 - public administration, public law, and public policy
4 - local and regional politics
5 - comparative politics (more than one country)
6 - comparative politics (specific countries)
7 - the political process
8 - international politics

with the number 9 reserved for special courses which are not regarded as dealing with a particular field of the discipline.

1 General Programme
Students choosing a three-year General programme in Political Science (see the University’s requirements for the General Programme on p. 15) will normally complete, before graduation, the equivalent of five full courses in Political Science beyond the 100 level, of which three must be from three different fields of the discipline as defined above.

2 Honours Programme
Students choosing an Honours programme in Political Science (see p. 37) must complete, before graduation, the equivalent of nine full courses in Political Science beyond the 100 level, of which four must be from four different fields of the discipline as defined above. Honours students may elect to pursue a series of connected courses as a minor programme in a related discipline such as Anthropology, Economics, Geography, History, Philosophy, Psychology, or Sociology in consultation with the departments involved.

3 Joint Honours Programmes
A number of joint Honours programmes have been arranged for students
a) Honours Anthropology and Political Science (page 17)
b) Honours Economics and Political Science (page 20)
c) Honours English and Political Science (page 24)
d) Honours French and Political Science (page 27)
e) Honours Geography and Political Science (page 31)
f) Honours History and Political Science (page 34)
g) Honours Philosophy and Political Science (page 36)
h) Honours Political Science and Psychology (page 38)
i) Honours Political Science and Sociology (page 38)

Students choosing a joint Honours programme involving Political Science must complete, before graduation, the equivalent of six full courses in Political Science beyond the 100 level of which three must be from three different fields of the discipline as defined above.

Joint Honours programmes other than those already approved may be arranged by consultation with Political Science and the department concerned.

4 Minor Programme
The Department will be glad to recommend a connected series of courses in Political Science beyond the 100 level for students majoring in related disciplines.

Graduate Programme
The Department of Political Science offers a programme leading to the degree of Master of Arts. The Department's graduate brochure provides details of the requirements for this degree, and other relevant information. The Department cooperates with the Departments at Brock University, the University of Guelph, McMaster University and Waterloo Lutheran University in a broad range of activities at the graduate level.

Undergraduate Courses

*Note* Very extensive descriptions of the content of Political Science courses are available in the Department at the time of pre-registration.

05*Introduction to the Political Process 1 A study of political ideas and processes, democratic and other.
3 hours, fall term.

6* Introduction to the Political Process 2 An introduction to modern political systems.
Prerequisite: Political Science 105* or consent of instructor.
3 hours, winter term.

115* Introduction to Politics 1 An introduction to the major political ideologies of the present world: socialism, communism, liberalism, capitalism, conservatism, and fascism.
3 hours, fall term.

116* Introduction to Politics 2 A study of selected aspects of government and politics.
Prerequisite: Political Science 115* or consent of instructor.
3 hours, winter term.

224* Quantitative Analysis An introduction to the use of quantitative methods in Political Science.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>251*</td>
<td>Comparative Politics</td>
<td>An introduction to comparative methods in, and alternative approaches to, the study of politics.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Prerequisite: An introductory course in Political Science or consent of instructor.</td>
</tr>
<tr>
<td>252*</td>
<td>West European Government and Politics</td>
<td>A comparative study of selected aspects of government and politics in west Europe.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Prerequisite: Political Science 251</em>.</td>
</tr>
<tr>
<td>260</td>
<td>Canadian Government and Politics</td>
<td>A critical examination of the institutions and practices of the Canadian political system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No prerequisite for students in the second year and above.</td>
</tr>
<tr>
<td>264*</td>
<td>American Government and Politics</td>
<td>The theory and practice of the American political system as revealed by the institutions and operations of American national government.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No prerequisite for students in the second year and above.</td>
</tr>
<tr>
<td>265*</td>
<td>Soviet Government and Politics</td>
<td>A survey of the development of Soviet political structures with an analysis of the relative influence of ideological goals on the one hand and social forces on the other.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No prerequisite for students in the second year and above.</td>
</tr>
<tr>
<td>266*</td>
<td>Problems in Soviet Politics</td>
<td>A study of the sources and formulation of selected Soviet policies including an analysis of Soviet foreign policy.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Prerequisite: Political Science 265</em>.</td>
</tr>
<tr>
<td>268*</td>
<td>British Government and Politics</td>
<td>An examination of the uniquely British characteristics of the British political system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No prerequisite for students in the second year and above.</td>
</tr>
<tr>
<td>281*</td>
<td>International Politics 1</td>
<td>Sovereignty and interdependence. The concept of the International System. Political change in the contemporary world.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Prerequisite: An introductory course in Political science or consent of instructor.</td>
</tr>
<tr>
<td>282*</td>
<td>International Politics 2</td>
<td>Institutional framework of international co-operation in economic and social fields. The functional pattern and the regional pattern. Economic underdevelopment and international politics.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Prerequisite: Political Science 281</em> or consent of instructor.</td>
</tr>
<tr>
<td>320</td>
<td>Problems in Political Philosophy</td>
<td>The course will examine each year a selected problem or problems in political philosophy through the study of a number of writings from certain major classical and modern political philosophers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Prerequisite: Political Science 220 or consent of instructor.</td>
</tr>
</tbody>
</table>
321* Socialism: Marxist and non-Marxist 1 A comparative study of the thought of the founders of anarchism and of "utopian" and Marxian socialism.
   No prerequisite for students in the third year and above.
   3 hours, fall term.

322* Socialism: Marxist and non-Marxist 2 A comparative study of the thought of Russian Marxists (both Bolshevik and anti-Bolshevik) and of contemporary "revisionist" Marxists.
   Prerequisite: Political Science 321*.
   3 hours, winter term.

330 Public Administration A comparative analysis of the public services of the major democracies with particular reference to the legal basis, organisation, and political and judicial control of the administrative process.
   Prerequisite: At least one previous course in Political Science.
   3 hours.

340 Urban Politics An analytical study of the responses of various urban political systems to contemporary metropolitan problems.
   Prerequisite: At least one previous course in Political Science.
   3 hours.

341* Provincial Politics A comparative study of the structure and practices of the various provincial political systems in Canada.
   Prerequisite: Political Science 260.
   3 hours, fall term.

   No prerequisite for students in the third year and above.
   3 hours.

352* Comparative Communist Political Systems An examination of selected aspects of various Communist political systems, e.g., political socialization, national minority questions, and problems of political legitimacy.
   Admission by consent of instructor.
   3 hours, winter term.

371* The Political System An examination of the concept of system as applied to the study of politics.
   Admission by consent of instructor.
   3 hours, winter term.

373* Political Parties An analytical and comparative study of the development, organization, activity and function of political parties, and the nature of contemporary party systems.
   Prerequisite: At least one of Political Science 252*, 260, 264*, 265*, or 268*.
   3 hours, fall term.

374* Interest Group Politics A study of interest group theory and comparative analysis of the internal politics of interest groups and their role in the political process.
   Prerequisite: At least one of Political Science 252*, 260, 264*, 265*, or 268*.
   3 hours, winter term.

375* Theories of Integration and Distintegration A study of the requirements for the development of an adequate conceptual framework for the analysis of political movements relating...
Prerequisite: Political Science 251* or consent of instructor.
3 hours, fall term.

376* Uninstitutionalized Political Movements

An analysis of the nature of two of the most prominent "groups" of uninstitutionalized political movements: fascism and populism; together with case studies of a number off nationalist political movements in Europe.
Prerequisite: Political Science 375*.
3 hours, winter term.

380 Theory and Practice of International Politics

Various theories and analytical approaches used in the study of international politics will be examined, and their application to the practice of foreign policy and international politics will be studied through consideration of specific important problems facing regimes as they interact.
Open only to students in the third year and above.
3 hours.

422* Liberalism, Socialism, and the Welfare State

An analysis of the development of western radicalism based on a study of the principles of the liberal tradition and the main elements of modern democratic socialism.
Prerequisite: Political Science 220 or consent of instructor.
3 hours, winter term (not offered, 1971-72)

423* The Federalist Papers

An examination the political thought expressed by Hamilton, Madison and Jay in the Federalist Papers.
Admission by consent of instructor.
3 hours, fall term.

425* English Political Theory of the Nineteenth Century

A survey of the development of English Liberal thought from the philosophic radicals through J.S. Mill to T.H. Green.
No prerequisite for students in the third year and above.
3 hours, fall term.

435* Canadian Constitutional Law

An introduction to the nature and basic principles of constitutional law. The course will deal especially with the distribution of powers in the Canadian federation, and its evolution, notably by judicial decision. It will consider leading cases and the writings of leading authorities.
Prerequisite: Political Science 260.
3 hours, fall term.

442* Politics in Ontario

A critical examination of the distinctive elements of government and politics in the province of Ontario.
Prerequisite: Political Science 260 or 341* or consent of instructor.
3 hours, winter term.

443* Politics in Western Canada

A critical examination of the distinctive elements of government and politics in the provinces of Manitoba, Saskatchewan, Alberta, and British Columbia.
Prerequisite: Political Science 260 or 341* or consent of instructor.
3 hours, fall term.

444* The Politics of French Canada

A study of the principles, practices and personalities of French Canadian politics.
Admission by consent of instructor.
3 hours, winter term.
451* Comparative Politics in the Commonwealth

An analytical comparison of parliamentary institutions and processes as they have developed in various political systems of the Commonwealth.

Prerequisite: Political Science 251* or consent of instructor.

3 hours, fall term.

458* The Third World

This course deals with the Third World primarily in the international context. As the problems of this group of countries are on a very large scale and very diverse, they will be examined on a comparative basis.

Prerequisite: Political Science 350 or consent of instructor.

3 hours, winter term.

463* Japanese Politics

A study of the institutions and practices of Japanese government and politics and of Japanese foreign policy.

Admission by consent of instructor.

3 hours, fall term.

470 Political Behaviour

An examination of the objectives, characteristics and problems of contemporary research on political behaviour, with emphasis on democratic electoral behaviour.

No prerequisite for students in the third year and above.

3 hours.

472* Voting Behaviour


Prerequisite: Political Science 224* or 373* or consent of instructor.

3 hours, winter term.

74* Canadian Labour in Politics

An examination of the origin and development of the Canadian labour movement and its role in the Canadian political process.

Admission by consent of instructor.

3 hours, winter term.

481* International Law

A survey of the principles and rules of international law with special emphasis on the element of change.

Admission by consent of instructor.

3 hours, fall term.

487* Theories of International Politics

A critical examination of alternative approaches to the study of international politics.

Admission by consent of instructor.

3 hours, fall term.

488* International Organizations

A study of the nature and functions of international organizations, and an evaluation of League of Nations and the United Nations systems.

Admission by consent of instructor.

3 hours, winter term.

490 Senior Research Seminar

Admission by consent of instructor.

3 hours.

491*-498* Special Subjects

In any year one or more subjects may be offered as special seminars. Course descriptions will be announced at the time of registration.

499 Senior Honours Essay

Students wishing to register in Political Science 499 should consult the Department.
Senior Undergraduate and Graduate Courses

Note: Courses at the 500 level are open to senior undergraduates and to students in qualifying programme as well as to those in graduate programmes. Admission is in all cases by consent of the instructor.

521* Contemporary Democratic Theory
An examination of recent and contemporary theories of democratic government.
3 hours, full term.

522* Classical Political Philosophy
The course will examine the nature of classical political science and philosophy in order both to clarify our own way of understanding political things through an investigation of that original kind of understanding, and to contrast the classical and modern versions of that understanding. One or more Platonic dialogues and/or one of Aristotle's works will be studied.
3 hours, winter term.

523* Empirical Theory
This course will consist of (i) a philosophical analysis of sociological theories of system and of behaviour, and (ii) the application of these theories to the field of politics.
3 hours, full term.

526* Contemporary Socialist and Communist Thought
A critical analysis of contemporary socialist and communist writings on such controversial subjects as the rights of the individual, the nature of socialist democracy, the problem of alienation in a classless society, or the dialogue with the theists.
3 hours, winter term.

532* Canadian Foreign Policy
A critical examination of the sources, challenges and methods of Canadian foreign policy together with case studies of major contemporary issues.
3 hours, winter term.

534* Comparative Foreign Policy
The course will explore the problem of the connections between types of regimes and types of foreign policy. Besides considering this problem from a theoretical perspective, a comparative analysis will be made of aspects of several foreign policies.
3 hours, winter term.

572* Public Opinion and Propaganda
A detailed study of the nature of public opinion and the attempt to control it through propaganda.
3 hours, winter term.

591*-598 Special Subjects
In any year one or more subjects may be offered as special seminars. Course descriptions will be announced at the time of registration.

Graduate Courses

620 Political Theory
Selected themes in political theory.

630 Public Administration
Selected problems in comparative administration.

650 Comparative Politics
Theories and concepts of comparative politics
660 Canadian Politics Selected problems of the Canadian political system.

670 Behavioural Studies Problems in the study of political behaviour.

680 International Politics Contemporary theoretical and empirical problems in international politics.

690 Graduate Research Seminar

699 Thesis
Department of Psychology

Professor Chairman of the Department
J.A. Dyak, B.A. (Oklahoma), Ph.D. (Illinois)

Professor
R.K. Banks, B.A., M.A., Ph.D. (Toronto)

Professor Chairman of the Committee on Human Relations Studies
G.T. Barrett-Lennard, B.Sc., B.A. (Western Australia), Ph.D. (Chicago)

Professor
M.P. Brydgen, S.B. (Massachusetts Institute of Technology), M.Sc., Ph.D. (McGill)

Professor
J.M. Butler, B.S., Ph.D. (Minnesota)

Professor
M. Lerner, B.A., M.A. (Ohio State University), Ph.D. (New York University)

Professor (Sociology and Psychology)
H.D. Kirk, B.S. (City College of New York), M.A., Ph.D. (Cornell)

Professor (Management Sciences and Psychology)
K.D. Mackenzie, A.B., Ph.D. (University of California, Berkeley)

Professor
R.K. Penney, B.S.C. (Wayne State), Ph.D. (Iowa)

Professor (Management Sciences and Psychology)
S.D. Saleh, B.A. (Cairo), Dip. Ed. and Psych(I-Irs), M.A., Ph.D. (Western Reserve)

Professor (Statistics and Psychology)
D.A. Sprott, B.A., M.A., Ph.D. (Toronto) F.S.S.

Professor
M.D. Vogel-Sprott, B.A. (McMaster), M.A., Ph.D. (Toronto)

Associate Professor
R. Bierman, B.A. (Yeshiva), Ph.D. (New York at Buffalo)

Associate Professor
K.S. Bowers, B.A., Ph.D. (Illinois)

Associate Professor
T.E. Cadell, B.A. (British Columbia), M.A. (Massachusetts), Ph.D. (Wisconsin)

Associate Professor
J.M. Cornell, B.A., M.S., Ph.D. (Washington)

Associate Professor
W.C. Corning, B.A. (Heidelberg), Ph.D. (Rochester)

Associate Professor (Counselling and Psychology)
W.W. Dick, B.Th. (University of Manitoba), B.A., B.D. (University of Toronto), M.A., Ph.D. (University of Ottawa)

Associate Professor
G.R. Engel, B.A., M.A., Ph.D. (Queen’s)

Associate Professor
W.D. Fenz, B.A. (Southern Missionary), M.A., B.D. (St. Andrew’s), M.Sc. (Hawaii), Ph.D. (Massachusetts)

Associate Professor
W.J. Hudspeth, B.A., M.A. (San Jose State), Ph.D. (Claremont)

Associate Professor (Sociology and Psychology)
R.D. Lambert, B.A., M.A. (McMaster), Ph.D. (Michigan)

Associate Professor
H.M. Lefcourt, B.A. (Antioch), M.A., Ph.D. (Ohio State)

Associate Professor
G.E. MacKinnon, B.A. (Queen’s), Ph.D. (Johns Hopkins)

Associate Professor
D. Meichenbaum, A.B. (City College of New York), M.A., Ph.D. (Illinois)

Associate Professor
P.M. Merkle, B.A. (Knox), M.A., Ph.D. (Virginia)

Visiting Associate Professor
P. Pentony, B.A., M.A. (Western Australia) (Associate Professor of Psychology, Australian National University)

Associate Professor
P.M. Rowe, B.A. (Toronto), M.A. (Dalhousie), Ph.D. (McGill)

Associate Professor (part-time)
R.R. Ross, B.A., M.A., Ph.D. (Toronto)

Associate Professor
R.A. Steffy, B.A. (Albright), M.A., Ph.D. (Illinois)

Associate Professor
R.V. Thysell, B.A. (Montana), M.A., Ph.D. (Iowa)

Associate Professor
E.E. Ware, B.A., M.A. (Richmond), Ph.D. (Illinois)

Associate Professor
D.M. Amoroso, B.A., M.A. (Toronto), Ph.D. (Waterloo)

Assistant Professor (part-time)
P.E. Bowers (Mrs.), B.A. (Rosemont), M.A., Ph.D. (Illinois)

Assistant Professor
M. Breidenbaugh (Mrs.), B.A. (Wittenburg), Ph.D. (Vienna)

Assistant Professor
M. Brown, B.Sc., M.Sc. (McGill), Ph.D. (Michigan)

Assistant Professor
J.A. Cheyne, B.A. (Waterloo Lutheran) M.A. Ph.D. (University of Waterloo)

Assistant Professor
R.A. Cole, B.A. (Univ. of Rochester), M.A., Ph.D. (University of California)
Assistant Professor M. Coltheart, B.A., M.A., Ph.D. (Sydney)
Assistant Professor J A.C. Firetto, C.R., B.A. (Western), M.A. (St. Louis), Ph.D. (Loyola)
Assistant Professor R.C. Godbout, B.A., Ph.D. (University of Texas)
Assistant Professor G.A. Griffin, B.A. (Colgate), M.A., Ph.D. (Wisconsin)
Assistant Professor F.D. Kemp, B.A. (Texas Christian), Ph.D. (Harvard)
Assistant Professor A.H. Miller, B.A., M.A. (Michigan)
Assistant Professor R. O'Day, B.A. (Univ. of British Columbia), M.A., Ph.D. (University of Michigan)
Assistant Professor (part-time) R.W. Robinson, B.A. (Rutgers Univ.), M.A., Ph.D. (Temple Univ.)
Assistant Professor R. D. Seim, B.A. (Queen's), Ph.D. (Waterloo)
Assistant Professor D.J. Torney, B.A., M.A. (Western Ontario), Ph.D. (Waterloo)
Assistant Professor D.L. Wahlsten, B.S. (Alma College), Ph.D. (California, Irvine)
Assistant Professor T.G. Waller, B.S., M.S. (Southern Mississippi), Ph.D. (Vanderbilt)
Assistant Professor J.L. Williams, B.A., M.A. (Alberta), Ph.D. (Missouri)
Assistant Professor J.J. Wine, B.A. (Bridgewater College), M.S. (Iowa State University), Ph.D. (University of Alberta)
Adjunct Professor S.S. Appleton, B.A., M.D. (Toronto)
Adjunct Professor D.S. Barnes, B.A., M.D. (Western Ontario)
Adjunct Professor J.J. Hartford, M.D. (Toronto)
Adjunct Professor P.M. Lerner, B.A., M.Ed., Ed.D. (Illinois)
Adjunct Professor M.G. Pruesse, B.S., M.A. (British Columbia), Ph.D. (Waterloo)
Adjunct Professor G. Sumner-Smith, M.R.C.V.S., B.V.Sc. (Univ. of Liverpool), F.R.C.V.S., M.Sc. (Univ. of Guelph)
Adjunct Professor L.E. Tauber, B.S. (Union College), M.A. (Univ. of Kentucky), Ph.D. (Purdue)

Undergraduate Offerings

A course in Introductory Psychology (Psychology 101*) is a normal prerequisite for all subsequent courses in Psychology.

In order to achieve a better understanding of experimentation in human behaviour, all students in introductory psychology courses are required to serve as subjects in up to 5 hours of appropriate psychological research.

In year 2 to 4 students in Honours Psychology must take Psychology 283*-284*, Psychology 499, and before entering the fourth year of the programme at least Two Research half courses: the Research courses must include at least one from each of the following groups:

Group 1: 293*, 295*, 297*
Group 2: 393*, 295*, 297*

The research courses provide the student with first hand experience in carrying out independent research. While the nature of the activity engaged in may vary from one research course to another, these courses are designed to familiarize the students with experimental, observational, case study and/or field projects.

Students in the General programme who wish to major in Psychology must include Psychology 283* and at least One Research half course (From either Group 1 or Group 2 above) as part of their programme.

Students in either the Honours or General programme in Psychology should choose their electives after consultation with their advisors in the Department.
Department of Psychology

Undergraduate Course

The number of hours of lectures shown after the course description is an attempt to indicate the "normal"; each instructor determines how often his particular class will meet.

101* Introductory Psychology
A general survey course designed to provide the student with an understanding of the basic concepts and techniques of modern psychology as a behavioural science.
3 hours.

102* Introductory Psychology
Special Topics
A more in depth study of selected topics introduced in Psychology 101* Prerequisite: Psychology 101*. 3 hours.

203* Learning and Motivation
This course is designed to introduce the student to theories in Learning and Motivation and to provide the student with an understanding of the experimental techniques in these areas.
3 hours.

205* Sensory Processes
A consideration of data and theory concerning sensory processes. Topics will include psycho-physical methodology, sensory mechanisms and the neuropsychological basis of perception.
3 hours.

206* Perceptual Processes
An examination of data and theory concerning perceptual processes. Topics will include the perception of form and space, perceptual learning and a consideration of the effect of personality variables in perception.
3 hours.

207* Cognitive Processes
An examination and evaluation of selected topics dealing with human learning, thinking, concept formation, memory and language.
3 hours.

211* Developmental Psychology
An examination of the process and factors of human development.
3 hours.

214* Socialization Processes in the Child
Consideration will be given to a number of topics relating to the development of social behavior in children.
3 hours.

214* Educational Psychology: The psychology of Classroom Learning
A consideration of the main variables affecting learning in the classroom with special focus upon the conditions essential to efficient learning.
3 hours.

242* Educational Psychology: Learning Disabilities
Analyses of learning disabilities associated with various categories of exceptionality including mental retardation, emotional problems, and receptive and expressive handicaps.
3 hours.

253* (Sociology 210*) Social Psychology
The relation between psychological processes and social interaction. Topics to be considered include (1) how we evaluate others' personalities, (2) determinants of friendship, (3) formation and change of attitudes, (4) conformity and independence, (5) the self-concept.
3 hours.
4* (Sociology 212) Interpersonal Relations. The contribution of social organization to the interpersonal processes. Consideration of some “theories” of social interaction. The social system approach to the problem of personal and interpersonal control. 
Prerequisite: Psychology 253*
3 hours.

261* Physiological Psychology The structure and function of the nervous system and their relation to behaviour.
3 hours.

271* Animal Behaviour An in depth study of the behaviour of animals emphasizing both observational and experimental research.
3 hours.

283* Statistical Methods in Psychology An introduction to the logical and theoretical base for the application of statistical methods to the solution of problems in the social sciences. Consideration will be given to descriptive statistics, to sampling statistics and to an introduction to inferential statistics. Required of all students in Honours Psychology.
3 hours.

284* Experimental Design An examination of the effective use and interpretation of statistics in the design and understanding of experiments in the social sciences. Required of all students in Honours Psychology.
Prerequisite: Psychology 283*
3 hours.

285* Tests and Measurements An introduction to the theory and use of psychological tests. Special emphasis is placed on the assessment of personality, intelligence, aptitudes and interests.
Prerequisite: Psychology 283*
3 hours.

293* Research in Learning and Motivation Open only to students in Honours Psychology (and Joint Honours programmes with Psychology) and to those students in the General programme who are majoring in Psychology. Open to students in other programmes by permission of instructor only.
Prerequisite: Psychology 283* and one of Psychology 203*, 207* or 271*.
3 hours.

295* Research in Perceptual and Cognitive Processes Open only to students in Honours Psychology (and Joint Honours programmes with Psychology) and to those students in the General Programme who are majoring in Psychology. Open to students in other programmes by permission of instructor only.
Prerequisite: Psychology 283* and one of Psychology 205*, 206* or 207*.

297* Research in Biopsychology Open only to students in Honours Psychology (and Joint Honours programmes with Psychology) and to those students in the General programme who are majoring in Psychology. Open to students in other programmes by permission of instructor only.
Prerequisite: Psychology 283* and one of Psychology 261* or 271*.
3 hours.

331* Individual Differences An analysis of individual and group differences in behaviour, with emphasis on studies of intelligence.
Prerequisite: Psychology 283*.
Department of Psychology

333* Industrial Psychology
An introduction to the methods and problems in Industrial Psychology.
3 hours.

334* Counselling Psychology
An introduction to the methods and problems in Counselling Psychology.
3 hours.

336* (Sociology 310*) - Group Dynamics
An analysis of natural and experimental groups from a social structural view. The study of processes of differentiation, integration, power etc., internally; and of nesting of small groups in larger collectives.
Prerequisite: 3rd or 4th year standing in a social science or by permission.

338* (Sociology 324*) Field Research in Canadian Institutions
A study of a selected institution in the local community, such as the Courts, Mass Media, and Labour Unions, will be conducted employing observational and interview procedures.
Permission of instructor.

350 J Principles of Facilitative Human Relations
Facilitative human relations within the context of education, guidance and interpersonal exchanges are treated in terms of current psychological theories and research. The demonstration and development of these concepts are aided by personal participation, observation and taped sessions. Application to both individual and group interaction.
Prerequisite: Psychology 101*-102 and Psychology, 355*, 357* or suitable alternative.
3 hours.

355* Personality Theory
An examination and evaluation of some of the outstanding theories of personality.
3 hours.

357* Psychopathology
The nature and origin of deviant behaviour.
3 hours.

363* - 366* - Special Subjects
One or more half courses will be offered at different times as announced by the Department.
Prerequisite: Consent of instructor.

393* Research in Developmental Psychology
Open only to students in Honours Psychology (and Joint Honours programmes with Psychology) and to those students in the General programme who are majoring in Psychology. Open to students in other Programmes by permission of instructor only.
Prerequisite: Psychology 283* and one of Psychology 211*, 241* or 331*.
3 hours.

395* Research in Social Psychology
Open only to students in Honours Psychology (and Joint Honours programmes with Psychology) and to those students in the General programme who are majoring in Psychology. Open to students in other programmes by permission of instructor only.
Prerequisite: Psychology 283* and 253*.
3 hours.

97* Research in Personality and Psychopathology
Open only to students in Honours Psychology (and Joint Honours programmes with Psychology) and to those students in the General programme who are majoring Psychology. Open to students in other programmes by permission of instructor only.
Prerequisite: Psychology 283* and one of Psychology 331*, 355* or 357*.
An examination of current theoretical approaches to psychological problems present in a historical context.

2 hours.

Logic and experimental designs. Randomization. Experimental and sampling errors. Designs applied to biological sciences. Methods of analysis for factorial designs. Latin squares, etc.

2 hours.

Seminars

Senior Seminar in Learning. Admission by consent of instructor.
2 hours.

Senior seminar in Perception. Admission by consent of instructor.
2 hours.

Senior seminar in Developmental Psychology. Admission by consent of instructor.
2 hours.

Senior seminar in Educational Psychology. Admission by consent of instructor.
2 hours.

Senior seminar in Social Psychology. Admission by consent of instructor.

Senior seminar in Personality. Admission by consent of instructor.
2 hours.

Senior seminar in Clinical Psychology. Admission by consent of instructor.
2 hours.

Senior seminar in Cognitive Processes. Admission by consent of instructor.
2 hours.

Senior seminar in Motivation. Admission by consent of instructor.
2 hours.

Senior seminar in Physiological Psychology. Admission by consent of instructor.
2 hours.

Senior seminar in Animal Behaviour. Admission by consent of instructor.
2 hours.

Senior seminar in Special Topics. Admission by consent of instructor.
2 hours.

Senior seminar in Special Topics. Admission by consent of instructor.
2 hours.

Senior seminar in Special Topics. Admission by consent of instructor.
466* Senior seminar in Special Topics. Admission by consent of instructor. 
2 hours

Selected Studies in Special Topics
For the student who desires to pursue a particular topic in depth through independent experimental research and/or extensive reading. A faculty member must approve a student's project prior to registration for this course. Open to exceptional students with permission of the instructor and the Department. May be repeated for credit. 
3 hours

499 Senior Honours Essay
Each student will work under the direction of a member of the department on an experimental study. The result of this investigation will be presented in the form of a thesis, which will be critically examined by members of the department and also, where pertinent, by members of other departments. Required of all students in Honours Psychology.

Graduate Programmes

General Introduction

Structure and Function of the Department
The graduate programme of the Department of Psychology is organized into six programme areas offering specialization at the Ph.D. level in Biopsychology, Child Development, Clinical, Learning, Perception and Cognition, and Social and Personality. A Master of Applied Science degree in Educational psychology also is offered. Academically, these programme areas are semi-autonomous; they are linked via the Graduate Affairs Committee, which consists of the Chairmen of each programme area plus two elected student representatives.

There is a strong emphasis on research in all programmes of the department. Students are expected to become involved in research as soon as possible after entering the department, either through participation in ongoing faculty research or through developing their own ideas into researchable projects. The training programme itself is based on the concept of research apprenticeship in which each student's training is, through consultation with his advisor, adapted to his specific interests and objectives. Formal course work in the programmes is intended to provide the student with (1) a general knowledge of the major areas of psychology and (2) intensive preparation in his area of concentration. Considering both of these objectives, a student enrolled in a given programme may be encouraged to take courses from other programme areas if, in the opinion of his advisor, such courses will facilitate the student's development. Courses in disciplines other than psychology may also be encouraged.

If it becomes clear that a student's interests do not fit well into one or other of the existing programmes it is possible for the student, with the assistance of a faculty advisor, to form an individualized programme committee drawing on faculty members who are appropriate to his interests. This committee is responsible to the Graduate Affairs Committee of the Department.

Students in the doctoral programme may receive the M.A. degree but the Department does not offer a M.A. programme as such.

An interdisciplinary programme in Human Relations, leading to the M.A.Sc. degree and the Ph.D. degree has been mounted from the Psychology Department and is moving toward independent status. Information concerning this programme is provided in the section...
Canada Council Scholarships and Fellowships, Ontario Government Fellowships, Ontario Mental Health Foundation Fellowships, National Health Bursaries, National Research Council Scholarships and Bursaries, Queen Elizabeth II Scholarships, Woodrow Wilson National Fellowships, Mental Health Training Bursaries, and other awards are tenable for graduate study at the University of Waterloo. Research assistantships average $2500 for the calendar year and teaching assistantships average $1400 for the academic year. Research assistantships, teaching assistantships and other fellowships may be combined in various ways yielding a range of student stipends from $2500- $4500 per year.

Tuition fees are $35.00, plus incidental fees of $47.85, for each of the three years in the Ph.D. programme. Students who are required to make up one preliminary year of undergraduate courses are advised to consult the undergraduate section of the calendar for information on undergraduate courses and tuition fees. Ph.D. candidates who require longer than three years beyond an honours B.A. (or its equivalent) to meet the degree requirements pay a fee of $130.00 if they remain on campus under faculty supervision or $30.00 per term if their work is carried out elsewhere.

Housing accommodations are available at the affiliated colleges, university student and married student residences, private homes and apartments. Information about accommodations may be obtained from the Office of the Registrar and the Off Campus Housing Office.

Research Facilities  
The Department of Psychology has extensive laboratory facilities. Animal and human research is conducted in laboratories in the Psychology Building and in the new Humanities Building which houses the Child Development and Social and Personality programmes. Five mobile psychological laboratories are available for research with children. Research requiring special populations (for example, clinical research) is often carried out at other institutions under the supervision of faculty members of the department.

A primate laboratory housing about 100 rhesus monkeys, and facilities for surgery, testing, and observation is available. Housing facilities for rats, birds, cats, and dogs are also available, with surgery, testing rooms, and a histology complex. In addition a Marine laboratory for research with marine invertebrate is available.

The University has an excellent Computing Center which is available to graduate students. The Department of Psychology has its own key punch machines and card sorter, and is rapidly acquiring a comprehensive library of statistical programmes. Electronics, carpentry, and machine shops are also maintained by the department, staffed with six full-time technicians.

Examinations  
Incoming graduate students are required to take a diagnostic examination in order to assess the student's background and, where it is found necessary to plan remedial work for the student. Some programme areas specify a minor area requirement, which may be fulfilled by passing one or more specified courses. Major-area (special area) examination requirements are determined by individual programme areas.

Faculty Advisors  
On entering the Department, each graduate student is assigned an advisor. The advisor will suggest a programme of study and direct the student to the appropriate programme area. If the student is not acquainted with a particular field, the advisor will aid in the selection of a programme.
Department of Psychology

necessarily act as his thesis supervisor. A student enrolled in one programme may select a faculty member of another programme area as his thesis supervisor if, in the opinion of his advisor, such faculty member is appropriate by virtue of his interest and qualification to supervise the student. The composition of the student's thesis committee, however, will ensure involvement of faculty members from his programme area in his thesis research.

Student Evaluation Each year every student registered in the Ph.D. programme must submit a report of his activities. This report provides the basis for evaluating the student’s progress. While the specific procedures for the evaluation vary from area to area the following aspects are common to all programme areas.

The evaluation takes place at the end of the academic year (during the month of May). The student is evaluated on several criteria, viz., his course grades, reports submitted by the student of research completed or in progress, and teaching assistantship activity. Typically, the student’s entire record is considered by all faculty members in his programme in addition to his research supervisor (if from another area) and/or any other faculty member associated directly with the student’s programme. For some programmes this evaluation is the functional equivalent of the Special Examination in the student’s area of concentration; for all programmes the evaluation provides an intensive assessment of the student on the basis of criteria relevant to his competence as a professional psychologist in his chosen area. While course marks represent only one aspect it is important to note that an average of at least 66 (B-) must be maintained.

The written recommendation of the evaluation committee (i.e., that the student’s training be terminated, continued, or continued on conditional standing) is forwarded to the Graduate Affairs Committee for its approval. Direct feedback is given to the student either by his faculty advisor or by his Programme Evaluation Committee.

Teaching Experience Development of the student's teaching ability is a major concern of the department. It is expected that two years of teaching experience will be obtained by all students during their graduate training. Toward this end, students are strongly encouraged to accept teaching assistantships.

Admission

General Requirements for Admission Candidates for a graduate degree in psychology who possess an ordinary bachelor’s degree must take at least one preliminary year of work in psychology to ensure that their preparation is equivalent to that of a graduate of an honours course in psychology. Candidates with an honours bachelor’s degree or equivalent preparation may enter directly into a research-oriented course leading to the Ph.D. degree. Candidates applying with a master's degree in Psychology may request advanced standing in the Ph.D. programme. All candidates for graduate study must arrange to have their grades on the Graduate Record Examination and the Miller Analogies Test forwarded to the department when applying for admission.

Application for admission to graduate study and further inquiries, except for the Human Relations programme, should be sent to: Graduate Secretary, Department of Psychology, University of Waterloo, Waterloo, Ontario, Canada. The deadline for applications for admission is March 1; applications received after that date will be considered if
sent April 1. Applications and inquiries regarding admission to the Human Relations programme should be addressed to the Secretary, Committee on Human Relations Studies, University of Waterloo, Waterloo, Ontario, Canada.

**Departmental Requirements for the Ph.D. Degree**

The department requires a minimum period of registration of three years beyond an honours bachelor's degree or two years beyond a master's degree.

A reading knowledge of a modern foreign language is no longer a Ph.D. requirement. Entry into any of the programmes of the department presupposes general proficiency in the English language.

For the Ph.D. in psychology, the Department requires successful defense of the Ph.D. dissertation and satisfactory performance in a minimum of two full-year graduate psychology courses or their equivalent in half-year courses. One full year course credit may be obtained by taking both Psychology 631 and Psychology 632, satisfactory performance in which satisfies the requirement of proficiency in statistics. Students who do not take these courses for credit are required to pass the final examination set by the instructor. Further requirements for the Ph.D. are outlined in sections describing particular programmes. While many courses may be taken on a pass-fail basis at least half the courses taken by a student must be graded.

*While a Ph.D. may be obtained within three years of an Honours B.A. a period of four or five years is more usual.*

**Specialization in Areas**

On the University application form for entry into graduate work, the prospective student is required to indicate one or more areas of special interest. The following description of programme emphases in the department may be useful in guiding such selection. (Refer to the section on Graduate Course Offerings for a description of the courses.)

**Biopsychology**

As an interdisciplinary field, Biopsychology (Psychobiology) requires diverse skills and training which are not provided in any single undergraduate department. Any student with a degree in a Life Science such as psychology, biology, physiology, pharmacology, or biochemistry who is attracted into this area will have only part of the necessary background. Consequently, in order to achieve the level of competence usually associated with the Ph.D. degree it is envisaged that a student will familiarize himself with the relevant aspects of the various related disciplines.

**Programme**

**Year 1**

Biopsychology Survey (714).†

Statistics and Experimental Design (631-632).† or equivalent qualifying exam.

Research Seminar (no credit)

M.A. Thesis.

† *In the event that a given student elects to take additional courses as a result of his diagnostic results, such courses may be taken in place of 631-632, which in turn, may be deferred to the second year. Since other options are open regarding the diagnostic examination, this typical programme may be considerably altered by the student and his advisor. It is conceivable that the first year could be essentially a qualifying year in which the student takes a limited number of courses.*
Year 2 Through 4

Special Topics Seminar(s) and/or Course(s) or Seminar(s) inside or outside the Department.

Research Seminar

Ph.D. Thesis.

Note 1 Apart from departmental requirements, the Biopsychology Programme requires only that the student take the Biopsychology Survey (714), participate in the research seminars, and submit a yearly progress report. The Biopsychology Survey will be, in effect, a proseminar lecture course which will cover extensively the material in the area of Biopsychology. This course will be taught by the faculty in Biopsychology and will be required of all students, including those with Master's degrees. Passing the course will be considered the equivalent of passing a Special Area exam.

Note 2 The Research Seminar will meet as the occasion demands. Presentation of a paper in the seminar is customary if a student is planning to present a paper outside the department. Otherwise the seminar will act as a forum for the discussion of theoretical and empirical issues relating to a student's or faculty member's ongoing research. Participation is strongly encouraged, but ultimately it is a decision left to the student and his advisor.

Note 3 Participation in Special Topics seminars will be based on the student's choice in consultation with his advisor. Two or three of these seminars will be presented each term. Care will be taken each year in the preparation of the topic list to ensure that a broad range of topics is covered over a two or three year period.

Note 4 No requirements have been established for a minor inside or outside the Department. The Biopsychology group feels that this is a decision to be left to the student and the faculty advisor.

Note 5 It is generally felt that students in Biopsychology should have experience writing and submitting a Master's thesis. However, this is also a decision for the student and his advisor. An alternative to the Master's degree is a research project which meets all the degree requirements except the submission of the thesis to the Graduate Office. The research project, like the Master's thesis, would have to be read by at least two persons.

Child Behaviour and Development

This graduate programme is concerned very broadly with theories and research on developmental processes. In specializing within child behaviour and development, students may select one of the following research areas: social and personality development, perceptual development, psychophysiologal development, learning and the educative process. Students who are interested in special clinical groups such as the mentally retarded or the perceptually handicapped also choose one of the above areas; however, these students are placed in appropriate clinical settings during the summer months, where they collaborate in research and develop appropriate clinical-research skills.

Emphasis is upon research training as well as content training. Students will be expected to be continually active in research during both the academic year and summer. There are five mobile trailers for studies with school children or special populations. Moreover, an Office of Child Research was established in 1965 to act as a liaison between the investigator and the school systems to assure continued co-operation and good-will. Last year approximately 3,500 school children participated in research.

Programme A typical program for an individual student might be as follows:
Department of Psychology

Statistics (631-632) or a qualifying examination
Individual Differences (735)
Child Seminar (736)

Note Developmental Methodology (725) may be taken in place of Developmental Theory (705), depending upon the student's background.

Summer
Research (i): Participation in an ongoing research project.
(II): Piloting of M.A. Thesis or equivalent project.

Year 2 Fall/Winter
Research - continuation of pilot project from the previous summer to be completed by the end of winter term.
Developmental Methodology (725) if not taken Year 1.
Child Seminar (737)

Summer
Research - piloting dissertation project.

Year 3 Fall/Winter
Research - dissertation project.
Child Seminar (738)

Summer
Research - dissertation

Note 1 Participation in the Child Seminar Series (736-7-8) is required of all students each year of their programme.
Note 2 A student, in consultation with his thesis advisor, may elect to either complete formal requirements for an M.A. thesis, or complete the Year 2 research requirement in a form appropriate for publication.
Note 3 No formal minor area requirement is stipulated.
Note 4 Special Topic seminars in Child will be offered as interest and faculty resources permit.
Note 5 Additional or substitute courses or seminars taken by the individual student will be chosen according to his research interests in consultation with his thesis advisor.

Clinical The goal of the programme is to develop a well rounded clinical Ph.D. along the lines recommended by the Boulder Conference. The graduate of the programme is one who can take a traditional or innovative approach to assessment and treatment. The student is urged to develop an investment in various collateral academic areas, e.g., social-personality, psychophysiology, learning theory and other. He is required to pass a statistical and research design course, and a special area comprehensive examination. The clinical programme offers a formal course experience. As part of the practical training the student is enrolled in a full year practicum in intelligence testing, personality assessment, and psychotherapy from year one to year three respectively. The programme also requires a four-month field work placement during each of the summers of the first two graduate years. A student is directed to one of four institutions in the area in which the Waterloo faculty and the institutional staff are cross-appointed. In the first summer of graduate training the student is given experience in interviewing and further ability assessment training. The major
year the student is directed towards intensive training in personality assessment.

