University of Waterloo
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.
University of Waterloo
Academic Calendar 1970-71

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1 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, in Architecture, Arts, Engineering, Environmental 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 the 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 buildings, three Arts buildings, an Arts lecture hall and the Theatre of the Arts. 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 300,000 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 is 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 completed in 1968 houses the Health Service staff which serves the university community. A fully qualified medical staff including a medical doctor and registered nurses is available for regular service from Monday to 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 on 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 will be available on campus beginning 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 55 students under the supervision of the School Sisters of Notre Dame.

Renison College An Anglican Arts College founded in 1959 and affiliated with the University since 1960. It offers integrated courses in International Studies and in Social Work as well as general arts. Residence accommodation for 100 men and 80 women.

St. Paul's College A residential self-governing community of students from all faculties, many religious backgrounds, 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 is being 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 Calendar

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 9) explains the policies and programmes of each individual faculty or school. The second division (Chapter 10) 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 11 to 18) 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 1970-1971 academic session which commences in September, 1970. 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
Anthropology and Geography
Economics
Economics and Geography
Economics and Mathematics
Economics and Political Science
English
English (Drama)
English and French
English and German
English and History
English and Latin
English and Philosophy
English and Russian
English and Spanish
French
French and German
French and German
French and Latin
French and Political Science
French and Russian
French and Spanish
Geography
Geography and Geology
Geography and History
German (with appropriate minor)
German and Russian
History
History and Philosophy
History and Political Science
Latin
Philosophy
Philosophy and Literature
Philosophy and Mathematics
Philosophy and Political Science
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:

<table>
<thead>
<tr>
<th>Programme 1</th>
<th>Programme 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honours Economics and Political Science</td>
<td>Honours French and Latin</td>
</tr>
<tr>
<td>Honours Political Science</td>
<td>Honours French and Russian</td>
</tr>
<tr>
<td>Honours English</td>
<td>Honours French and Spanish</td>
</tr>
<tr>
<td>Honours English and French</td>
<td>Honours Geography</td>
</tr>
<tr>
<td>Honours English and German</td>
<td>Honours History</td>
</tr>
<tr>
<td>Honours English and History</td>
<td>Honours History and</td>
</tr>
<tr>
<td>Honours English and Latin</td>
<td>Political Science</td>
</tr>
<tr>
<td>Honours English and Spanish</td>
<td>Honours Latin</td>
</tr>
<tr>
<td>Honours French</td>
<td>Honours Spanish</td>
</tr>
<tr>
<td>Honours French and German</td>
<td></td>
</tr>
</tbody>
</table>

**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.

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.

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 Early Final Admission must apply before April 1, 1970. All other applicants must apply and have submitted all the necessary documents by August 1, 1970. 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 itself guarantee admission to any of the programmes. If clarification is required on any of the admission requirements, applicants should communicate with the Office of the Registrar, University of Waterloo, Waterloo, Ontario.

The admission requirements listed in the calendar are applicable for admission in September 1970.

**Application Documents** All applicants must submit an application form, certified transcripts of secondary or post-secondary education, and at least one letter of reference. Applicants enrolled in Ontario Grade 13 in the 1969-70 academic year must apply on the “General Application for Admission to University” form which is available from the secondary school. All other applicants must apply on forms available from the Office of the Registrar. All educational institutions attended by the applicant must be accounted for on certified documents. In
addition, applicants from non-English speaking countries must arrange to submit certified English translations of their academic documents.

**Admission to Year 1 — Ontario**

Applicants from the Province of Ontario are required to have completed Ontario Grade 13 showing a minimum overall average of 60% in the seven required credits. For applicants who have taken more than one year to complete the work of Grade 13, a somewhat higher average may be required.

Standing is required in seven Ontario Grade 13 credits as follows:

- A minimum of four credits chosen from
  - English (2)
  - one language other than English (2)
  - Mathematics (2)
- three additional credits chosen wherever possible in accordance with the student’s proposed major field of study.

Additional credits can be selected from any of the optional subjects offered at the Grade 13 level with the qualification that no more than one of the following may be counted as an “additional” credit: Accountancy Practice, Art, Home Economics, Mathematics of Investment, Music, or Secretarial Practice. The marks received in one of these subjects will be included in the computation of the applicant’s average. Standing with the Royal Conservatory of Music in Grade 8 practical and Grade 2 theory will be considered as “one additional credit” on the same terms as these subjects except that the marks received will not be computed in the average.

**Note 1**

*If English is not chosen as a Grade 13 subject offered for admission, applicants must have standing in English at the Grade 12 level.*

**Note 2**

*The University will use the following definition of credits for admission purposes:*

- 3 credits Mathematics A and Mathematics B combined
- 2 credits All language subjects, Mathematics A
- 1 credit All other subjects

*The University will consider other systems of credit definition from Ontario secondary schools.*

**Note 3**

*A number of secondary schools in Ontario are engaged in innovative programmes. The University will consider courses for admission purposes which are not formally listed in the Ontario Department of Education Circular H.S.I. Applicants should confirm with their secondary school's guidance officials that new courses and programmes have been approved by the University for admission purposes.*

**Early Final Admission — Ontario**

Students enrolled in full time in Ontario Grade 13 will be considered for Early Final Admission. To be eligible for consideration, applicants must arrange to have the “General Application for Admission to University” form submitted by April 1, 1970. Consideration of candidates for Early Final Admission will be based on the Secondary School record, the Principal’s recommendation, and the results of the Canadian Scholastic Aptitude Test and specified Achievement Tests. Successful applicants may expect to be notified after June 11, 1970 of their acceptance and will be asked to indicate their decision by June 26, 1970. Those applicants who are not offered Early Final Admission will be considered on the
The Faculty of Arts

basis of the Grade 13 final results and will be notified as soon as possible after the release of the Grade 13 results.

**Note** *All applicants will be required to complete Grade 13 to the satisfaction of the Secondary School principal.*

**Aptitude and Achievement Test**

OACU-Ontario Tests for Admission to College and University  
SACU-Service for Admission to College and University

Applicants will be required to write the Canadian Scholastic Aptitude Test (CSAT) and the appropriate (OACU) Achievement Tests in English, Mathematics and Physics if the corresponding