At the end of the three years residence at the University, by which time he should have developed a doctoral dissertation and some psychotherapy skills, the student takes a full year's internship.

The research training is a continuous, ongoing process. Each student is assigned to a research advisor upon his arrival on campus, and the student is expected to serve an apprenticeship, research assistant role in his first year. As his research interests develop, he is expected to define a master's level research project; which is followed by the dissertation in the third academic year.

An APA accredited programme

Programme

Year 1
Fall/Winter
Clinical Psychology I (627)
Statistics (631-632) or an equivalent qualifying examination
Practicum in Intelligence Testing (633)
Minor area
Guided Research

Summer
Clinical Field Work Practicum (635)
Directed projects

Year 2
Fall/Winter
Clinical Psychology II (628)
Practicum in Personality Assessment (639)
M.A. Research
Summer
Clinical Field Work Practicum (635)
Directed projects

Year 3
Fall/Winter
Psychotherapy Practicum (626)
Dissertation Research
Seminar options
Special examinations
Summer
Directed projects

Year 4
Full year's internship

Note During the third year all clinical majors will be required to pass a written and oral comprehensive examination. The examination is offered in January and May of each year and assesses the candidate's breadth of knowledge and understanding of his professional role.

Learning This programme is designed to provide a thorough grounding in the area of learning research and teaching. In many cases, this training provides the foundation for approaching problems which impinge on other areas of psychology (e.g., developmental, clinical, perception) or other disciplines (e.g., biology, statistics). As a consequence the learning programme is constructed to permit maximum flexibility in course
courses which allows their learning interest to link with other academic areas (eg. ethology, linguistics, perception), or to focus on various practical problems (eg. addictions, behaviour modification, education, psychopathology).

Because of the various directions that learning research may take, research facilities for students are quite diverse. They encompass laboratories for human psychophysiology, information processing, memory and instrumental behaviour. Mobile laboratories are available for studies with school or hospital populations. In addition, facilities are provided for the study of a wide variety of animals (e.g., rats, monkeys, fish, cats, and marine invertebrates).

Students are expected to be actively engaged in research throughout their three years of residence. A student is assigned to a research advisor as soon as he arrives on campus. While his initial studies may be closely supervised, the successful student is expected to assume increasing independence and responsibility for his research.

Programme

Although the specific order and selection of courses will depend on the particular student's background and interests Year 1 would normally involve completion of a Statistics course (Psych 631-632 or passing a qualifying exam), Psych 702 and a M.A. thesis.

One or more full-year graduate courses are selected for each of the two subsequent academic years. These courses are chosen by the student in consultation with his advisor. They may remain within the core learning area (Psych 722 and 732) and/or range broadly (eg. Psych 613, 615, 628, 640, 641, 660, 661, 670, 676, 705, 714). The major requirement for the Ph.D. degree is fulfilled by submission of the Ph.D. thesis.

Students are strongly encouraged to hold Teaching Assistantships during their graduate programme.

Perception and Cognition

The programme is designed to provide a thorough grounding in the area of Perception and Cognition. The major emphasis is on the development of competence as an independent researcher. The research interests of the faculty and students in the programme are diverse, encompassing problems and issues in information processing, memory, psychophysics and sensory mechanisms, person perception and perceptual learning. In many cases, the training provides the foundation for approaching problems in other areas of psychology (e.g., learning, developmental, physiological and clinical). As a result, the programme allows students the flexibility to include courses and seminars related to their particular interests.

The research facilities for students include laboratories especially equipped for work with human subjects. Mobile laboratories are available also for studies with school children and hospital or other special populations (e.g., blind, deaf and otherwise handicapped individuals). In addition, facilities are available for studies with animals.

Programme

A typical programme is outlined below. It is to be emphasized that the programme for any particular student will be designed by the student in consultation with his advisor to fit the student's needs and interests. It is expected, however, that every student will take a minimum of two full courses (from the honours B.A.) while he is working towards the M.A. and a minimum of four full courses from the M.A. while he is working towards the Ph.D.

Year 1

Statistics course (631-632) or qualifying examination
Department of Psychology

† (Normally a student will be expected to have completed his M.A. thesis no later than the beginning of his second year in the programme).

Year 2 Perception (741)
One other full course
Research

Year 3 Full year course in Perception (all students will be expected to attend the senior seminar in Perception).
One other full course
Ph.D. thesis

Note 1 While it is possible for a student to complete the programme and receive the Ph.D. degree in three years, normally it takes four years.

Note 2 All students entering either the Honours B.A. (or its equivalent) are required to complete a M.A. thesis.

Note 3 While there is no formal Minor area of specialization required for the Ph.D. students are encouraged to take courses and seminars related to their research interests.

Note 4 There is no formal special area examination required for the Ph.D. (In special cases, a student may be permitted to sit for a Special Area Examination upon request, and have his results on such an examination included in his yearly overall evaluation. See "Student Evaluation".)

Note 5 Each student in the programme is required to attend and participate actively in the senior seminar in Perception every year he is enrolled in the programme. As part of his participation in the senior seminar, a student working on Ph.D. research will from time to time meet with seminars to discuss (a) a review of the literature pertinent to his research, (b) pilot data collected, and (c) the data from the research.

Note 6 From time to time Special Topic Seminars will be offered by the faculty and students in the programme. These seminars may be equivalent to either a full or half-course. Special Topic Seminars offered in the past include: Psychometric Methods, Language and Thought, Mathematics and Psychology, Person Perception.

Social and Personality

The students in this division are expected to develop a broad and intensive understanding of the major areas of research and theory in personality and social psychology. In addition, the students will have experience with the major research methodologies—experimental, multivariate, survey, observation, etc. Clearly the major emphasis of this program is to train people who understand the strategy and techniques underlying research. It is expected that this background is appropriate to an effective career in teaching, academic or social problem oriented research or community action work. To better enable the students to achieve these skills and level of sophistication the faculty advisors work closely and intensively with each student. Beyond the basic requirements formal course work, and examinations are tailored to each students background and goals.

Students and faculty in the area are presently engaged in such diverse research areas as impression formation, anxiety, audience influence, decision making in groups, sex-role development, helping behavior, social psychology of justice, studies of attitude change, Machiavellism, prejudice and Discrimination. Research space, including observation rooms, is readily available.

Programme

Year 1 Statistics (Psychology 631-632) or qualifying examination
Other content courses chosen in consultation with student's advisors

Year 2  Research seminar
Other content courses chosen in consultation with student's advisors
Ph.D. thesis proposal and "pilot" work

Year 3  Ph.D. thesis

Note 1  Generally prior to the major data collection for the Ph.D. thesis, an oral examination will be held by the candidate's thesis committee on the dissertation proposal. In general, a formal written proposal will be circulated to the members about two weeks prior to this meeting. A copy of the proposal will be made available to any other interested persons, who are also invited to attend the meeting. It will be the function of this oral to approve the question being investigated and the appropriateness of the design and procedures.

Note 2  The structure of this programme is in an evolving state at present. Students interested in a fuller description of the program should contact the Chairman: Social and Personality Programme, Department of Psychology.

Applied  This two year programme, leading to the M.A.Sc. degree, combines both full-time academic studies and practical training in field work settings. At the present time, only specialization in educational problems is available, although it is planned that specialization in such areas as industrial, addiction, etc. may be available by the fall of 1971.

The objective of the present programme is to provide training at the terminal master's level that will be complete and adequate for pursuit of a job career in the educational system of Ontario. The programme emphasizes the acquisition of knowledge in experimental research, theoretical foundations, and necessary applied skills.

Students must complete two full theoretical courses, one of which is Developmental Theory (705). The second course would normally relate to his particular interests in educational problems (learning, perception, personality, etc.) Two applied courses must be taken: Individual Differences (Test Administration and Use) (735) and Educational Psychology (640-641). Competence must be shown in statistical procedures, as is usually evidenced by successful completion of Statistics (631). All students must carry out a research project similar to the M.A. thesis, on a problem directly related to the school situation.

A variable internship programme is planned for the student. It would normally include full-time work at some setting during the summer following the first academic year. Further placement during the second year would be specially planned in accordance with the work loads of the field settings and the availability of the students. Such a variable work schedule permits a student to continue his course work while experiencing work in a field setting. As far as possible, placements will be in local settings.

Programme

Year 1  Fall/Winter
Statistics (631)
Developmental Theory (705)
Individual Differences (735)
Educational Psychology (640)
One other course
Summer Internship

Year 2 Fall/Winter
Educational Psychology (641)
2 other courses
Internship (variable)

Summer
Research Project
Internship (variable)

Graduate Courses

*Indicates half year course

601*-610* Special Topics in Clinical Psychology
May be graded on a pass-fail basis

615* Multivariate Procedures for Psychologists
The following topics will be introduced with the emphasis placed on application, understanding, and interpretation: Elements of matrix algebra, multiple and partial correlation, component and factor analysis, canonical correlation, discriminant analysis, multi-dimensional scaling.
May be graded on a pass-fail basis.

619* Seminar in Behaviour Modification
This course deals with issues and techniques derived from learning theory and social psychology which contribute to the modification of behaviour. Emphasis is placed on methodological and design problems in modification research and the practical application of behaviour modification strategies and procedures.

626 Psychotherapy Practicum
A supervised psychotherapy training in one-to-one therapy. The supervision is conducted in small groups and individually; theoretical and practical issues are discussed in special seminars.
Graded on a pass-fail basis.
* Indicates half year course

627 Clinical Seminar
This course is designed to give the first year graduate student a comprehensive coverage of the core topics in clinical psychology. It features sections on psychological assessment, description and classification of abnormal behaviour, personality theory, behaviour change, and a discussion of other basic issues in clinical psychology. It is required of all students in the clinical programme.

628 Seminar in Clinical Psychology
Credit for this course will be offered on the basis of work done in four individual seminars. This course is advised for the second and third year students in the programme and open to others in the department. It allows students to elect special topic seminars offered by other divisions of the department in the place of these topics.
Examples of electives that have been offered are as follows: Psychotherapy Techniques, Psychopathic Personality, Seminar in Community Psychology, Seminar in the Biological Foundation of Pathological Behaviour, Seminar on Deviance, Seminar on Nature of Utopias, Seminar on Psychophysiological Methods of Assessment in Clinical Practice and Clinical Research.
630* Directed Study
This course offers an opportunity for students who have previously taken a half-year course in a specific area to explore selected problems in greater depth.

631* Advanced Statistics
An advanced introduction to statistical inference.
Prerequisite: Psychology 280 or its equivalent.

632* Experimental Design
Basic principles used in the design of experiments and the analysis of experimental data, with emphasis on complex analysis-of-variance techniques.
Prerequisite: Psychology 631*.

633 Intelligence Test Practicum
Instruction and supervision in the use of standard IQ tests and report writing is emphasized. The course also covers the assessment of brain damage, basic interviewing procedures, and MMPI testing. This course is a requirement for all first year clinical graduate students.
Graded on a pass-fail basis.

635* Clinical Fieldwork Practicum
Training in research in assessment and treatment procedures in a clinical setting. All clinical students are obliged to enroll for this course in their first and second years.
Graded on a pass-fail basis.

637*-638* Experimental Personality Research
Two half-year courses emphasizing experimental approaches to personality psychology. 637 will be given in the Fall term. 638 in the Winter term, but 637 is not a prerequisite for 638.
Prerequisite: Psychology 711.

639 Personality Assessment Practicum and Lab
A survey and supervision of personality assessment procedures featuring projective tests. It is required for all second year clinical students.
Graded on a pass-fail basis.

640*-649* Special Topics in Psychology
Some examples of Special Topics that have been offered recently are:
Topics in Mathematical Psychology and Educational Psychology
May be graded on a pass-fail basis.

650*-659* Special Topics in Perception and Cognition
May be graded on a pass-fail basis.

660*-669* Special Topics in Learning and Motivation
Some examples of Special Topics that have been offered recently are:
Research in Personality Development, and Learning Addiction.
May be graded on a pass-fail basis.

670*-679* Special Topics in Biopsychology
Some examples of Special Topics that have been offered recently are:
Developmental Genetics, Advanced Behaviour Genetics, Current Topics in Biopsychology, Man: A Biological Organism, Chemistry of Learning and Memory, and Zoo-biology.
May be graded on a pass-fail basis.

680*-689* Special Topics in Child Behaviour and Development
Some examples of Special Topics that have been offered recently are:
The Development of Aggression, and Conformity and Approval Seeking.
May be graded on a pass-fail basis.

690*-697* Special Topics in Social and Personality
Some examples of Special Topics that have been offered recently are:
May be graded on a pass-fail basis.
Department of Psychology

698 Internship

699 Thesis

701 Sensory and Perceptual Processes
A general graduate seminar in perception and cognition that will attempt to familiarize the student with contemporary theory and research in perception and cognition. This seminar is required of all incoming students in perception and cognition, and is open to any other student who wishes to learn about the area, although a good undergraduate course in perception is strongly recommended as a prerequisite. The seminar is not didactic and will lean heavily on student presentations and participation.

702 Contemporary Research Problems in Learning
The purpose of the course is to examine in depth a limited number of contemporary research topics in the area of learning.
*May be graded on a pass-fail basis.*

704, 724 Social Psychology 1, 2
Seminars dealing with theoretical issues and research findings in the area of social psychology.
*May be graded on a pass-fail basis.*

705 Contemporary Developmental Psychology
A detailed study of theoretical issues and research in the areas of child development and behaviour. Recent research findings from fields both within and outside the traditional limits of child and developmental psychology including experimental, comparative, cross-cultural, and studies of interactive processes will be considered. Special emphasis will be given to an indepth consideration of Piaget's theory and work. Open to all graduate students with permission of instructor.

707, 727, 747 Biopsychology 1, 2, 3
Seminars dealing with topics in the comparative, psychological and neurological study of behaviour.

711 Seminar in Personality
Systematic review of personality theories and related research.

712 Social Development
Theory and data relating to the social development of humans, and sub-human species.

714 Biopsychology Survey
A course designed for broad coverage of topics related to biology and behaviour. Current topics include those from the areas of: neuroanatomy and histology, neurophysiology, biochemistry, endocrinology, genetics, evolution, ethology and embryology.

721, 741 Sensory and Perceptual Processes 2, 3
Two advanced graduate seminars in perception and cognition.
*May be graded on a pass-fail basis.*

722, 732, 742 Learning 2, 3, 4
Advanced research seminar
*May be graded on a pass-fail basis.*

724 Social Psychology 2
A research seminar dealing with theoretical issues and research findings in the area of social psychology.

725 Current Methods in Developmental Psychology
The course will focus on the essential methodological issues in developmental psychology and will indicate the research methodology, variables and findings, via selected examples from the developmental research literature. Special attention will be given to the following topics: Early experience and critical periods, learning and conceptual development, language development.
735 Individual Differences in Children
This course deals with the available psychological measuring instruments used in research exploring the behavioural structure of the individual child. Emphasis will be placed upon the development of evaluative skills for the selection and research use of various standardized procedures in terms of rationale, validity, reliability, and interpretive value. A practicum portion of the course will involve the selection and use of instruments appropriate to research in representative investigations. *Open to all graduate students with permission of instructor. May be graded on a pass-fail basis.*

736, 737, 738 Child Psychology Issue Seminar
A seminar dealing with current issues and related research findings in the broad area of child behaviour and development. *Restricted to Child Graduate Students. May be graded on a pass-fail basis.*

750 Individual Research Project
A supervised experimental study, together with a survey of relevant findings in the literature.

760 Advanced Experimental Psychology
Detailed study of selected problems in the student's major area of specialization; e.g., cognition, learning, motivation, perception. *May be graded on a pass-fail basis.*

801 Psychometric Theory
An examination of methods and issues in the construction, selection and evaluation of psychological tests.

Human Relations Studies

Origins, Concept and Scope
The Committee on Human Relations Studies, established in July, 1970, is an emergent academic programme unit, incorporating and developing from the Counselling and Human Relations graduate programme of the Psychology Department, and moving toward independent status. The programme is developing qualitatively and expanding in scope in accordance with an over-all concept characterised by the following component perspectives and emphases.

1) Interdisciplinary perspective: The field of human relations is seen as a major interface or area of converging interest between a number of more traditional disciplines. It is concerned broadly with the experiencing person in his transactions with his human environment. It deals with human interaction and communication processes and effects and with individual, interpersonal and social system (or structural) determinants of these processes and effects. The phenomena and problems involved call for the collaboration of persons with articulating but complementary perspectives and expertise reflecting a variety of special interests, experience and specialised background. In keeping with this position, the human relations programme is appointing faculty with connected interests but varying formal disciplinary origins and specialization, and welcomes students of varying background and experience.

2) Humanistic perspective: The programme is oriented explicitly toward contributing to the quality of human life. This value orientation tends to be associated with a holistic view of man as an experiencing, self-conscious being, acting upon and reacting to events and relationships in terms of their meanings to him. It is also imposes the challenge and need to transcend a neutral, descriptive level of inquiry and to include the development, testing and application of normative principles. Human relations, in this sense, is seen as a programme that is devoted to developing this type of perspective and expertise.
major axis or locus of concern of the programme. These aspects of the orientation of the unit are reflected, directly and indirectly, in its component educational and research programmes, in the activities of individual members in the University and larger community, and in its current work toward the development of a combined resource, field-training and action-research centre in the community.

3) Scholarly/scientific orientation: The programme seeks to achieve a genuine fusion of humanistic/applied and scholarly/scientific values and activities. Fresh conceptual perspectives and increasingly salient and integrative knowledge are seen as essential conditions for adequate understanding of and response to human and social problems—which include damaging, often dangerous communication difficulties and failures at many levels; institutionalised social structures that are no longer responsive to human needs or the realisation of human potential; and large-scale problems of human suffering and interpersonal/experiential deprivation. The very complex patterning of influences and relationships among these phenomena call for advances in methodology in which a naturalistic and ecological emphasis is prominent, and for massive extension and addition to the present ‘beach-heads’ of systematic and functional knowledge in the human relations field.

4) Educational orientation and processes Consistent with its other emphases, the programme is concerned with the integrated scholarly-scientific and personal-professional development of its members. Students are substantially engaged in intensive practical-experiential learning situations as well as those of an explicitly conceptual and scholarly nature. The situations involved engage the learner in ways that assume his commitment and capacity to actually break new ground in his own development, his knowledge-in-action, and his scholarly inquiry. The predominant educational orientation of programme members is student-centered, and students (at present, graduate students) are actively and responsibly involved in the operation and development of the programme.

Graduate Degree Programmes

Graduate programmes lead to the Master of Applied Science (M.A.Sc) or Ph.D. degrees. (The M.A. degree is infrequently used but available in some circumstances to students in the doctoral programme.) Applicants to the M.A.Sc. or Ph.D. programme should hold, or be completing, a four-year honours bachelor degree or its equivalent. Their academic record and other relevant evidence should provide clear indication of a high level of intellectual-scholarly ability. Evidence of substantial engagement in human issues, reflected in an applicant’s previous inquiry and extra-academic activities, and of relevant personal and interpersonal resources and potential, are also of major importance in selection of candidates. Applicants are asked to describe themselves and their goals in ways that go beyond their formal records and experience and individual and/or planned group interviews are arranged wherever possible before final acceptance of an applicant. To date, applicants admitted directly to full graduate standing in the programme all have undergraduate (or, in some cases, master’s degree) majors or specialisation in one or more of the behavioral and social science disciplines. However, persons with other academic backgrounds who believe their actual interests, experience and general scholarly and personal resources are consonant with the emphases and objectives of the Human Relations Programme, are also encouraged to apply. Successful candidates in this category may be admitted to regular graduate standing or, where preferred or necessary, to a preliminary qualifying year.
Applicants who do not hold an honours bachelor degree or its equivalent may apply for a qualifying year, which would be flexibly designed to advance their preparation to an honours equivalent level, taking into account their actual background and intended graduate programme.

Candidates may be admitted from an honours degree to the M.A.Sc. programme or directly to the Ph.D. programme. As the formal prerequisites do not differ, the choice among these alternatives depends largely on the applicant's current interest, motivation and objectives, and the openings available. A candidate in the M.A.Sc. degree programme may make fresh application for admission to doctoral studies at the conclusion of his master's programme. The decision on his application would result from an up-to-date appraisal in relation to other applicants and current resources and openings for advanced doctoral work.

**M.A.Sc. Degree Programme**

The master's programme is designed to prepare candidates who will be qualified, on graduation, to proceed directly to career positions in the human relations field, in such settings as counselling and rehabilitation agencies, community service and welfare organisations, relevant kinds of community development programmes, correctional institutions oriented toward rehabilitation, community colleges and school systems, and clinics, community mental health programmes and other health-related institutions employing human relations and counselling specialists.

The degree course is formally a two-(calendar) year full-time programme, including internships, and may take one or two terms longer. It typically requires (from the honours B.A. level) four on-campus terms and two terms or equivalent of full-time supervised internship experience. As presently arranged, it is a non-thesis degree but includes an individual 'research essay' project, counting as a one-term course. Steps are now being taken to introduce an additional alternative option, involving a full research thesis. Students complete an individually planned academic programme, normally equivalent to 12 one-term (or six full-year) graduate level courses plus the internships carrying two further one-term course credits.

Except for the research essay project (or research thesis), there are no individually required courses in the programme. Some general constraints exist in terms of each candidate drawing from specified clusters of course offerings. Varying emphases, and individual adaptions and combinations of these emphases, can characterise a student's total programme, although no formal or standard options (besides the prospective thesis/non-thesis options) are distinguished. In terms of present resources and directions of development these potential emphases include counselling and personal facilitation, group and organisational processes, community studies and development, and human relations in education.

**The Ph.D. Programme**

The doctoral programme is intended to prepare candidates who will make significant, innovative contributions to knowledge and practice in the human relations field. The programme emphasises the development of resources for facilitative intervention in dyadic, group, organisational and community contexts; the study of man in his human environment from a naturalistic and ecological perspective; the investigation of social innovation and change; and the application and development of methodology suited to investigation of the complex phenomena involved.

The Ph.D. programme, in the first two years, draws substantially on the same pool of courses, practicum provisions and other resources as the M.A.Sc. programme and includes future work in the area of
Department of Psychology

pre-doctoral research. Candidates accepted for doctoral studies may qualify for the M.A.Sc. degree en route to the Ph.D. The total programme normally includes the equivalent of at least one full year of supervised internship experience divided among two or more appropriate field settings.

The formal duration of the Ph.D. programme is four calendar years, including internships, teaching experience (as a teaching fellow for one academic year, at least) and research experience and dissertation. By present provisions the candidate's third and fourth academic years would involve a continuing advanced seminar in human relations, not more than one other full course each year, the dissertation research and, in relevant instances, a part-time internship during one of these academic years. Formal annual reviews of each candidate's progress and performance in his field include a comprehensive 'mid-programme' evaluation typically held at the end of his second year of graduate study, or after a shorter period if he was admitted with advance standing.

Graduate Courses

The following courses are offered specifically through the Human Relations Programme. It is likely that additional courses will be introduced by Fall, 1971.

811*Personality Theory course under revision

830*Personality Variation & Human Effectiveness An examination of concepts of optimal, healthy or mature personality, and of theoretical, normative and empirical foundations of these concepts. Basic issues, approaches, and relevant research in the study of personality variation in a normative perspective.

832*Basic Processes in the Helping Interview Concepts and prepractice workshop in fundamentals of personal facilitation.

835*Counselling Theory and Research General theoretical and descriptive study of counselling and psychotherapy phenomena, emphasising developmental and actualization or growth orientations and concepts. Studies of process and outcome phenomena and of instrumental or facilitative conditions in personality and behavior change. Salient issues and developments in relevant contemporary research.

836*Counselling Practicum Supervised practice in individual and group counselling. Students will meet with supervisors individually and in small groups for intensive examination and discussion of their own counselling sessions and related issues. Prerequisite: Psychology 832 and 835, or consent of instructor. May be graded on a PASS/FAIL basis.

855*Child and Family Counselling Theory, research and supervised practice in actualization counselling with children and families.

845*Behaviour Therapies The thinking underlying a behavioural approach to the systematic understanding and helping of people is examined. Techniques for effecting behavioural change are studied and practiced. Included, for example, are Wolpe's method of systematic desensitization for alleviation of specific anxieties, and positive reinforcement procedures in their application with school children and "chronic" patients. Aversive treatment procedures are also critically examined.
838*Small Group Processes

The course will be concerned primarily with applications and interpretations of small-group procedures with normal persons, where the intention is to facilitate increasing sensitivity and skill in human relations, to foster self-related learning, or to facilitate communication and reduce tensions in an ongoing group or set of interacting individuals. Research investigations of small-group processes and their effects will be considered. A series of practicum sessions will provide a personal experience of a basic encounter or human relations training group process.

*May be graded on a PASS/FAIL basis.*

848*Organisational Psychology:

Analysis of Organisational Behaviour

A consideration of current theories of organisational behavior and the use of the system approach in its analysis. Special emphasis is placed on interpersonal interaction and organisational change.

822*Social Problems

An analysis of major contemporary social movements and socially deviant behaviour patterns. Seminars sessions will focus on specific areas, e.g. student protest, drug dependence, delinquency, changing family patterns, etc.

812*Assessment of Abilities

Theories of human abilities and nature of tests derived from these theories, including intelligence tests. Criteria for the selection of tests. Review of relevant research. Practice in test administration and evaluation of results.

816*Assessment Methods in Counselling

The role and use of various approaches to assessment in counselling, with respect to both applied and research questions. Examination of theoretical issues, empirical data and ethical issues. Prepracticum experience with various interest and personality assessment devices.

820*Assessment Practicum

Intensive assessment of individuals (adults or children) and/or interactional patterns, with emphasis on integrating data and on relating the resulting information to an appropriate educational or personal helping process.

851*Contemporary Issues in Education

A critical evaluation of current curriculum development, educational theory and related issues in education.

2*Assessment and Treatment of Exceptional Children

The eight or ten most prevalent forms of exceptionality in children are studied to understand the defining characteristics of each. The implications of the exceptionality are investigated to understand its impact on the child's development, life-style, and education. Methods of detection and of helping exceptional children in the home and school are considered in detail. Attention is given to the work of prominent exponents of relevant theory and procedures, such as Piaget, Montessori, Frostig, and Kephart.

839*Naturalistic Research

An introduction to naturalistic research in areas in which it may be impossible, undesirable or impracticable to engage in controlled experimentation. Discovery and refinement of hypotheses will be stressed since they are intrinsic to naturalistic research. A model for naturalistic research and analysis will be presented. May be graded on a PASS/FAIL basis.

870*-874*Selected Topics in

*May be graded on a PASS/FAIL basis*
Human Relations

730-731 Advanced Human Relations Seminar
Advanced seminars, 1, 2 dealing with theoretical, research and professional developments and problems, and with critical contemporary issues in the field.
May be graded on a PASS/FAIL basis.

860*-864*Internship
Four-month (one-term) full-time supervised internships, in a professional field setting affiliated or co-operating with the University for this purpose.
May be graded on a PASS/FAIL basis.

843*Research Essay
A formal paper which may either:
 a) report an empirical research study carried out under faculty supervision; or
 b) present an extensive review of the literature on a selected topic; or
 c) present a systematic case study or series of related case studies, within a theoretical framework.
May be graded on a PASS/FAIL basis.

699 Thesis

Note Courses currently used in the Programme also include Psychology 631, Advanced Statistics, 613 Multivariate Analysis, and 801 Psychometric Theory. Further courses in Psychology and other departments are available on an elective basis.
Department of Recreation

Professor, Dean of the School of Physical Education and Recreation. G.S. Kenyon, B.P.E. (British Columbia) M.S. (Indiana) Ph.D. (New York.)

Associate Professor, Chairman of the Department C.A. Griffith, B.A. (Sir George Williams) M.S., Re.D. (Indiana).

Assistant Professor D.J. Arnold, B.P.E. (British Columbia), M.Sc. (San Francisco), Re.D. (Indiana).

Assistant Professor D.Ng, B.A. (Lingnan), M.A. (Carver), M.S., Re.D. (Indiana).

Assistant Professor J.D. Pearse, B.A. (Toronto).

Course Descriptions

102* Introduction to Community Recreation A course designed to develop an overview of the total field of recreation including fundamental concepts of administration and programmes. 2 hours lecture, 1 hour tutorial.

103* Current Developments in Recreation An examination of current developments and problems in the fields of recreation, in social and historical perspective. An attempt is made to analyze these situations and determine trends. 2 hours lecture, 1 hour tutorial.

201* Community Recreation Programmes A study of the scope of community recreation programmes and the factors involved in programme planning. Emphasis will be placed on the organization, conducting and evaluation of various recreation programmes. 2 hours lecture, 2 hours lab.

215* Park Management An overview of park systems in Canada with an emphasis on municipal parks; general policies of acquisition, operation and development; basic administrative procedures in park management. 3 lectures.

225* Administration of Outdoor Education and Camping The philosophy and objectives of outdoor education and camping; organization, planning and leadership of programmes in outdoor education and camping; current practices in schools, public and voluntary agencies. The emphasis in this course will be on the place of the resident camp in education, social welfare, and recreation with particular reference to administrative policies and procedures. 3 lectures.

226* Outdoor Education Concepts, philosophy, principles and practices for the enrichment of the school curriculum through the use of the natural environment. Emphasis on the role of the school; the community, the provincial and federal governments relative to an integrated approach toward leadership, program, areas, facilities and administration. 3 lectures.

230* Specialized Institutions in Recreation A course designed to examine different recreation institutions in detail. Included will be the structure of such departments and institutions as Municipal Recreation and Industrial Recreation, Y.M.C.A.'s, Therapeutic and Retarded Children's Centres, etc. 3 lectures.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>240*</td>
<td>Statistical Techniques Applied to Recreation</td>
<td>An introduction to descriptive and inferential statistics and the interpretation of data. A major consideration of the course is the use of statistics in the solution of problems in recreation. 2 hours lecture, 2 hours laboratory.</td>
</tr>
<tr>
<td>280*</td>
<td>Principles of Administration</td>
<td>A study of the principles underlying general administrative behaviour with an emphasis upon understanding the role and mechanics of decision making. Case study analysis and practical project work are utilized to foster the development of the students’ administrative technique. 3 lectures.</td>
</tr>
<tr>
<td>285*</td>
<td>Basic Recreation Skills</td>
<td>Instruction in the basic skills and fundamentals of a wide selection of physical, social, and cultural activities and including folk and modern dancing; individual and team activities; canoeing, sailing and camp skills; performing and visual arts; music, communication techniques, etc. Instruction and practice in these activities are embraced by the course sequence Recreation 285*, 286*, 385*, 386*. 4 hours per week per term. Prerequisite: Honours Recreation Student.</td>
</tr>
<tr>
<td>300*</td>
<td>Philosophy of Recreation and Leisure</td>
<td>A course designed to expose the student to a variety of philosophies of leisure and to examine leisure through the ages; with a view to developing a personal philosophy consistent with modern society. 3 lectures. Prerequisite: Recreation 102/103</td>
</tr>
<tr>
<td>310*</td>
<td>Organization and Administration of Recreation Services</td>
<td>The organization and administration of recreation on federal, provincial, and municipal levels; legislation, financing, budgeting, personnel management, public relations, administrative practices and departmental organization with particular emphasis on the municipal level. Prerequisite: Recreation 102/103</td>
</tr>
<tr>
<td>315*</td>
<td>Introduction to Therapeutic Recreation</td>
<td>Philosophic concepts of recreation as therapy; therapeutic recreation services in the treatment and rehabilitation of individuals with physical, emotional and intellectual maladjustments; organizational and administrative structure of treatment settings and inter-relationships of the various disciplines within the settings. 3 lectures. Prerequisite: Consent of the instructor.</td>
</tr>
<tr>
<td>320*</td>
<td>School Recreation</td>
<td>An analysis of the relationship between recreation and education with particular emphasis on the sponsorship of community recreation programmes by education authorities including leisure education and co-curriculum activities. 3 lectures.</td>
</tr>
<tr>
<td>325*</td>
<td>Outdoor Recreation</td>
<td>The present status of outdoor recreation in modern society; government functions and policies related to outdoor recreation services, the planning and administration of outdoor recreation activities. Current problems. 3 lectures.</td>
</tr>
<tr>
<td>350*</td>
<td>Research Design</td>
<td>An introduction to the methods and techniques basic to research in recreation. The student will be familiarized with various materials and equipment used in this research. 3 lectures. Prerequisite: Recreation 240 or equivalent</td>
</tr>
</tbody>
</table>
385* Basic Recreation Skills (See Recreation 285*).

386* Basic Recreation Skills (See Recreation 285*).

100* Comparative Programmes in Recreation A study of recreation programmes in Canada, the United States and several European countries.

3 lectures.

10* Planning and Administration of Facilities A course to introduce the student to the planning, design and layout of recreation areas and facilities. It will also include a study of the administrative problems relating to the use of the facilities.

3 lectures.

420* Growth, Development and Aging The changing capacities and interests of man are studied as he grows and develops. The contribution of physical activity to growth and physical, psychological and sociological development is examined.

3 lectures.

440* Research Project Each student will work under the direction of a member of the Department on an approved research topic in recreation. The results of the investigation will be presented in thesis form.

1 lecture, 1 hour lab.

Prerequisite: Recreation 240*/350*. Honours Recreation Student.

470* Seminar in Recreation An analysis of the current major issues found in the field of recreation. Included will be discussions of current trends in recreation.

3 hours.

Prerequisite: Fourth Year Honours Recreation Student.
Religious Studies

Associate Professor and Acting Chairman
J.R. Horne, M.A. (Western), B.Th. (Huron), Ph.D. (Columbia)

Associate Professor G
W. Klaassen, B.A. (McMaster), B.D. (McMaster Divinity School)
D. Phil. (Oxford)

Associate Professor P
A.M. McLachlin, M.A. (Toronto), B.D. (Emmanuel), Th.D. (Emmanuel)

Associate Professor G and Convenor
J.W. Miller, B.A. (Goshen), M.A. (N.Y.U.), B.D. (Princeton), Th.D.
(Basel)

Assistant Professor R
M. Bird, B.A., M.A. (Iowa)

Assistant Professor G
D. Sahas, B.D. (Athens), S.T.M. (Christian Theological Seminary), Ph.D.
(Hartford Seminary Foundation)

Assistant Professor J
J.A. Wahl, C.R., B.A. (Western), M.A., Ph.D. (St. Louis)

Lecturer J
W.H. Hall, B.A. (Loyola), B.Th., S.T.L. (Montreal)

Lecturer R

Lecturer P
D.R. Newman, B.A. (Toronto), B.D. (Emmanuel), M.A. (Toronto)

Lecturer P
L.L. Newmarch, B.A. (Toronto), B.R.E. (Victoria), M.A. (Columbia)

Lecturer G
J.E. Toews, B.A. (Tabor), M.A. (Wichita)

Note 1 Purposes of the Programme in Religious Studies:
a) to expose the student to the issues and problems involved in, and to the
nature of the questions raised by, the study of religious phenomena and
ideas;
b) to enable him to approach, in a methodical way, the study of the major
religious traditions living today, for the purpose of encountering and
understanding the life and the expression of religion through the various
religions of the world;
c) to introduce him to the distinctive features of one or more religious
traditions and to the methods for their systematic study.

Note 2 Students majoring in Religious Studies must have their programmes
approved by the programme adviser. Courses should be selected in
accordance with either a philosophic or historical approach to the study of
religion, and should therefore be taken in the following pattern:
Year 1 Any 100-level RS course
Year 2 Two RS courses, one of which deals with the literary sources of a
religious tradition, (i.e.- its Scriptures)
Year 3 Two RS courses, one of which deals with the theological expression
of a religious tradition.

Note 3 The honours programme in Religious Studies can be found in Section 2 of
this Calendar.

Note 4 Students at the University of Waterloo and Waterloo Lutheran University
may, with the permission of their adviser, take courses in Religious
Studies at either university. For details regarding registration procedures,
and courses available at Waterloo Lutheran University, consult the
undergraduate officer, Religious Studies.

Undergraduate Courses

103G* Origins of the
Judaic-Christian Tradition 1

A study of the history, literature and basic concepts of the religion of
ancient Israel in the pre-Christian era, against the background of the
religions of the ancient Near East.

3 lectures, fall term.

104G* Origins of the
Judaic-Christian Tradition 2

A study of the origins of the Christian community and faith, with
special focus on the church's relation to Jesus and the emergence of
Religious Studies

105P Introductory Hebrew
An introduction to Hebrew grammar. Translation and exegesis of selected passages from the Old Testament.
_Not offered 1971-72._

106P New Testament Greek
This course will consist of two parts:
a) An introduction to Greek grammar with appropriate grammatical exercises and development of vocabulary;
b) An exegetical study of the Greek text of the Synoptic Gospels, with Mark as the basis.
_3 lectures._

110* Religions of Mankind 1
An introduction to the religious traditions of the East: history, religious beliefs and practices of Hinduism, Buddhism, Shinto, Zen Buddhism, and Confucianism.
_3 lectures, fall and winter terms._

111* Religions of Mankind 2
Encounter with Judaism, Christianity and Islam: the history and interaction of the three major religious traditions which have shaped the image of the Western World.
_3 lectures, fall and winter terms._

130P*-131P* Introduction to Theology
A study of the nature of the Christian Faith with consideration of questions such as these: How do you speak of God in a secular age? What authority do the scriptures and Church doctrines have for faith? What bearing does faith have on morality? What part does the Church play in the life of faith?
_3 lectures, fall and winter terms._

135* (Philosophy 135*) Fundamentals of the Philosophy of Religion
A philosophical consideration of problematic aspects of religious belief. Topics to be discussed will include: attempts to prove the existence of God, the problem of evil, faith and reason, religious experience, and religious language. Classical and contemporary reading will be used.
_3 lectures._

160R* Introduction to Religion and Culture 1
An exploration of the interrelationships of religion and culture, using representative materials from the Classical Period to the present. An effort to understand the religious dimension of man's literary and artistic achievement, as well as to comprehend the ultimate questions implied in culture. Historical emphasis.
_Fall term._

161R* Introduction to Religion and Culture 2
A consideration of religious thought and the quest for meaning in contemporary culture: art, science, cinema, drama, fiction and music. Contemporary emphasis.
_Winter term._

201J* Introduction to the Old Testament
Principles of Exegesis; date of composition, authorship, literary forms, historical and psychological backgrounds.
_3 lectures, fall term._

202J* Introduction to the New Testament
This course will be conducted on the same lines as RS 201J*.
_3 lectures, winter term._

205G The Hebrew Prophets
A study of the writings of Amos, Hosea, Isaiah, Micah, Jeremiah, and Ezekiel in the historical, social, and religious context of the ancient world, and of their influence upon the development of Old Testament thought.
_3 lectures, fall term._
Religious Studies

208P* Myth and the Modern Consciousness
The role of the apocalyptic imagination. Interpretations and distortions of the Book of Revelation. Apocalyptic motifs in the literature of radicalism, and secular versions of millenial hopes. The presence of the apocalyptic myth in major works of modern fiction.
3 lectures, fall term.

212G* Ancient Near Eastern Religions
An analysis of the myths, epics, legends, rituals, incantations, prayers and festival texts of ancient and near Eastern peoples with special emphasis on the religions of Egypt, Babylonia and Phoenicia-Canaan.
Not offered 1971-72.

213* Hinduism
A study of the development of religious thought in India from the Vedic Period to the present. The course will combine a historical survey with a study of representative texts from the religious, philosophical, social, and political thought of the Hindus.
3 hours.

214* Buddhism in India, China and Japan
This course will consist of a historical survey of the essential doctrines and practices of Buddhism in India, China and Japan, along with a study of representative texts from the various schools of thought.
3 hours.

215* Chinese Religions
A historical survey of the various expressions of Chinese spirituality from the classical period to the present. Special attention will be given to the dynamics between the indigenous traditions (e.g., Taoism) and those imported into China (e.g., Buddhism).
3 hours.

216* Islam
The religion of the Muslims through fourteen centuries of its existence. An introduction to the life and the personality of Muhammad the Prophet, the Qur'an, the Muslim Tradition, the development of the Muslim Theology and Philosophy, Sufism, Muslim expansion and civilization, Muslim life and piety, and present condition of the religion in the Muslim world.
3 hours.

217* Judaism
The religion of Israel through its 4000-year of existence. An introduction to the history, Scriptures, intellectual life, practice and modern situation of the religion.
3 hours.

220 (History 258) History of Mediaeval Europe
The political, cultural, economic and ecclesiastical development of Europe from 300 to 1300.
3 hours, lectures and seminars.

222G The Left Wing of the Reformation
The history and philosophy of the sixteenth century sectarians contrasted with the major reformers and evaluation of their place in modern Christianity.

223G* History of the Ancient Church (A.D.33-450).
A study of the history of the ancient church, special emphasis being placed on the new Testament period and on subsequent developments in form and doctrine and their relation to the culture and thought of the time.
Not offered 1971-72.

224G* History of the Late (A.D. 1200-1560). Especially emphasized are parish life and belief and
Religious Studies

with Lutheran, Reformed and Anglican Christianity.  
*Not offered 1971-72.*

225G* Cultural Conflict in Early Christianity

A study of the conflict within the early church over the nature of the Christian message and community, with special consideration of the writings of Paul, one of the leading missionaries and theologians of the church.  
*Fall term.*

226G* Jewish-Christian Dialogue

An analysis of the relations between the Jewish and Christian communities from the first century to the present. Special attention will be given to the problem of anti-Semitism.  
*Winter term.*

230G* Modern Study of Jesus

An examination of recent approaches to the study of Jesus of Nazareth to determine his significance for the beginnings of the Christian church and for modern man.  
*Fall term.*

231J Revelation, Religion and Doctrine

An examination of the meaning of revelation and its significance for the study of religion. An investigation of the move in the early Church from Kerygma to dogma and the need for theology. A survey of the development of the fundamental truths of the Christian Faith: The meaning of God; The Mystery of the Incarnation; The role of the Spirit; The Church and the Sacraments; The development of Mariology; The problem of Evil.  
*Prerequisite: 2nd Year Standing*  
3 lectures.

232J Christ and Contemporary Man

*Prerequisite: 2nd Year Standing*  
2 hours.

233P*-234P* Contemporary Atheism and Faith in God

3 lectures, fall and winter terms.

235* Philosophy and Mysticism

A critical examination of mystical writings, with regard to the nature of the experience reported, their typology, and their implications for epistemology, ethics, and philosophy of religion.  
*Prerequisite: Consent of Instructor*  
2 hours.

237* Men of Religious Wisdom

An introduction to the life and thought of men of religious wisdom in the religions of Judaism, Christianity and Islam. Those studied will be figures selected from the Hebrew patriarchs, the Prophets, the Scholastics and the Mystics; the Apostles, the Apologists, and the Fathers; the Mutazilites, the Sufis and the Muslim intellectuals.  
3 hours, fall term.
Religious Studies

239P* Philosophies of Education
A study of religious and secular theories of the nature and purpose of education. The thought of classical Greek and Biblical writers, Reformation and Renaissance thinkers, and selected educators of the present day.
*Not offered 1971-72

240P* Psychology of Religion
A study of theories of the psychological nature of religious experience and the sources of religious belief. Special attention to such questions as faith and doubt, conversion, revivalism, conscience, and religious prejudice.
3 hours, winter term.

245G* Religion and Psychotherapy
A review and analysis of the dialogue between theistic religion in the west and the personality sciences since Freud: their respective views of God, man, sin, sickness and the therapeutic process. Clinicians and theorists in psychotherapy and religion from the surrounding community will contribute to the exploration.
Winter term.

250* (Fine Arts 218*) Western Religious Art
An introductory survey of the visual art and architecture of Judaism and Christianity in the Common Era. The development and subsequent changes of style in places of worship and ceremonial objects and ornaments, and the changing forms of religious expression through visual art, will be studied.

254R* Literary and Religious Horizons 1
A discussion of fundamental presuppositions concerning the relationship of religion and literature in general. Subsequently, an investigation of religion as a factor in literary vision, drawing from a wide selection of writings, including novels, essays, poetry and short stories from Eastern and Western cultures.
Fall term

255R* Literary and Religious Horizons 2
A thematic consideration of religious questions in contemporary literature. Reading selections will include in addition to selected theological writings a variety of representative materials from contemporary authors.
Winter term.

262R* Religion, Ethics and Politics 1
A historical overview of several religious traditions in terms of their stance with respect to selected socio-political issues. A consideration of the problems and possibilities presented by religious factors in the choice of ethical responses to political problems.
Fall term.

263R* Religion, Ethics and Politics
A consideration of varied religious responses to 20th century political realities. An examination of theological and/or ethical reflections within various religious standpoints on the static ideologies of nationalism, statism, racism, fascism, the revolutionary movements of Marxism and Utopianism, and the problems of war and revolution, force and nonviolence.
Winter term.

298*-299* Directed Readings in Special Subjects.

300G* Seminar in 20th Century Values
The purpose of this course is to help members of the university struggle with current value questions in various areas of human activity. It will include questions in the areas of economics, computer science,
Religious Studies

Waterloo and several other universities will participate. Open to third and fourth year students from any discipline in the University.

Winter term.

01* Readings in World Religions
Prerequisite: consent of the instructor
3 hours.

310* (Classical Civilization 371*)
Greek myth and religion

311* (Classical Civilization 372*)
Early Christianity and the Roman Empire.

15*-316* (Philosophy 365*-366*)
Oriental Philosophy
Studies of a selected area of non-western Philosophy (e.g., Indian or Chinese). Parallels will be drawn between modes of Eastern thinking and European conceptions with Emphasis on essential differences as well as similarities.
Prerequisite: Consent of the instructor

323* (History 353*)
Church History from 312 to 1122
A study of the evolution of the dogmatic approach. Topics will include dogmatic, moral and political questions which have affected the teaching of the Church.
3 hours, lectures and seminars.
Not offered in 1971-72

324* (History 354*)
Church History from 1122-1449
A study of the evolution of the dogmatic approach. Topics will include dogmatic, moral and political questions which have affected the teaching of the Church.
3 hours, lectures and seminars.
Not offered in 1971-72.

330J Contemporary Social Doctrine of the Church
The Church and society; the pronouncements of the Church on civil, domestic, professional and international societies.
Not offered in 1971-72.

331J The Church in the Modern World
An attempt to elaborate a Christian life-style for the contemporary situation by analysing the Christian qualities of Freedom, Hope and Joy. An investigation of the task of the Christian as he faces fundamental issues of our time: War and Non-Violence; Politics and Revolution; Racism and Poverty; Sexuality and Marriage; The Individual and Technology. Special use will be made of Church documents on these questions.
Prerequisite: 2nd year standing
2 hours

333* Moses, Jesus and Muhammad
The figures, which the religions of Judaism, Christianity and Islam put at their center, viewed as historical persons and through the eyes of the faithful; a study of the sources and of the common piety. Their life and their teachings as they have been followed and/or transformed by the respective religious communities.
3 hours, fall term.

335* (Philosophy 335*)
Philosophy of Religion
A critical examination of the methods and substantive arguments found in selected major works of religious philosophy. The writings chosen for study will be from the following areas: Judaism, Christianity, Islam, and Eastern religions.
Religious Studies

Prerequisite: One full or two half Philosophy courses.
3 hours.

336P Contemporary Theology
The sources of contemporary theology in 18th and 19th century thought with particular reference to Kant, Schleiermacher and Kierkegaard. Selected 20th century theologians including Barth, Bultmann, Tillich and Bonhoeffer. Special attention to current themes, such as secularization, the 'death of God', and hope.
3 hours.

337J The Ideas of Teilhard de Chardin
Man's place in the Universe: Evolution; Creative Union and Transformation; hominisation; Love and Personalization. Nature and Grace: role of Christ—Omega; scientific knowledge and revelation; human endeavour and grace.
Not offered in 1971-72.

341J* Theologians of Renewal: John Henry Newman
An investigation of the renewal in Catholic Theology through a study of contemporary theologians with special reference to this nineteenth century English Churchman. His specific contribution will be evaluated by an analysis of his concerns and methods.
Prerequisite: 2nd Year Standing.
2 hours, fall term.

342J* Theologians of Renewal: Bernard Lonergan
An investigation of the renewal in Catholic Theology through a study of contemporary theologians with special reference to this twentieth century Canadian Jesuit. His specific contribution will be evaluated by an analysis of his concerns and methods.
Prerequisite: 2nd Year Standing.
2 hours, winter term.

345* (Sociology 355*) Sociology of Religion
The analysis of religion as a social institution; its relationship to culture, personality and social change with consideration given to theories of religious behaviour and contemporary research findings.
3 lectures.

350J The Ecumenical Movement
An examination of the origin and history of the modern ecumenical movement through a study of its important leaders and events. Documents of the different Christian Churches will be examined and major doctrines in the Christian understanding of the Church will be analysed: Word, Authority and Sacrament.
Prerequisite: 2nd Year Standing
3 hours.

360* The Orthodox Church
A study of the Eastern branch of Christianity, which claims to preserve intact the purest continuation of Christian doctrine and tradition; its history, theology, mysticism, culture, art and its modern situation in Greece, Russia, Eastern Europe, the Middle East, as well as in the West.
Prerequisite: Consent of the instructor
3 lectures, fall term.

362* Religion and Technology
An analysis of some of the theories that have been given to explain the influence of the Judeo-Christian religious tradition on the rise of the modern technological world-view.
3 hours.

398*-399 Directed Reading in Special Subject.
401 Studies in the Jewish Scriptures.†

402 Studies in the Christian Scriptures.†

411 Tutorial in the History of the Muslim-Christian Encounter.†

415 Studies in Comparative Religion.†

20 (History 476) Senior Tutorial in History of Renaissance and Reformation

Prerequisite: History 260 or Religious Studies 223G*-224G*.

2 hours.

421 Tutorial in the History and Methodology of the History of Religions.†

425 Studies in Church History.†

430 Studies in Historical Theology.†

431 Studies in Contemporary Religious Thought.†

432 Studies in Selected Theological Problems.†

35*-439* (Philosophy 435*-439*)

Studies in Philosophy of Religion

A study of a particular philosopher or problem. The topic will be announced in advance each year. 

Prerequisite: Consent of instructor.

3 hours.

†Students wishing to enrol in a course marked with a dagger (†) should consult the department.
Science

The Faculty of Science offers the following courses of a general nature, intended mainly for students registered in the Faculties of Arts and Mathematics, the School of Physical Education or the Division of Environmental Studies as well as for Science students desiring electives, especially in the General Science Programme, as noted.

100* Geological Foundations of the Environment


2 lectures per week. 2 hours laboratory alternate weeks, full term.

Not normally available to students in Regular Science programmes.

Note: Students desiring a full-year Geology elective should consider Earth Sciences 130 (Introductory Geology) to be found in the listings of the Earth Sciences Department.

200* Contemporary Science 1

An examination of some of the issues and developments in contemporary science (e.g., molecular biology, astrophysics, etc.) at a non-technical level. The interaction between science and society will also be discussed. Extensive skills or background knowledge in mathematics or science are not necessary. Open to first year or upper year students. (Students registered in Science or Engineering may not take this course for credit.)

No prerequisites.

3 lectures per week, full term.

201* Contemporary Science 2

Similar discussions to those of Science 200*. (Science 200* need not be taken first.) Open to first year or upper year students. (Students registered in Science or Engineering may not take this course for credit.)

No prerequisites.

3 lectures per week, winter term.

209* Scientific Literature and Writing

Information search and retrieval: libraries, scientific and technical literature, abstracts, sources of data, use of computers. Patents. The art of writing: scientific papers, technical reports, letters.

No specific course prerequisites but only recommended for students in upper years of any Science programme or for similar Mathematics students who are pursuing a Science minor.

2 lectures or discussion sessions per week, one term.

237* Descriptive Astronomy

A survey course in astronomy intended for non-Science students (primarily Arts, Environmental Studies and Physical Education students). The solar system, stars, the galaxy, galaxies and the universe. Open to first year or upper year students. Students registered in Engineering, Mathematics or Science may not take this course for credit.)

No prerequisites.

3 lectures per week, one term only.

238* Descriptive Astronomy

A survey course in astronomy intended for Mathematics, Engineering and Science students. The solar system, stars, the galaxy, galaxies and the universe. Open to first year or upper year students. (Students whose major field is Physics may not take this course for credit.)

No prerequisites.
Note Students interested in the above courses in Astronomy should note that because of overlapping material both courses may not be taken for credit - only the one most suitable to their background.

251* Genetics and Evolution
The principles, methods and applications of genetics. The basis and implications of modern evolutionary theory. The modern approach and social implications will be discussed. Open to first year or upper year students. (Students whose major field is Biology may not take this course for credit.)
No prerequisites.
3 lectures per week, fall term.

252* Biology and Society
A topical approach to problems of human society directly related to biological systems. Areas for discussion in any one year will be chosen from a wide range of topics. These will be dealt with both from the theoretical and practical aspects of modern biology. Open to first year or upper year students. (Students whose major field is Biology may not take this course for credit.)
No prerequisites.
3 lectures per week, winter term.

400 The History of Science
The development of scientific concepts from the Renaissance to the early 20th century, Copernicus and Galileo, Sir Isaac Newton. The physical and biological sciences during the 18th century. Lavoiser. 19th century developments in physics, chemistry, geology, biology and technology. Evolution and the rise of modern genetics. The 20th century revolution. Emphasis will be given to the reading of the works of historically important scientists.
Prerequisites: The first year Science programme (page 000) or equivalent.
2 lectures per week, two terms.

451* Our Biological Environment. The Land.
A lecture, seminar and practical course providing a study of the terrestrial environment with special reference to the impact of man. Topics covered will include a consideration of the main terrestrial ecosystems of the world; energy flow and material cycling, succession and adaptation; soils and soil erosion; applied ecology including aspects of conservation and pollution; biological versus chemical control of pests; and a discussion of the problems of human population and world food supply. (Students registered in Honours Biology programmes may not take this course for credit.)
No prerequisites.
2 lectures and 3 hour laboratory or field trip per week, fall term.

452* Our Biological Environment. The Water.
A lecture, seminar and practical course providing a study of freshwater and marine environments with special reference to the effects of modern man. Topics covered will include a survey of the ecosystems and biota; nutrients and biological growth; eutrophication; biological aspects of water supply and water pollution; pests and their control; fish and fisheries problems. (Students registered in Honours Biology programmes may not take this course for credit.)
No prerequisites.
2 lectures and 3 hour laboratory or field trip per week, winter term.
Department of Sociology and Anthropology

Sociology

Professor and Chairman of the Department

Professor
H.J. Fallding, B.A., B.Sc., M.A. (Sydney), Ph.D. (Australian Nat.)

Visiting Distinguished Professor
T. Abel, M.A., Ph.D. (Columbia)

Professor G

Professor
H.D. Kirk, B.S. (City College, New York), M.A., Ph.D. (Cornell)

Associate Professor

Associate Professor
D. Kubat, M.A. (Kansas), Ph.D. (L. Maximilian, Munich).

Associate Professor
R.D. Lambert, B.A., M.A. (McMaster), Ph.D. (Michigan)

Associate Professor R

Associate Professor

Associate Professor
W.G. Scott, B.A. (Western), M.A. (Toronto).

Associate Professor R
Barry Sheppard, B.A. (Queen’s), M.S.W. (Ottawa).

Associate Professor

Assistant Professor J
J.M. Alleyne, B.A. (Sir George Williams), Ph.D. (Johannes Gutenberg).

Assistant Professor
M.A. Beauchamp, B.A., M.A. (Buffalo).

Assistant Professor

Assistant Professor (Part-time)

Assistant Professor

Lecturer
M. Eichler, (Goettingen), M.A. (Duke).

Lecturer

Lecturer

Associated Faculty

Professor
H. Abell, M.S., Ph.D. (Cornell), School of Urban and Regional Planning.

Professor
G.S. Kenyon, B.Phys.Ed. (British Columbia), M.S. (Indiana), Ph.D. (New York University), School of Physical Education and Recreation.

Anthropology

Professor
L. Krader, B.A. (City College, N.Y.), Ph.D. (Harvard)

Associate Professor
Wm.B. Roosa, B.A. (Texas Christian), M.A. (New Mexico) Ph.D. (Michigan)

Assistant Professor
T.S. Abler, B.A. (Northwestern), M.S. (Wisconsin-Milwaukee), Ph.D. (Toronto)

Assistant Professor
D.E. Counts (Mrs.), B.S. (S.W. Texas State College), M.A. (Kentucky), Ph.D. (Southern Illinois)

Assistant Professor
G. Gaherty, B.Sc. (McGill), M.A., Ph.D. (Toronto)

Assistant Professor

Assistant Professor
S.M. Weaver (Mrs.), B.A., M.A., Ph.D. (Toronto)

Assistant Professor
J. Rogers (Mrs.), B.A. (Radcliffe), M.A. (New Mexico)

(part-time)
Undergraduate Courses in Anthropology

Note 1  General students who major in anthropology must elect the following courses: Anthropology 101*/102*, a course in ethnography, a course in prehistory, Anthropology 350, and at least one other advanced (200 or above) course in Anthropology.

Note 2  Students who pursue an Honours Programme in Anthropology must take Anthropology 101*/102*, a course in ethnography, a course in prehistory, a course in physical anthropology, Anthropology 320 or 322, Anthropology 350, Anthropology 450, and three additional advanced (200 or above) anthropology courses.

Note 3  Students may pursue a joint honours programme with the permission of Anthropology and the other discipline involved. Ordinarily this would mean taking seven anthropology courses (including Anthropology 101*/102*, 350, and 450), seven courses in the other discipline, and eight electives. Requirements of the second department may lead to some alteration of the formula. Students taking a combined honours programme should consult with advisers in both disciplines to obtain a programme tailored to their needs.

101* Origins of Man and Culture  An introductory course in Physical Anthropology and Archaeology. Lectures on living and fossil primates, the fossil primates, the fossil evidence for the origins and development of man, modern races, and archaeological evidence for the origins and development of culture.

102* Cultural and Social Anthropology  An introductory course on the nature of culture. Data are presented on several primitive cultures.

218* North American Archaeology Paleo-Indian and Archaic  A survey of the earliest known cultures in North America.
Prerequisites: 101 or permission of the instructor.

219* North American Archaeology - the later cultures  A survey of North American cultures from the emergence of food production as a major factor in cultural development to the advent of Europeans.
Prerequisites: 101 or permission of the instructor.

220* Old World Prehistory The Food Procuring Phases  A survey of the development of culture, from the beginnings of tool making to the transition to agriculture. Primary attention to sequences from Africa, Western Asia, and Europe. Comparative attention to the nonagriculture peoples of recent times.
Prerequisites: 101 or permission of the instructor.

221* Old World Prehistory The Food Producing Phases  Examination of the transition to an economy based on food production, the spread of food producing economies, the rise of civilization in the Near East to the early literate periods. Consideration of later prehistoric developments in Africa, Asia and Europe.
Prerequisites: 101 or permission of the instructor.

227* Peoples of Africa  A survey of the cultures and societies of sub-Saharan Africa. An emphasis will be placed upon the ethnographic present, but the effects of modernization will also be considered.
Prerequisites: 102 or permission of the instructor.

228* Peoples of the Pacific  A comparative ethnological survey of selected indigenous societies in the Pacific region.
230 (Art 216*) Primitive Art A study of Paleolithic, Mesolithic and Neolithic world art, aspects of Bronze Age Europe, Asia, and the Near East, the art of the African continent, the North and South American Indians in pre-Columbian and colonial times, and Australian-Oceania, together with related fields such as folk art, naive art and child art.

233* Eskimo Cultures Eskimo cultures of Alaska, Canada and Greenland from the time of European and Asian contact to the present. Administrative systems imposed on the Eskimo will be analysed and compared, as will the contemporary problems these communities face today.
Prerequisites: 102 or permission of the instructor.
Fall term.

234* North American Indians A survey of the cultures of the native peoples of Canada and the United States at the time of contact with European Civilization. Emphasis will be placed upon such aspects as cultural ecology, tribal socio-political organization and nativist reactions to Europeans.
Prerequisites: Anthropology 102 or permission of the instructor. Fall term.

235* Contemporary Canadian Indian Scene An analysis of present day Canadian Indian politics, economics, social organization, education and religion. The Indian Act and its implementation by the Indian Affairs Department will be studied in view of assessing its role in maintaining Indian cultures. Comparative data will be drawn from the literature of Indians in the United States.
Prerequisites: Anthropology 234* or permission of the instructor. Winter term.

238* Caribbean Society A survey of Caribbean society in which particular attention will be devoted to an analysis of the historical, cultural and socioeconomic background of selected representative Caribbean societies, within the general framework of the continuing process of acculturation in this area.
Prerequisites: Anthropology 102 or permission of the instructor.

247* Urban Anthropology Approaches to the study of urban centres as undertaken by anthropologists. Selected topics such as urban social networks, the urbanization of non-western societies, and the culture of poverty will be pursued.
Prerequisites: 102 or permission of the instructor.

248* Peasant Society A survey course with data taken from Latin America, Europe, India, Southeast Asia. Included will be a consideration of different types of peasant societies, the relationship of peasants to urban areas, and the effects of modernization on peasant society.

260* Human Evolution A detailed survey of the fossil evidence for human evolution. Laboratory projects with casts and skeletal material will be required.
Prerequisites: 101 or permission of the instructor.

270* (Music 270*G) The Folk Music of Europe and North America Countries to be discussed: British Isles, France, Germany, the Balkans and Eastern Europe, including the Ukraine and Russia; Canada and the USA through Library of Congress record albums, Czechoslovakia, Greece, Hungary, Rumania.

280 Language and Culture The importance of language in culture. Language is examined as a vehicle of culture (a linguistic code as a device for communication), as a mirror for culture (lexical and semantic aspects), and as a tool of society.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>320</td>
<td>Introduction to Structural Linguistics</td>
<td>A general introduction to structural linguistics. A survey of linguistic approaches to the analysis and description of languages.</td>
</tr>
<tr>
<td>330*</td>
<td>Cultural Ecology</td>
<td>This course will study the interrelations between societies and their environments. It will cover both the cultural relations to the natural surroundings and community organization.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Prerequisites: 101 and 102 or permission of the Instructor. Winter term.</td>
</tr>
<tr>
<td>340*</td>
<td>Community Organization</td>
<td>Historical development, modern structuring and functioning, institutional arrangements and space factors will be dealt with. Past and current theories will be reviewed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Prerequisites: 102 or permission of the instructor</td>
</tr>
<tr>
<td>350</td>
<td>Culture Theory</td>
<td>A survey of the historical development of the concepts of culture, cultural evolution, and acculturation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Prerequisites: 101 and 102.</td>
</tr>
<tr>
<td>353*</td>
<td>Primitive Social Organization</td>
<td>A study of primitive social structure. Systems of kinship and marriage, residence patterns, and family structure are discussed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Prerequisites: 102 or permission of the instructor</td>
</tr>
<tr>
<td>356*</td>
<td>Comparative Economic Organization</td>
<td>A discussion of the alternative means of organizing economic activity, focused primarily on non-market societies.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Prerequisites: 102 or permission of the instructor</td>
</tr>
<tr>
<td>357*</td>
<td>Hunting and Gathering Cultures of North America</td>
<td>Archaeological and ethnological data on various prehistoric and historic groups are presented. Emphasis is on hunting and gathering cultures as a distinct type.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Prerequisites: 101 and 102, or permission of the instructor.</td>
</tr>
<tr>
<td>358*</td>
<td>Archaeological Theory</td>
<td>A seminar on current Archaeological theory.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Prerequisites: 101 or permission of the instructor</td>
</tr>
<tr>
<td>359*</td>
<td>Political Anthropology</td>
<td>The study of political behaviour in both state and non-state society. A comparative approach will be used with a thorough examination of the political systems of selected societies.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Prerequisites: 102 or permission of the instructor.</td>
</tr>
<tr>
<td>360*</td>
<td>Variability in Human Populations</td>
<td>Study of physical variation and its causes in contemporary human populations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Prerequisites: 260 or permission of the instructor.</td>
</tr>
<tr>
<td>362*</td>
<td>New World Civilizations</td>
<td>Problems in cultural dynamics will be considered as exemplified in the rise and effects of the civilizations of meso and South America. Data are provided primarily by the archaeological record.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Prerequisites: 101 or permission of the instructor.</td>
</tr>
<tr>
<td>70*</td>
<td>Ethnographic Field Methods</td>
<td>Traditional and recently developed approaches to ethnographic field work are explored. The problems the worker faces in the field, and possible solutions to them, are discussed. Some effort will be made to develop field technique in simulated and/or real field situations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Prerequisites: 102 or permission of the instructor.</td>
</tr>
</tbody>
</table>
Department of Sociology and Anthropology

Prerequisites: 101 or permission of the instructor.
Offered summer 1971.

380* Cross-Cultural Analysis
Examination of theory, method, and selected achievements of comparative studies. Classic and recent literature dealing with such topics as comparability of units will be considered and a joint study undertaken as a class project.
Prerequisites: 102 or permission of the instructor.

388* Applied Anthropology
The technical and ethical aspects of directed culture change will be examined.
Prerequisites: 370 or permission of the instructor.

390 or 391* Reading in Anthropology
Guided reading in a selected portion of the anthropological literature.
Prerequisites: Anthropology major and permission of the instructor.

401 Seminar in the Literature of Social and Cultural Anthropology
Prerequisites: 102 or permission of the instructor.

420* Social and Cultural Change
An analysis of contemporary thought on culture contact and cultural evolution. The concepts to be explored: integration, assimilation, conflict, nativistic reactions, general and specific evolution.
Prerequisites: Anthropology 350 or permission of the instructor.
Fall term.

450 Honours Seminar
Seminar on selected contemporary issues in anthropology. Open only to Honours Anthropology students.

460* Advanced Physical Anthropology
An examination of selected topics of current research interest in physical anthropology. Students will be encouraged to undertake guided research projects.
Prerequisites: Anthropology 260*, 360* and permission of the instructor.

499 Honours Essay
Directed reading and research in a selected area of anthropological inquiry. Open only to Honours Anthropology students.

Undergraduate Courses in Sociology

Note 1 General students who major in Sociology must elect the following courses: Sociology 101*, a half course in sociological methods, a half course in sociological theory, and three full courses (or equivalent half courses) in Sociology. Students are strongly encouraged to elect Sociology 202*, although this is not required.

Note 2 An Honours programme in Sociology is a pre-professional degree, so the specific requirements have been formulated in the light of professional and graduate school requirements. Students are reminded that Sociology is now accepted as a high school teaching subject in Ontario. Potential high school teachers should keep informed of the requirements for teaching Sociology in high schools.

Note 3 Interdisciplinary programmes linking Sociology and some other discipline are encouraged by the Department. In general, the following courses (or equivalents) in Sociology will be required of Honours students: a minimum of a half-course in Introductory Sociology, (e.g., 101*) a basic course in Statistics (e.g., 202*) a year's course in Methods of Research (e.g., 321*, 322*), a year's course in Social Theory and the Development
Sociology, plus an honours thesis course (e.g. 499). There are a number of joint Honours programmes, combining Sociology with other disciplines, e.g. Anthropology, Political Science, Psychology, Modern Languages and Literature, Philosophy, Mathematics, Canadian Studies etc.

Note 4 The student is reminded that an Honours or a major programme in Sociology is intended to provide a liberal arts education. Students are encouraged to avoid excessive concentration in Sociology, and to elect courses in a variety of social sciences, humanities, modern languages, as well as other Faculties.

**101* Introduction to Sociology**
An introduction to the basic concepts and frames of reference of Sociological investigation and interpretation. Topics for analysis will include communities, associations and institutions, classes and status groups, crowds and publics, social processes, and social change.

**200* Canadian Society in Comparative Perspective**
Analysis of Canadian society: its institutions such as family and religion, and social processes, such as integration, stratification and demography, with comparisons to other industrialized societies.

**202* Sociological Statistics**
A first course in sociological statistics; sampling, central tendency, probability, co-variance, as illustrated in specifically sociological data.

**205* Social Problems**
An examination of cultural forces that create social problems and failures in personal and institutional adjustments. Specific attention is paid to the problems of emotional disturbance, addictions, delinquency and crime.

**210* (Psychology 253*) Introductory Social Psychology**
The relation between psychological processes and social interaction. Topics to be considered include (1) how we evaluate others’ personalities, (2) determinants of friendship, (3) formation and change of attitudes, (4) conformity and independence, (5) the self-concept.

**212* Interpersonal Relations**
The contribution of social organization to interpersonal processes. Consideration of some “theories” of social interaction. The social system approach to the problem of personal and interpersonal control.

**215* Sociology of Women**
A comparative analysis of women’s roles in past and present with selected cross-cultural data. Assessment of the present situation: Subjective factors: socialization of women into "women's" roles, internalization of role expectations by women, perpetuation of stereotypes and symbolic expression of differential worth of men and women. Objective factors: the legal situation, women on the labor market, the "sex revolution", and the women's liberation movement.

**216* Sociology of Women**
Based on the facts elaborated in the first term, the second term will focus, first, upon the implications of the findings on selected areas of contemporary sociological theory and questions that need to be researched will be formulated. Secondly, alternative patterns of division of labor and family structure will be discussed and evaluation will be attempted.

**240* Collective Behaviour**
The sociological analysis of the behaviour of crowds, mobs, publics, and related phenomena and their relationships to social organization and social change.

**241* Social Movements**
The sociological analysis of varieties of social movements and their relationships to social organization and social change.
Department of Sociology and Anthropology

250* Crime and Society: An analysis and criticism of the major theories of criminal behaviour. Emphasis is given to the relationship between social structure and criminal behaviour; types of criminal behaviour such as drug addiction; statistics and contemporary research. A sound knowledge of sociological concepts is advisable.

251* Ethnic and Racial Relations: Relations between different racial and cultural groups; analysis of majority-minority group status.

252* Juvenile Delinquency: A systematic analysis and criticism is presented of biological, psychological, psychoanalytical and sociological theories of juvenile delinquency. Attention is given to statistics and contemporary research with special emphasis on the distribution and types of delinquent subcultures.

261* Population Issues: The study of population as an area of sociological investigation; population size, composition, and distribution; population trends and problems.

265* Social Structure of East Asia: China and Japan: An analysis of the social structure and stratification of East Asia in terms of class, status, prestige, rank, and function with especial consideration given to the question of class formation in Japan and attempted class elimination in China.

270* Communication: An analysis of the role of language and other symbol systems in social interaction; the interplay between communication and the social system, the formation of attitudes through language; social and individual disorders as caused by, and reflected in, the breakdown in the communication process.

280* Social Organization of Animal Societies: The social behaviour of various species of animals will be examined and compared. The main emphasis will be on exploring the nature of social behaviour and gaining further understanding of human societies by comparing them with others.

301* Urban Sociology: The comparative study of urbanization as a process; the culture and social organization of cities, urban problems; special attention is given to industrial cities of Western societies.

10* Seminar in Group Dynamics: An analysis of natural and experimental groups for a social structural view. The study of processes of differentiation, integration, power, etc., internally; and of nesting of small groups in larger collectivities.

Prerequisite: 3rd or 4th year standing in a social science or by permission.

311* Dehumanizing Institutions: A supposedly value-free social science cannot address itself to questions of the despoilment or enrichment of the human condition. Once values are taken as essential in human societies, reference to cultural or subcultural values facilitates evaluative analysis of social institutions and of interpersonal behaviour. Within a value frame of reference and with the analytic tools of behavioural science, this course seeks to explore the institutional origins, evolving social structures, and behavioural consequences of imperialism, slavery, racism, and total war.

Fall term.

2* Liberating Social Movements: Dehumanizing institutions are not infrequently undermined by countervailing forces. Peasant and slave revolts, socialism and anarchism, women's rights movements, and the labour movement have all been impelled by the hope of creating a new social order, a liberation from the coercive and dehumanizing institutions of the past. This course will examine the roots of these movements in the context of imperialism and industrialization and analyze their strategies for social change.
movements that indicate directions toward more humane social institutions. This course inquires into causes of success and failure of movements of social reconstruction by asking what structural constraints and facilitators were encountered by the movements, and what structural incongruities and dilemmas of action may have deflected men from their goals in the process of building new institutions.

Winter term.

315* Social Stratification
Analysis of social classes in society including their basis for development, composition, and consequences for society.

321* Research Methods 1
A systematic treatment of the logic and practice of methods basic to social research. Emphasis is on problems of research design based on the analysis of case studies. Special attention is given to problems of participant observation, use of available data, measurement of variables, and simple multivariate analysis. Students will be given laboratory and field experience in several techniques of research.
2 lectures, 2 hours lab., fall term.

322* Research Methods 2
Continuation of Research Methods 1. Includes an introduction to sampling, scaling, the analysis of change, and experimental design. Students will be asked to construct a research design for the study of a theoretically relevant problem in sociology.
Prerequisite: Sociology 321*
2 hour lab. Winter term.

323* Project in Sociological Research
Introduction to sociological research through the formulation of a theoretically based research objective and its implementation in a small scale team research project. Students must be willing to participate in team research with 6 - 8 other students. Readings are assigned that relate to the steps in the team project. The course grade is based on each team’s final project report and on a final examination covering the readings.
Laboratory 3 hours.

324* Field Research in Canadian Institutions.
A study of a selected institution in the local community, such as the Courts, Mass Media, and Labour Unions, will be conducted employing observational and interview procedures.
Permission of Instructor.

330* Comparative Social Structure
General theoretical and methodological issues facing comparative sociology; comparative methods at work in the treatment of Western and non-Western societies (including Canada).

331* Theories of Social Change
A systematic review and analysis of major theories of social change including some of the classical and modern theories. Analysis will focus upon the sources, patterns, processes and consequences of change. Special topics to be included are: Marxism, social change in developing countries, the role of ideas, and the breakdown and reorganization of social structure.

332* Social Conflict and Modernization
This course constitutes a sociological study of violent and nonviolent conflict and modernization in comparative perspective. A critical review of the selected theoretical explanations of collective protest and social change will be done to discover linkage between social conflict and modernization. An attempt will be made to examine causes and consequences of racial and political violence in modernizing society.
338* Sociology of Literature
This course attempts to provide the student with an opportunity for exploring literature as a social phenomenon. Specific areas to be dealt with might include: 1) the relationship of the artist to his social structure; 2) the nature of the relationship of the work and its audience; 3) the attitudes toward the social structure implicit in the work of art. In general the course is viewed as an attempt to combine both the scientific approach and the humanistic approach to literature. Here literature is viewed as including both belles lettres and popular culture. The course will be taught by someone in Sociology and someone in Literature in dialogue method.
Prerequisites: Sociology 101/102 and English 101 (or equivalent).

339* Industrial Sociology
Sociological analysis of industry, including relationships between labour and management and industry and society.

340* Formal Organizations
A survey of theory and research on formal organizations making use of selected contributions from the scientific management and human relations approaches, but with emphasis on the structure and functions of large scale organizations. The nature and types of formal organizations; control techniques and leadership; relations of the organization to its clients and publics; informal aspects of the organization; organizational tensions and pathologies of bureaucratic systems; how the organization adjusts to change.

341* Sociology of Occupations
The sociological study of occupations as an aid to understanding the social structure; social and demographic aspects of the labour force; the meaning of work; the relation of work and leisure; career and occupational mobility patterns; occupation and status; professionalization; trends in occupations.

350* Seminar in Socialization Processes
The social creation of Actors; the establishment of legitimacy and the development of loyalty; socialization through the life cycle; cohorts and age-grading; generational differences and youth movements.
Prerequisite: 3rd or 4th year standing in a social science or by permission.

355* Sociology of Religion
The analysis of religion as a social institution; its relationship to culture, personality and social change with consideration given to theories of religious behaviour and contemporary research findings.

360* Political Sociology
The sociological analysis of the institutionalization of power, political movements, parties, conflict and its accommodation.

365* Social Structure of the Soviet Union
A sociological analysis of contemporary Soviet society focusing on the patterns and functions of its basic institutions including the family, government, education, and industry; consideration of class formation and distribution of power.

382* Techniques of Demographic Analysis
Introduction to the standard techniques of analysis of enumeration and registration data.

400 Processes of Planned Change
The goal of the course is to develop models of social change, through active participation in action groups in the community, reading, seminars, and written analyses. All students will be expected to join a group oriented to altering or maintaining existing social structures, to participate as full members, and at the same time to make social scientific sense of social process as manifested in the group and its
402* Marxist Social Theory
This course will focus on the contribution of Marxism to the development of sociological theory in its relation to other types of social thought. Readings will include selections from Marx, Engels, Lenin, Gramsci, Plekhanov, Lukacs, and contemporary sources.
Prerequisites: 4th year Honours and Graduate students only.

425*-426* Sociological Theory
Major European and American sociologists and "schools" from Comte to the present. Emphasis will be less on history and biography than on the ideas and their application to an understanding of major issues generated in human societies. Limited to third and fourth year students majoring in sociology-anthropology, honours sociology-psychology (etc.) Others admitted by permission of instructor.

451* Seminar: Problems in Contemporary Theory and Research
Examinations of current frames of reference and theories in sociology and related disciplines. Their utility in sociological problem formulation and their test by current methods and techniques.

466*-467* Reading
Selected readings and essay assignments under the direction of a staff member.

470 Seminar: Praticum in Theory and Methodology
A preparation for advanced undergraduate students for an independent, sophisticated orientation to graduate study. The practicum provides opportunities for:
(1) developing research designs on the basis of extant theory, and
(2) theorizing on the basics of the reanalysis and reinterpretation extant data.

480* Advanced Social Statistics
Multiple and partial correlation; regression; analysis of variance and covariance; selected non-parametric techniques.
Prerequisite: Sociology 202* or equivalent.

481* Mathematical Sociology
Selected mathematical techniques with applications to sociology; sets and graphs, Markov chains and game theory.
Prerequisite: Permission of instructor.

499 Senior Honours Essay
Required of all honours students in Sociology or by election by joint honours students in their fourth year.

The following courses are administered by Conrad Grebel College

207* G Educational Sociology
This course is designed for co-op and regular students who plan to enter the teaching field. Attention will be focused on the concepts and theories of sociology as they apply especially to the educational system.
Winter Term.

230* G Family and Kinship
An evaluation of the origin and growth of the family as a social institution; its structures and functions in primitive and modern societies; the effect of modern technology on the family, trends and contemporary problems.

90G Utopian Communities Past and Present
An examination of intentional communities; extinct and contemporary. Attention will be paid to origin, purpose, structure and process in each community studied. An assessment of factors contributing to success and failure will be attempted.
Department of Sociology and Anthropology

The following courses are administered by Renison College

220*R Sociological Analysis
Sociological Analysis. Applying sociological analysis to three selected areas: the major institutions of Education, Religion and Law, and developing a pattern and an approach which could be applied to the study of other social areas.

221*R Trends in Modern Society
Master Trends in Modern Society. Introducing the student to the main ideas of urban, industrial and political sociology studied within a framework emphasizing social change; illustrations will be drawn from emergent as well as advanced societies.

The following courses are administered by St. Jerome's College

232J The Family and Society
An analysis of the family as a universal institution. The role of the family as the basic unit of social organization in all human societies. The biological basis of the family as the foundation for its universality. Courtship, mate selection and the institution of marriage will be cross culturally examined, along with a brief overview of human sexuality and the role of sex in marriage and family stability.
Prerequisite: Sociology 101 or permission of the Instructor.
Three hours per week. Year Course.

238*J Caribbean Society (See The Department of Sociology of the University of Waterloo offers Anthropology 238) graduate training leading to the Master of Arts and Doctor of Philosophy degrees in Sociology. The programme is primarily oriented towards a preparation for research and an academic career in Sociology.

Admission Requirements
For Graduate work in Sociology a student must have at least an Honours Degree in Sociology or its equivalent, a B average or its equivalent in Sociological course work and an acceptable average in other courses. He must also submit his results from the Graduate Record Examination. Applicants will not be considered unless they submit this complete information for evaluation. Deadline for applications is April 1.
Students who do not meet these standards for graduate work in Sociology may, with the approval of the Graduate Committee of the Department, be admitted to a programme of qualifying work.

All students must enrol for an initial year of work in Sociology.

Course Requirements:
a) Two semester courses in Sociological Theory
b) Two semester courses in Research Methods
c) Two semester courses in a substantive area. The student may, with the approval of the instructor, substitute tutorials for course work.
d) In addition the student must complete a course in Introductory Statistics unless he can otherwise demonstrate proficiency.

Qualifying Examination
All students must sit for a written Qualifying Examination no later than six months after completion of the course requirements. The examination will cover three fields: (a) Sociological Theory, (b) Sociology Research Methods, and (c) an area of specialization. Successful students in the Qualifying Examinations may proceed towards the M.A. degree or the Ph.D. degree. This is a decision of the Graduate Committee of the Department. A failing student may retake the Qualifying Examination
Master of Arts Degree in Sociology

M.A. Thesis.
A Thesis Committee consisting of two faculty members (one of whom will serve as chairman) selected in consultation with and acceptable to the student will supervise the student's thesis. The Thesis Committee will select a departmental reader in addition to the readers who supervise the thesis.

a) Students who proceed towards the M.A. degree must submit a thesis proposal no later than three months after successful completion of the Qualifying Examination. The thesis topic will be largely a matter of the student's choice. The proposal will contain a statement of the problem, its relationship to a body of sociological theory and a statement of the research techniques to be used.

b) The student must give an oral defense of the thesis. Normally not more than two years are needed to complete all requirements for the M.A. degree.

Doctor of Philosophy Degree in Sociology. Admission Requirements

Entrance requirements for the Ph.D. degree in Sociology are an M.A. degree in Sociology or its equivalent, a B average or its equivalent in course work. The student must submit his results from the Graduate Record Examination.

Requirements
a) the student for the Ph.D. degree, in consultation with his adviser, is required to enrol for a minimum of six semester courses in Sociology. Transfer students must satisfy Departmental requirements of competence in Sociological Theory and Research Methods.

b) At any time the student may, with the approval of the instructor, substitute a tutorial instead of course work in his special field.

c) The student must enrol for a one semester course in Intermediate Statistics unless he can otherwise demonstrate proficiency.

d) The student whose Ph.D. dissertation requires familiarity with a subject not normally given in the Department of Sociology is encouraged to elect additional work in the appropriate department.

e) The student must demonstrate reading proficiency in a language other than English. Canadian students are strongly encouraged to read French.

f) Having completed all prior requirements, and before submitting a dissertation proposal, the student must sit for a written Comprehensive Examination. Successful completion of the Comprehensive Examination entitles the student to Candidacy for the Ph.D. degree.

g) The candidate must submit a proposal for the Ph.D. dissertation no later than six months after having been admitted to candidacy for the Ph.D. degree.

h) The candidate must give an oral defense of his dissertation. Normally no more than four years beyond the B.A. are needed to complete all requirements for the Ph.D. degree.

Note The student must maintain a B average throughout his course work. A review is made of the student's work at the end of his first year in the Ph.D. programme.

Graduate Courses

(These courses may be available as tutorials when not available as seminars.)
500* Modern European Social Theory
Discussion and reports on leading social thinkers and the development of a systematic body of knowledge about social life. Special emphasis will be given to the emergence of sociological thought from the turn of the century to the period between the two World Wars. Topics will include: Durkheim and the French Sociological Tradition; Max Weber and German Interpretative Sociology; Pareto and Machiavellian Social Theory; Marx and Historical Materialism; trends in contemporary existential social philosophy.
(Open also to fourth year honours Sociology students.)

507* The Sociological Imagination
C. Wright Mills viewed the link between private troubles and public issues as the mainspring to a proper science of society. This seminar seeks to assess Mills' writings and the contributions of other sociologists within this perspective.
(Open to fourth year Sociology honours students.)

508* Explanation in Sociology
The writings of sociologists will be studied with a view to identifying among them actual or potential explanatory models and such tests of the theories as may have been devised. Where no testing of theory has been undertaken students are asked to specify possible approaches.
(Open to fourth year Sociology honours students.)

542* Seminar: Organizational Analysis
This seminar will study diverse theories, models and methods, and interdisciplinary approaches relevant to the analysis of complex organizations, such as industrial enterprises, public and governmental organizations, educational institutions, etc. Particular attention will be given to problems of productivity and organizational effectiveness, power and human relations, decision-making, innovation, and resistance to change.
(Open to fourth year sociology honours students who have successfully completed course 339 in Industrial Sociology.)

603* Sociological Theory
A stock-taking of the present fund of conceptual equipment for handling distinctively social phenomena, with proposals for its refinement for purposes of measurement.

604* Selected Problems in Sociological Theory
Relation of Social Theory to specific problems of sociological analysis.

605* Sociological Methods
An examination of the techniques used in theoretically oriented research: these include gathering, processing and analyzing qualitative and quantitative data, field methods, use of documents, laboratory observation and punched-card techniques. Problems of statistical inference, causality and measurement are discussed.

606* Selected Problems in Sociological Research Method
Analysis of selected research procedures with special attention to the types of research problems to which they are applicable and research designs within which they are most effectively incorporated. Examination of ways in which effective use of these procedures can contribute to conceptual and theoretical development in sociology.

611* Theories of Social Change
A systematic review and analysis of major theories of social change. Theoretical problems are examined within a specific context such as social organization, economic institutions, social stratification, and urban structures.
612* Demographic Variates in Social Change
An interpretation of social change from the demographic perspective; this includes an outline of demographic analysis.

615* Social Stratification
This course will deal with class, status, and power groups in an industrial society as they strive to maximize their share of wealth, prestige, and power. Occupational structures of modern societies will be examined.

620* Comparative Social Structure
The course is devoted to the comparative study of selected Western and non-Western societies in relation to their institutions, structures, value systems, changes and interactions.

625* Socialization and Social Structure
Comparison of childhood socialization in family settings with socialization in formally organized settings, such as Kibbutzim. Analysis of socialization in adolescent and young adulthood focuses on the interplay of the family, educational, and political institutions in occupational placement. North America is compared with England, Russia and Japan.

631* Sociology of Knowledge
On the basis of a thoroughgoing analysis of Mannheim's Ideology and Utopia and related studies, the seminar undertakes to develop a general theory of the relation of social thought to social action, comparative value systems and the role of the scientist, artist and intellectual in his society.
(Open to fourth year honours students who have completed Sociology 500.)

632* Sociology of Science
The study of science as an institution; its historical development and contemporary relationships with other institutions including government, education and industry.

636* Sociology of Deviance
The seminar undertakes a critical examination of the major theoretical perspectives in the sociology of deviance.

637* Selected Problems in the Sociology of Deviance
A seminar in theory and research in the sociology of deviance; special emphasis is given the fields of crime and delinquency.

643* Industrial Society
Selected topics in the sociological analysis of industrialized societies.

644* Sociology of Developing Nations
An analysis of the structural and processual aspects of modernization occurring in developing nations with emphasis upon a specific area (e.g. Africa, or Latin America, or Middle East) depending on the instructor.

645* Community Power Structures
An analysis of the theoretical and selected empirical, sociological studies of community power structures and their practical implications. The sociological material will be supplemented with relevant contributions from the fields of anthropology and political science.

650* Sociology of Religion
Religion is considered as an activity generated by the social process itself. The significance of its recoil and attempted recovery in secular society is considered, as well as the encounter in the forum of secular society of the different faiths.

655* Family and Kinship
Family and kinship are viewed as the rudimentary structures of society from which other structures differentiate. They are shown to persist in modern society as a reinforcement structure beneath the specialized institutions.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>660*</td>
<td>The Bases of Community</td>
<td>Community is considered as an affinity bond rather than place (Durkeim's &quot;mechanical solidarity&quot;; Toennies' Gemeinschaft&quot;). The competitive strengths of the following in generating community are considered: kingship, territory, language, race, class and faith.</td>
</tr>
<tr>
<td>666* 667*</td>
<td>Graduate Readings in Sociology</td>
<td>Selected readings in a specific topic, including the preparation of a research paper under the supervision of a faculty member.</td>
</tr>
<tr>
<td>670*</td>
<td>Social Psychology</td>
<td>A seminar dealing with theoretical issues and research findings in the area of social psychology.</td>
</tr>
<tr>
<td>699</td>
<td>Thesis</td>
<td></td>
</tr>
</tbody>
</table>
Department of Systems Design

Professor and Chairman
H.K. Kesavan, B.Sc., B.E.(Mysore), M.S.(Illinois), Ph.D (Michigan State)
Professor
T.M. Fraser, M.D., Ch.B. (Edinburgh, M.Sc. Ohio State), L.M.C.C., F.A.C.P.M.
Professor
V.K. Handa, B.Sc. (Calcutta), B.Sc. (Eng.) (London), M.Sc. (Queen's), M.Sc., Ph.D. (Waterloo)
Professor
P.H. O'N.Roe, B.A.Sc. (Toronto), M.Sc., Ph.D. (Waterloo)
Professor
G.N. Soulis, B.A.Sc. (Toronto)
Associate Professor
M.L. Constant, B.A.Sc. (Toronto)
Associate Professor
R.N. Howard, B.Sc. (London), Ph.D. (London)
Associate Professor
P.L. Seeley, B.A.Sc. (Toronto)
Assistant Professor
Assistant Professor
P.H. Meincke, B.Sc. (Manitoba)
Assistant Professor
Assistant Professor
D.D. Schleiermacher, Diploma (Technische Hochschule, Munich), Diploma (Hochschule für Gestaltung, Ulm)
Assistant Professor
S. Toida, B.S. (U. of Tokyo), M.S., Ph.D. (Illinois)
Assistant Professor
B.L. Wills B.A.Sc., M.A.Sc., Ph.D. (Waterloo)
Lecturer
C.K.G. Hahn, M.A.Sc. (Waterloo)
Lecturer
D.G. McGeary, B.Sc. (Manitoba), M.A.Sc.(Waterloo)

Associate Faculty
Professor
D.J. Clough, B.A.Sc. (Toronto), M.B.A. (Toronto)
Associate Professor
W.C. Lennox, B.A.Sc., M.Sc. (Waterloo), Ph.D. (LeHigh)
Visiting Professor
D.C. Fraser, B.Sc. (Glasgow), M.Sc. (Cantab), M.A., Ph.D. (Edinburgh).

Undergraduate Courses

110 Calculus 1 Functions and limits, the derivative, Differentiation formulae,

112 Finite Mathematics Symbolic logic, set theory, permutations combinations, discrete probability theory.

113 Linear Algebra Vectors and matrices, vector spaces, determinants, matrix algebra, linear dependence, linear equations, linear inequalities, linear transformations.

114 Design of Experiments Principles of scientific method, experimental procedures, experimental controls, hypothesis testing, inference, null hypothesis, random sampling, bivalent and multivalent experiments, types of error, scaling, probability distributions, measures of central tendency and scatter, tests of significance, treatment of functional data, experimental design methods, deduction, induction and operational concepts.

120 Digital Computation 1 Introduction to electronic digital computers; hardware and software organization, basic features of Fortran examples of efficient algorithms for engineering computation, computing problems.
Department of Systems Design

130 Engineering Economics
Cost-benefit analysis, critical path methods, interest, project economics, decision making, utility theory, project organizational theory.

150 Physics 1
151 Physics 2
Vectors, rectilinear motion, plane motion, dynamics of particles, work and energy, linear momentum, rotational motion, statics, angular momentum, harmonic motion, gravitation, wave motion, sound waves.

160 Engineering Synthesis
An introductory course on the principles of engineering design culminating in a project involving the solution of a relevant need. Specific topics introduced are: The systems approach, principles of planning, the statement of a design problem and the flow of information. Innovation and the creation of design solutions physical, economic and financial feasibility, solution evaluation and selection. Finally, value and utility, simulation, modelling and optimization.

215 Theory and Applications of Probability
Probabilities as measures on sets; random variables and probability distributions; transformations of random variables. Applications in physics, operations research and engineering (e.g., queuing theory, reliability theory).

216 Theory and Applications of Statistics
Sample statistics as random variables; statistical models; limit theorems; inference. Applications in operations research and engineering (e.g., design of industrial experiments, sample surveys).

217 Differential Equations

231 Micro-Economic Analysis and Policy
Analysis of public and private choices among users of scarce resources. The interaction of choices to form micro systems. Examples of policy questions: costs and benefits of alternative methods of pollution control, pricing of private and public goods.

241 Human Systems Engineering 1
The structure and function of man in relation to systems design; the relationship of biology and human physiology to engineering; biology concepts, biological variation; the cell as a micro-system man as a complex of systems and subsystems.

242 Human Systems Engineering 2
The attributes, assets and liabilities of man within a man-machine system; man’s characteristics as a component of a system; the man-machine interface; display of information; problems of controls; workplace layout; human factors in systems design.

251 Physical Systems 1
Component models, interconnection models, system equations and their rank properties and solutions. These concepts are developed with respect to electrical systems.

261 Systems Design Workshop 1
262 Systems Design Workshop 2
A problem oriented course wherein the emphasis is placed on designing and presenting creative solutions to currently relevant real-life problems. The graded selection of minor, medium and major problems are intended to cover all disciplines to which the student becomes exposed each year. The concept and form of multi-media input will be continued in each succeeding workshop while the output is expected to increase in sophistication and complexity in accordance with the student’s progress.
322 Computer Simulation of Systems
System modelling discrete and continuous system models; system simulation techniques, digital computer methods, fundamentals of analog computation, time and magnitude scaling; analog computer simulation methods; digital simulation of analog computers; block oriented languages; advantages and disadvantages of digital and analog simulation techniques, introduction to system simulation using hybrid computers.

323 Computer Aided Design
The design process; factors influencing design, phases of design; the role of analysis, optimization; computer oriented system models; simulation languages for digital computers; problem oriented computer languages; man-machine interaction, interaction in the design process; graphic input-output, time-sharing, conversational mode language design of problem-oriented computer languages.

332 Statistical Models for Socio-Economic Systems
Applications of econometric models, regression analysis, factor analysis, statistical decision theory, and other methods and models for the policy analysis of socio-economic systems. Selected references will be assigned.

334 Elements of Operations Research Techniques
Survey course in concepts of operations research; mathematical modelling of production, transportation, and other systems, employing queuing theory, mathematical programming and other techniques.

336 Conflict Analysis
The application for non-quantitative game theory to the analysis of conflicts, particularly conflicts arising in the implementation of design projects, the general characteristics (through metagame theory) and specific applied techniques for analyzing conflicts between parties each with separate objectives.

43 Human Systems Engineering
Problems of man within a man-machine environmental complex; the nature of human environmental stress; problems arising in association with environmental hazards.

352 Physical Systems 2
The subject matter is similar to 251 except that the development is based on other physical systems such as structural and hydraulic systems.

63 Systems Design Workshop 3
A problem oriented course wherein the emphasis is placed on designing and presenting creative solutions to currently relevant real-life problems. The graded selection of minor, medium and major problems are intended to cover all disciplines to which the student becomes exposed each year. The concept and form of multi-media input will be continued in each succeeding workshop while the output is expected to increase in sophistication and complexity in accordance with the student’s progress through the course.

371 Communications 1
Study of human and machine communication processes, communication theories as applied to education. Design of communication systems including languages and messages.

372 Communications 2
A continuation of 371 with special emphasis on the theories of persuasion and coercion. The design of complex systems which imply a need for individual and social change will be studied.

381 Applied Electronics
Component models of various electronic devices, oscillation, amplification, modulation, detection, application to instrumentation.

414 Optimization Theory
Mathematical Programming (linear, integer, non-linear and quadratic
### 433 Macro-Economics and Public Policy

The functioning of National and Regional economics. The relation between the behaviour of classes of decision-making units and the performance of the economic system. Examples of policy questions: cost and benefits of alternative methods of attaining price stability. Full employment and economic growth.

### 444 Human Systems Engineering

Human aspects in design of a specific operational systems, e.g. urban system, ground transportation system, air transportation system, etc. A specific system will be examined each time the course is presented.

### 453 Physical Systems

A study of multiparameter sensitivity analysis and probabilistic system analysis, with special reference to physical systems.

### 465 Systems Design Workshop

A selection of open-ended design problems and seminars designed for final year undergraduate students.

### 466 Systems Design Workshop

A selection of open-ended design problems and seminars designed for final year undergraduate students.

### 501 Human Factors

Man-machine systems; man-machine interface; presentation of information; design of displays and controls; workplace, layout, human factors in design.

### 502 Ergonomics

Significance of ergonomics; man-machine-environment complex; physiology of work, fatigue, and boredom; environmental factors in industry (noise, vibration, vision, illumination, heat, cold, toxic chemicals, radiation); industrial, and automotive safety.

## Graduate and Research Programme

The Department of Systems Design offers post-graduate programmes leading to the degrees of Master of Applied Science (M.A.Sc.) and Doctor of Philosophy (Ph.D.).

These programmes are founded upon the belief that the need for broadly educated individuals who are capable of solving interdisciplinary problems can be met uniquely by a programme which combines the philosophy of design with the discipline of system theory. These two fields of study form the core of a curriculum which is designed to prepare students not only for industry but for research work in such areas as transportation systems, electronic control, process control, water resources systems, computer aided design, etc.

The post-graduate programmes consist of research and project work under the direction of faculty members from the department, Department of Systems Design course work, and electives from other departments. In addition, the student, through the Industrial Research Institute, is provided with the opportunity for work and contact with a varied group of professional consultants who have backgrounds in areas germane to his studies.

At present research is being carried forward within the department in the following general areas:

- **Communications**, including **Computer Graphics**.
- **Computer-Aided Design**
- **Conflict Analysis**
- **Design Methodology and Morphology**
- **Human Systems Engineering**
Master's Degree Programmes

The Master's degree programmes in the Department of Systems Design are open to candidates who have demonstrated excellence in the completion of studies toward the Bachelor's degree at a recognized university. Because of the breadth of the scope of research within the department it is not necessary that this prior work be within Engineering; candidates with degree in areas such as Commerce, Communication, Economics, Mathematics and Computer Science, or Sociology may be admitted. Qualifying work is however, required of those students who do not have a background in Mathematics or the Science related to Engineering.

The objective of the Masters degree programme in Systems Design is to demonstrate individual accomplishment of a high professional and academic standard. The candidate, with the approval of his advisor, may elect to submit either a research thesis as a portion of requirements, or an engineering project report of a professional calibre on a design or theoretical application problem.

The complete programme submitted for the M.A.Sc. degree consist of at least five one term post-graduate courses together with a thesis, or at least eight one term post-graduate courses and an engineering project. Suitable courses offered by other departments, chosen with the advice of the student's advisor, form a part of the programme, as appropriate.

The Ph.D. Degree Programme

The primary objective of the Ph.D. programme is the accomplishment of independent and original research work and reporting thereon in a research thesis. The subsidiary requirements are completion of a suitable course-work programme passing a comprehensive examination, demonstration of reading knowledge of a foreign language, and receiving a satisfactory review by a supervising committee. All of these must be construed as contributing to the competent performance of the research objective.

Admission to the Ph.D. programme is based upon the student's academic record and evidence of ability to pursue independent research.

No candidate will be admitted to the Ph.D. programme before a faculty advisor willing to supervise the candidate's research is appointed. The Ph.D. programme in Systems Design generally requires at least three years beyond the Master's degree to complete.

Graduate Courses

Courses numbered in the 600's are given on a regular basis.
Courses numbered in the 700's are offered as and when required.

610 Linear Graph Theory

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>611</td>
<td>Applications of Linear Graph Theory</td>
<td>Topological formulas for general linear systems, synthesis of communication nets, system diagnosis. Applications to switching theory, sociology, economics, etc.</td>
</tr>
<tr>
<td>622</td>
<td>Introduction to Computer-aided Design</td>
<td>The design process, factors influencing design, phases of design, the role of analysis, optimization; the role of a model in design types of models, computer models, simulation languages; computer-implemented methods of analysis, problem-oriented languages; man-machine interface studies, developments in graphic input-output, time-sharing conversational mode languages.</td>
</tr>
<tr>
<td>631</td>
<td>Games, Metagmes and Rationality</td>
<td>The theory of games and metagames is seen as the general mathematical theory of interactions between conscious “political” decision-makers. Wars, crises, negotiations and economic problems are seen as fields of application for this theory. The paradoxes and “dilemmas” of game theory are seen as leading to a breakdown of the concept of “rational” behaviour, and a positive approach, tested by experiments, is introduced as leading to useful applications to real-world problems.</td>
</tr>
<tr>
<td>632</td>
<td>Applied Metagame Theory</td>
<td>Recently developed techniques for modelling real world conflicts as “games” are taught in a practical manner, illustrated with examples of actual applications. Practice in the techniques is obtained through project work. At the same time, mathematical explorations of the rationale behind the techniques is carried far enough to give the student a sound, non-mechanical understanding of their significance and limitations.</td>
</tr>
<tr>
<td>642</td>
<td>Human Function 1</td>
<td>Extensive reading in the fields of human physiology and psychology; seminars and discussions in relation to assigned material; lectures and presentations on human environmental physiology, e.g., high altitude, underwater, sustained acceleration, or other pertinent topics. (Deferred grade will be given to those proceeding to SD643.)</td>
</tr>
<tr>
<td>643</td>
<td>Human Function 2</td>
<td>Extension of SD 642; continued reading in human physiology and psychology, continued seminars; lectures and presentations on human physiology, e.g., sound and noise, heat and cold, impact acceleration, restrictive confinement, or other pertinent topics. Prerequisite: SD642.</td>
</tr>
<tr>
<td>652</td>
<td>System Theory 2</td>
<td>A continuation and generalization of SD651. Formulation of state models for discrete systems. Introduction to time domain sensitivity models.</td>
</tr>
<tr>
<td>668</td>
<td>Design Morphology and Organization</td>
<td>Generation of problem statements, system identification, generation of solution sets, feasibility determination. Construction of archetypes; sensitivity, compatibility and stability analysis; behaviour prediction and solution communication.</td>
</tr>
</tbody>
</table>
671 Theory of Human Communications

680 Introduction to Decision, Value and Utility Theories
Problems of decisions, values and utility, basic models, decision-making to an individual, to a statistician, in certainty, risk and uncertainty. Models for preference analysis, utility theories, dominance in strategies. Classical and Bayesian statistical decision theory. Sequential and Markovian decision making problems. Decision-making in games.

685 Optimal Control Theory
Optimization problems through variational methods and mathematical programming. Optimal control for discrete time and continuous time systems. Maximum principle with equality and inequality constraints, feedback control, linear systems with quadratic criteria, the stochastic optimal control problem.
School of Urban and Regional Planning

Professor and Director of the School
L.O. Gertler, B.A. (Queen's), M.A. (Toronto), Planning (McGill), M.T.P.I.C.

Professor
H. Abell, (Miss), B.H.Sc. (spec.) (Toronto) M.Sc., Ph.D. (Cornell)

†Professor and Dean of the Division
P.H. Nash, B.A., M.A. (California); C.E. (Grenoble); M.C.P., M.P.A., Ph.D. (Harvard), A.I.P.

Visiting Professor
E.A. Beecroft, B.A., M.A. (Toronto), Ph.D. (Yale)

†Professor and Associate Dean
R.S. Dorney, B.Sc., M.Sc., Ph.D. (Wisconsin)

(Graduate Studies)

Professor
H. Abell, (Miss), B.H.Sc. (spec.) (Toronto) M.Sc., Ph.D. (Cornell)

†Associate Professor
J.T. Horton, B.A. (Wheaton), M.A. (Northwestern)

Associate Professor

Associate Professor
K.S. Sayegh, B.Sc. (Cairo), M.C.P., Ph.D. (Harvard)

†Associate Professor
W. Shalinsky, B.A., B.S.W. (McGill) M.Sc. (Western Reserve) D.S.W. (Western Reserve)

Assistant Professor
T.L. Burton, B.Sc. (London), Ph.D. (London)

Assistant Professor
L.R.G. Martin, B.A. (Queen's), M.A., M.R.P., Ph.D. (Syracuse)

†Assistant Professor
G. Priddle, B.A. (Western), M.A. (Clark)

†Assistant Professor
K.E. Rawling, (Miss), A.B. (Catawba College)

Assistant Professor
J.B. Theberge, B.Sc.A. (Guelph), M.Sc. (Toronto)

Assistant Professor
M.G. George, B.Sc. (Mysore), M.Sc. (Bombay), Ph.D. (Delhi)

Assistant Professor
L.R.G. Martin, B.A. (Queen's), M.A., M.R.P., Ph.D. (Syracuse)

†Assistant Professor
G. Priddle, B.A. (Western), M.A. (Clark)

†Assistant Professor
K.E. Rawling, (Miss), A.B. (Catawba College)

Lecturer
S. Herzog, B.Arch. (Toronto)

Lecturer
C.M. Kitchen, B.A. (Queen's), M.A. (Waterloo)

†Divisional appointments: Faculty members appointed also in other Schools or Departments in the Division of Environmental Studies

Bachelor of Environmental Studies, Honours Urban and Regional Planning
The Honours Planning Programme as indicated on page 90, is the recommended pattern of courses. The programme for each student will be worked out in consultation with the School.

Graduate Programmes, Regional Planning and Resource Development
The School offers M.A. and Ph.D. Degrees in Regional Planning and Resource Development. The general requirements, with respect to admission and standards, for these programmes are outlined on page 164. For more specific information, you may obtain the Division's brochure on graduate programmes, from Mrs. Helen Bensusan, Administrative Assistant, Division of Environmental Studies.

Note 1 Students in other disciplines may select from Planning 156* and Planning 342*/343*. Entrance to other Planning Courses requires consent of instructor.

Note 2 Not all the courses listed below are offered each year. Students should consult the School prior to registration.

Note 3 Course numbers followed by an asterisk (e.g., 156*) are half-year courses.

Note 4 The number of hours of lectures shown after the course description is an attempt to indicate the “normal”; each instructor determines how often his particular class will meet.

Note 5 Planning 156* is offered in the Fall term for Honours Planning students only, and in the Winter term for students other than Honours Planning.
### Undergraduate Planning Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Prerequisites</th>
<th>Credits</th>
</tr>
</thead>
</table>
| 156*        | Introduction to Urban and Regional Planning Concepts | Planning concepts and principles; the development of contemporary planning ideas; the nature, purpose and scope of urban and regional planning; the planning process and decision making in a democratic society.  

*No prerequisite.  
2 hours lecture and one-hour discussion session, (fall term for Honours Planning only. Winter for non-Planning students.) |
| 157*        | Introduction to Urban and Regional Planning Techniques | Introduction to techniques and methodologies employed in the Planning Process; from goals and objectives formulation to implementation with emphasis placed upon survey, analysis and synthesis.  

*Prerequisite: Planning 156* or consent of instructor.  
One 2 hour lecture and 2 hours studio, (winter term) |
| 200*        | Principles of Biogeography and Ecology            | Principles of plant and animal geography, biogeography and ecology.  

*Prerequisite: Honours Geography or Honours Planning, or consent of instructor.  
3 hours lecture, 2 hours lab. (fall term). |
| 222*        | Canadian Regional Issues                          | Selective study of Canadian development issues pertaining to the use of land, urbanization, regional and resource development; issues will be related to the structural and functional forces that are characteristic of the major regions of Canada, e.g., Atlantic Provinces, British Columbia.  

*Prerequisite: Planning 156*/157* or Geography 101*/102*.  
Honours Planning students only.  
3 hours lecture, (fall term). |
| 255*        | Planning Surveys and Analysis                     | Sources of data for Planning and their analysis. The course will emphasize the sources and methods of collection of rural and urban land-use data. Particular attention will be paid to the types of land-use information essential to transportation, housing and recreation planning.  
The setting up of regional and urban land-use data banks will also be outlined. A series of laboratory sessions will be conducted on land-use sources and methods of data collection.  

*Prerequisite: Planning 156*/157*, or consent of instructor.  
2 hours lecture, 2 hours studio. (fall term) |
| 256         | Principles of Environmental Design                | Design Concepts in urban and regional planning, illustrated by recent work; integration of aesthetic and functional elements in regional environments; individual and group projects in planning design, using graphic, model, film and verbal presentation.  

*Prerequisite: Planning 156*/157*, or consent of instructor.  
Honours Planning students only.  
2 hours lecture, 2 hours studio. |
| 271*        | Introduction to Quantitative Research Methods     | An introduction to scientific method; descriptive and inferential statistics; computer programmes. This course is the same as Geography 271*.  

*Prerequisite: Only for students in Planning, and General or Honours Geography, Man-Environment or Architecture.  
2 hours lecture, 2 hours lab (fall and winter terms) |
| 307*        | Social Survey Techniques                          | Social research and the planning process; interview and self-administered surveys; questionnaire design; profile data; sampling; data processing.  

2 hours lecture, 2 hours lab (fall and winter terms) |
school of urban and regional planning

prerequisite: planning 271*; may be taken in 2nd or 3rd year.
2 hours lecture, 1 hour practical or discussion (winter term)

314 urban society
an exploration of the economic, technological and social factors which underlie the planning for urban areas and the location and distribution of urban settlements. the course will stress comparative analysis of urban behaviour and its reflection in urban physical forms among various cultures in both economically developed and underdeveloped regions.
prerequisite: sociology 101*/102* or consent of instructor.
3 hours lecture (winter term)

316 multivariate statistics (616*)
the theory and application of multivariate statistics, with particular emphasis upon the use of the computer.
prerequisite: planning 271*
3 hours seminar and/or tutorial (fall term)

317* nonparametric statistics (617*)
the theory and application of non-parametric statistics with emphasis upon social science problems.
prerequisite: planning 271*
2 hours lecture, 1 hour practical (winter term)

318* spatial analysis (618*)
advanced quantitative analysis of spatial patterns and interactions. the course will focus on a selection of techniques from gravity models, linear programming, nearest neighbour analysis, markov chain analysis, graph theory, simulation and trend surface analysis.
prerequisite: planning 271* or consent of instructor.
3 hours lecture (winter term)

319* regional planning techniques (619*)
application of economic and social measurement techniques in regional planning; includes discussion of input-output analysis; regional accounting techniques; cost-benefit analysis; planning, programming and budgeting systems; the multiplier and accelerator concepts; and balance of payments.
prerequisite: planning 271* or consent of instructor
3 hours seminar and/or tutorial (fall term)

332* the sociology of regions
basic concepts of sociology; occupational and concomitant social adjustments of rural society in response to forces of urbanization and industrialization; social movements generated within the farm population.
prerequisite: sociology 101*/102* or consent of instructor.
3 hours lecture (fall term)

333* the sociology of regional planning
power structures, basic social institutions, attitudes and values related to the implementation of regional plans; regional development of human and natural resources in canada and abroad.
prerequisite: planning 332* or consent of instructor.
3 hours lecture (winter term)

342* urban, regional and resource planning: a survey of the field (part 1)
the classic theories and concepts in planning and their evolution from howard and geddes to blumenfeld; the planning process and its application at the various levels—from neighbourhood to nation—in relation to one another; basic data and their procurement and utilization in planning.
Note  Planning 342* is designed particularly for students in disciplines other than Planning.

343* Urban, Regional and Resource Planning: A Survey of the Field (Part 2)
The physical structure of the city and its socio-cultural bases; private and public roles in urban development and their powers and implements; physical plans in relation to social programmes and policies; case studies in urban and regional planning.
Prerequisite: 156*, 342* or consent of instructor.
3 hours lecture (winter term—normally this course will follow Planning 342*).

Note  Planning 343* is designed particularly for students in disciplines other than Planning.

344* Principles of Recreational Planning
An exploration of the nature and functions of recreation in modern urban-industrial societies and an analysis of alternative approaches to the planning of recreation opportunities in urban-centred regions. The course will include a discussion of the demand for and supply of recreation opportunities; standards, models and systems; recreation planning policies and agencies; and selected recreation planning issues.
Prerequisite: two of Planning 156*, 157* and Geography 101*, 102*, or consent of instructor.
3 lectures (winter term)

357* Conservation and Resource Development
History of the conservation movement; principles of conservation management and development of resources. Analysis, use and planning of recreational resources. This course is the same as Geography 357*.
Prerequisite: Planning 200* or consent of instructor. Honours Planning or Honours Geography students only.
2 hours lecture. (winter term—normally this course will follow Planning 200*).

358* Regional Planning and Development
The relationship of economic planning to regional planning; principles of planning and development in urban-centred, broad economic and frontier regions; Canadian and international case studies; study of Canadian agencies such as A.R.D.A., and A.P.E.C., research projects.
Prerequisite: Planning 255* or consent of instructor.
2 hours lecture, 2 hours studio (fall term).

411* Field Research Methods and Projects
A variety of field experiences; camp session; preparatory assignments, and follow-up seminars with presentation of research papers.
Prerequisite: Honours Planning students only.
2 hours seminar (fall term and winter).

414* Housing Policies
The course will focus on Canadian housing policies and programmes particularly with regard to the housing of low and moderate income families. Economic, political, physical and social considerations underlying these policies will be examined in detail. Some consideration will also be given to the housing problems and programmes in the United States and developing countries.
Prerequisite: Planning 156*/157*, Planning 255*, Planning 256, or consent of instructor.
3 hours lecture (fall term).

415* The Small Group in the Planning Process
This course will study the small group and its relevance to the planning process. The focus will be on work groups such as committees, councils, etc.

be examined and related to planning.

Prerequisite: Consent of instructor.
3 hours lecture (winter term)

456 Political and Administrative Processes in Urban and Regional Planning

Historical development of planning legislation in various parts of the world; the provincial and federal legislation affecting urban, regional and resource planning in Canada; the jurisdiction of provincial bodies and agencies.

Prerequisite: One course in Political Science or consent of instructor.
3 hours lecture.

475* Projects, Problems and Readings in Planning

Special planning projects and problems chosen in consultation with instructor.

Prerequisite: Consent of instructor.
3 hours seminar and/or tutorial.

476 Projects, Problems and Readings in Planning

Special planning projects and problems chosen in consultation with instructor.

Prerequisite: Consent of instructor.
3 hours seminar and/or tutorial.

480 The Philosophy and Methodology of Urban and Regional Planning

Focus on basic values implicit in policies and decisions in environmental planning. Major currents in Planning thought are traced and related to the problems and issues typically faced in both urban-centred and resource-based Planning in Canada.

Prerequisite: Honours Planning students only.
3 hours seminar.

490 Senior Honours Essay

A research project involving field work; analysing statistical data; written, graphic and cartographic presentation must be in form suitable for publication.

Prerequisite: Honours Planning students only.
3 hours seminar.

Graduate Planning Courses

604* Resource Survey Techniques for Regional Plans

Examination of the techniques for determining potentials of renewable resources; agriculture, forestry, recreation, etc., and the study of resource capability surveys in the regional planning process. Inventory techniques, organization of an integrated resource survey. Case studies.

Fall term.

605* Socio-Economic Surveys for Regional Plans

The relationship between resource surveys and socio-economic surveys required for comprehensive plans in both urban-centred and resource-based regions. Surveys will be placed in the context of the regional planning process and will be related to planning objectives and plan implementation. Emphasis will be both on analytical techniques and field experience. Case studies.

Winter term.

614* Housing Policies

The course will focus on Canadian housing policies and programmes, particularly with regard to the housing of low and moderate income families. Economic, political, physical and social considerations underlying these policies will be examined in detail. Some consideration will also be given to the housing problems and programmes of the
616* Multivariate Statistics
(Geography 616*)
The theory and application of multivariate statistics, with particular emphasis upon the use of the computer.
Prerequisite: Planning 271*
3 hours seminar and/or tutorial (fall term)

617* Nonparametric Statistics
(Geography 617*)
The theory and application of nonparametric statistics with emphasis upon social science problems.
Prerequisite: Planning 271*
2 hours lecture, 1 hour practical (winter term).

18* Spatial Analysis (Geography 617*)
Advanced quantitative analysis applied to spatial patterns and interactions. The course will focus on a selection of techniques from gravity models, linear programming, nearest neighbour analysis, Markov chain analysis, graph theory, simulation and trend surface analysis.
Prerequisite: Planning 271* or consent of instructor
3 hours (winter term)

619* Regional Planning Techniques (Geography 619*)
Application of economic and social measurement techniques in regional planning; includes discussion of input-output analysis; regional accounting techniques; cost-benefit analysis; planning, programming and budgeting systems; the multiplier and accelerator concepts; and balance of payments.
Prerequisite: Planning 271* or consent of instructor
3 hours (winter term)

623* Sociological Concepts Relevant to Regional Planning
Relevant sociological, economic, political and psychological concepts, social and natural environment, group settlement patterns, rural-urban interdependence, and social systems within a region.
fall term.

624* Sociological Problems and Projects in the Implementation of Regional Development
The formulation and acceptance of regional development plans (Canada and abroad); principles and problems in inter-group relationships relevant to regional planning and implementation.
Prerequisite: Planning 623*.
winter term.

652* Natural Resource Planning: Policies and Programmes
(Geography 662*)
Natural resources and the planning process. The course will include discussion of the social, economic, political and legislative settings for natural resource planning; current federal and provincial policies and programmes, with special emphasis upon federal-provincial resource agreements; major areas of public controversy and conflict in natural resource use and development; natural resources and international relations; and the formulation of criteria for future resource planning policies.
fall term

653* Recreational Resource Planning (Geography 663*)
The nature, measurement and forecasting of demand for recreation; classification of recreation resources; Canada's recreation resource base; recreation and the quality of the environment; the role of recreation in economic development; proposals for a national recreation planning policy.
winter term

654* Ecological Foundations of Resource Use (Geography 664*)
Principles of biogeography and environmental biology. Ecological principles in resource use and development. Case studies and projects.
fall term
655* Resource Conservation and Development (Geography 665*)

Appraisal of renewable natural resources with reference to demands and changing technology. Problems related to management and development of resources. Resource-oriented regional case studies and projects.

Prerequisite: Planning 654* or equivalent. winter term.

656 The Process of Urban and Regional Planning

An advanced course, conducted as a seminar, in urban and urban-centred regional planning in theory and practice. The course is based on case studies—amplified by readings—which demonstrate the techniques used in various aspects of plan preparation. These however, are considered within the overall framework of the planning process, from goal formulation to political implementation in the urban-centred region.

fall term

658 Regional Development Planning

The first term in the course will focus on the concept and definitions of region; the development processes, tools, policies and allocation of resources; formulation of planning goals, strategies and organization; and the evaluation of regional plans. The second term is intended to deal with the implementation of regional plans with the emphasis on the broad regions of Canada, and Federal and Provincial responsibilities and with reference to case studies in the United States, a developing country, and a socialist country. Part of this term will be devoted to a plan for the development of a selected Canadian region.

fall term

659 Special Problems and Projects

Special planning or resource management problems and projects chosen in consultation with a professor.

675* Special Readings and Seminar on Selected Planning Topics

Major philosophical issues in regional planning, both in urban-centred and resource-based regions. The course is concerned primarily with the normative phase of the planning process. Basic traditions in Planning ideology are compared and juxtaposed with trends in Canadian social development.

699 Thesis.
12 Student Services
It is the goal of the University Counselling Service to provide effective assistance to individual students. More specifically, professionally trained counsellors wish to help the student with his vocational, personal, and/or emotional development during his university years. Our aim, first and foremost, is to help the student develop his own resources and is based on the philosophy that the resources and responsibility for change lie within the student. Consistent with this philosophy, counsellors work together with the student in a mutual effort to maximize his potential. By helping in this co-operative way, it is hoped that counselling can serve to strengthen both the student's individuality and his ability to make decisions realistically. Successful counselling should result in a student being able to generalize methods he learns to a variety of other situations and relationships.

To aid in this endeavour, Counselling Services offer a wide variety of programmes and techniques, (including individual and/or group counselling, psychological and vocational testing, and a self-serve reference and loan library of occupational, educational and sex information, etc.) which aim to help the student to better understand himself and his relationship to the world around him. For some individuals, this may mean delving into their social context and their methods of relating to other people and helping them to achieve increased skills in communication; for some, it may mean joining sensitivity or self-actualization groups, for some it means discovering what career or vocational or academic plans are most likely to be satisfying and rewarding for them; for others, it means working on personal, family, or emotional problems which are hindering their work progress or causing them to feel tense, anxious, depressed, alienated, confused, or in some cases, almost overwhelmed by their situation. Occasional needs fall outside the realm of the Counselling Services' resources and the student is then referred to an appropriate person or agency for further help. In every case, all information is held in strictest confidence.

The Counselling Service Centre is located on the 6th floor of the Mathematics and Computer Building (north-east elevator). There is also a counsellor in the Engineering Building, Room 2359, in the Social Sciences Building, Room 303, in the Biology Link, Room 381, and in
made with the secretary for any time from 9:00-5:00, Monday through Friday, either in person or by calling extension 2655.

Dean of Women

The office of the Dean of Women carries out a programme of interviewing all first year female students, and provides special counselling for women students. Most of the counselling pertains to academic matters and this office assists in liaison between women students and the faculty.

The office also works closely with Counselling Services, Health Services, Co-ordination and Placement, and the residences, to assist women who request service from the Dean of Women in seeking solutions for non-academic problems. Certain student-faculty social events are arranged by this office again with a view to facilitating communications between students and faculty.

Campus Health Services

Medical Director 
H. Reesor, B.A., M.D.

Supervisor of Nursing
P. Livingston, R.N.

Health Services Building

The Health Services provides day care and infirmary care when students are ill.

Full-time registered students can receive medical and nursing care on campus in case of accident, illness or for ongoing treatment ordered by their family doctor. Registered nurses are on duty around the clock except from the last examination in August until the first registration in September.

A roster of family doctors attends the Health Services each morning to see students; this is on a fee-for-service basis.

Nurses provide only emergency service between 8:00 p.m. and 8:00 a.m. daily.

The infirmary gives convalescent care to students who require nursing but are not ill enough for admission to a general hospital.

Visitors are welcome in the afternoon from 1:00 p.m. to 8:00 p.m.

Vehicular access to the Health Services Building is via Westmount Road.

Student Health Insurance

The Health Services fee which students pay at registration provides funds for the operation of the Health Services facility, excluding physicians' salaries, and for extended health insurance which supplements that provided by the government plan.

Students should make every effort to be aware of the complexities of medical and hospital insurance to be sure they are insured and that they are taking full advantage of certain premium exemption and assistance provisions. A booklet outlining these plans is available from the Insurance Clerk, Health Services Building.

Student Discipline

The doctrine of in loco parentis would have a university entirely
affect the rights and welfare of other individuals in the University. This does not mean that members of the University community are unaccountable for their personal behaviour. The University is not, and should not become, a sanctuary where its members are sheltered from such personal responsibility. All members of the University, as members of society at large, must expect to be subject to the general civil jurisdiction and recognize that those who commit violations of the Criminal Code of Canada (or other public statutes) will be dealt with by the public courts whether such actions are committed on or off campus.

By statute, the University has been given the necessary jurisdiction and authority with respect to the operation, protection and control of its property and plant and the regulation of persons on campus insofar as necessary to ensure the orderly performance of a university's various functions. This jurisdiction is parallel to, but quite independent of, the civil jurisdiction. The question of university jurisdiction depends entirely on the nature of the offending act. If the act interferes with the normal operation of the university then the offender may be disciplined by the university aside from whether or not the act is unlawful under the Criminal Code. The motive of the university in such a case is not primarily to punish the individual but to protect the university community and its functions.

To the extent necessary to fulfill such responsibilities, the University will exercise its statutory authority.

Foreign Student Office

The Foreign Student Office provides assistance and information to all foreign students who are registered at the University and who desire to be aided in adjusting to and understanding both the University and North American society.

All students who enter Canada on a Student Entry Certificate are requested to register with the Foreign Student Office and to report their local address to this office. This office arranges for the Canadian Immigration Office to come on campus to renew Student Entry Certificates each September.

Assistance with Immigration Regulations or any personal problem is available. The International Students Association and other campus organizations work closely with this office in assisting to meet and aid all students from outside of Canada.

Campus Centre

The campus centre—as its very name suggests—is the social centre of the campus community: students, faculty, staff, administration, alumni and guests.

Its facilities include the spacious great hall (the main gathering place), smaller lounges equipped for reading, music, television and games, as well as a music rehearsal room, conference rooms, a lounge area equipped to serve as a pub for licensed events, and private dining facilities.

Located next to the secretary's and turnkeys' office is the rap-room, a drop-in counselling centre staffed 24 hours a day.

In addition to these facilities, the campus centre houses the offices of the Federation of Students, the Chevron, and various clubs and
student council.

A community centre would be incomplete without service facilities: in the basement are located the Federation's Campus Shop, a post office, a branch of the Canadian Imperial Bank of Commerce, and a barbershop.

A coffee shop is located next to the pub area.

Almost all rooms can be booked by any group or individual on campus; indeed, the campus centre has become part of the educational set-up with lecture series in the great hall and teach-ins.

The social and recreational areas are the responsibility of the autonomous campus centre board, a committee of students, faculty and staff, which sets policies regarding use and operation of these areas of the building.

The campus centre is open 24 hours a day throughout most of the year, with turnkeys on duty at all times to provide assistance.

**Federation of Students**

"The philosophers have only interpreted the world, in various ways; the point, however, is to change it." —Marx

The complementary education received from participation in extracurricular activities, in many cases, has a significant, beneficial and lasting effect on students as formal curricular education. At the University of Waterloo the opportunity to participate in such activities is provided for those who wish to take advantage of it by the Federation of Students and its various agencies. All students of the University of Waterloo are members of the Federation of Students. The Charter of the Federation of Students which guarantees certain rights and privileges to students was approved by the Board of Governors of the University and then by the Provincial Secretary on April 27, 1967. It supercedes the Constitution of the Federation which was approved in a campus-wide referendum in 1964.

**Objects**

The principal "Objects" of the Federation are:

- To promote the welfare and interests of the students of the University of Waterloo in all matters respecting their common interests.
- To act as the representative of the students.
- To promote and maintain responsible student government.
- To promote and co-ordinate student participation in athletics, cultural and social activities.
- To promote and maintain communication between the student body and the duly elected and appointed authorities of the University of Waterloo.
- To promote and assist in maintaining good conduct and proper discipline.

**The Students' Council**

Twenty-five elected members plus officers make up the Students' Council which is the governing body of the Federation. Members representing all faculties, societies and colleges are included.

The functions of the Students' Council, the governing body of the Federation, include upholding the objects of the Federation, administration and control of finances, and operation and control of all Boards and Committees of the Council. Almost all of the social and cultural activities of the student body are managed by the Students' Council as well as off campus representation of the student body.
The activities of the Students' Council are carried out by its various boards and committees which are directed by a student chairman.

The Executive Board is composed of the principal officers of the Students' Council including the President, Vice-President, Treasurer, and all Board Chairmen. The Board controls day-to-day administration, finance, and recommends policy to the Students' Council. It also co-ordinates the activities and programmes of all other Boards and provides liaison between them.

The Creative Arts Board, whose membership includes students and also faculty and staff, provides cultural programmes and activities in music, art, drama and films. Performing and interest groups in each area are supported and assisted by this Board, and its three professional directors of music, drama and art. In addition, a series of professional attractions are selected by the Board for presentation throughout the academic year. Groups sponsored by the Creative Arts Board include, in drama: St. Aethelwold's Players and the University Drama Group; in music: Chamber Orchestra, Concert Band, Dance Band, Warrior's Band, Madrigal Singers, Glee Club and the Opera Chorus; in art: Gallery Exhibitions and lecture series; and, in film; International Film Series and Noon-Hour Film Series.

The Board of External Relations represents the Federation of Students, and handles its activities, programmes and organizations in all areas that are outer-directed in relation to the campus, activities which connect and relate the student to the local, national, and international communities. Board functions are roughly divided into three commissions: Domestic Affairs, International Affairs and Information and Services, and a Hosting Committee which welcomes official student groups from other Canadian campuses and other countries. In the past, the Board through its Commissions has provided, or worked for: a high school tutorial service, overseas travel service, C.U.S. Life insurance, seminars on the Canadian Indian, speakers from foreign countries, a court of revision on campus for provincial elections, a Waterloo drop-in centre, a study of Red China, and many other activities within its broad area of concern. Through the International Affairs Commission, the Board also provides support for the Student United Nations Association of Canada (S.U.N.A.C.), Canadian University Services Overseas (C.U.S.O), Conference on Inter-American Student Projects (C.I.A.S.P.), and others.

The Board of Education sponsors programmes to examine and improve the quality of education. These activities include anti-calendars, course critiques, speakers, seminars, films, and research, as well as communication with high schools.

The Board of Publications major publications include: The Chevron which is the weekly student newspaper; the Compendium, the University yearbook; the Student Directory, the tri-annual campus telephone directory; the Handbook Series involving a set of informative guidebooks; Liontayles, a bi-annual literary magazine. In addition the Board provides financial assistance to the Faculty Societies for the production of faculty anti-calendars.

The Board of Student Activities co-ordinates and supervises all campus-wide programmes, including, Freshman Orientation, Homecoming, Winter Frolic and Good Friday Spectacular. The Board also plans and arranges the annual Spring Ball.
Industrial Research Institute

students, supports the House of Debates, the Flying Club (which operates three aircraft and a flying school), and assists the operation of over thirty clubs whose membership is open to all members of the Federation.

Judicial Committee

The Judicial Committee of the Federation serves as a student court and determines such matters as breach of Federation rules, the constitutionality of student government actions and matters referred to it by other authorities. The five justices who are graduate or senior students receive the support of university and civic officials in many areas of student self-discipline.

Persons wishing more information on any aspect of Federation activities are advised to write

The Federation of Students
University of Waterloo
Waterloo, Ontario, Canada.

Book Store

University of Waterloo students may purchase text books, stationery and engineering supplies at the University's modern Book Store located on the main floor of the South Campus Hall. The Book Store is open weekdays from 8:30 a.m. to 5:00 p.m. throughout the year. It is intended to extend Book Store hours in September and October. Students are advised to watch our bulletin board for further notice. In addition to text books, reference material, paper supplies, crested gift and souvenir items and drawing materials, the University of Waterloo Book Store also features the largest display of quality paperbacks in Kitchener and Waterloo.

Office of Research Administration

The Office of Research Administration was set up in March, 1969, and operates under the direction of Dr. J.W. Tomecko, and is responsible for the administration of research grants and contracts for the University of Waterloo.

Among the functions of the ORA are the following: to provide interested members with application forms for the main granting agencies; to review and forward to the appropriate bodies all requests for money to be used for research and training grants in the university; to advise interested parties of the terms of each individual grant or contract and to act as a centre of communication between granting agencies and members of the university staff.

Industrial Research Institute

The IRI was established in December, 1967, as an organization within the University of Waterloo to provide assistance in research and development to organizations wishing to obtain such help on a contract basis. The essential purpose of the IRI is to provide a working liaison between the university and all organizations in which contracted research and development offers potential assistance.
The IRI stimulates, arranges and manages the execution of research and development programmes sponsored by industry and other organizations. The Institute draws upon the resources of all faculties of the university to achieve this purpose.

The scope of research available through the IRI is as broad as the range of academic studies at the university. There are many special research strengths at the university and they are frequently brought together in interdisciplinary studies. The major faculties and their departments and the numbers of permanent faculty members indicate the scope of research carried out at the University of Waterloo. Competence in many disciplines abounds among the university faculty and students and the Industrial Research Institute identifies those who are best able to assist with specific problems.

The IRI operates under the direction of Dr. J.W. Tomecko, Director, and Mr. C. Frank Phripp, Assistant Director.

Planning and Resources Institute

The Planning and Resources Institute, established in 1966, now functions under the aegis of the Office of Research Administration.

The main purpose of the PRI is to foster and support research which will further the understanding of human settlement and its relationship to the natural environment, and contribute to sensitive planning and development, at any level, of regions of settlement.

A second major purpose is, broadly, to act as a bridge between interested elements of the university community and outside agencies concerned with resource use and administration and with the planning, design, servicing and development of man-oriented regions. This bridging may take the form of seminars, conferences, short courses, or publications.

The PRI has already sponsored a number of research studies ranging in focus from the influence of urbanization on rural life in Ontario to the socio-economic impact of the GO Transit Lakeshore Line on the Toronto region.

The Director of the Institute is Professor J.W. Wilson.

Regular Officers' Training Plan (ROTP)

Under this plan successful applicants are enrolled as Officer Cadets. They are paid $193.00 per month. Tuition is paid on their behalf and they also receive a book and instrument grant in the amount of $125.00 annually. Successful applicants must agree to serve four years in Canadian Armed Forces after graduation.

Applicants must be Canadian citizens, single and under twenty-one at the commencement of their university or college training.

For further information:
Canadian Forces Recruiting Centre
Suite 202
251 King Street W.
Kitchener, Ontario
Telephone 743-6661
Residence Information

Off Campus Housing

The Off Campus Housing Office provides addresses of private homes to students wishing to live off-campus. These houses are not inspected or supervised by the University. All inquiries must be made in person between the hours of 9:00 a.m. and 4:00 p.m. Monday to Friday. The Housing Office, located in "the farmhouse", observes all legal holidays.

Residence and Fees

Conrad Grebel College
Conrad Grebel College, a Mennonite Residential college and student centre, became affiliated with the University in 1961. The College provides accommodation on campus for sixty-six men and forty women. All rooms are double rooms. The residence facilities include a small library and archives, recreation rooms, dining facilities, classrooms, a large common room and a chapel with capacity for one hundred and fifty. Preference will be given to students who give evidence of wanting to develop an intelligent understanding and practice of the Christian faith as an integral part of their University life and studies.

<table>
<thead>
<tr>
<th>Fees Per Academic Year</th>
<th>Per Academic Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double $900.00</td>
<td>$450.00</td>
</tr>
</tbody>
</table>

Renison College
Sponsored by the Anglican Church of Canada for students of all denominations and affiliated with the University of Waterloo, Renison College offers integrated courses in Social Work, as well as general arts. Priority in admission is given to Arts students particularly with an interest in Social Work. The College has residences for 97 men and 80 women. A limited number of residence places are available in the Fall and Winter terms for students in other faculties.

Residence accommodation at reduced rates is generally available during the Spring term (April-August).

<table>
<thead>
<tr>
<th>Fees Per Academic Year</th>
<th>Per Academic Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept.-April Single $1050.00</td>
<td>$525.00</td>
</tr>
<tr>
<td>Double $980.00</td>
<td>$590.00</td>
</tr>
<tr>
<td>Fall and Winter</td>
<td></td>
</tr>
</tbody>
</table>

St. Jerome's College
St. Jerome's College is a Roman Catholic liberal arts college federated with the University of Waterloo. Its residence is on campus and is open to men enrolled in its own General Arts course, or registered in any faculty of the University. Both single and double accommodation are available.

(Single accommodation is not available to first year residents.)

<table>
<thead>
<tr>
<th>Fees Per Academic Year</th>
<th>Per Academic Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single $1075.00</td>
<td>$537.00</td>
</tr>
<tr>
<td>Double $975.00</td>
<td>$875.00</td>
</tr>
</tbody>
</table>

Notre Dame College
Notre Dame College is the women's residence of St. Jerome's College. It is open to women registered in St. Jerome's or in any faculty of the University of Waterloo. Single and double rooms, each provided with personal study built-in desk, bookshelves and double bed, are available.

<table>
<thead>
<tr>
<th>Fees Per Academic Year</th>
<th>Per Academic Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single $1075.00</td>
<td>$537.00</td>
</tr>
<tr>
<td>Double $975.00</td>
<td>$875.00</td>
</tr>
</tbody>
</table>
its own chapel along with lounges, kitchenettes and laundrettes for the convenience of its residents. The College is designed to provide a satisfying atmosphere for study and social life while still preserving the informality and comforts of home.

### Fees

| Single | $1075.00 | $537.50 |
| Double | $975.00 | $487.50 |

St. Paul's College

St. Paul's is a residential and teaching affiliate of the University, sponsored by the United Church. A deliberate attempt is made to have a student body representing many religious traditions and all faculties, and to include undergraduate students from abroad and those seriously questioning their religious heritage. The purpose of the College is to provide an atmosphere in which a student may pursue his academic studies and, at the same time, participate fully in College programmes involving dialogue with the Fellows, College faculty members and other students of different backgrounds. Preference in admission is given to students whose interest clearly lies in the stated aims of the College. The residence provides accommodation in seventy-five semi-private rooms for one hundred men and fifty women. The number of vacancies differs each year, the average being fifty. A Library, Chapel, refectory, common rooms, recreation room and laundry facilities are contained in the college. St. Paul's offers elective courses in Religious Studies for academic credit toward degrees in Arts engineering, Mathematics and Science.

### Fees

| Semi-Private | $985.00 | $492.50 |

University of Waterloo Residence

The University of Waterloo Residences (non-denominational) known as "Student Village 1" and "Student Village 2" are adjacent to the teaching facilities of the campus.

**Village 1**

Village 1 consists of 26 houses with a total of 1259 rooms of which 873 are single rooms, 370 inter-connecting rooms and 8 are double rooms. A House comprises three floors. In addition to the usual facilities, each floor has a lounge and kitchenette and houses 16 students in 12 single and 4 inter-connecting rooms each well-equipped for study purposes. Each House is under the supervision of a Don. Accommodation is available for 906 men and 353 women. The "Village Square" includes a town hall, three dining halls, a TV lounge, coffee house, tuck shop, and pick-up service area as well as outdoor recreational facilities.

**Village 2**

Consists of four hundred and eighty double rooms that accommodate nine hundred and sixty residents. In addition, twenty Don's suites are available as well as accommodation for two tutors. Residents are divided into groups of twenty-four with two groups forming a house. Five houses form a hall. Accommodation in double rooms is available for both women and men. Although Village 2 comes under the jurisdiction of the Warden, it is a self-contained and separate unit with its own recreation and common rooms, dining halls, etc.

Applicants for Village 2 will be assigned to double rooms, and should indicate their preference of a roommate. If no preference is shown, the choice of a roommate will be made by the Village Office. In order to assist the Office in pairing off residents, a separate questionnaire will be sent to each student after he has been accepted into residence. Careful consideration in filling out this questionnaire will better enable the Office
Residence Information

after a one month period has elapsed.

<table>
<thead>
<tr>
<th>Fees</th>
<th>Per Academic Year</th>
<th>Per Academic Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>$1200.</td>
<td>$600.</td>
</tr>
<tr>
<td>Double</td>
<td>$1100.</td>
<td>$550.</td>
</tr>
<tr>
<td>Interconnecting</td>
<td>$1150.</td>
<td>$575.</td>
</tr>
</tbody>
</table>

Married Student Apartments

Location The Married Student Apartments at the University of Waterloo are located on the South East corner of the Main Campus, south of University Avenue and adjacent to Hammarskjold House of Waterloo Co-Operative Residences Incorporated. The Complex consists of two 14 storey high rise towers each containing 120 one-bedroom apartments and 4 three storey courts each containing 90 two-bedroom walk-up apartments. The Apartment Complex was built by the Ontario Student Housing Corporation and is operated by the University of Waterloo through the office of the Director of Housing and Residence Operations.

Eligibility for Tenancy The apartments are intended for use by the student family as listed on the application form; boarders, unauthorized occupants, or prolonged house guests will not be permitted.

How to Apply Application Forms are available from the Housing Admissions Manager to whom the completed application form should be returned.

Lease Subject to further evaluation the rental rates anticipated are:

<table>
<thead>
<tr>
<th></th>
<th>1 Bedroom</th>
<th>2 Bedroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Month lease</td>
<td>$140.</td>
<td>$160.</td>
</tr>
<tr>
<td>8 Month lease</td>
<td>$135.</td>
<td>$155.</td>
</tr>
<tr>
<td>12 Month lease</td>
<td>$130.</td>
<td>$150.</td>
</tr>
</tbody>
</table>

Leases may be renewed at any time up to one month prior to the termination date of the present lease. Leases will normally commence on September 1, January 1, or May 1. The terms and conditions under which the tenant agrees to occupy the apartment are those contained in the official lease document signed by the tenant notwithstanding information contained in handbooks or brochures.

Enquiries The University of Waterloo Housing Administration is located in Annex 5 (the Farmhouse) north of the South Campus Hall, and is open from 9 a.m. to 4:45 p.m. Monday to Friday. Any student coming to the University of Waterloo who wishes accommodation information please contact:

Director of Housing and Residence Operations
Housing Administration, University of Waterloo
Waterloo, Ontario, Canada.

Minota Hagey Residence The Minota Hagey Residence can accommodate seventy-four women graduate students. The building is the first in a four house residence complex and is situated at the southwest part of the campus. Each floor of the three storey building accommodates twenty-five students and each floor has its own washrooms and service core. Each room of approximately 130 square feet, is equipped with built-in fixtures such as closet, dresser, desk and vanity, in addition to a sink and counter space. There are no major dining facilities included, but residents may use the facilities available in the complex. For further information please contact the Director of Housing and Residence Operations.
Continuing Education

in the basement. Other features are a third floor terrace, reading room and Don's apartment. A large two storey meeting place and lounge area is included.

<table>
<thead>
<tr>
<th>Fees</th>
<th>Per Academic Year</th>
<th>Per Academic Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>$700</td>
<td>$350</td>
</tr>
</tbody>
</table>

Continuing Education

One of the responsibilities of the University is to provide opportunities for the continuing education of adults. In an atmosphere of directed study within the environment of academic disciplines these opportunities can be fulfilled. The first concern of continuing education is to attend to those needs of the community which can best be provided by the University.

To help us undertake part of this responsibility, a rapidly expanding task, many community leaders provide advice, counsel and guidance. In addition, many citizens dedicated to the concept of continuing education for adults, give freely of their time to help in the development of courses and programmes. These many and varied proposals are carefully considered in the light of offering the resources of the University.

The Catalogue of Continuing Education contains those courses and programmes that were available at time of going to press. These comprise University Extension Courses, Degree Credit Courses available to Part-Time Students, Correspondence Courses for Degree Credit (on magnetic tapes), Marketing Centre Programmes and the presentations of the Creative Arts Board. The administrative office of the University responsible for each of these groups is indicated at the beginning of each section.

Since 1968 the University has been offering a programme of “off-campus” courses by correspondence, i.e. the lectures recorded on magnetic tapes with accompanying diagrams, equations etc. have been prepared by the professor to explain and supplement material in the text. Courses are offered in Physics, Mathematics and Chemistry. The programmes are designed primarily to assist elementary and secondary school teachers to upgrade their teaching qualifications. These courses are for credit, and are administered by the Department of Physics.

Since the introduction of counselling for adult students early in 1968 the Continuing Education Services available have increased considerably. The Counselling and Testing Service for example includes both vocational and educational assistance. Workshops and laboratories have been arranged for Effective Reading, Study and Writing on both an individual and a group basis. A Conference and Seminar Office has been formalized to provide supporting services such as planning, design, administrative arrangements for meals, hospitality, lecture spaces and accommodation as well as budgeting, registrations, advertising, publication and promotion, with secretarial and clerical staffing. The Office supervises the on-going facilitation of the conference and seminar arrangements.

Residential Adult Education facilities are available primarily between 1 May and 1 September of each year when the air-conditioned lecture spaces and the residence facilities are more generally available.
University Extension

During the Fall and Winter Semesters primarily, in the special area of business and professional development, as well as the increasing enquiries for self-improvement, courses and programmes are presented to complement both the experience and the varied interests of adults in the course subject matter. The up-dating or refresher approach, is reflected in the new programmes designed and being planned with this in mind to meet the changing needs of the professional community. Courses for self-improvement are offered in education, liberal arts and the humanities, second languages, social sciences and matters of community interest.

Part of the continuing concern for the affairs of the community in which the University wishes to contribute is expressed in the arrangements that can be made for off-campus groups that wish to conduct educational functions on the University Campus. Enquiries should be directed by letter to the Director, University Extension at the University.

Details of the courses and programmes are included in the Continuing Education Catalogue. From time to time additional educational opportunities are published in the local press. Further information and details are available by visiting the offices of Continuing Education, South Campus Hall or by telephoning (519) 744-6111.

Centre for Continuing Studies in Marketing

The Centre for Continuing Studies in Marketing offers short courses, seminars, and workshops for the business community in both marketing and management. They are designed to help managers do a better job in their current assignments, to better prepare them for the job ahead and to give them new perspectives through exposure to their peers in a wide range of business and industry.

In addition, the Centre's staff assists in the preparation of management development programmes to meet the particular needs of an organization.

No degree courses are offered by the Centre and no courses involve degree credits.

In the eight years in which courses have been offered, over five hundred organizations from coast to coast have enrolled one or more of their upper or middle management people for a total of over 4500 people who participated in the various courses which have comprised the Centre's programmes.

The programme has grown from the original Advanced Course in Marketing and Sales Management in 1962 to almost forty offerings in 1970-71. The Centre will continue to explore new opportunities for service in the coming year.

1970-71 Programme

<table>
<thead>
<tr>
<th>Courses</th>
<th>Offerings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Sales Management</td>
<td>3</td>
</tr>
<tr>
<td>Sales Management</td>
<td></td>
</tr>
<tr>
<td>Industrial Marketing Management</td>
<td></td>
</tr>
<tr>
<td>Marketing Management</td>
<td></td>
</tr>
<tr>
<td>Leader- Trainer Seminar</td>
<td></td>
</tr>
<tr>
<td>Profession of Management</td>
<td>3</td>
</tr>
</tbody>
</table>

Centre for Continuing Studies in Marketing
Centre for Continuing Studies in Marketing

Seminars
Advertising Management
Management Development
Management by Objectives (3 offerings)
Sales Promotion
New Product Development
Marketing Planning
Physical Distribution
Product (or Brand) Management
Sales Office Management (2 offerings)
Advanced Salesmanship (2 offerings)
Interpersonal Relations
Basic Management for the Newly Appointed Manager
Fiscal Administration for Sales and Marketing Management
Management of Scientists and Engineers

Special Subject Workshops
Human Relations
Communications
Motivation
Managing Management Time (4 offerings)
Leadership
Managerial Performance Standards

For more information re scheduled dates of above courses write or phone Centre for Continuing Studies in Marketing, University of Waterloo, Waterloo, Ontario. Canada Area Code 519, 744-6111 (ext 2579)
13 Fees
Fees

All fees for the academic session are due and payable on the day of registration. Credit for scholarships or bursaries will be given only on the authority of the Registrar after presentation of proof of the award.

Students who have received notice of assistance under the Province of Ontario Student Award Programme and are relying upon this source of funds for the payment of their fees, may make arrangements on the day of registration to direct payment to the University, up to the value of the award.

If, for reasons acceptable to the Treasurer, payment in full cannot be made on the day of registration, fees may be paid in two instalments but an extra charge of $10.00 for regular students and $5.00 for co-operative students will then be added to the total fee. The first instalment to be paid on the day of registration is a minimum of 60% of tuition fees plus 100% of incidental fees. The balance must be paid as follows:

Regular students  On or before the first day of the second term.
Co-operative students  On or before the first day of the eighth week of the term.

Failure to comply with terms of payment as set out above, will result in an additional charge of 5% of the outstanding balance plus interest calculated at the current bank rate from the due date.

It is the intention of the University to proceed with registration by mail in 1971-72 and, at such time, instructions regarding payment or arrangements for payment through the Province of Ontario Student Award Programme will be mailed to students along with the fee statement.

Failure to pay all outstanding fees, accounts or other assessments, such as library fines, before conclusion of lectures may bar a student from writing examinations and will result in withholding of credit for previous work.

A student who finds it necessary to withdraw from attendance is required to obtain a withdrawal voucher from the Registrar. This voucher, when signed by both the Dean and the Registrar, may entitle him to a refund of a portion of his fees. No fees will be refunded unless this procedure is followed.

Refunds of tuition fees are made at the discretion of the University. The amount of refund will be calculated as follows:

a) Total tuition fee less registration of $50.00 and the balance subject to refund on a diminishing basis, calculated weekly to a total of 23 weeks for regular students and 12 weeks for co-operative student terms.

b) Incidental fees for Federation of Students, Athletics and Health Services are refundable on a pro rata basis over 13 weeks for regular students and 6 weeks for co-operative student terms.

The fee schedule shown is the one approved for the 1971-72 year but at the time of printing is still subject to review and possible change. If a fee change is made, a notice will be issued with a new fee schedule; however, the University does not undertake or accept responsibility to so notify all recipients of this calendar. The Board of Governors reserves the right to make changes in the published schedule of fees without notice.
Schedule of Fees - Undergraduate Programmes Tuition and Incidental For All Years

<table>
<thead>
<tr>
<th>Faculty or School</th>
<th>Tuition Fees</th>
<th>Tuition</th>
<th>Incidental Fees*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arts</td>
<td>Sessional</td>
<td>$510.00</td>
<td>$61.80</td>
<td>$571.80</td>
</tr>
<tr>
<td>Engineering</td>
<td>Co-operative, per term</td>
<td>332.50</td>
<td>31.20</td>
<td>363.70</td>
</tr>
<tr>
<td>Environmental Studies</td>
<td>Sessional</td>
<td>545.00</td>
<td>61.80</td>
<td>606.80</td>
</tr>
<tr>
<td></td>
<td>Architecture</td>
<td>510.00</td>
<td>61.80</td>
<td>571.80</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Co-operative, per term</td>
<td>332.50</td>
<td>31.20</td>
<td>363.70</td>
</tr>
<tr>
<td>Integrated Studies</td>
<td>Sessional</td>
<td>510.00</td>
<td>61.80</td>
<td>571.80</td>
</tr>
<tr>
<td>Mathematics</td>
<td>Sessional</td>
<td>510.00</td>
<td>61.80</td>
<td>571.80</td>
</tr>
<tr>
<td></td>
<td>Co-operative, per term</td>
<td>315.00</td>
<td>31.50</td>
<td>346.20</td>
</tr>
<tr>
<td>Science</td>
<td>Sessional</td>
<td>510.00</td>
<td>61.80</td>
<td>571.80</td>
</tr>
<tr>
<td></td>
<td>Co-operative, per term</td>
<td>315.00</td>
<td>31.20</td>
<td>346.20</td>
</tr>
<tr>
<td>Optometry</td>
<td>Sessional</td>
<td>510.00</td>
<td>61.80</td>
<td>571.80</td>
</tr>
<tr>
<td>Physical Education and Recreation</td>
<td>Sessional</td>
<td>510.00</td>
<td>61.80</td>
<td>571.80</td>
</tr>
<tr>
<td></td>
<td>Co-operative, per term</td>
<td>315.00</td>
<td>31.20</td>
<td>346.20</td>
</tr>
<tr>
<td>Part-time Students</td>
<td>Per Course (limit, 2 courses per session)</td>
<td>100.00</td>
<td>Nil</td>
<td>100.00</td>
</tr>
</tbody>
</table>

The Co-operative fee shown above includes an amount of $60.00 per term for extra University costs entailed in operating the Co-operative Programme.

Incidental fees included in the above schedule are shown in detail below.

<table>
<thead>
<tr>
<th>Incidental Fees*</th>
<th>Session</th>
<th>Co-Operative Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federation of Students</td>
<td>$22.00</td>
<td>$11.00</td>
</tr>
<tr>
<td>Athletic</td>
<td>$22.00</td>
<td>$11.00</td>
</tr>
<tr>
<td>Tenth Anniversary fund— (see Note 1)</td>
<td>$10.00</td>
<td>$85.00</td>
</tr>
<tr>
<td>Campus Health Services— (see Note 2)</td>
<td>$7.80</td>
<td>$4.20</td>
</tr>
<tr>
<td>Society Fees (see Note 3)</td>
<td>$61.80</td>
<td>$31.20</td>
</tr>
</tbody>
</table>

Note 1—Tenth Anniversary Fund
In January, 1968, the Students' Council of the Federation of Students petitioned the Board of Governors to assess each student $5.00 per term as a donation to the Tenth Anniversary Fund.

It is anticipated that this assessment will continue until a total donation of $500,000 has been accumulated. The objective of the Tenth Anniversary Fund is $5,500,000, an amount needed by the University as its contribution to the University Building Programme.

Payment of the assessment is required at registration but a student who does not wish to participate may obtain a refund by presenting a receipted copy of the Fee Statement to the Federation of Students' Office in the Campus Centre Building within three (3) weeks after the close of registration.

Note 2—Campus Health Services
The amount assessed includes:

a) for regular students—the operating cost of campus health facilities for the session and the premium for supplemental medical coverage for a 12 month period from date of registration,

b) for part-time students—the operating cost for the session.
Fees

coverage for an 8-month period from date of registration. First year co-operative students registering in January for a second term, have an adjusted assessment to ensure coverage until the date of next registration. Final year co-operative students registering in January have an adjusted assessment to complete coverage to the end of the final term.

Note The Health Insurance plan does not include the premium or benefits of the Ontario Hospital Services Commission (OHSC) or Ontario Health Service Insurance Plan (OHSIP). Such coverage is the student's own responsibility.

Details of supplementary medical coverage may be obtained by direct communication with the Campus Health Services office.

### Note 3—Society Fees

The following schedule of fees applies:

<table>
<thead>
<tr>
<th>Session</th>
<th>Co-operative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arts</td>
<td>$2.50</td>
</tr>
<tr>
<td>Engineering</td>
<td>$3.00</td>
</tr>
<tr>
<td>Mathematics</td>
<td>$3.00 $1.50</td>
</tr>
<tr>
<td>Environmental Studies</td>
<td>$4.50 $2.25</td>
</tr>
<tr>
<td>Science (including Optometry)</td>
<td>$4.00 $2.00</td>
</tr>
<tr>
<td>Physical Education &amp; Recreation</td>
<td>$4.00 $2.00</td>
</tr>
<tr>
<td>St. Jerome's Student Council</td>
<td>$4.00</td>
</tr>
</tbody>
</table>

Payment of the Society Fee is required at registration but a student who does not wish to participate may obtain a refund by applying to his Society within three (3) weeks after the close of registration.

### Miscellaneous Fees

<table>
<thead>
<tr>
<th>Fee</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination—Supplemental, each paper</td>
<td>$10.00</td>
</tr>
<tr>
<td>—Presiding fee (at outside centre each half day)</td>
<td>$7.00</td>
</tr>
<tr>
<td>Late Registration —First day</td>
<td>$10.00</td>
</tr>
<tr>
<td>— Each additional day</td>
<td>$5.00</td>
</tr>
<tr>
<td>—Maximum</td>
<td>$25.00</td>
</tr>
<tr>
<td>Transcript of record</td>
<td>$1.00</td>
</tr>
</tbody>
</table>

### Residence Fees

Information concerning Residence Fees can be found on page 495.
Schedule of Fees - Graduate Studies

For specific details of programmes and definitions see the Graduate Studies Section, page 00

<table>
<thead>
<tr>
<th>Full-time Degree Students</th>
<th>Tuition</th>
<th>Incidental*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>to the minimum fee for the programme</td>
<td>$135.00</td>
<td>$15.95</td>
<td>$150.95</td>
</tr>
<tr>
<td>term</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>beyond the minimum fee for the programme</td>
<td>30.00</td>
<td>15.95</td>
<td>45.95</td>
</tr>
<tr>
<td>term</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part-time Degree Students</th>
<th>Tuition</th>
<th>Incidental*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>to the minimum fee for the programme</td>
<td>79.00</td>
<td>Nil</td>
<td>79.00</td>
</tr>
<tr>
<td>term</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>beyond the minimum fee for the programme</td>
<td>30.00</td>
<td>Nil</td>
<td>30.00</td>
</tr>
<tr>
<td>term</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Full-time Qualifying Students</th>
<th>Tuition</th>
<th>Incidental*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty of Arts</td>
<td>255.00</td>
<td>32.45</td>
<td>287.45</td>
</tr>
<tr>
<td>Faculty of Engineering</td>
<td>272.50</td>
<td>34.20</td>
<td>306.70</td>
</tr>
<tr>
<td>Faculty of Mathematics</td>
<td>255.00</td>
<td>32.45</td>
<td>287.45</td>
</tr>
<tr>
<td>Faculty of Science</td>
<td>255.00</td>
<td>33.20</td>
<td>288.20</td>
</tr>
<tr>
<td>Vision of Environmental Studies</td>
<td>255.00</td>
<td>32.70</td>
<td>287.70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part-time Non-Degree Students</th>
<th>Tuition</th>
<th>Incidental*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full course (2)</td>
<td>100.00</td>
<td>Nil</td>
<td>100.00</td>
</tr>
<tr>
<td>Half course</td>
<td>50.00</td>
<td>Nil</td>
<td>50.00</td>
</tr>
</tbody>
</table>

Note 1 Minimum tuition fees are as follows:
A) ‘One Year’ programme | $405.00
b) ‘Two Year’ programme | $10.00
c) ‘Three Year’ programme | $1,215.00

Note 2 Full and Half courses: A full course is one with a duration of two terms or its equivalent. A half course is one with a duration of one term or its equivalent. In certain cases, half-equivalent courses may be offered over two terms or full-equivalent courses over only one term. In all such cases, the credit value of the course for purposes of satisfying programme requirements shall be the deciding factor for fee purposes.

Incidental* Per term
Full-time students
Graduate student Society | $1.67
Atheletics | 7.34
Tenth Anniversary Fund (See Note 1) | 3.34
Campus Health Fee | 3.60
Total | $15.95

Qualifying Students Per Term
Federation of Students | $11.00
Atheletics | 11.00
Tenth Anniversary Fund (See Note 1) | 5.00
Campus Health Services (See Note 2) | 4.20
Total | $31.20
Fees

### Plus Society Fees for Qualifying Students

<table>
<thead>
<tr>
<th>Subject</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arts</td>
<td>$1.25</td>
</tr>
<tr>
<td>Engineering</td>
<td>$3.00</td>
</tr>
<tr>
<td>Mathematics</td>
<td>$1.50</td>
</tr>
<tr>
<td>Environmental Studies</td>
<td>$1.25</td>
</tr>
<tr>
<td>Science</td>
<td>$2.00</td>
</tr>
</tbody>
</table>

### Note 3—Tenth Anniversary Fund

In January, 1968, the Students' Council of the Federation of Students petitioned the Board of Governors to assess each student $10.00 per year as a donation to the Tenth Anniversary Fund.

It is anticipated that this assessment will continue until a total donation of $500,000 has been accumulated. The objective of the Tenth Anniversary Fund is $5,500,000, an amount needed by the University as its contribution to the University Building Programme.

Payment of the assessment is required at registration but a student who does not wish to participate may obtain a refund by presenting a receipted copy of the Fee Statement to the Business Office, Arts Library Building within three weeks after the close of registration.

### Note 4—Campus Health Services

The amount assessed includes the operating cost of campus health facilities for the term and the premium for supplementary medical coverage for a 4-month period from date of registration.

The Health Insurance plan does not include the premium or benefits of the Ontario Hospital Services Commission (OHSC) or Ontario Health Service Insurance Plan (OHSIP).

If the student is employed by the University, coverage under OHSC and OHSIP must be obtained through the University's group at registration.

It is the students' own responsibility to ensure that he is covered.

Details of supplementary medical coverage may be obtained by direct communication with the Campus Health Services Office.

### Note 5—Society Fees

Payment of the Society Fee is required at registration but a student who does not wish to participate may obtain a refund by applying to his Society within three (3) weeks after the close of registration.

### Miscellaneous Fees

<table>
<thead>
<tr>
<th>Service</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Late Registration</td>
<td>$10.00</td>
</tr>
<tr>
<td>—1st two weeks after registration date</td>
<td>$25.00</td>
</tr>
<tr>
<td>—after first two weeks, additional</td>
<td>$51.00</td>
</tr>
<tr>
<td>Transcript of Record</td>
<td></td>
</tr>
</tbody>
</table>

### Residence Fees

Information concerning Residence Fees can be found on page 495.
14 The University Libraries
The University Libraries

University Librarian  William J. Watson, B.J. (Carleton), M.A., B.L.S. (McGill)
Collections Development Librarian Doris E. Lewis (Mrs.), B.A., B.L.S. (Toronto), L.L.D. (Trent)
Systems Librarian Robert G. Bean, B.A. (Western), B.L.S. (Toronto)
Assistant to the Librarian Paul Wiens, B.A., B.L.S. (U.B.C.)

Technical Services
Head Murray C. Shepherd, B.Ed. (Saskatchewan), M.A. (I.S.) (Denver)

Acquisitions Department
Head Enid Waterman (Mrs.), B.A. (McMaster), B.L.S. (Toronto)

Serials Department
Head Jeanette Schmidt (Miss), B.A. (Western), B.L.S. (Toronto)

Bibliographic Searching Department
Head Ramma Kamra (Mrs.), B.A. (Panjab), M.L.S. (Western)

Cataloguing Department
Head Joan Scanlon (Miss), B.A., M.A., B.L.S. (Toronto)
Cataloguers
Thomas Alburger, A.B. (Rutgers), M.S.L.S. (Western Reserve)
Samuel Alexander, B.A., M.A. (Delhi), M.L.S. (Western)
Amy Chan (Mrs.), B.A., (Hong Kong), M.L.S. (Western)
Mary Deschetza (Miss), B.S.c., B.Ed. (Acadia), B.L.S. (Toronto)
Yulerette Gordon (Mrs.), B.A. (Manitoba), B.L.S. (Toronto)
Eva Huygen (Miss), B.Soc.Sc. (Hong Kong), M.S. (L.S.) (Wisconsin)
Lesley Sangster (Miss), B.A. (Adelaide), Dip.Lib. (N.S.W.)
Wasyl Sirskyj, B.A. (Toronto), M.A. (Waterloo), B.L.S. (Toronto)

Public Services, Arts Library
Head Helen McKinnon (Miss), B.A. (Saskatchewan), B.L.S. (Toronto), M.L.S. (McGill)

Circulation Department
Head Elaine Reaman (Miss), B.A. (McMaster), B.L.S. (Toronto)

Reference Department
Reference Librarians
Brenda Bailey (Miss), B.A. (London), Dip.Ed. (Oxford), M.L.S. (Western)
Lois Black, (Miss), B.A. (Waterloo College), B.L.S., M.L.S. (Toronto)
Marsha Blok (Mrs.), B.A. (Waterloo), M.L.S. (Western)
Judith Boettger (Miss), B.A. (Waterloo), B.L.S. (British Columbia)
Rienzi W.G. Crusz, B.A. (Ceylon), B.L.S. (Toronto)
Alison Fitzgerald (Miss), B.A. (Queen's), B.L.S. (Toronto)
Lynne Primrose (Miss), B.A., M.L.S. (McGill)
Diane Wilkins (Miss), B.A. (Waterloo), M.L.S. (McGill)

Public Services, Engineering, Mathematics and Science Library
Head Ada Berti (Miss), B.A. (Windsor), B.L.S. (Toronto)

Circulation Department
Supervisor Frances Breithaupt (Mrs.), B.A. (Toronto)
The University Libraries

**Reference Department**

**Head**

Emily Chang (Miss), B.Sc. (Loyola), M.L.S. (McGill)

**Reference Librarian**

Douglas Chambers, B.Sc., M.Sc (Western), B.L.S. (Toronto)

Carlotta Harvey (Miss), B.Sc., B.L.S. (Alberta)

Eleanor MacLean (Miss), B.Sc., M.L.S. (McGill)

James Parrott, B.Sc. (Queen's), M.Sc., B.L.S. (Toronto)

Benjamin Toth, B.A. (Queen's), M.L.S. (McGill)

**Government Publications**

**Head** (to be appointed)

The University Libraries are central to teaching, study, and research programmes going on throughout the University. Their function is to provide books, journals, and other library materials to support those programmes. The library staff, supported by the university community in a variety of important ways, works to make the library system an excellent base for academic endeavor.

The Arts Library Building has ten floors, seven of which were officially opened in 1965. The top three floors were constructed during 1969-70. At present the Library occupies parts of floor 1, and all of floors 2, 3, 4, 9, and 10. University administrative offices are housed temporarily on floors 5, 6, 7, and 8, which are to be turned over for library facilities during 1972.

The second (main) floor of the Arts Library houses the public catalog, the reference department, the circulation department, and technical services. The third floor holds collections, provides seating for users, and houses the microforms room, the periodicals collection, government publications, and the library administration. The reserve book area is on the fourth floor. Floors 9 and 10 accommodate readers and collections. Altogether, the Library has room for some 300,000 volumes and 750 users.

The Engineering, Mathematics and Science Library is located on the fourth floor of the Mathematics and Computer Science Building. Space is provided for a collection of 180,000 volumes and for 550 readers. The E.M.S. Library offers a reference and circulation service for its users.

The Arts Library collections number 290,000 volumes of books and periodicals in the Humanities and Social Sciences, plus pamphlets, theses, microforms, documents, reports, records and other materials. The rate of growth has accelerated year by year, and in 1971-72 another 50,000 volumes are expected to be added. The Library has 2,400 subscriptions to current periodicals.

The E.M.S. Library collections number 140,000 volumes of books and periodicals, plus many kinds of special materials. Additions in 1971-72 are expected to be 20,000 volumes. The Library has 1,900 subscriptions to current journals, plus a good collection of indexes and abstracts.

The library staff of 200 persons, both professional and supporting, is engaged in obtaining material, in processing it for the collections, and in bringing it to the attention of users. During the day and evening hours reference and circulation staff are on duty to assist in making use of the collections and facilities. Week nights the libraries are open for use, under the custodianship of library attendants.

Handbooks are available to explain the use of the libraries: the classification system, the card catalogs, the serials lists, and in general the rules and procedures. Also available are other publications, such as bibliographies and lists of reference materials.

Since November 1969 the Library has been engaged in making a
The University Libraries

system, to be instituted in the Autumn of 1971. When fully operational the system should make the circulation of books a much swifter procedure. At some stage, it is intended that circulation will be on-line to the computer, which will produce additional benefits. Other projects of automation to be undertaken in due course will deal with acquisitions, serials check-in, bibliographic searching, and aspects of cataloguing.
15 The Department of Coordination and Placement
Department of Co-ordination and Placement

Co-ordination and Placement

Director
A.S. Barber, B.I.E., P.Eng.

Assistant Director Engineering

Faculty Liaison

Assistant Director, Operations
B.A. McCallum, B.A.

Engineering and Applied Sciences
Assistant Director Mathematics,
J.W. Hoag, B.Arch.

Programs
Kinesiology and Recreation
G.L. White, B.A.Sc., P.Eng.

Architectural Program Director
Post Graduate Careers Information
R.J. Wieser, B.Eng. (Saskatchewan), P.Eng.

Officer
J.C. Wilson, B.Sc. (U.N.B.), P.Eng.

Placement Officer
E. Zapf, B.Ed., B.S.W.

Department of Co-ordination and Placement

Functions of Department of Co-ordination and Placement

The Department of Co-ordination and Placement is responsible for the work terms in the Co-operative Programmes (Co-ordination), and assists undergraduate and graduating students in all programmes in planning careers and in obtaining employment (Placement). The Post Graduate Careers Information section assists students graduating with advanced degrees.

The staff of the department is comprised of professional personnel having extensive experience related to their fields of service.

Director
A.S. Barber, B.I.E. (GMI), P.Eng.

Executive Assistant
J.R. Culley, B.Comm. (McGill)

Engineering
Assistant Director Engineering

Faculty Liaison
R.J. Wieser, B.Eng. (Saskatchewan), P.Eng.

Assistant Director, Operations
J.C. Wilson, B.Sc. (U.N.B.), P.Eng.

Engineering and Applied Sciences
Programs
Executive Assistant
J.C. Wilson, B.Sc. (U.N.B.), P.Eng.

Co-ordinators
D.G.S. Anderson, B.A.Sc. (Toronto), P.Eng.
H.D. Ball, B.A. (Western), P.Eng.
G.P. Berthin, B.Sc. (Manitoba), Eng
E.A. Cochrane, B.Eng. (Saskatchewan), P.Eng.
G.W. Ellis, B.Sc. (Alberta) P.Eng.
R.A. Grant, B.Sc. (Queen's), P.Eng.
R. Grant, B.A.Sc. (Toronto), P.Eng.
L.B. Jones, B.A.Sc. (Toronto), P.Eng.
A.L. Lind, B.Sc. (Queen's), Eng.
R. McDowell, B.Sc. (Saskatchewan), P.Eng.
T.W. Ridout, B.A.Sc. (Waterloo), P.Eng.
W.A. Runge, B.Sc. (Queen's) P.Eng.
M.M. Smith, B.Sc. (Queen's), P.Eng.
M.S. Stevens, B.Sc. (Queen's), P.Eng.
The Co-operative Plan

Co-operative education is based on the principle that during the undergraduate years an academic programme combined with integrated work experience in alternating terms, is relevant to, and desirable for, effective professional preparation. The work terms allow the student to acquire experience in the area of his career interest, while the academic terms can more properly be devoted to fundamental and theoretical studies. At Waterloo, most programmes consist of eight four-month academic terms. Thus the practical experience is in no sense a substitute for, but is rather a complement to, the academic studies.

The motivation, responsibility and opportunity for insight gained through co-operative education can be of inestimable value to the student's future. The co-operative principle is important precisely because it enables those with a career orientation to become full-time students of their subject - not only during the academic terms on campus but during the related work terms, and not in a random and uncertain manner, but within a structure of organized purpose and serious study.

Operation of the Plan

The necessary arrangements for the integration of the work terms, the securing of potential employers of the students, the arranging of interviews, the professional guidance involved, and generally the whole operation, is handled through an on-campus Co-operative Program Office.
Department of Co-ordination and Placement

students, visit them on the job, and assist them in adjustment to work situations, and in professional development.

The Work-Study Sequence

In most of the co-operative programmes at Waterloo, all year 1 students enrol in September and spend the first term together at the University. As indicated on the diagram, they rejoin as a class for the last term to complete their course, and graduate together. Between the first and last terms, the diagram shows that each class is split into two approximately equal groups (streams) for continuity of employment opportunity in the co-operative programme. Both groups, of course, have the same total time on campus and in industry; one group having a double academic term at the start of the course and the other having a double academic term at the end of the course. Final choice of A or B streams is made by students during interviews with co-ordinators shortly after registration. As far as possible students' choices of A or B streams will be honoured, but in the case of a major imbalance of the streams, students may be requested to enter the deficient stream. Precise dates for the beginning and end of various terms are shown in the Academic Calendar.

The eight terms of study and six terms of employment provided in the co-operative programmes are arranged as shown in the diagram.

<table>
<thead>
<tr>
<th>1971</th>
<th>Fall</th>
<th>Winter</th>
<th>1972</th>
<th>Fall</th>
<th>Winter</th>
<th>1973</th>
<th>Fall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream</td>
<td>First</td>
<td>Second</td>
<td>Work</td>
<td>Third</td>
<td>Work</td>
<td>Fourth</td>
<td>Work</td>
</tr>
<tr>
<td>“A”</td>
<td>Term</td>
<td>Term</td>
<td>Term</td>
<td>Term</td>
<td>Term</td>
<td>Term</td>
<td>Term</td>
</tr>
<tr>
<td>1A</td>
<td>1B</td>
<td>1</td>
<td>2A</td>
<td>2</td>
<td>2B</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

| Stream | First | Second | Work | Third | Work | Fourth |
| “B” | Term | Term | Term | Term | Term | |
| 1A | 1 | 1B | 2 | 2A | 3 | 2B |

<table>
<thead>
<tr>
<th>1974</th>
<th>Winter</th>
<th>Spring</th>
<th>Fall</th>
<th>1975</th>
<th>Winter</th>
<th>Fall</th>
<th>1976</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream</td>
<td>First</td>
<td>Sixth</td>
<td>Work</td>
<td>Seventh</td>
<td>Work</td>
<td>Eighth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“A”</td>
<td>Term</td>
<td>Term</td>
<td>Term</td>
<td>Term</td>
<td>Term</td>
<td>Term</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3A</td>
<td>4</td>
<td>3B</td>
<td>5</td>
<td>4A</td>
<td>6</td>
<td>4B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Stream | Fifth | Work | Sixth | Work | Seventh |
| “B” | Term | Term | Term | Term | Eighth |
| Term | 3A | 5 | 3B | 6 | 4A |
| 4 | 3A | 5 | 3B | 6 | 4A | 4B |

Exceptions occur in the co-op pattern in the following programs. Kinesiology and Recreation operates on “A” stream only, Systems Design (Engineering) and Chartered Accounting (Mathematics) are on B stream only and variations of the standard program are used for Applied Physics, Environmental Studies-Architecture and the option in Co-operative Mathematics for Prospective High School Teachers.

Work Terms

A basic requirement of the Co-operative Programmes at the University of Waterloo is satisfactory performance during co-operative work terms.
Registration in a co-operative course commits students to the acceptance of work assignments either through the regular interview procedure or, where their best interests are served, on an assignment that the Department may determine. All positions held by students must be approved by the Co-ordination Department.

By registering in a co-operative course, students give permission for the release of their grades to employers. Academic grades, work term evaluations and a résumé written by the student constitute the student records which are sent to prospective employers in the course of the interview process.

Students and employers choose each other through the following process. Job notices are posted on Co-ordination Department bulletin boards and students are asked to examine the notices and indicate their interest by applying for up to twelve interviews. Students make these applications by completing and returning to the Department specially designed computer cards which are made available to them.

When the application period has ended, each prospective employer is mailed the records of all students who have applied for interviews with his organization. A list of the students whom he wishes to interview is returned and, from these, a schedule of interviews is drawn up.

Interviews arranged through this procedure are conducted on campus in the offices of the Department.

When a student has completed all his interviews he must rank (on cards provided by the Department and given him by the interviewers) in order of preference, all, except perhaps two, of the companies by whom he was interviewed. These cards are then submitted to the Department. In the same manner students are ranked by employers and a computer is used at this point to match the interests of both parties. Under this procedure, there will be companies and students who do not obtain students and/or jobs. In such cases the Department will make every effort to place these students and satisfy the employers where the best interests of each can be served.

It should be noted that a student is obligated to accept the employment offered him through the interview procedure unless extenuating circumstances prevail, in which case he must consult with and obtain the permission of the Department before the job is refused.

Salaries paid co-operative students are determined within the employer's own wage structure, although employers may consult with the Co-ordination Department. Wages can be expected to increase when merited as the student progresses through the course and assumes more responsibility. However, the student should not expect the income from his work terms to make him completely self-supporting.

Students in co-operative courses are required to return for a second work term when acceptable to employers. First work terms with employers include learning periods varying in length with the complexity of the jobs. Second work terms provide the students with an opportunity for better assessment of the jobs and employers with the benefits of increased productivity. In many instances the second term also offers students some new duties and responsibilities.

Valid reasons for exceptions to this rule will be considered by the Co-ordination Department. Additional work terms with co-operative organizations are a matter of mutual agreement between employers and students. The student is required to prepare a written report dealing with some phase of his employment during each work term.

Such reports serve a dual purpose. Experience is gained in the preparation of written reports similar to those which an employer
Department of Co-ordination and Placement

thorough appreciation for analysis. The work report is designed to help train the student to think, to organize and to express himself on paper in a clear, logical and concise form. When possible it should be a project of benefit to the employer as well as the student.

Evaluation

At the end of each work term, it is recommended that each student have an exit interview with his supervisor. During the interview they should discuss together the completing of two forms provided by the Department (the “Employer’s Evaluation of Co-operative Student” and the “Employer’s Evaluation of Student’s Written Report”). These forms will subsequently be included in the student’s records.

Conduct and Responsibilities

The satisfactory completion of co-operative work terms is a requisite of graduation. It is emphasized that during the student's work terms he carries a responsibility to build and maintain his own good reputation as well as that of the University.

No student may continue in a co-operative course at the University of Waterloo if he is not achieving acceptable progress during his work assignments. A student who fails to honour an agreement to work with an employer or who leaves his co-operative employment without prior approval from the Co-ordination Department, or who conducts himself while on the job so as to purposely cause his discharge, may be suspended immediately from the Co-operative programme.

Unsatisfactory performance by a student in two work terms will result in a thorough investigation of his suitability for professional training and he may be required to withdraw from the course.

The above discussion of Co-ordination has been written with the assistance of the Student Advisory Council to the Department of Co-ordination. The Council strongly recommends that students interested in co-operative education read a brochure designed to supplement the Calendar, entitled “Where it’s at with Co-op Education” before deciding whether such a programme is designed to best further their academic interests. The brochure presents more details about Co-op in areas solely relevant to students, and should be available in most High School Guidance Departments or upon request from the Department of Co-ordination and Placement.

Student Advisory Council to the Department of Co-ordination and Placement.

The Student Advisory Council advises the Department of Co-ordination and Placement on matters of interest and policy from the students’ points of view. Members of Council also act as liaison between the student body and the Department. Council membership is by Society appointment as follows.

4 students Faculty of Engineering
2 students Faculty of Mathematics
2 students School of Physical Education and Recreation
1 student Department of Physics
1 student Department of Chemistry
1 student School of Architecture
Employers' Advisory Councils for Co-operative Programmes

The employers' advisory councils are composed of representatives from organizations interested in Co-operative education. These Councils act in an advisory capacity to the University on the operation of the Co-operative programmes to which they are related, as it affects the relations of the University and its students with employers. Lists of members of the three Advisory Councils follow.

Industrial Advisory Council for Co-operative Engineering and Applied Sciences

Mr. A.E. Ades     Air Canada
Chairman
Dr. D.H. Laughland Public Service Commission
Vice Chairman
Mr. D.L. Dickson Pioneer Saws Limited
Secretary
Mr. H.W. Adcock Ontario Department of Highways
Mr. Wm. Bobbie B.F. Goodrich Canada Limited
Mr. W.C. Bradbury Canadian Westinghouse Company Limited
Mr. W.R. Coulter Coulter Copper and Brass Co. Ltd.
Mr. J.R. Crase Horton Steel Works Limited
Mr. A.W. Downe Joseph E. Seagram & Sons Limited
Dr. F.S. Eadie Northern Electric Co. Ltd.
Mr. L.J. Eskritt Ball Brothers Limited
Mr. R. Fortier Bell Canada
Mr. P.C. Gunyon Aluminum Co. of Canada Limited
Mr. H.L. Hinchcliffe Shell Canada Limited
Dr. H.B. Marshall Domtar Limited
Mr. G. Roelofson Montgomery Elevator Company Limited
Mr. A. Staig Proctor and Redfern Limited
Dr. H.R.L. Streight DuPont of Canada Limited
Mr. W.L.W. Taylor Falconbridge Nickel Mines Limited
Mr. D.H. Wilson McIntyre Porcupine Mines Limited

Advisory Council for Option in Co-operative Mathematics for Prospective High School Teachers

Mr. G.R. Allen        Director of Education, Sudbury Board of Education
Mr. W.H. Baxter      Waterloo County Board of Education
Mr. H.B. Dean        Deputy General Secretary, O.S.S.T.F., Toronto
Mr. H.G. Dearborn    Burnhamthorpe Collegiate Institute, Etobicoke
Mr. J.J. Del Grande  Co-ordinator of Mathematics, North York
Mr. A.F. Duncan      Superintendent of Education, Waterloo County Board of Education
Mr. J.W. Fencott     Stephen Leacock S.S., Scarborough
Mr. J.C. Gardner     Superintendent of Programme Development, Carleton Board of Education, Ottawa
Mr. H.J. Hill        St. Mary's Collegiate Institute, St. Mary's
Mr. E.G. Marcy       Ancaster High and Vocational School, Ancaster
Mr. W.G. Nediger     Registrar, Althouse College of Education, London
Mr. D.H. Pelzer      Mathematics Co-ordinator, London
Department of Co-ordination and Placement

Dr. H. Partlow Superintendent of Professional Development Board of Education for the Borough of North York

Mr. J.N.C. Sharp Co-ordinator of Mathematics, Etobicoke

Mr. J.T. Stubbs Superintendent of Secondary Schools, Sault Ste. Marie

Advisory Council - Kinesiology and Recreation

Mr. W.J. Hare Mississauga Parks and Recreation Dept.
Chairman

Mr. L.G. Branch Burlington Recreation Department

Mr. Wm. Houston Ontario Department of Education

Mr. R. Kisby National Young Men's Christian Association

Mr. D.L. Minshall Ontario Department of Education

Mr. B. Parker London Board of Education

Mr. T. Riley Etobicoke Recreation Department

Mr. C. Simmons North York Board of Education

Dr. D. Zarfas Ontario Department of Health

Career Planning and Placement

Students requiring assistance in determining their career goals are encouraged to use the facilities of Career Planning and Placement. Types of current organizations and agencies compatible with the individual student's needs and abilities are explored during personal interviews. Career information is made known, such as the availability of opportunities, salaries, and trends. A broad selection of active company or agency files containing background information and employment histories are available for perusal. The Careers Information Library contains descriptive material on most occupations. Through these the student is assisted in finding a meaningful career and ultimately his right employment choice.

In the Placement function, several hundred companies are invited to conduct on-campus interviews for graduating students at all levels. It is customary for employers interested primarily in students graduating from the faculty of Arts to participate in interviews during a three week period in November/December. Some of these employers also have requirements for students in non co-operative programmes graduating from the faculties of Mathematics and Science. A second three week interview period in January is provided for students graduating from all faculties. Employers will interview postgraduate students during both interview periods.

The Career Planning and Placement Offices are located on the 6th Floor of the Mathematics and Computer Building.

Post-Graduate Careers Information

The Post-Graduate Careers Information section of the Department of Co-ordination and Placement provides assistance to students graduating with advanced degrees who are seeking employment. The section discusses career plans with students, assembles information on job opportunities, and advises employers on the availability of people with advanced degrees to fill their requirements. It is concerned with any activities designed to increase the efficiency of organization.
16 Scholarships, Bursaries, Prizes and Financial Aid
Undergraduate Scholarships

Alberta Optometric Association Scholarships-(Undergraduate) The Alberta Optometric Association Scholarships are in the amount of $250 each. One scholarship will be provided for each of 2 students from the Province of Alberta entering the study of Year 1 of the Optometry Course at the School of Optometry, Faculty of Science, University of Waterloo.

One scholarship will be provided for each of 2 students from the Province of Alberta entering the study of Year 2 of the Optometry Course, at the School of Optometry, Faculty of Science, University of Waterloo. They are awarded on the basis of academic achievement.

Allied Chemical Canada Scholarship This scholarship is awarded annually to one student not otherwise holding a scholarship, entering final year of undergraduate studies in Chemical Engineering or majoring in Chemistry. Based on merit, the award is in the amount of $750 and made with the recommendations of both the Faculties of Engineering and Science. Application is not necessary.

Alcan Scholarship The Aluminum Company of Canada Ltd. is offering a scholarship in the amount of $500 to students in any course leading to a degree in engineering, an honours degree in science or arts, or any other faculty producing honours graduates. Eligibility for co-op students is restricted to those in the first year. The Award will be made on the basis of financial need, character and ability. Applications should be forwarded to the Awards Officer, Office of the Registrar.

American Optical Company of Canada Ltd. Scholarship (Value $525.00) The American Optical Co. of Canada Ltd. presents an annual scholarship to any Canadian student entering Year 2 in the School of Optometry.

Application for this Scholarship should be submitted to the Scholarship Committee before July 31st, 1971.

Association of Professional Engineers Entrance Award The Association of Professional Engineers of the Province of Ontario provides a $500 Entrance Award to the student having the highest academic standing in the Grade 13 examinations and who is entering an accredited engineering course at the University of Waterloo.

Association of Professional Engineers Undergraduate Scholarship The Association of Professional Engineers of the Province of Ontario offers three annual scholarships of $250, one to the student in each of the first, second and third years in an accredited engineering course who has the highest average in the examinations of his year.

British Columbia Optometric Association Scholarship The British Columbia Optometric Association offers an award of $250 to two British Columbia students enrolling in Year II of the school of Optometry.

Application should be made to the Director, School of Optometry.

Centennial Optical Scholarship The Centennial Optical Company offers three scholarships in the amount of $150 each to students entering first year Optometry. $50 is awarded in first year and the remaining $100 automatically upon admission to Year 2. Recommendations for these awards are made by the School of Optometry. No application is necessary.

City of Waterloo Scholarship The City of Waterloo is offering an entrance scholarship of $400 to a student, normally resident in the City of Waterloo, who has been
Undergraduate Scholarships

leading to a degree offered by the University. The award is made by the Scholarship Committee and no application is necessary.

Cominco Scholarships To assist in ensuring a continuing supply of qualified graduates in fields vital to industry in Canada, Cominco Ltd. has established a programme of twenty-four scholarships at specified Universities in Canada. One of these scholarships will be awarded annually in the form of a two-year award of $800 per year, at the University of Waterloo. It is open to students who, in the fall, will enter the penultimate undergraduate year of a course leading to a degree in Chemical Engineering, Honours Geology, Geological Engineering, Mining, Mineral Engineering, Metallurgy, Metallurgical Engineering, Honours Chemistry, Soil Science, Agronomy. Students must apply to the University of Waterloo by November 1st, on forms obtainable from the Awards Officer, University of Waterloo, Waterloo, Ontario. Renewals for the second year will be subject to attainment of academic standards satisfactory to the Scholarship Committee of the University.

Concordia Club Scholarship in Germany A scholarship in the value of $300 will be awarded annually in the Faculty of Arts by the Kitchener-Waterloo Concordia Club to promote and encourage the study of German language and literature.

DeLeuw Cather and Company Scholarship. The DeLeuw Cather and Company of Canada Limited, in memory of the Company’s founder, is making an annual award available to a 4th year Civil Engineering student with the transportation option. The award is in the amount of $500. and will be given to the student showing high academic achievement, good character, and financial need. The Senate Committee on Scholarships and Student Aid will work in conjunction with the Department of Civil Engineering in determining the winner. Application should be made to the Awards Office.

Rene Descartes Scholarships, Fellowships, and Bursaries. Awards in varying amounts are offered through the Faculty of Mathematics to first year students enrolled in that Faculty and showing the University of Waterloo as their first choice on the application for admission to the university. In order to be eligible, a student must write the Ontario Senior Mathematics Problems Competition. Applications may be received through the Association Dean, Faculty of Mathematics.

E.L. Ruddy The E.L. Ruddy Company Limited is offering an annual scholarship of $250 to be awarded to a third or fourth year student registered in the Honours Urban and Regional Planning programme. The student must have attained high academic standing and indicate an interest in planning. Application should be made to the Awards Officer.

Elgin County Council Awards Two awards, each for $100 are offered to the boy and girl attaining the highest academic standing in any university year. The student(s) will be in attendance at either this University or Waterloo Lutheran University. Residents of the city of St. Thomas are ineligible. 

G. Elmore Raeman Scholarship (History) A scholarship in the value of $300 is offered each year to a 3rd or 4th year student of the University for study and research in the social history of Upper Canada, from the earliest time to 1818. The award will be made by the Department of History, on the basis of a formal Research Paper prepared by the candidate.
Undergraduate Scholarships

Friedrich Lehner Scholarship  This scholarship will be awarded to a third or fourth year undergraduate student of German Literature and Language. The value of this award is $100 and is provided annually by Mr. Friedrich Lehner of Lehner Travel Service, Toronto, Ontario, Canada.

Huron County Scholarship  Huron County Council is offering two $100 Scholarships to be awarded to the boy and girl from Huron County who obtain the highest standing regardless of the year in which he or she is registered. No formal application is necessary.

Issac Newton Scholarships  The Department of Physics awards Issac Newton Scholarships annually to the top three students entering each year in Physics. Each scholarship is valued at $150.

Issac Newton Assistantships  The Department of Physics offers Isaac Newton Assistantships to recognize academic excellence in students proceeding to a degree in Physics. The awards are valued at $2,000, payable at the rate of $500 annually, renewable each year, provided that a satisfactory academic standing is maintained. Recipients of this award are required to undertake minor academic or research responsibilities within the Department. All Freshman Students declaring an interest in Physics are automatically considered for both awards, which may be held concurrently.

J.P.Bickell Foundation Scholarships  The Trustees of the J.P. Bickell Foundation provide a number of J.P. Bickell Foundation scholarships of $1500. each to be awarded to qualified students in the Chemical Engineering Department and the Earth Sciences Department in any of the second, third or fourth years of the course. To be eligible for one of these scholarships a student must obtain an average of 75% in the previous term's or year's examinations and maintain this standing throughout the course. The scholarship will be paid at the rate of $250. a term. Awards will be made by the Scholarships Committee. No application is necessary.

Kitchener-Waterloo Council of Friendship Scholarship Fund  The Kitchener-Waterloo Council of Friendship offers scholarships totalling $2000. to first year students who were born in a non-English speaking country and are residents of the Kitchener-Waterloo school area. Further details may be obtained from the Officer of the Registrar of the University of Waterloo or from your Secondary School.

The Percy Hermant Centennial Bursary Scholarships  These awards are the gift of Sydney Hermant. Bursary Scholarships are awarded on the basis of academic achievement in first year General Science at any Canadian University and financial need to a student who is proceeding into Year 2, School of Optometry. Six Scholarships are available, each of a total possible value of $1,200., being $300. per year over the four professional years (years 2, 3, 4 and 5) provided a satisfactory standing is maintained. One scholarship is awarded to a student who resided in the Maritimes immediately prior to his first University year; two scholarships are awarded to students who resided in Ontario; three scholarships are awarded to students who resided in Western Canada. The various Provincial Optometrical Associations are consulted in awarding these Bursary Scholarships. Application for this Scholarship should be submitted to the Scholarship Committee before July 31st, 1971.
The Saskatchewan Optometric Association Scholarship (value $500.00)
The Saskatchewan Optometric Association presents an annual scholarship of $500.00 to a Saskatchewan student enrolling in the School of Optometry.

Application for this Scholarship should be submitted to the Scholarship Committee before July 31st, 1971.

Science Society Scholarship
The Science Society, University of Waterloo, is offering a $50.00 scholarship to the undergraduate student attaining the highest mark in the Faculty of Science in any academic year. This award may not be held concurrently with other scholarships or merit awards.

Ukrainian Credit Union
"Buduchnist" Scholarship in Ukrainian Studies
This Scholarship of $100. will be awarded annually to an outstanding full-time student who attains the highest academic standing in a Ukrainian course.

University of Waterloo
Undergraduate Research Assistantships
These Assistantships are made available by the Faculty of Engineering to give the opportunity to outstanding students to become involved in non-classroom activities associated with research being done within the Faculty. The student must have an outstanding academic record and be interested in spending time during his academic term on activities not associated with the prescribed curriculum. The Value of this award is $500. per term on campus.

Undergraduate Bursaries

Note
Second class standing is normally required of applicants for bursary assistance. Applications must be submitted by end of first month of first term unless otherwise indicated.

ATA Trucking Industry Educational Foundation Bursaries
The Automotive Transport Association Trucking Industry Educational Foundation was established in 1958 by a group of transport companies who decided to divert monies formerly spent in customer gift-giving at Christmas to bursaries for deserving and needy students. The funds are to be distributed to students in all faculties, who, because of extenuating circumstances, are deserving of financial help, and would not be in a position to continue their studies without some assistance.

Awards will be made by the Scholarships Committee. Application for a bursary should be made through the Awards Office.

Atkinson Charitable Foundation Bursaries
The Atkinson Charitable Foundation has established a bursary programme which gives assistance to students of merit and proven financial need. Awards are made only to students who are bonafide residents of the Province of Ontario.

Further information and application forms may be obtained from the Awards Office.

Birks Family Foundation Bursary
Birks Family Foundation have made an amount available to the University of Waterloo to distribute in bursary form. The amount of the award varies depending upon proven need. Applications should be forwarded to the Awards Office.

Canada Packers Award
Canada Packers Limited is making available two $100. awards to fourth year Chemical Engineering students having attained high academic achievement in third year. One award will be made in each of stream 'A' and stream 'B'. Other determining factors include personal
Undergraduate Bursaries

recipients will be male and winners will be determined by the Senate Committee on Scholarships and Student Aid in conjunction with the Chemical Engineering Department. *No application is necessary.*

**Huron County Bursaries**
Huron County Council has established a bursary fund at the University of Waterloo for students who attended High School in Huron County and whose home is in that County. The bursaries, offered annually, will be for an amount of $100, and will be awarded to full-time undergraduate students in any faculty of the University who have good academic records and who are in need of financial assistance to enable them to continue their studies.

**The Hydro-Electric Power Commission of Ontario Bursary**
A bursary, of the value of $500., is offered annually by the Hydro Electric Power Commission of Ontario to a student in second year in any of the following honours courses: Mathematics, Physics, Applied Science and Engineering. It is to be awarded to undergraduates with good academic standing who are in need of financial assistance. The bursary may be held concurrently with other awards where the need exists. Awards will be made by the Scholarships Committee. *Applications should be made through the Awards Office.*

**V·Thomas J. Watson Memorial Bursaries**
The University of Waterloo has been invited to participate in the IBM-Thomas J. Watson Memorial Bursary Programme, established by the IBM Company Limited. The objective of the program is to provide financial assistance to undergraduate students in need with good academic standing. This will apply to all years and faculties of the University. A bursary may be held concurrently with other awards provided that a definite need is established. *Bursaries will be awarded by the Scholarships Committee. Application may be made through the Awards Office.*

**Inspiration Limited Bursary**
Inspiration Limited is making available a bursary in the amount of $500. to a deserving undergraduate student in second year Geology. If the receipt of this award conflicts with the Ontario Student Awards Programme, distribution may be divided between two or more students. The award is made on the recommendation of the Department of Earth Science. *No application is necessary.*

**Interprovincial Pipeline Company Bursary**
The Interprovincial Pipe Line Company Bursary Fund, of a total value of $2,500., has been established by Interprovincial Pipe Line Company to benefit students beyond the first year in any faculty who are in need of financial assistance in order to continue their studies. The company has stipulated that at least 50% of the funds granted, go to students in the applied sciences. Preference will also be given to students whose normal residence is Canada or the U.S.A. *Application for a bursary should be made through the Awards Office.*

**Bickell Foundation Bursaries**
The Foundation is making available a sum of money to be used in providing bursary assistance to Chemical Engineering and Earth Science students of good academic standing who need financial assistance. *Awards will be made by the Scholarships Committee. Application for a bursary should be made to the Awards Office.*

**Canadian Federation of University Women - Kitchener - Waterloo**
The Canadian Federation of University Women has established a bursary fund at the University of Waterloo to assist one or more girls in second, third or fourth year who have attained Second Class Standing in their college work. *Awards will be made by the Scholarships Committee. Application for a bursary should be made to the Awards Office.*
Undergraduate Bursaries

Undergraduate bursaries are available to students not holding tuition scholarships. Application should be made on the forms provided by the Awards Office.

Lambton County Bursary
Lambton County Council offers a bursary valued at $100. to a student from the County but excluding residents of the city of Sarnia. Application should be made through the Awards Office.

Litton Systems Bursary
A bursary, to the value of $500., is offered annually by Litton Systems (Canada) Limited. The bursary may be awarded to students in the Faculty of Engineering with preference being given to those in the electronic or electro-mechanical fields. It is intended to provide financial assistance to undergraduates in need and may be held concurrently with other awards where the need exists. Awards will be made by the Scholarships Committee and the amount available may be apportioned among two or more students. Applications for a bursary should be made to the Awards Office.

Lloyd C. Meyer Bursary
This bursary to the value of $300. is awarded annually to a student in the Faculty of Engineering who is in need of financial assistance and who has a satisfactory academic standing. Application should be made through the Awards Office.

Middlesex County Bursaries
Middlesex County Council offers two bursaries, each valued at $150. to students from Middlesex County who are of approved academic standing and in need of financial aid. Application should be made through the Awards Office. Selection will be made by the Senate Committee on Scholarships and Student Aid.

Monsanto Can. Ltd. Bursaries
Two bursaries, each for $500.00, are being offered to 4th year Chemical and Mechanical Engineering students. A “B” standing in 3 B term is necessary in order to be considered eligible. Recipients will be determined in conjunction with the respective Engineering departments. Applications should be forwarded to the Awards Office.

Oxford County Bursaries
Oxford County Council has granted the University of Waterloo an amount of $1000. to be distributed to Oxford County students excluding those from the municipalities of Woodstock and Ingersoll. Students must be of good academic standing and in need of financial assistance. Application should be made through the Awards Office.

Perth County Bursary
Perth County Council offers two bursaries of $100. to deserving students beyond the freshman year. Candidates must have resided in Perth County for one year previous to admittance to the University of Waterloo. Application should be made through the Awards Office.

P.L. Robertson Manufacturing Co. Ltd. Bursary
A bursary, to the value of $100., is offered annually by the P.L. Robertson Manufacturing Co. Ltd. The bursary is to be awarded to students in the Faculty of Engineering who are in need of financial assistance and who have satisfactory academic standing. Where the need exists the bursary may be held in conjunction with other awards. The Scholarships Committee will award the bursary and application should be made to the Awards Office.

The Minnesota Mining and Manufacturing of Canada Limited Bursaries
Two bursaries, to the value of $500. each, are offered annually by the Minnesota Mining and Manufacturing of Canada Limited. The bursaries are open to students of all faculties and undergraduates only. Where the need exists the bursary may be held in conjunction with other awards. The Scholarships Committee will award the bursary and application should be made to the Awards Office.
The Steel Company of Canada, Limited Bursary

The Steel Company of Canada is offering an admission bursary in the amount of $500. each year for four years to give financial assistance to students of superior ability who might not otherwise go to university because of lack of funds.

Applicants must be permanent residents of Canada and must have completed the final year's work for university entrance in one school year and have attained a minimum average mark of 66%. The Stelco Bursary is not tenable with scholarships totalling in excess of $200. but may be held with other bursaries at the discretion of the university.

Application may be made by writing to the Awards Office, University of Waterloo.

Uniroyal (1966) Ltd. Student Aid Plan

Beginning with the academic year 1961-62 Uniroyal has included the University of Waterloo in its programme of aid to education. Awards will be made by the Scholarships Committee. A candidate must have completed at least one academic year, should establish a need for financial assistance and be willing to assume a moral obligation to repay the university over a reasonable period at least twenty-five per cent of any funds received.

Further information and application forms may be obtained from the Awards Office.

Waterloo Young Men's Club Bursary

A bursary to the value of $100. is offered by the Waterloo Young Men's Club to a full-time student who is a permanent resident of the City of Waterloo, who has a good academic standing and needs financial assistance.

Application should be made through the Awards Office.

Undergraduate Prizes

The Association of Professional Engineers of the Province of Ontario makes this award to the student in the fourth year of an accredited engineering course, who having received honours, has obtained the highest standing in the final examinations of the current academic year. Included with this award is a gift of technical books valued at approximately $50.

The Canadian Ophthalmic Laboratories' and Suppliers' Prizes

The Canadian Ophthalmic Laboratories' and Suppliers' provide funds to award the following prizes. Since the amount in the fund varies from year to year, they will be awarded in the following sequence until the fund is exhausted each year:

a) Four General Proficiency Prizes (value $200. each) awarded to the student in the School of Optometry standing highest in General Proficiency in each of the second, third, fourth and fifth years.

b) Four General Proficiency Prizes (value $100. each) awarded to the student in the School of Optometry standing second highest in General Proficiency in each of the second, third, fourth and fifth years.

All of the above prizes are made available through contributions of the following Canadian Suppliers and Laboratories:

Bausch and Lomb Optical Company (Canada) Limited Toronto, Ontario
Undergraduate Prizes

Centennial Optical Limited
Dominion Contact Lens Laboratory, New Toronto, Ontario
Eastern Optical Laboratories Limited, Dartmouth, Nova Scotia
Kahn Optical Company Limited, Toronto, Ontario
K & W Optical Co. Ltd.
Monarch Optical Company Limited, Toronto, Ontario
Professional Optical Co.

Classics Prize
The Classics Prize of $50. will be awarded annually to the student who attains the highest mark in either Latin 190 or Greek 190. To qualify for the prize the student must enroll in the second year of an honours programme offered by the Classics and Romance Languages Department.

The Optometrical Women's Auxiliary Prize (value $100.00)
The gift of the Women's Auxiliary to the Optometrical Association of Ontario is awarded to a student in second year in the School of Optometry standing highest in the subject of Physiological Optics.

The Optometrical Women's Auxiliary Prize (value $100.00)
The gift of the Women's Auxiliary to the Optometrical Association of Ontario is awarded to a student in third year in the School of Optometry standing highest in the subject of Optometry.

The J.C. Thompson Memorial Prize (value $100.00)
The award of the Alumni Association in memory of the late Dean J.C. Thompson is made to a final year student in the School of Optometry who has ranked highest in Optometry.

The Percy Herman General Proficiency Prizes (value $200.00 and $100.00)
The gifts of Sydney Herman are awarded to the final year student in the School of Optometry ranking first and second in general proficiency.

The General Proficiency Medal
The gift of the Board of Directors, College of Optometrists of Ontario, is awarded to the final year student in the School of Optometry ranking highest in General Proficiency.

The Arthur A. Johnson Medal
The gift of Arthur A. Johnson is awarded to the final year student in the School of Optometry ranking highest in Optometrical Optics.

The T.T. Beattie Medal
The bequest of T.T. Beattie is awarded to the final year student in the School of Optometry ranking highest in Orthoptics or Visual Training. The award is made once every three years, approximately as funds permit.

The E.F. Attridge medal
The gift of E.F. Attridge is awarded to the final year student in the School of Optometry ranking highest in Pathology.

Optical Company Limited Prizes
Two awards in the amount of $250. each are being made available to two final year students in the School of Optometry. The award winners are determined by the Awards Committee within the School of Optometry. No application is required.

The Canadian Contact Lens Society Prize (value approximately $75.00)
The proceeds of a fund invested on behalf of the Canadian Contact Lens Society will be awarded to a final year student in the School of Optometry who shows the greatest proficiency in the theoretical and practical application of Contact Lenses.

Faculty and Staff Prize
The University of Waterloo Faculty Association has established a fund to award prizes, of the value of $50. each, to the students who rank first in the second year of the School of Optometry.
Undergraduate Prizes

examinations, is not repeating his year, has no supplemental examinations, and carries a full course load.

An application is not required. The Faculty Association has the final decision in all cases.

French Department Prize

The French Prize, of the value of $50. will be awarded to the student who attains the highest mark in the honours programme at the end of his 2nd year. To qualify for the prize the student must enroll in the 3rd year honours programme.

The Jerome T. Miller Memorial Prize

This book prize was established in 1968 by relatives and friends in memory of the late Jerome Thomas Miller, B.Sc., M.Sc. (1966)—Honours Chemistry and Physics. The book is to be awarded each year, on the basis of marks, to the student in third year of a programme which combines studies in Chemistry and Physics.

Pennsylvania German Folklore Society of Ontario Prize in German

This prize of $50. will be awarded annually to the student in the Faculty of Arts, born in Canada, who has made the most progress in German during the year.

The Bobby Bauer Memorial Award

Beginning with the No application is necessary, the Bobby Bauer Memorial Foundation will make one or more awards annually to students demonstrating outstanding proficiency in Hockey who qualify for admission to a full-time undergraduate course at a Canadian university.

Application should be made prior to August 31 on forms provided by the Foundation. A letter of reference from a person actively involved in Hockey must accompany each application.

Inquiries and applications should be sent directly to:
Bobby Bauer Memorial Foundation,
60 Victoria Street North,
Kitchener, Ontario.

The Bruce Wyler Kelly Memorial Prizes

These book prizes were established in 1960 by relatives and friends in memory of the late Bruce Wyler Kelly, the first Dean of Science at the University of Waterloo, 1958-1960. These prizes are awarded in the General Science Course at the end of the second year to two students, one registered with Biology as his major subject and one registered with Chemistry as his major subject. Qualifications are (a) a clear pass standing and (b) highest standing in Biology with a minimum of B standing, in chemistry or highest standing courses taken with a minimum of B standing in the average of these courses.

The Engineering Institute of Canada Student Prize

The E.I.C. Student Prize is awarded to a Student Member of the Institute in the year prior to the graduating year on the basis of the marks made in his academic year, and his activities in the student engineering organization or in the local branch of a recognized engineering society.

The Chemical Institute of Canada Prize

Two awards, one each to a Chemistry and a Chemical Engineering student, are made annually by the Institute. The awards, consisting of an inscribed medal and a $25. gift, are given to the student standing at the top of the penultimate year of either course. No application is necessary.

The George Crabbe Prize for
categories: short story, novelette, one-act play, full-length play, poetry. Contestants should submit their manuscript or manuscripts, typed double space and in duplicate, to the Office of the Registrar by October 31. Each manuscript shall bear a pseudonym and shall be accompanied by a sealed envelope containing the real name of the person using the pseudonym.

The Joseph Addison Essay Prize
This prize, open annually to all full-time students in all faculties, consists of $100. to be awarded, in whole or in part at the discretion of the judges, for the best essay or essays on one or more of a number of themes to be set each year. The themes for 1967 were the following:
1) The effects of nationalism on literature.
2) Changing fashions in iconography.
3) The role of literature in the reform of manners.
Each essay, which may be no shorter than 2,000 words and no longer than 5,000, shall be on one of these themes, and should evince, in addition to a competent handling of the subject, the qualities of grace, clarity, and gentlemanly ease which characterizes the essays of Joseph Addison. Contestants should submit their manuscript or manuscripts, typed double space and in duplicate, to the Office of the Registrar by January 31. Each manuscript must bear a pseudonym and must be accompanied by a sealed envelope containing the real name of the person using the pseudonym.

Society of Plastics Engineers, Polymer Engineering Prize
This award, in the amount of $150., is offered to the full-time student with the highest over-all standing in graduating year enrolled in Chemical Engineering with Polymer option. Selection is made in co-operation with the Chemical Engineering Department.

Society of Plastics Engineers, Polymer Chemistry Prize
This award, in the amount of $150., is offered to the full-time student with the highest over-all standing in graduating year enrolled in Applied Chemistry with Polymer option. Selection is made in co-operation with the Chemistry Department.

Student Loans
The purpose of the Canada Student Loans plan is to make bank loans available to students who need financial help to enable them to engage in full-time studies directed towards a degree or diploma at universities or certain other educational institutions above the high-school level.

The Canada Student Loans Plan is a Federal Government programme which is administered by the provincial agencies. The provisions of the plan are set out in a brochure issued by the Federal Authority. For more detailed information, reference should be made to that publication. Eligibility for a loan is based on need as determined by criteria established by the Federal Government in consultation with the provinces.

The Canada Student Loans Plan was set up to supplement family and other financial sources available to students, not to replace them. It follows that Certificates of Eligibility may be issued only if you can establish that the financial resources available to you, including those of your parents, are not enough to meet what the awarding authority considers to be reasonable costs for the academic year. To this end, you will be asked to give a signed statement which will include information concerning your financial resources. Since, in general, parents usually are responsible for the education of their children, they will be asked to provide information as well.
Student Loans

parents will normally be asked to give information concerning their income. Under the plan, a ceiling is placed on the total loans that may be authorized by a province, and a Provincial Authority cannot be expected to use its part of the loan funds to approve loans to students who are really not in need of such assistance.

Copies of the application form are available at all post-secondary institutions. When completed in accordance with the instructions on the application form the required number of copies should be sent to:

Awards Officer
Office of the Registrar
University of Waterloo
Waterloo, Ontario

When need has been determined in accordance with the established criteria, the student and the institution he proposes to attend will be informed of the loan assistance the student can expect to receive.

If the student feels that he or his family has had exceptional costs or that there have been substantial changes in the financial situation, he may request a review by the student awards officer of the institution he proposes to attend or is attending. The student awards officer of the institution may, if he considers the circumstances merit it, recommend an adjustment in the calculation of need.

The amount of loan finally authorized can be secured by the student after registration. Applications should be submitted prior to July 15. Applications submitted after this date may also be processed in time for registration but, to ensure this, the forms should be received by the date specified.

Grants Under Ontario Student Awards Programme
The Province of Ontario offers a grant to meet part of the need as determined by the criteria for the Canada Student Loans Plan as set out above.
Further information may be obtained from the high school principal or Awards Office.

Alumni Association Student Assistance Plan.
This Loan Fund has been instituted by the Alumni Association, University of Waterloo.
Loans up to $100. with repayment periods of up to 4 months are available to students in all faculties.
Further information may be obtained from the Awards Office.

The Adelaide Detweiler Student Loan Fund
This loan fund has been established by Mr. J.R. Detweiler in memory of his mother, Adelaide Detweiler, to provide short-term loans interest free, to students who may be confronted with unexpected expenses during their academic year. Further information may be obtained and application may be made through the Awards Office.

Engineering Society "A" Loan Fund
This fund was established by the Engineering Society "A" to assist students in need of short term loans. Further inquiries should be directed to the Awards Office.

Ian Carr Loan Fund
This loan fund has been set up by the parents in memory of their son, a former student at the University of Waterloo. It is intended to provide short-term loans, interest free, to students who may be faced with unexpected expenses during their academic year. Further information may be obtained, and application may be made through the Awards Office.
Environmental Studies Society Loan Fund

Short term non interest bearing loans are available to full time undergraduate students enrolled in the Division of Environmental Studies. The maximum loan is normally $100. These funds are made available by the Society and represent a part of the proceeds of functions sponsored by the Society.

Application should be made to the Awards Office.

Ginny Lee Memorial Fund

Students' Council has set aside a sum of money to be used in assisting students by providing interest free, short term loans. It is intended that this fund be used only when other avenues of obtaining assistance have been tried unsuccessfully.

Further information may be obtained from the Awards Office.

Graham, Myall, Thompson Memorial Fund

A memorial fund has been instituted by the classmates of the late J. Graham, M. Myall and J. Thompson, who lost their lives in an auto accident in 1969. The fund represents contributions received from their classmates and other interested donors. Loans are made available to students enrolled in the Engineering faculty and to those who have completed at least one full year of academic study. Maximum loans are $200. with repayment terms extending up to 90 days. Further information may be obtained from the Awards Office.

John Faber Memorial Fund

This fund was established by the Circle K Club at the University of Waterloo in memory of John Faber, former club member. Short term loans are offered to full time students at the University of Waterloo. For further information, enquiries should be directed to the Awards Officer.

Co-operative Lecture Emergency Loan Fund

This fund was established by Canadian politician T.C. Douglas in 1970. It is intended to provide short term, interest free loans to needy students who have been faced with unexpected expenses during their academic year.

Kitchener-Waterloo Council of Friendship Loan Fund

Students in their final year may apply for loans up to $200. through the Awards Officer. These loans are interest free and should be repaid within two years after graduation.

Graduate Scholarships and Fellowships

Alberta Optometric Association Graduate Scholarship

The awarding of this scholarship will be made only by, or on the recommendation of the committee of the School of Optometry, University of Waterloo. Applications should be forwarded to the Director of the School by July 1st of each year. In the amount of $1,000 the scholarship will be awarded to a graduate of outstanding academic merit who undertakes to pursue postgraduate studies in the field of Optometry or any other discipline having relevance to Optometry.

University of Waterloo Teaching Fellowship

Various departments in the University offer Teaching Fellowships which allow a student to do elementary demonstrating, marking, and instruction while carrying on graduate work. Information concerning these departmental Fellowships may be obtained by applying directly to the department concerned.

Note: Some departments offer research assistantships which provide an opportunity for professional experience, and which may involve light...
Graduate Scholarships and Fellowships

Canada Council Grants
The Canada Council offers fellowships and grants in the social sciences and humanities and a variety of assistance to professional artists. Among Council programmes of aid are: Doctoral fellowships*, Post-Doctoral fellowships*, Leave fellowships*, Research Grants, Arts Awards*, Arts bursaries*, short-term grants. (Asterisked items are annual competitions, with specified deadlines in fall each year.)

Brochures giving detailed information, including deadlines for annual competitions, on these and other Canada Council programmes of aid are available on campus from: the University Graduate Office, or from The Canada Council, 140 Wellington St., Ottawa 4, Ont., as follows: Awards Service—For annual competitions, Social Sciences and Humanities Division—For research grants, Art Division—For short term grants.

English Speaking Union, Waterloo-Wellington Branch Travel Scholarship
The English Speaking Union, Waterloo-Wellington branch, offers a travel scholarship in the amount of $200. to a foreign student in the Graduate School of Engineering who would profit by travel to a Canadian industrial plant closely associated with his graduate studies. This industrial plant must be located in Canada. The student selected for this scholarship will be determined by the Associate Dean of Engineering (Graduate studies).

College of Optometrists of Ontario's Scholarship (value $1,200.00)
The award of the College of Optometrists of Ontario is made to an Optometry graduate who is recommended by the faculty and is proceeding toward a graduate degree at the University of Waterloo. The award is payable in installments subject to satisfactory achievement. Application for this Scholarship should be submitted to the Scholarship Committee before July 31st, 1971.

National Research Council Postgraduate Scholarships and Postdoctorate Overseas Fellowship
The National Research Council awards each year, in open competition, a number of postgraduate scholarships, bursaries, and science scholarships in science and engineering to assist students in undertaking graduate study and research leading to advanced degrees, and a limited number of postdoctorate fellowships for those wishing to add to their experience by specialized training abroad. These scholarships are open to men and women on equal terms, and are awarded on the basis of high scholastic achievement and evidence of capacity to do research. Completed application forms from students in attendance at the University of Waterloo for postgraduate scholarships, bursaries, and science scholarships must be submitted to the department. Applications for postdoctorate and PIER scholarships must be filed directly with NRC. Further information may be obtained from the University Graduate Office.

The Queen Elizabeth 2 Ontario Scholarships
In honour of the visit of Her Majesty Queen Elizabeth to Ontario in July, 1959, the Government of the Province established a fund to provide annually a number of postgraduate awards to be known as “The Queen Elizabeth II Ontario Scholarships”. In 1971 five such Scholarships, each of the value of $5,000, will be available in the fields of the humanities, social sciences and mathematics. Scholarships are intended for candidates nearing the completion of the Ph.D. degree. Further information may be obtained from the University Graduate Office.

Woodrow Wilson National Fellowship Foundation
The Woodrow Wilson National Fellowship Foundation offers 100 Fellowships annually for the first year of study in any qualified graduate programme of the University of Waterloo. The fellowship is equal to the full tuition fee and, in addition, provides funds for books and other supplies, and for travel and living expenses. Application forms should be submitted directly to the fellowship foundation. Further information may be obtained from the University Graduate Office.
become college teachers.

A fellow receives $2,000. plus dependency allowance for wife and children. The Foundation also pays directly to the graduate school tuition and fees for the fellow.

A candidate must be nominated by a faculty member no later than October 31, 1971.

**Imperial Oil Graduate Research Fellowships**

Imperial Oil Limited in 1946 established for annual competition Graduate Research Fellowships, now five in number, and having a potential value of $9,000. each ($3,000. a year for a maximum of three years). There are no restrictions on other concurrent awards held.

The fellowships are open to any graduate of any approved Canadian university and are offered for research leading to a Doctor's degree in the fields of Pure and Applied Natural and/or Exact Sciences, including Mathematics (three fellowships), and Social for the fellowships is made by the university—such nominations to be received by the Secretary, Committee on Higher Education, Imperial Oil Limited, 111 St. Clair Avenue West, Toronto 7, Ontario, not later than February 1 of each year.

**Steel Company of Canada Graduate Research Fellowship in Metallurgy**

The Steel Company of Canada Limited offers four fellowships for research in Metallurgy of the value of $3,500. each plus $100. to the Metallurgy Department of the University in which the research will be carried out.

The competition for these fellowships is open to permanent residents of Canada who are graduates of a Canadian university. Application for renewal may be made in succeeding years, but the award may not be held for more than three years.

Applications should be forwarded to the Director of Awards, Association of Universities and Colleges of Canada, 151 Slater Street, Ottawa 4, Ontario, not later than February 28.

**The Athlone Fellowships**

Her Majesty's Government in the United Kingdom has established a number of fellowships to be awarded annually to enable Canadian Engineering graduates to take postgraduate training in the United Kingdom. Additional fellowships are available for award to graduates who have already spent some time in industry. The fellowships, which are normally tenable for a period of two years, cover costs of transportation, fees and maintenance. Candidates must be Canadian citizens or British subjects normally resident in Canada and should preferably be less than twenty-seven years of age.

Further information may be obtained from the Dean of the Faculty

**Commonwealth Scholarship and Fellowship Plan**

The Commonwealth Scholarship and Fellowship Plan aims at providing opportunities for Commonwealth students to pursue advanced courses in other Commonwealth countries. The scholarships are intended for men and women of high intellectual promise who may be expected to make a significant contribution to their countries on their return from studies abroad. At present, graduate scholarships are available for study in the United Kingdom, Australia, New Zealand, Hong Kong, Malaya, Rhodesia and Nyasaland, Malta, India, Ceylon, East Africa, Nigeria and Pakistan, and the Canadian Government offers scholarships for other Commonwealth students to study in Canada. Awards will normally be made for a period of two academic years and will cover return transportation, tuition fees, a personal Maintenance allowance, and a grant for incidental expenses. Deadline dates for receipt of applications vary according to each country.
Graduate Scholarships and Fellowships

Ottawa 4, Ontario

Commonwealth Research Fellowships

In addition to the Commonwealth Scholarships which Canada already offers to other Commonwealth countries, awards to be known as Commonwealth Research Fellowships are now to be made. Commonwealth Research Fellowships are intended to bring to Canada from universities and research centres of other countries of the Commonwealth, scholars of established reputation whose presence in Canadian universities is expected to be of benefit to themselves and to their countries as well as to their Canadian hosts. A fellow will be free to do his own study and research and to engage in other activities for the purpose of building up his contacts with his Canadian colleagues during his stay in Canada. He will normally be attached to a single university during the period of his fellowship although his programme might include short visits to other institutions.

Up to three Fellowships in this category will be available for each academic year; however, a university may not make more than one nomination for any given year and may not be host to Research Fellows in two consecutive years.

Further information may be obtained from the Association of Universities and Colleges of Canada, 151 Slater Street, Ottawa 4, Ontario.

Province of Ontario Graduate Fellowships

Fellowships, up to the value of $1,500, for one academic year (8 months) or an amount not to exceed $2,250. for an academic year and the period between academic years (12 months), are offered by the Province of Ontario. The minimum prerequisite is an Ontario Honours B.A. or its equivalent. A fellow pledges to give serious thought to a career in university teaching and during tenure he will undertake a full-time programme of graduate study. Fellowships are tenable only at Ontario universities and most awards will be made to candidates who are residents of Ontario.

Application is to be made on the prescribed form which may be obtained from the University Graduate Office. Deadline date is February 15.

The Shore Fellowship in Environmental Design

This Fellowship in the amount of $500. was established in 1964, and is awarded to a full-time student doing work in Architecture in the Coll. of Env. Studies.

Further information may be obtained from the School of Architecture.

Gulf Oil Canada Limited Graduate Fellowships

Gulf Oil Canada Limited offers five graduate fellowships to be awarded annually and, upon request, each may be renewed for further study, subject to the approval of the selection committee. Each fellowship is valued at $4,000.; $3,000. to be paid to the successful candidate and $1,000. to the department of the university in which the Fellow is registered.

The Fellowships are open to any resident of Canada who is a graduate of a Canadian University which is a member of the Association of Universities and Colleges of Canada.

Graduate students in any field of study at member institutions of the A.U.C.C. may apply for the awards. Applications are to be sent directly to the Director of Awards, Association of Universities and Colleges of Canada, 151 Slater Street, Ottawa 4, Ontario.

Completed applications must be received no later than March 1st.

International Nickel Graduate Research Fellowships in Engineering and Science

The International Nickel Company of Canada, Limited provides a number of Graduate Research Fellowships in Engineering and Science...
$3,800. is payable to the Fellow and $700. to the Department for materials and equipment to support the research.

The Fellowships are open to students who are proceeding to either the Master's or Doctor's degree and whose research will be concerned with basic science intrinsically related to the following specializations:

Chemistry or Physics of Metals or Minerals
Geology (including Geophysics and Geochemistry)
Metallurgy (both Physical and Extractive, including Mineral Dressing)
Mining
Mineral Processing

Application is made in letter form by the candidate's supervising professor to The International Nickel Company of Canada, Limited, P.O. Box 44, Toronto-Dominion Centre, Toronto 8, Ontario, prior to January 15. Not more than one application (either new or renewal) will be considered annually from any one Department, and not more than three Fellowships will be tenable annually at any one university.

Chemcell (1963) Limited
The Chemcell (1963) Limited has recently instituted a programme of Graduate Research Fellowships open to Canadian residents and graduates of a Canadian university or college in the fields of Chemistry, Engineering, Physics or Mathematics who wish to pursue graduate work in a Canadian university. Six awards, valued at $2,500. plus $1,000. to the relevant department of the receiving university will be made each year.

Further information and application forms may be obtained from the Director of Awards, Association of Universities and Colleges of Canada, 151 Slater Street, Ottawa 4, Ontario. Deadline date is March 1.

Royal Commission for the Exhibition of 1851—Science Research Scholarships
Value 750 per annum; tenable ordinarily for two years, a candidate must be a citizen of the British Commonwealth, and under 26 years of age, except in very special circumstances. He must have been a student of science in a university for a period of not less than three years, and must have spent one full academic year ending not more than 12 months prior to the date of recommendation at the Institution by which he is recommended.

The record of a candidate's work must indicate high promise of capacity for advancing in science or its applications by original research. Evidence of this capacity, which is the main qualification for the Scholarship, is essential and should take the form of a full account by the candidate of the research work he has done. This may be either in the form of publications or of a thesis or of manuscript reports.

Further details concerning this award may be obtained from the University Graduate Office.
Main Entrance to the University of Waterloo
17 Governing Bodies and Staff
The Board of Governors

Officers

C.A. Pollock—Chairman
J.W. Brown—Secretary

Ex-Officio Members

The Chancellor
The President
The Mayor of the City of Kitchener
The Mayor of the City of Waterloo
The Warden of Waterloo County

Members Appointed by the Lieutenant-Governor in Council

William H. Evans, Toronto, Willowdale
G.R. Henderson, Sarnia

Elective Members

Donald S. Anderson
Toronto
W.A. Cambell
Oakville
George H. Craig
Toronto
J. Craig Davidson
Toronto
George H. Dobbie
Galt
R. Fraser Elliott
Montreal
Lewis Hahn
New Hamburg
E.L. Healy
Toronto
Colonel H.J. Heasley
Waterloo
P.R. Hilborn
Preston
P.J. Ivey
London, Ontario
A.R. Kaufman
Kitchener

R. Bruce Marr
Kitchener
Wm.W. McGrattan
Islington
John E. Motz
Kitchener
C.H. Pollock
Kitchener
W.M. Rankin
Toronto
A.I. Rosenberg
Kitchener
J.W. Scott
Kitchener
James G. Thompson
London
J.P.R. Wadsworth
Montreal
C.N. Weber
Kitchener
J. Leo Whitney
Waterloo

Vacancies—7
Senate

Officers
Chairman — The President and Vice-Chancellor
Vice-Chairman — The Academic Vice-President
Secretary — The Registrar

Ex-Officio Members
The Chancellor — I.G. Needles, A.B., LL.D.
The Vice-Chancellor — B.C. Matthews, B.S.A., A.M., Ph.D.
The Academic Vice-President — H.E. Petch, B.Sc., M.Sc., Ph.D., F.R.S.C.

The Principal of each Federated or Affiliated College
J.R. Finn, C.R., M.A., Ph.D. (President, St. Jerome’s College)
J.W. Fretz, B.A., M.A., B.D., Ph.D. (President, Conrad Grebel College)
A.M. McLachlin, M.A., B.D., Th.D. (Principal, St. Paul’s United College)
A.W. Rees, M.A. (Principal, Renison College)

The Dean of each Faculty or School of the University
P.G. Cornell, E.D., M.A., Ph.D. (Dean of Arts)
A.N. Sherbourne, B.Sc., M.S., M.A., Ph.D. (Dean of Engineering)
P.H. Nash, B.A., M.A., Ph.D. (Dean of Environmental Studies)
D.A. Sprott, M.A., Ph.D. (Dean of Mathematics)
G.S. Kenyon, B.P.E., M.S., Ph.D. (Dean of Physical Education & Recreation)
G.E. Cross, M.A., Ph.D. (Dean of Graduate Studies)

The Academic Dean of each Federated College
J.A. Wahl, C.R., B.A., M.A., Ph.D. (St. Jerome’s College)

The Librarian
W.J. Watson, B.A., M.A., B.L.S.

The Chairman of the Board of Governors
C.A. Pollock, B.A.Sc., B.S.

The Registrar
C.T. Boyce, B.A.

The Director of Extension
A.A. Beveridge, B.A., M.Sc.

Faculty Representatives

Elective Members
To 1971
M. Brown, B.A., M.S., Ph.D. (Arts)
J.C. Gray, B.A., M.A., Ph.D. (Arts)
L.A.K. Watt, B.Sc., M.S., Ph.D. (Engineering)
T.E. Bjornstad, B.Arch., A.I.A. (Environmental Studies)
A. Kerr-Lawson, B.A., S.M., Ph.D. (Mathematics)
W.A. Delahey, B.A., B.P.H.R.E. (Physical Education & Recreation)
W.S. Long, B.A., O.D. (Science)
P.E. Morrison, M.Sc., Ph.D. (Science)
A.M. MacQuarrie, B.A., M.A. (St. Jerome’s)

To 1972
J.F.H. New, M.A., Ph.D. (Arts)
B.G. Hutchinson B.E., M.Sc., Ph.D. (Engineering)
J. Aczel, Ph.D., Habil. D.Sc. (Mathematics)
C.A. Griffith, B.A., M.S., Ph.D. (Physical Education & Recreation)
H.D. Sharma M.Sc. Ph.D. (Science)
Senate

To 1973
A. Aages, B.A., M.A., Ph.D. (Arts)
H. M. Hill, B.A.Sc., M.Sc., D.Phil. (Engineering)
R. Y. M. Huang, B.Sc., M.A.Sc., Ph.D. (Engineering)
H. C. Abell (Miss), B.H.Sc., M.Sc., Ph.D. (Environmental Studies)
J. W. Leech, B.Sc., Ph.D., F.Inst.P. (Science)
F. F. Centore, B.Sc., M.A., Ph.D. (St. Jerome's)

Alumni Representatives
To 1971
J. H. Shaw, B.A.Sc.
R. C. VanVeldhuisen, B.A.Sc.
P. A. Boucher, C.R., B.A., (St. Jerome's)

To 1972
M. Kuxdorf, B.A., M.A., Ph.D.
B. C. Hayes, C.R., B.A. (St. Jerome's)

To 1973
C. Lavigne (Miss), B.A., (St. Jerome's)
Administrative Offices

President

President Emeritus
J.G. Hagey, B.A., LL.D.

President and Vice Chancellor
B.C. Matthews, B.S.A., A.M., Ph.D.

Office of Operations Analysis

Director
J.S. Minas, B.A., Ph.D.

Associate Director
B.R. Foord, C.A.

Dean of Women
H. Marsden (Mrs.), B.A., M.A.

Assistant Dean of Women
I. Mackay (Mrs.) B.Sc.

Information Services

Director
J.D. Adams, B.A.

Vice-President, Academic

Vice-President, Academic
H.E. Petch, B.Sc., M.Sc., Ph.D., F.R.S.C.

Assistant to the Vice-President, Academic
P.C. Brother, B.A., B.D.

Faculty of Arts

Dean of Arts
P.G. Cornell, E.D., M.A., Ph.D.

Associate Dean
M. Brown, B.A., M.S., Ph.D.

Associate Dean (Undergraduate Affairs)
W.R. Needham, B.Com., M.A., Ph.D.

Associate Dean (Graduate Affairs)
A. Ages, B.A., M.A., Ph.D.

Assistant to the Dean
M.C. Taylor, B.A.

Faculty of Engineering

Dean of Engineering
A.N. Sherbourne, B.Sc., M.S., M.A. Ph.D.

Associate Dean (Undergraduate Studies)
B.G. Hutchinson, B.E., M.Sc., Ph.D.

Associate Dean (Graduate Studies)
H.C. Ratz, B.A.Sc., S.M., Ph.D.

Executive Assistant to the Dean
J.D. Weller, C.A.

Division of Environmental Studies

Chairman, Undergraduate Affairs Committee
P.H. Nash, B.A., M.A., Ph.D.

Associate Dean, Graduate Affairs
L.H. Russwurm, B.A., M.A., Ph.D.

Assistant to the Dean
R.R. Krueger, B.A., M.A., Ph.D.

H. Bensusan (Mrs.)

Faculty of Mathematics

Dean of Mathematics
D.A. Sprott, M.A., Ph.D.

Associate Dean
C.F.A. Beaumont, B.A., M.A.

Associate Dean
K.D. Fryer, B.A., M.A., Ph.D.

Assistant to the Dean
R.G. Dunkley, B.A.

Assistant to the Dean
W.I. Miller, B.A.

School of Physical Education and Recreation

Dean of Physical Education & G.S.
G.S. Kenyon, B.P.E., M.S., Ph.D.
Administrative Offices

Director of Athletics  C.A. Totzke, B.A.
Director of Women’s Athletics  R.E. Priddle (Mrs.) B.P.H.E.

Faculty of Science

Associate Dean (Undergraduate Affairs)  R.G. Woolford, M.Sc., Ph.D.
Associate Dean (Graduate Affairs)  F.W.C. Boswell, B.A., M.A., Ph.D.

Interfaculty Programme Board

Director  W.U. Ober, B.A., Ph.D.

University Graduate Office

Dean of Graduate Studies  G.E. Cross, M.A., Ph.D.
Associate Registrar (Graduate Studies)  B. Ingram, B.A.
Assistant Registrar (Graduate Studies)  J.J. Bonesteel, B.A.
Foreign Student Advisor  E. Beausoleil (Mrs.)

Division of Continuing Education

Director  A.A. Beveridge, B.A.

Centre for Continuing Studies in Marketing

Director  D.V. Deverall, B.A.
Associate Director  R.D. Eaton, B.E., P.Eng

Computing Centre

Director  J.W. Graham, M.A.
Administrative Assistant  G. Hill
Faculty Liaison  J.F. Bolce, B.Sc., M.Sc.

Academic Services

Director of Academic Services  D.P. Robertson, B.Comm.

Audio Visual Centre

Director  G. Downie

Co-ordination and Placement

Director  A.S. Barber, B.I.E., P.Eng.
Assistant Director, Engineering Faculty Liaison  D.H. Copp, B.A.Sc. P.Eng.
Assistant Director, Mathematics, Kinesiology and Recreation  B.A. McCallum, B.A.
Architectural Programme Director  J.W. Hoag, B.Arch.
Post Graduate Careers Information Officer  G.L. White, B.A.Sc., P.Eng.
Placement Officer  E. Zapf, B.Ed., B.S.W.
Administrative Offices

Creative Arts

Director P. Berg

Counselling Services

Director W.W. Dick, B.A., B.D., M.A., Ph.D.

Health Services

Medical Director H. Reesor (Mrs.) B.A., M.D.

Library

University Librarian William J. Watson, B.A., M.A., B.L.S.

Head, Technical Services Murray C. Shepherd, B.Ed., M.A.

Graduate Library, Public Services, Arts Library Helen McKinnon (Miss), B.A., B.L.S., M.I.L.

Graduate Public Services, Engineering, Mathematics and Science Ada Berti (Miss), B.A., B.L.S.

Divisional Library

Office of The Registrar

Registrar C.I. Boyes, B.A.

Associate Registrar, Admissions B.A. Lumsden, B.A.

Associate Registrar, Records and A.R. Grenier, B.Sc.

Scheduling

Assistant Registrar—Arts J.F. Willms

Assistant Registrar—Engineering G.J. Smiley, B.A.

Assistant Registrar—Mathematics R.J. Bullen, B.Math.

Assistant Registrar—Science, G.V. Ambrose

Physical Education and Recreation

Environmental Studies J.E. Fauquier, B.A.

Secondary School S.J. Little, B.A.

Liaison Officer

Student Awards Officer A.R. Dejeet

Systems Analyst W.G. Ullman

Vice-President, Finance and Operations

Vice-President, Finance and A.B. Gellatly, B.A., C.G.A.

Operations

Internal Auditor R.H. Brooks, C.A.

Operating Budgets Analyst S.S. Farrell, M.B.A.

Financial Services Office

Comptroller A.H. Headlam, C.A.

Assistant to Comptroller V.E. Leavoy (Miss)

Chief Accountant W.L. Seguin, B.Comm., C.A.

Capital Financing Control E.D. Coburn, B.Comm.

Payroll Manager W.J. Scott

Staff Accountant W.K. Randell, R.I.A.

Physical Plant and Planning


Assistant Director (Physical Plant) J.W.G. Sloan, P.Eng.

Assistant Director (Planning) A.E. Lappin, P.Eng.
Administrative Offices

Purchasing
- Purchasing Agent: W.G. Deeks
- Assistant Purchasing Agent: W. Buzza
- Manager, Purchasing Services: A. Bergen
- Manager - Central Stores: C.A. Lawrence
- Office Services Manager: G.N. Selinger
- Supervisor, Bookings and Conference Facilities: U. Mundhenk
- Director: E.S. Lucy, B.A.
- Assistant Director, Pension & Benefits: A.H. Boyd
- Assistant Director, Salary Administration: L.W. Brown

Ancillary Enterprises
- Director: J.W. Brown, B.A.
- Bookstore Manager: E. Fischer (Mrs.)
- Food Services Manager: R.W. Mudie
- Graphic Services Manager: J.W. Hammond

Development
- Acting Director: J.W. Brown, B.A.

Residences and Housing Administration
- Warden: H.R.N. Eydt, M.Sc., Ph.D.
- Director of Housing & Residence: H.C. Vinnicombe, B.Sc.

Operations Safety
- Director: N. Ozaruk
- Security

Director: A.E. Romenco
18 The Faculty
Faculty

Abbott, C.C. Classes and Romance Languages
Abbott, W.R. Philosophy
Abell, H. School of Urban and Regional Planning
Abell, H. Sociology and Anthropology
Abler, T.S. Sociology and Anthropology
Aczel, J. Applied Analysis and Computer Science
Aczel, S. Applied Analysis and Computer Science
Adams, K.G. Mechanical Engineering
Adamczewski, Z. Philosophy
Ages, A. Classics and Romance Languages
Albright, S. Optometry
Allen, H.A.I. Statistics
Alleyne, J.M. Sociology and Anthropology
Alpay, S.A. Mechanical Engineering
Amoroso, D.M. Psychology
Anderson, A. Physics
Anderson, E. Combinatorics and Optimization
Anderson, J.G. Pure Mathematics
Anderson, J.H. Electrical Engineering
Andracki, S. Political Science
Andrews, G.C. Mechanical Engineering
Andrews, W.R. Optometry
Anthes, R.G. Electrical Engineering
Aplevich, J.D. Electrical Engineering
Appleton, S.S. Psychology
Appleyard, E.C. Earth Sciences
Ariaratnam, S.T. Civil Engineering
Armour, L. Philosophy
Arnold, D.J. Recreation
Aschcroft, E.A. Applied Analysis and Computer Science
Ashton, N.J. Kinesiology
Ashworth, E.J. Philosophy
Atkinson, G.F. Chemistry
Aziz, R.A. Physics

Bailey, B.A. History
Baker, D.N. History
Baker, Irving Optometry
Baker, J.A. Applied Analysis and Computer Science
Bakos, G.A. Physics
Balasubramanian, A. Chemistry
Baldock, Alan J. Optometry
Banerji, A. School of Architecture
Banks, R.K. Psychology
Barbier, J.A. History
Barker, J.A. Physics
Barnes, C.R. Earth Sciences
Barnes, D.S. Psychology
Barrett-Lennard, G.T. Psychology
Barron, F.L. History
Bater, J.H. Geography
Batke, T.L. Chemical Engineering
Faculty

Beachey, R.W.
Beam, P.D.
Beausire, M.

Beauchamp, M.A.
Beaumont, C.F.A.
Beecroft, E.A.
Beingessner, C.J.
Beneschi, R.

Bennett, G.W.
Bennett, K.M.H.
Bennett, M.A.
Benz, W.
Bergman, N.J.
Berman, G.
Bernhardt, Irwin
Bierman, R.
Binamé, J.J.
Bird, M.
Bishop, P.J.
Bjornstad, T.E.
Blake, I.F.
Bobetic, V.M.
Bobier, C.W.
Bock, R.R.
Bodnar, L.E.
Boeschenstein, H.

Bondy, J.A.
Boswell, F.W.
Bowers, K.S.
Bowers, P.E.
Bragg, G.M.
Brandon, J.K.
Brayshaw, G.S.
Breidenbaugh, M.
Brillinger, P.C.

Brisbon, D.A.
Brodie, D.E.
Brown, J.M.
Brown, M.
Brown, W.A.
Brubacher, L.J.
Brundrett, E.
Bryant, C.
Bryant, P.R.
Bryden, M.P.
Brzozowski, J.A.

Brzustowski, T.A.
Buchner, E.L.
Bullock, R.A.
Bunting, T.E.

History
English
Applied Analysis and Computer Science

Sociology and Anthropology
Applied Mathematics
School of Urban and Regional Planning

Mechanical Engineering
Applied Analysis and Computer Science

Statistics
Economics
Statistics
Pure Mathematics
Electrical Engineering
Combinatorics and Optimization
Management Sciences
Psychology

Classics and Romance Languages
Religious Studies
Kinesiology

School of Architecture
Electrical Engineering
Applied Mathematics
Optometry
Optometry
Chemical Engineering
Germanic and Slavic Languages
Literature

Combinatorics and Optimization
Physics
Psychology
Psychology
Mechanical Engineering
Physics
Electrical Engineering
Psychology

Applied Analysis and Computer Science
Chemistry
Physics
Pure Mathematics
Psychology
Electrical Engineering
Chemistry
Mechanical Engineering
Geography
Electrical Engineering
Psychology

Applied Analysis and Computer Science
Mechanical Engineering
Optometry
Geography
Geography
Management Science
<table>
<thead>
<tr>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burns, C.M.</td>
</tr>
<tr>
<td>Burns, D.J.</td>
</tr>
<tr>
<td>Burns, R.N.</td>
</tr>
<tr>
<td>Burris, S.</td>
</tr>
<tr>
<td>Burton, T.L.</td>
</tr>
<tr>
<td>Butler, J.M.</td>
</tr>
<tr>
<td>Byerley, J.J.</td>
</tr>
<tr>
<td>Byers, W.I.</td>
</tr>
<tr>
<td>Cadell, T.E.</td>
</tr>
<tr>
<td>Callender, M.G.E.</td>
</tr>
<tr>
<td>Campbell, G.T.</td>
</tr>
<tr>
<td>Campbell, J.M.</td>
</tr>
<tr>
<td>Capindale, J.B.</td>
</tr>
<tr>
<td>Carter, J.C.H.</td>
</tr>
<tr>
<td>Carty, A.J.</td>
</tr>
<tr>
<td>Centore, F.</td>
</tr>
<tr>
<td>Chamberlain, S.G.</td>
</tr>
<tr>
<td>Chang, K.S.</td>
</tr>
<tr>
<td>Charles, A.M.</td>
</tr>
<tr>
<td>Charlwood, R.G.</td>
</tr>
<tr>
<td>Chatterton, P.A.</td>
</tr>
<tr>
<td>Chen, Y.</td>
</tr>
<tr>
<td>Cherniavsky, M.T.</td>
</tr>
<tr>
<td>Cherry, J.A.</td>
</tr>
<tr>
<td>Cherry, W.H.</td>
</tr>
<tr>
<td>Cheyne, J.A.</td>
</tr>
<tr>
<td>Chieh, P.C.</td>
</tr>
<tr>
<td>Chow, Y.L.</td>
</tr>
<tr>
<td>Chvatal, V.</td>
</tr>
<tr>
<td>Cianci, J.D.</td>
</tr>
<tr>
<td>Cizek, J.</td>
</tr>
<tr>
<td>Clarke, S.G.</td>
</tr>
<tr>
<td>Clough, D.J.</td>
</tr>
<tr>
<td>Clough, Donald J.</td>
</tr>
<tr>
<td>Clow, D.E.</td>
</tr>
<tr>
<td>Cockfield, R.W.</td>
</tr>
<tr>
<td>Cohen, D.J.</td>
</tr>
<tr>
<td>Cohen, R.S.</td>
</tr>
<tr>
<td>Cohn, M.Z.</td>
</tr>
<tr>
<td>Cole, R.A.</td>
</tr>
<tr>
<td>Coles, Robert</td>
</tr>
<tr>
<td>Collijn, A.W.</td>
</tr>
<tr>
<td>Condon, P.</td>
</tr>
<tr>
<td>Conrath, D.W.</td>
</tr>
<tr>
<td>Conrath, D.W.</td>
</tr>
<tr>
<td>Constant, M.L.</td>
</tr>
<tr>
<td>Cook, J.R.</td>
</tr>
<tr>
<td>Corbet, P.S.</td>
</tr>
<tr>
<td>Corbett, J.M.</td>
</tr>
<tr>
<td>Cornell, J.M.</td>
</tr>
<tr>
<td>Cornell, P.G.</td>
</tr>
<tr>
<td>Corning, W.C.</td>
</tr>
<tr>
<td>Cornwall, G.M.</td>
</tr>
</tbody>
</table>
Faculty

Cowan, D.D.
Cowan, J.A.
Crapo, H.H.
Craton, M.J.
Cross, G.E.
Cross, J.D.
Csanady, G.T.
Culik, K.

Cummings, L.A.
Cummings, L.J.
Curtis, J.E.

Dagg, I.R.
Danard, M.B.
Dankert, G.
Davies, D.A.
Davies, G.S.
Davis, H.F.
Davis, K.R.
Davis, P.
De Gre, G.L.
Delahey, W.A.
DeMarco, D.T.
Dembiski, P.E.
De Werra, D.
De Witte, Paul
De'Ath, C.E.
Dick, W.W.
Dickey, L.J.
Diem, A.
Dixon, A.E.
Djokovic, D.Z.
Donocik, R.I.
Donskov, A.

Dorney, R.S.

Downer, R.G.H.
Drynan, W.R.
Dubey, R.N.
Dubinski, R.R.
Dufault, G.J.
Duff, G.L.
Dugan, J.R.
Dullien, F.A.L.
Dumbroff, E.B.
Dumont, J.
Dunkley, R.G.
Dust, A.I.
Duthie, H.C.
Dutt, O.
Dvoracek, Z.
Dyal, J.A.
Dyck, J.W.

Applied Analysis and Computer Science
Applied Analysis and Computer Science
Physics
Physics
Pure Mathematics
Pure Mathematics
Mechanical Engineering
Electrical Engineering
Applied Analysis and Computer Science
Science
English
Pure Mathematics
Sociology and Anthropology

Physics
Mechanical Engineering
Pure Mathematics
History
Man Environment Studies
Combinatorics and Optimization
History
Kinesiology
Sociology and Anthropology
Kinesiology
Philosophy
History
Management Sciences
Pure Mathematics
Man Environment Studies
Psychology
Pure Mathematics
Geography
Physics
Pure Mathematics
Electrical Engineering
Germanic and Slavic Languages
Literature
School of Urban and Regional Planning
Biology
Civil Engineering
Mechanical Engineering
English
Electrical Engineering
Electrical Engineering
Classics and Romance Languages
Chemical Engineering
Biology
Classics and Romance Languages
Combinatorics and Optimization
English
Biology
School of Architecture
Applied Mathematics
Psychology
Germanic and Slavic Languages
Literature
Faculty

Applied Analysis and Computer Science

Dyck, V.A.

Eagles, K.D.
Eastman, P.C.
Edington, R.V.
Edmonds, J.
Eichler, M.
Ellenton, H.K.
Elsdon, W.L.
Engel, G.R.
Enns, K.
Erb, D.K.
Erdos, P.
Estok, M.J.
Evans, J.E.
Eydt, H.R.N.

Fahidy, T.Z.
Fairbrother, J.A.V.
Falling, H.J.
Farquhar, G.J.
Farvolden, R.N.
Fasick, F.A.
Faulkner, G.B.
Fenz, W.D.
Ferguson, D.C.
Fernandez, C.M.
Fernando, C.H.
Fernando, M.G.
Field, J.A.
Finn, J.R.
Firrezzo, J.A.C.
Firnau, G.

Fischer, C.Froese
Fischer, D.W.
Fischer, P.C.

Fisher, L.G.
Fisher, E.J.
FitzGerald, M.P.
Fletcher, L.P.
Fiorentin, J.J.
Forbes, W.F.
Ford, J.D.
Forsey, E.A.
Forsyth, P.
Forte, B.
Fournier, H.S.
Fournier, R.J.
Francis, G.R.
Fraser, D.C.
Fraser-Reid, B.O.
Fraser, T.M.
Fraser, T.M.
Frecker, R.C.

History
Physics
Political Science
Combinatorics and Optimization
Sociology and Anthropology
Physics
Chemistry
Psychology
Chemical Engineering
Geography
Mathematical Research
English
Classics and Romance Languages
Biology

Chemical Engineering
Physics
Sociology and Anthropology
Civil Engineering
Earth Sciences
Sociology and Anthropology
Combinatorics and Optimization
Psychology
Mechanical Engineering
Classics and Romance Languages
Biology
Optometry
Electrical Engineering
Classics and Romance Languages
Psychology
Germanic and Slavic Languages
Literature

Applied Mathematics
Man Environment Studies
Applied Analysis and Computer Science

Management Sciences
Optometry
Physics
Economics
Mathematical Research
Statistics
Chemical Engineering
Political Science
Classics and Romance Languages
Applied Mathematics
Classics and Romance Languages
Classics and Romance Languages
Man Environment Studies
Systems Design
Chemistry
Biomedical Research
Systems Design
Statistics
Faculty

Fretz, J.W.
Frey, H.E.
Friedman, O.
Friesen, R.J.
Frind, E.O.
Fritz, P.
Froese, J.
Fryer, K.D.
Fulkerson, D.R.

Gabrielian, A.
Gall, C.E.
Gallagher, J.E.
Gentleman, J.E.

Gentleman, W.M.
George, M.G.
George, R.A.
Gertler, L.O.

Ghosh, S.K.
Gilbert, W.J.
Gilhoocy, D.R.
Gillmor, D.A.
Gladwell, G.M.L.
Godbout, V.P.
Godbout, R.C.
Gold, J.
Gold, L.
Gold, M.
Gold, P.J.
Goodman, F.O.
Gosselink, R.N.
Gough, T.E.
Gowda, C.V.B.
Grady, L.W.

Graham, J.W.
Graham, R.D.
Grant, C.H.
Grant, Garry
Gray, J.C.
Gray, J.R.
Green, H.J.
Green, R.
Gregory, Douglas
Grey, E.
Grierson, D.E.
Griffin, G.A.
Griffith, C.A.
Grindlay, J.
Grosvenor, T.P.
Guest, R.M.
Gupta, R.P.

Sociology and Anthropology
Physics
Chemistry
Earth Sciences
Earth Sciences
Applied Mathematics
Applied Analysis and Computer Science
Sociology and Anthropology
Applied Analysis and Computer Science
Applied Analysis and Computer Science
School of Urban and Regional Planning
Philosophy
School of Urban and Regional Planning
Economics
Pure Mathematics
Optometry
Geography
Civil Engineering
Statistics
Psychology
English
Optometry
Classics and Romance Languages
Classics and Romance Languages
Applied Mathematics
English
Chemistry
Civil Engineering
History
Applied Analysis and Computer Science
Kinesiology
Political Science
Optometry
English
Integrated Studies
Kinesiology
Civil Engineering
Optometry
Classics and Romance Languages
Civil Engineering
Psychology
Recreation
Physics
Optometry
Chemistry
Combinatorics and Optimization
<table>
<thead>
<tr>
<th>Faculty</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haag, E.</td>
<td>Classics and Romance Languages</td>
</tr>
<tr>
<td>Haag, S.B.P.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Hass, R.C.G.</td>
<td>Economics</td>
</tr>
<tr>
<td>Habibagahi, H.</td>
<td>Combinatorics and Optimization</td>
</tr>
<tr>
<td>Haff, C.E.</td>
<td>Integrated Studies</td>
</tr>
<tr>
<td>Hagger, G.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Hale, A.M.</td>
<td>Religious Studies</td>
</tr>
<tr>
<td>Hall, W.H.</td>
<td>Systems Design</td>
</tr>
<tr>
<td>Handa, V.K.</td>
<td>Physics</td>
</tr>
<tr>
<td>Haner, A.B.</td>
<td>Optometry</td>
</tr>
<tr>
<td>Hansford, Ronald R.</td>
<td>Electrical Engineering</td>
</tr>
<tr>
<td>Hanson, J.V.</td>
<td>Mathematical Research</td>
</tr>
<tr>
<td>Harary, F.</td>
<td>Integrated Studies</td>
</tr>
<tr>
<td>Harding, D.J.</td>
<td>History</td>
</tr>
<tr>
<td>Harrigan, P.J.</td>
<td>Biology</td>
</tr>
<tr>
<td>Harrison, A.D.</td>
<td>Psychology</td>
</tr>
<tr>
<td>Hartford, J.J.</td>
<td>Applied Analysis and Computer Science</td>
</tr>
<tr>
<td>Haruki, H.</td>
<td>English</td>
</tr>
<tr>
<td>Haworth, H.E.</td>
<td>Philosophy</td>
</tr>
<tr>
<td>Haworth, L.L.</td>
<td>Kinesiology</td>
</tr>
<tr>
<td>Hayes, D.</td>
<td>Electrical Engineering</td>
</tr>
<tr>
<td>Heasell, E.L.</td>
<td>Chemical Engineering</td>
</tr>
<tr>
<td>Heatley, A.H.</td>
<td>English</td>
</tr>
<tr>
<td>Hedges, C.S.</td>
<td>English</td>
</tr>
<tr>
<td>Hedges, D.L.</td>
<td>Germanic and Slavic Languages</td>
</tr>
<tr>
<td>Heier, E.</td>
<td>Literature</td>
</tr>
<tr>
<td>Hemming, D.</td>
<td>Physics</td>
</tr>
<tr>
<td>Henderson, D.J.</td>
<td>Applied Mathematics</td>
</tr>
<tr>
<td>Henderson, D.J.</td>
<td>Physics</td>
</tr>
<tr>
<td>Hendley, B.P.</td>
<td>Philosophy</td>
</tr>
<tr>
<td>Hermance, C.E.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Herzog, S.</td>
<td>School of Urban and Regional Planning</td>
</tr>
<tr>
<td>Hibbard, G.R.</td>
<td>English</td>
</tr>
<tr>
<td>Higgs, D.</td>
<td>Pure Mathematics</td>
</tr>
<tr>
<td>Hilderbrand, A.E.</td>
<td>Geography</td>
</tr>
<tr>
<td>Hill, H.M.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Hill, M.H.</td>
<td>Sociology and Anthropology</td>
</tr>
<tr>
<td>Hinchcliffe, P.M.</td>
<td>English</td>
</tr>
<tr>
<td>Hoefert, S.</td>
<td>Germanic and Slavic Languages</td>
</tr>
<tr>
<td>Hoffmann, P.</td>
<td>Literature</td>
</tr>
<tr>
<td>Hollands, K.G.T.</td>
<td>Pure Mathematics</td>
</tr>
<tr>
<td>Holmes, R.H.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Holt, J.</td>
<td>Philosophy</td>
</tr>
<tr>
<td>Honeyford, B.N.</td>
<td>Statistics</td>
</tr>
<tr>
<td>Honsberger, R.A.</td>
<td>English</td>
</tr>
<tr>
<td>Hopkins, D.R.</td>
<td>Combinatorics and Optimization</td>
</tr>
<tr>
<td>Hopkins, P.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Horne, J.R.</td>
<td>Kinesiology</td>
</tr>
<tr>
<td>Horton, D.F.</td>
<td>Religious Studies</td>
</tr>
<tr>
<td>Horton, J.T.</td>
<td>History</td>
</tr>
<tr>
<td>Hotson, J.H.</td>
<td>School of Urban and Regional Planning</td>
</tr>
<tr>
<td>Houston, M.E.</td>
<td>Economics</td>
</tr>
<tr>
<td>Howard, J.H.C.</td>
<td>Kinesthesiology</td>
</tr>
<tr>
<td>Howard, J.H.C.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Howard, J.H.C.</td>
<td>Psychology</td>
</tr>
<tr>
<td>Howard, J.H.C.</td>
<td>Applied Analysis and Computer Science</td>
</tr>
<tr>
<td>Howard, J.H.C.</td>
<td>English</td>
</tr>
</tbody>
</table>
Faculty

Howard, R.N.
Huang, R.Y.-M.
Hudgins R.R.
Hudspeth, W.J.
Huertas-Jourda, J.
Hultin, N.C.
Huseyin, K.
Hutchinson, B.G.
Hyma, B.
Hynes, H.B.N.

Inniss, W.E.
Irish, D.E.
Irland, B.
Irving, R.M.
Isenor, N.R.

Jakobsh, F.
Jenkyns, T.A.
Johannessen, S.K.
Johnson, E.L.
Johnson, L.A.
Joyce, Lorne S.

Kairies, H.H.
Kalbfleisch, J.D.
Kalbfleisch, J.G.
Kalra, S.N.
Kameda, T.H.
Kannappan, P.L.

Kapoor, N.N.
Karasek, F.W.
Kardasz, S.W.
Karrow, P.F.
Katzner, D.W.
Keeler, J.S.
Keith, R.F.
Kemp, F.D.
Kemp, S.
Kempton, A.G.
Kendall, D.W.
Kendrick, W.B.
Kenyon, G.S.
Keppel-Jones, D.S.
Keresztes, P.
Kerr, H.W.
Kerr, M.R.
Kerr-Lawson, A.
Kersell, J.E.
Kerton, R.R.
Kesavan, H.K.
Kesik, A.B.
Kessel, J.T.
King, P.
Kirby, Michael

Systems Design
Chemical Engineering
Chemical Engineering
Psychology
Philosophy
English
Civil Engineering
Civil Engineering
Geography
Biology

Biology
Chemistry
Fine Arts
Geography
Physics

Germanic and Slavic Languages
Literature
Combinatorics and Optimization
History
Combinatorics and Optimization
History
Optometry

Mathematical Research
Statistics
Statistics
Electrical Engineering
Electrical Engineering
Applied Analysis and Computer Science
Biology
Chemistry
Economics
Earth Sciences
Economics
Electrical Engineering
Man Environment Studies
Psychology
Kinesiology
Biology
Integrated Studies
Biology
Kinesiology
English
Classics and Romance Languages
Mechanical Engineering
English
Pure Mathematics
Political Science
Economics
Systems Design
Geography
Systems Design
Kinesiology
Optometry
<table>
<thead>
<tr>
<th>Faculty</th>
<th>School of Urban and Regional Planning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kitchen, C.M.</td>
<td>History</td>
</tr>
<tr>
<td>Klaassen, G.W.</td>
<td>Religious Studies</td>
</tr>
<tr>
<td>Klaassen, W.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Kneen, P.W.</td>
<td>Applied Analysis and Computer Science</td>
</tr>
<tr>
<td>Kohn, C.E.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>Koppel, J.L.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Kowen, N.</td>
<td>Sociology and Anthropology</td>
</tr>
<tr>
<td>Krader, L.</td>
<td>Solid Mechanics</td>
</tr>
<tr>
<td>Krishnasamy, S.G.</td>
<td>Fine Arts</td>
</tr>
<tr>
<td>Kristof, J.</td>
<td>Political Science</td>
</tr>
<tr>
<td>Kristof, L.K.D.</td>
<td>Geography</td>
</tr>
<tr>
<td>Krueger, R.R.</td>
<td>Physics</td>
</tr>
<tr>
<td>Kruuv, J.</td>
<td>Sociology and Anthropology</td>
</tr>
<tr>
<td>Kubat, D.</td>
<td>Mathematical Research</td>
</tr>
<tr>
<td>Kurepa, S.</td>
<td>Germanic and Slavic Languages</td>
</tr>
<tr>
<td>Kuxdorf, M.</td>
<td>Literature</td>
</tr>
<tr>
<td>LaFrance, J.</td>
<td>Classics and Romance Languages</td>
</tr>
<tr>
<td>Lambert, R.D.</td>
<td>Sociology and Anthropology</td>
</tr>
<tr>
<td>Lamers, D.N.</td>
<td>History</td>
</tr>
<tr>
<td>Lamont, D.H.</td>
<td>Optometry</td>
</tr>
<tr>
<td>Larkworthy, D.R.</td>
<td>Optometry</td>
</tr>
<tr>
<td>Lastman, G.J.</td>
<td>Applied Mathematics</td>
</tr>
<tr>
<td>Lavelle, M.</td>
<td>Kinesiology</td>
</tr>
<tr>
<td>Lavigne, N.E.</td>
<td>Economics</td>
</tr>
<tr>
<td>Lawrence, R.G.R.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Lawson, D.E.</td>
<td>Earth Sciences</td>
</tr>
<tr>
<td>Lawson, J.D.</td>
<td>Applied Analysis and Computer Science</td>
</tr>
<tr>
<td>Lawson, W.M.</td>
<td>Economics</td>
</tr>
<tr>
<td>Ledbetter, K.</td>
<td>English</td>
</tr>
<tr>
<td>Ledwell, T.A.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Leech, J.W.</td>
<td>Religious Studies</td>
</tr>
<tr>
<td>Leech, J.W.</td>
<td>Physics</td>
</tr>
<tr>
<td>Lefcourt, H.M.</td>
<td>Psychology</td>
</tr>
<tr>
<td>Leger, F.</td>
<td>Solid Mechanics</td>
</tr>
<tr>
<td>Legge, R.D.</td>
<td>Religious Studies</td>
</tr>
<tr>
<td>Leipholz, H.H.E.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Leissner, W.</td>
<td>Mathematical Research</td>
</tr>
<tr>
<td>LeLievre, B.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Lemon, H.T.</td>
<td>School of Urban and Regional Planning</td>
</tr>
<tr>
<td>Lennox, W.C.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Lentin, A.</td>
<td>History</td>
</tr>
<tr>
<td>Leon, Sister M.</td>
<td>English</td>
</tr>
<tr>
<td>Lerner, G.</td>
<td>Economics</td>
</tr>
<tr>
<td>Lerner, M.</td>
<td>Psychology</td>
</tr>
<tr>
<td>Lerrier, P.M.</td>
<td>Psychology</td>
</tr>
<tr>
<td>Lerner, S.C.</td>
<td>Man Environment Studies</td>
</tr>
<tr>
<td>Leslie, J.D.</td>
<td>Physics</td>
</tr>
<tr>
<td>Letson, D.</td>
<td>English</td>
</tr>
<tr>
<td>Levitsky, I.</td>
<td>Germanic and Slavic Languages</td>
</tr>
<tr>
<td>Lim, C.C.</td>
<td>Literature</td>
</tr>
<tr>
<td>Led, N.G.</td>
<td>Physics</td>
</tr>
<tr>
<td>Faculty Member</td>
<td>Department</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------------------------------</td>
</tr>
<tr>
<td>Linders, J.G.</td>
<td>Applied Analysis and Computer Science</td>
</tr>
<tr>
<td>Lipshitz, S.P.</td>
<td>Applied Mathematics</td>
</tr>
<tr>
<td>Lister, R.</td>
<td>English</td>
</tr>
<tr>
<td>Little, W.D.</td>
<td>Electrical Engineering</td>
</tr>
<tr>
<td>Lodhi, A.Q.</td>
<td>Sociology and Anthropology</td>
</tr>
<tr>
<td>Logan, H.M.</td>
<td>English</td>
</tr>
<tr>
<td>Long, W.S.</td>
<td>Optometry</td>
</tr>
<tr>
<td>Lovelock, D.</td>
<td>Applied Mathematics</td>
</tr>
<tr>
<td>Luk, W.K.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Lundberg, A.</td>
<td>Mathematical Research</td>
</tr>
<tr>
<td>Lunskey, Marvin</td>
<td>Optometry</td>
</tr>
<tr>
<td>Lyle, W.M.</td>
<td>Optometry</td>
</tr>
<tr>
<td>Macdonald, I.F.</td>
<td>Chemical Engineering</td>
</tr>
<tr>
<td>MacGillivray, R.C.</td>
<td>History</td>
</tr>
<tr>
<td>MacKay, D.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>Mackay, D.I.</td>
<td>Fine Arts</td>
</tr>
<tr>
<td>MacKenzie, D.C.</td>
<td>Classics and Romance Languages</td>
</tr>
<tr>
<td>MacKenzie, K.D.</td>
<td>Psychology</td>
</tr>
<tr>
<td>MacKenzie, M.</td>
<td>Classics and Romance Languages</td>
</tr>
<tr>
<td>MacKinnon, A.</td>
<td>Optometry</td>
</tr>
<tr>
<td>MacKinnon, G.E.</td>
<td>Psychology</td>
</tr>
<tr>
<td>MacKinnon, H.</td>
<td>History</td>
</tr>
<tr>
<td>Macleod, D.I.</td>
<td>Applied Mathematics</td>
</tr>
<tr>
<td>MacNaughton, W.R.</td>
<td>English</td>
</tr>
<tr>
<td>MacPhie, R.H.</td>
<td>Electrical Engineering</td>
</tr>
<tr>
<td>MacQuarrie, A.M.</td>
<td>English</td>
</tr>
<tr>
<td>MacRae, C.F.</td>
<td>English</td>
</tr>
<tr>
<td>Malcolm, J.D.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Malzan, J.</td>
<td>Pure Mathematics</td>
</tr>
<tr>
<td>Manning, E.G.</td>
<td>Applied Analysis and Computer Science</td>
</tr>
<tr>
<td>Manske, R.H.F.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>Mansour, W.M.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Mark, J.W.</td>
<td>Electrical Engineering</td>
</tr>
<tr>
<td>Marsden, H.</td>
<td>Germanic and Slavic Languages</td>
</tr>
<tr>
<td>Marshman, B.J.</td>
<td>Literature</td>
</tr>
<tr>
<td>Martens, H.</td>
<td>Applied Mathematics</td>
</tr>
<tr>
<td>Martin, H.R.</td>
<td>Fine Arts</td>
</tr>
<tr>
<td>Martin, L.R.G.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Martin, W.R.</td>
<td>School of Urban and Regional Planning</td>
</tr>
<tr>
<td>Masters, D.C.</td>
<td>English</td>
</tr>
<tr>
<td>Matthews, B.C.</td>
<td>History</td>
</tr>
<tr>
<td>Matthews, B.C.</td>
<td>Earth Sciences</td>
</tr>
<tr>
<td>Matyas, E.L.</td>
<td>Geography</td>
</tr>
<tr>
<td>Mayfield, C.I.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Maynes, A.D.</td>
<td>Biology</td>
</tr>
<tr>
<td>McBoyle, G.R.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>McBryde, W.A.E.</td>
<td>Geography</td>
</tr>
<tr>
<td>McCormack, E.P.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>McCourt, F.R.</td>
<td>English</td>
</tr>
<tr>
<td>McDonald, M.F.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>McGee, I.J.</td>
<td>Philosophy</td>
</tr>
<tr>
<td>McKenney, J.C.</td>
<td>Applied Mathematics</td>
</tr>
<tr>
<td>McKee, W.W.</td>
<td>Classics and Romance Languages</td>
</tr>
<tr>
<td>Faculty</td>
<td>Kinesiology</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>McKillop, R.</td>
<td>Religious Studies</td>
</tr>
<tr>
<td>McLachlin, A.M.</td>
<td>Pure Mathematics</td>
</tr>
<tr>
<td>McLaren, I.N.</td>
<td>History</td>
</tr>
<tr>
<td>McLaughlin, K.M.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>McLaughlin, W.A.</td>
<td>Geography</td>
</tr>
<tr>
<td>McLellan, A.G.</td>
<td>Applied Mathematics</td>
</tr>
<tr>
<td>McLenaghan, R.G.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>McLeod, H.G.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>McLeod, N.W.</td>
<td>English</td>
</tr>
<tr>
<td>McMullin, S.E.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>McNeice, G.M.</td>
<td>Management Sciences</td>
</tr>
<tr>
<td>McReynolds, W.P.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>McTavish, D.R.</td>
<td>Physics</td>
</tr>
<tr>
<td>McVicar, D.S.</td>
<td>Psychology</td>
</tr>
<tr>
<td>Meichenbaum, D.</td>
<td>Electrical Engineering</td>
</tr>
<tr>
<td>Meikle, W.N.</td>
<td>Systems Design</td>
</tr>
<tr>
<td>Meincke, P.H.</td>
<td>Psychology</td>
</tr>
<tr>
<td>Merikle, P.M.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>Michael, M.C.</td>
<td>Psychology</td>
</tr>
<tr>
<td>Miller, A.H.</td>
<td>Religious Studies</td>
</tr>
<tr>
<td>Miller, J.W.</td>
<td>Combinatorics and Optimization</td>
</tr>
<tr>
<td>Miller, W.I.</td>
<td>Philosophy</td>
</tr>
<tr>
<td>Minas, A.C.</td>
<td>Philosophy</td>
</tr>
<tr>
<td>Minas, J.S.</td>
<td>Geography</td>
</tr>
<tr>
<td>Mitchell, W.B.</td>
<td>Physics</td>
</tr>
<tr>
<td>Mitra, T.K.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>Moffat, J.B.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Mohapupt, U.H.</td>
<td>Optometry</td>
</tr>
<tr>
<td>Moir, James</td>
<td>Physics</td>
</tr>
<tr>
<td>Moore, R.A.</td>
<td>Chemical Engineering</td>
</tr>
<tr>
<td>Moo-Young, M.</td>
<td>Optometry</td>
</tr>
<tr>
<td>Moreland, J.D.</td>
<td>Applied Analysis and Computer</td>
</tr>
<tr>
<td>Morgan, D.E.</td>
<td>Science</td>
</tr>
<tr>
<td>Morrison, H.M.</td>
<td>Physics</td>
</tr>
<tr>
<td>Morrison, P.E.</td>
<td>Biology</td>
</tr>
<tr>
<td>Morton, J.K.</td>
<td>Biology</td>
</tr>
<tr>
<td>Moskal, E.M.</td>
<td>Pure Mathematics</td>
</tr>
<tr>
<td>Moss, J.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Mowat, D.</td>
<td>Pure Mathematics</td>
</tr>
<tr>
<td>Mueller, F.</td>
<td>Economics</td>
</tr>
<tr>
<td>Mueller, F.</td>
<td>Earth Sciences</td>
</tr>
<tr>
<td>Mullin, R.C.</td>
<td>Combinatorics and Optimization</td>
</tr>
<tr>
<td>Munn, M.S.</td>
<td>Optometry</td>
</tr>
<tr>
<td>Murkerjea, R.N.</td>
<td>School of Architecture</td>
</tr>
<tr>
<td>Murty, U.S.R.</td>
<td>Combinatorics and Optimization</td>
</tr>
<tr>
<td>Myers, R.L.</td>
<td>Classics and Romance Languages</td>
</tr>
<tr>
<td>Naftolin, Harvey</td>
<td>Optometry</td>
</tr>
<tr>
<td>Narveson, J.F.</td>
<td>Philosophy</td>
</tr>
<tr>
<td>Nash, J.C.</td>
<td>Kinesiology</td>
</tr>
<tr>
<td>Nash, P.H.</td>
<td>School of Urban and Regional</td>
</tr>
<tr>
<td></td>
<td>Planning</td>
</tr>
<tr>
<td>Nash-Williams, C.ST.J.A.</td>
<td>Combinatorics and Optimization</td>
</tr>
<tr>
<td>Needham, W.R.</td>
<td>Economics</td>
</tr>
<tr>
<td>Nelson, A.D.</td>
<td>Political Science</td>
</tr>
<tr>
<td>New, J.F.H.</td>
<td>History</td>
</tr>
<tr>
<td>Neufeld, B.</td>
<td>Biology</td>
</tr>
<tr>
<td>Faculty</td>
<td>Department</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>Newmarch, L.L.</td>
<td>Religious Studies</td>
</tr>
<tr>
<td>Ng. D.</td>
<td>Recreation</td>
</tr>
<tr>
<td>Nichols, A.</td>
<td>Optometry</td>
</tr>
<tr>
<td>Nicoll, W.B.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Nicolai, H.</td>
<td>Germanic and Slavic Languages</td>
</tr>
<tr>
<td>Niessen, P.</td>
<td>Literature</td>
</tr>
<tr>
<td>Nofal, F.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Norman, R.W.</td>
<td>Management Sciences</td>
</tr>
<tr>
<td>North, J.S.</td>
<td>Kinesiology</td>
</tr>
<tr>
<td>Noton, A.R.M.</td>
<td>English</td>
</tr>
<tr>
<td>Ober, W.U.</td>
<td>Electrical Engineering</td>
</tr>
<tr>
<td>O'Day, R.</td>
<td>English</td>
</tr>
<tr>
<td>O'Driscoll, K.F.</td>
<td>Psychology</td>
</tr>
<tr>
<td>O'N.Roe, P.H.</td>
<td>Chemical Engineering</td>
</tr>
<tr>
<td>Officer, E.R.</td>
<td>Systems Design</td>
</tr>
<tr>
<td>Ord, J.L.</td>
<td>Geography</td>
</tr>
<tr>
<td>Ostrander, G.M.</td>
<td>Physics</td>
</tr>
<tr>
<td>Otbo, K.</td>
<td>History</td>
</tr>
<tr>
<td>Paldus, E.</td>
<td>School of Architecture</td>
</tr>
<tr>
<td>Paldus, J.</td>
<td>Statistics</td>
</tr>
<tr>
<td>Pallett E.M.</td>
<td>Applied Mathematics</td>
</tr>
<tr>
<td>Pallett, E.M.</td>
<td>School of Architecture</td>
</tr>
<tr>
<td>Panthel, H.W.</td>
<td>Man Environment Studies</td>
</tr>
<tr>
<td>Pasternak, J.J.</td>
<td>Germanic and Slavic Languages</td>
</tr>
<tr>
<td>Patterson, E.P.</td>
<td>Literature</td>
</tr>
<tr>
<td>Patterson, N.L.</td>
<td>Biology</td>
</tr>
<tr>
<td>Pearce, G.F.</td>
<td>History</td>
</tr>
<tr>
<td>Pearse, J.D.</td>
<td>Fine Arts</td>
</tr>
<tr>
<td>Pearse, B.Y.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Pearson, W.B.</td>
<td>Recreation</td>
</tr>
<tr>
<td>Pearson, W.B.</td>
<td>Recreation</td>
</tr>
<tr>
<td>Pei, D.C.T.</td>
<td>Combinatorics and Optimization</td>
</tr>
<tr>
<td>Pekau, O.A.</td>
<td>Physics</td>
</tr>
<tr>
<td>Pellowe, R.D.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Penney, R.K.</td>
<td>Chemical Engineering</td>
</tr>
<tr>
<td>Penton, P.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Petch, H.E.</td>
<td>Optometry</td>
</tr>
<tr>
<td>Pick, R.J.</td>
<td>Psychology</td>
</tr>
<tr>
<td>Piekarowski, K.R.</td>
<td>Psychology</td>
</tr>
<tr>
<td>Pietrzykowski, T.</td>
<td>Physics</td>
</tr>
<tr>
<td>Pinder, J.T.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Pintar, M.M.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Plumtree, A.</td>
<td>Physics</td>
</tr>
<tr>
<td>Pollock, J.D.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Ponzo, P.J.</td>
<td>Optometry</td>
</tr>
<tr>
<td>Porter, R.L.</td>
<td>Applied Mathematics</td>
</tr>
<tr>
<td>Powcr, G.</td>
<td>Classics and Romance Languages</td>
</tr>
<tr>
<td>Prasad, T.</td>
<td>Biology</td>
</tr>
<tr>
<td>Pratschke, J.L.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Prece, R.J.C.</td>
<td>Economics</td>
</tr>
<tr>
<td>Prentice, R.L.</td>
<td>Political Science</td>
</tr>
<tr>
<td>Pretz, C.</td>
<td>Statistics</td>
</tr>
</tbody>
</table>
Priddle, G.B.  Geography
Priddle, R.E.  Kinesiology
Pruesse, M.G.  Psychology
Qualter, T.H.  Political Science
Ragade, R.K.  Systems Design
Ramshaw, R.S.  Electrical Engineering
Ratz, H.C.  Electrical Engineering
Rawling, K.E.  Geography
Read, R.C.  Combinatorics and Optimization
Rees, A.W.  History
Rees-Thomas, D.  Chemistry
Reesor, G.E.  Physics
Reeve, J.  Electrical Engineering
Reilly, P.M.  Chemical Engineering
Remole, A.  Optometry
Rempel, G.L.  Chemical Engineering
Rhodes, E.  Chemical Engineering
Richards, J.M.  Mechanical Engineering
Richter, M.  Germanic and Slavic Languages
Rich, S.G.  Literature
Rickert, W.S.  School of Urban and Regional Planning
Roberts, D.D.  Statistics
Roberts, D.L.  Philosophy
Roberts, R.G.  Physics
Robinson, C.W.  Earth Sciences
Robinson, J.  Chemical Engineering
Robinson, J.C.  Economics
Robinson, P.  Statistics
Robinson, R.W.  Statistics
Roden, R.B.  Psychology
Rogers, J.  Applied Analysis and Computer Science
Roland, P.  Sociology and Anthropology
Roorda, J.  English
Roosa, Wm.B.  Civil Engineering
Ross, R.R.  Sociology and Anthropology
Roulston, D.J.  Psychology
Rowe, K.A.  Electrical Engineering
Rowe, P.M.  Pure Mathematics
Ruden, A.  Psychology
Rund, H.  Chemistry
Russwurm, L.H.  Applied Mathematics
Sachs, S.  Geography
Sahas, D.  Arts
Saleh, S.D.  Religious Studies
Salter, D.L.  Management Sciences
Sauer, W.L.  Earth Sciences
Sayegh, K.S.  Sociology and Anthropology
Scharrer, J.M.  School of Urban and Regional Planning
Schellenberg, P.  Chemical Engineering
Schleiermacher, D.D.  Combinatorics and Optimization
Schlesier, J.  Systems Design
Faculty

Schroeder, J.  
Schultz, S.  
Schuster, R.M.  
Scoles, G.  
Scott, D.S.  
Scott, W.G.  
Scrutton, R.F.  
Seeley, P.L.  
Seim, R.D.  
Seligman, P.  
Semple, T.McL.  
Sengupta, S.S.  
Shah, K.R.  
Shalinsky, W.  
Shank, H.S.  

Sharma, H.D.  
Shaw, K.N.  
Shelest, W.  

Sheppard, Barry  
Sherbourne, A.N.  
Shields, E.F.  
Shinghal, R.  

Shortreed, J.  
Siebrand, W.  
Siirala, A.J.  
Silver, E.A.  
Silveston, P.L.  
Simpson, J.  
Singh Nagi, A.D.  
Skarecky, R.  
Skinner, T.N.E.  
Slethaug, G.E.  
Smith, H.J.T.  
Smith, J.G.  
Smith, K.N.  
Smith, P.H.  
Smith, P.S.  
Snieckus, V.A.  
Snyder, M.E.  
Snyder, R.A.  
Snyder, R.A.  
Solomon, S.I.  
Somfay, J.C.  
Sommerville, E.  
Sommer, T.  

Soulis, G.N.  
Sowerby, R.  
Sparks, B.B.  
Spink, D.R.  
Springer, C.C.  
Sprott, D.A.  
Srivastava, K.D.  
Srivastava, K.D.  

Civil Engineering  
School of Architecture  
School of Architecture  
Chemistry  
Chemical Engineering  
Sociology and Anthropology  
Mechanical Engineering  
Systems Design  
Psychology  
Philosophy  
Man Environment Studies  
Management Sciences  
Statistics  
Man Environment Studies  
Applied Analysis and Computer Science  
Chemistry  
Chemistry  
Germanic and Slavic Languages  
Literature  
Sociology and Anthropology  
Civil Engineering  
English  
Applied Analysis and Computer Science  
Civil Engineering  
Chemistry  
History  
Management Sciences  
Chemical Engineering  
Kinesiology  
Physics  
Mechanical Engineering  
Applied Mathematics  
English  
Physics  
Chemistry  
Civil Engineering  
Arts  
History  
Chemistry  
Applied Mathematics  
Biomedical Research  
Physics  
Civil Engineering  
School of Architecture  
Geography  
Germanic and Slavic Languages  
Literature  
Systems Design  
Mechanical Engineering  
Optometry  
Chemical Engineering  
Statistics  
Statistics  
Electrical Engineering  
Pure Mathematics
<table>
<thead>
<tr>
<th>Faculty</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steiner, H.D.</td>
<td>Geography</td>
</tr>
<tr>
<td>Stevens, R.G.</td>
<td>Political Science</td>
</tr>
<tr>
<td>Stone, J.S.</td>
<td>English</td>
</tr>
<tr>
<td>Stothart, J.P.</td>
<td>Kinesiology</td>
</tr>
<tr>
<td>Stradal, O.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Strong, A.R.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Stuart, J.M.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Suits, B.H.</td>
<td>Philosophy</td>
</tr>
<tr>
<td>Sullivan, H.F.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Sumner, D.B.</td>
<td>Pure Mathematics</td>
</tr>
<tr>
<td>Sumner-Smith, G.</td>
<td>Psychology</td>
</tr>
<tr>
<td>Surich, J.E.-C.</td>
<td>Political Science</td>
</tr>
<tr>
<td>Taht, V.</td>
<td>Statistics</td>
</tr>
<tr>
<td>Tang, F.C.Y.</td>
<td>Pure Mathematics</td>
</tr>
<tr>
<td>Taplin, D.M.R.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Tauber, L.E.</td>
<td>Psychology</td>
</tr>
<tr>
<td>Taylor, M.A.</td>
<td>Applied Analysis and Computer Science</td>
</tr>
<tr>
<td>Tchir, M.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>Thalman, B.</td>
<td>Classics and Romance Languages</td>
</tr>
<tr>
<td>Theberge, J.B.</td>
<td>Man Environment Studies</td>
</tr>
<tr>
<td>Thompson, F.</td>
<td>School of Architecture</td>
</tr>
<tr>
<td>Thompson, Howard C</td>
<td>Optometry</td>
</tr>
<tr>
<td>Thompson, Hartley</td>
<td>Optometry</td>
</tr>
<tr>
<td>Thompson, J.C.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Thompson, J.E.</td>
<td>Biology</td>
</tr>
<tr>
<td>Thompson, M.E.</td>
<td>Statistics</td>
</tr>
<tr>
<td>Thyssell, M.G.</td>
<td>English</td>
</tr>
<tr>
<td>Thyssell, R.V.</td>
<td>Psychology</td>
</tr>
<tr>
<td>Timkulu, D.G.S.M.</td>
<td>Sociology and Anthropology</td>
</tr>
<tr>
<td>Toews, J.E.</td>
<td>Religious Studies</td>
</tr>
<tr>
<td>Toida, S.</td>
<td>Systems Design</td>
</tr>
<tr>
<td>Toida, S.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>Toida, S.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Topper, T.H.</td>
<td>Psychology</td>
</tr>
<tr>
<td>Torney, D.J.</td>
<td>Physics</td>
</tr>
<tr>
<td>Torrie, B.H.</td>
<td>Kinesiology</td>
</tr>
<tr>
<td>Totzke, C.A.W.</td>
<td>Applied Mathematics</td>
</tr>
<tr>
<td>Trim, D.W.</td>
<td>Pure Mathematics</td>
</tr>
<tr>
<td>Tucker, J.W.</td>
<td>Philosophy</td>
</tr>
<tr>
<td>Tucker, J.W.</td>
<td>Chemical Engineering</td>
</tr>
<tr>
<td>Turner, G.A.</td>
<td>Combinatorics and Optimization</td>
</tr>
<tr>
<td>Tutte, W.T.</td>
<td>English</td>
</tr>
<tr>
<td>Tuyn, H.</td>
<td>Fine Arts</td>
</tr>
<tr>
<td>Uhde, J.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Unny, T.E.</td>
<td>Chemical Engineering</td>
</tr>
<tr>
<td>Van der Hoff, B.M.E.</td>
<td>Physics</td>
</tr>
<tr>
<td>Vanderkooy, J.</td>
<td>Fine Arts</td>
</tr>
<tr>
<td>Van Dop, K.</td>
<td>Philosophy</td>
</tr>
<tr>
<td>Van Evra, J.W.</td>
<td>Electrical Engineering</td>
</tr>
<tr>
<td>van Heeswijk, R.G.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>Vatcher, M.</td>
<td>Sociology and Anthropology</td>
</tr>
<tr>
<td>Vaz, E.W.</td>
<td>Applied Analysis and Computer Science</td>
</tr>
<tr>
<td>Vellinga, J.H.</td>
<td>Mechanical Engineering</td>
</tr>
</tbody>
</table>
Vincze, I.                                          Mathematical Research
Viswanatha, T.                                    Chemistry
Viswanathan, T.R.                                 Electrical Engineering
Vlach, J.                                          Electrical Engineering
Vogel-Sprott, M.D.                                Psychology
Vranch, J.D.                                      Combinatorics and Optimization
Vuorinen, P.A.                                    Electrical Engineering

Wahl, J.A.                                        History
Wahl, J.A.                                        Religious Studies
Wahlsten, D.L.                                    Psychology
Wahlsten, Douglas L.                              Man Environment Studies
Wainwright, J.                                    Applied Mathematics
Walker, D.F.                                      Geography
Wallier, T.G.                                     Psychology
Walsh, V.C.                                       Economics
Walsh, T.R.S.                                     Combinatorics and Optimization
Walter, D.                                        Classics and Romance Languages
Wang, S.F.                                        Physics
Ware, E.E.                                        Psychology
Watson, Ronald B.                                 Optometry
Watt, L.A.K.                                      Electrical Engineering
Weaver, D.S.                                      Civil Engineering
Weaver, S.M.                                      Sociology and Anthropology
Wei, L.Y.                                         Electrical Engineering
Wentzell, R.A.                                    Applied Mathematics
Wertheim, D.G.                                    Applied Mathematics
White, O.L.                                       Civil Engineering
Whitney, J.B.                                     Statistics
Whiton, J.                                        Germanic and Slavic Languages

Widmeyer, W.N.                                    Literature
Wigley, T.M.L.                                    Kinesiology
Williams, I.                                      Mechanical Engineering
Williams, J.L.                                    Kinesiology
Williams, T.D.                                    Psychology
Wills, B.L.                                       Optometry
Wilson, J.W.                                      Systems Design

Wilson, J.M.                                       School of Urban and Regional Planning
Wilson, T.C.                                       Political Science
Wilson, W.D.                                       Applied Analysis and Computer Science
Wilton, R.C.                                      Classics and Romance Languages
Wine, J.J.                                        Pure Mathematics
Wipper, A.                                        Psychology
Woo, G.C.S.                                       Sociology and Anthropology
Woodruff, M.E.                                    Optometry
Woolford, R.G.                                    Optometry
Woolner, K.A.                                     Chemistry
Woolstencroft, R.P.                               Physics
Wright, D.T.                                      Political Science
Wright, D.E.                                      Civil Engineering
Wright, R.L.                                      History
Wubnig, J.                                        Electrical Engineering
Wylie, K.J.R.                                     Philosophy
Wynne, B.E.                                       English

Facility
Faculty

Wyszecki, G.W.  
Yagar, S.  
Young, J.C.  
Young, L.J.  
Younger, D.H.  
Yovanovich, M.M.  
Zachariah, K.  
Zahar, R.V.M.  
Zelen, M.  
Zima, P.  
Zimmer, J.A.  
Zweers, A.  

Optometry  
Civil Engineering  
Statistics  
Physics  
Combinatorics and Optimization  
Mechanical Engineering  
Biology  
Applied Analysis and Computer Science  
Statistics  
Combinatorics and Optimization  
Combinatorics and Optimization  
Germanic and Slavic Languages  
Literature
### Academic Calendar

The University of Waterloo reserves the right to change its academic calendar at any time.

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971 July 1, Thursday</td>
<td>Last Day for Receipt of Fall 1971 Academic Applications</td>
<td></td>
</tr>
<tr>
<td>July 5, Monday</td>
<td>Registration—Summer Session</td>
<td>Summer Session</td>
</tr>
<tr>
<td>July 5, Monday</td>
<td>Lectures Begin—Summer Session</td>
<td>Spring Term</td>
</tr>
<tr>
<td>July 19, Monday</td>
<td>Supplemental Examinations Begin</td>
<td></td>
</tr>
<tr>
<td>August 2, Monday</td>
<td>Civic Holiday—University Closed</td>
<td></td>
</tr>
<tr>
<td>August 6, Friday</td>
<td>Lectures End—Spring Term</td>
<td></td>
</tr>
<tr>
<td>August 7, Saturday</td>
<td>Examinations Begin—Spring Term</td>
<td></td>
</tr>
<tr>
<td>August 12, Thursday</td>
<td>Lectures End—Summer Session</td>
<td></td>
</tr>
<tr>
<td>August 13, Friday</td>
<td>Examinations Begin—Summer Session</td>
<td></td>
</tr>
<tr>
<td>August 14, Saturday</td>
<td>Examinations end—Spring Term—Summer Session</td>
<td></td>
</tr>
<tr>
<td>August 27, Friday</td>
<td>Spring Work Term Ends—Co-operative Programmes</td>
<td></td>
</tr>
<tr>
<td>August 30, Monday</td>
<td>Fall Work Term Begins—Co-operative Programmes</td>
<td></td>
</tr>
<tr>
<td>September 6, Monday</td>
<td>Labour Day—University Closed</td>
<td></td>
</tr>
<tr>
<td>September 7, Tuesday</td>
<td>Registration Begins—Undergraduate, Regular and Co-operative Programmes</td>
<td></td>
</tr>
<tr>
<td>September 10, Friday</td>
<td>Registration Ends—Undergraduate, Regular and Co-operative Programmes</td>
<td></td>
</tr>
<tr>
<td>September 10, Friday</td>
<td>Registration—Graduate Studies</td>
<td></td>
</tr>
<tr>
<td>September 13, Monday</td>
<td>Lectures Begin</td>
<td></td>
</tr>
<tr>
<td>October 1, Friday</td>
<td>End of Course Change Period—Fall Session</td>
<td></td>
</tr>
<tr>
<td>October 7, Thursday</td>
<td>Meeting—Senate Executive Committee</td>
<td></td>
</tr>
<tr>
<td>October 11, Monday</td>
<td>Thanksgiving Day—University Closed</td>
<td></td>
</tr>
<tr>
<td>October 12, Tuesday</td>
<td>Meeting—Board of Governors</td>
<td></td>
</tr>
<tr>
<td>October 21, Thursday</td>
<td>Meeting—University Senate</td>
<td></td>
</tr>
<tr>
<td>October 22, Friday</td>
<td>Fall Convocation</td>
<td></td>
</tr>
<tr>
<td>November 8, Monday</td>
<td>Supplemental Examinations Begin—Co-operative Programmes</td>
<td></td>
</tr>
<tr>
<td>November 10, Wednesday</td>
<td>Pre-registration Begins—On-Campus Co-operative Students for Spring 1972</td>
<td></td>
</tr>
<tr>
<td>November 12, Friday</td>
<td>Pre-registration Ends—On-Campus Co-operative Students for Spring 1972</td>
<td></td>
</tr>
<tr>
<td>December 2, Thursday</td>
<td>Meeting—Senate Executive Committee</td>
<td></td>
</tr>
<tr>
<td>December 10, Friday</td>
<td>Lectures End—Fall Term</td>
<td></td>
</tr>
<tr>
<td>December 11, Saturday</td>
<td>Examinations Begin—Fall Term</td>
<td></td>
</tr>
<tr>
<td>December 16, Thursday</td>
<td>Meeting—University Senate</td>
<td></td>
</tr>
<tr>
<td>December 22, Wednesday</td>
<td>Examinations End—Fall Term Ends—Co-operative Programmes</td>
<td></td>
</tr>
<tr>
<td>December 24, Friday</td>
<td>Fall Work Term Ends—Co-operative Programmes</td>
<td></td>
</tr>
<tr>
<td>December 25, Saturday</td>
<td>Christmas Day—University Closed</td>
<td></td>
</tr>
<tr>
<td>December 27, Monday</td>
<td>Winter Work Term Begins—Co-operative Programmes</td>
<td></td>
</tr>
</tbody>
</table>
1972 January 1, Saturday  New Year's Day—University Closed
January 3, Monday  Registration—Undergraduate Co-operative Programmes
January 4, Tuesday  Registration—Undergraduate Co-operative Programmes
January 5, Wednesday  Registration—Winter Term—Graduate Studies
January 5, Wednesday  Lectures Begin—All Undergraduate Students
January 18, Tuesday  Meeting—Board of Governors
January 25, Tuesday  End of Course Change Period
February 3, Thursday  Meeting—Senate Executive Committee
February 17, Thursday  Meeting—University Senate
March 13, Monday  Supplemental Examinations Begin—Co-operative Programmes
March 13, Monday  Pre-registration Begins—Regular and Co-operative Students for Fall 1972
March 17, Friday  Pre-registration Ends—Regular and Co-operative Students for Fall 1972
March 31, Friday  Good Friday—University Closed
April 6, Thursday  Meeting—Senate Executive Committee
April 7, Friday  Lectures End
April 8, Saturday  Examinations Begin
April 18, Tuesday  Meeting—Board of Governors
April 20, Thursday  Meeting—University Senate
April 28, Friday  Winter Work Term Ends—Co-operative Programmes
April 28, Friday  Examinations End—Winter Term Ends
May 1, Monday  Spring Work Term Begins—Co-operative Programmes
May 2, Tuesday  Registration—Undergraduate Co-operative Programmes
May 2, Tuesday  Registration—Graduate Studies—Spring Term
May 3, Wednesday  Lectures Begin—Co-operative Programmes
May 22, Monday  Victoria Day—University Closed
May 23, Tuesday  End of Course Change Period
May 25, Thursday  Spring Convocation
May 26, Friday  Spring Convocation
May 27, Saturday  Spring Convocation
May 29, Monday  Pre-registration Begins—Co-operative Students for Winter 1973
May 31, Wednesday  Pre-registration Ends—Co-operative Students for Winter 1973
June 20, Tuesday  Meeting—Board of Governors
July 1, Saturday  Last Day for Receipt of Fall 1972 Academic Applications
July 17, Monday  Supplemental Examinations Begin
August 3, Thursday  Lectures End—Spring Term
August 4, Friday  Examinations Begin—Spring Term
August 7, Monday  Civic Holiday—University Closed
August 12, Saturday  Examinations End—Spring Term Ends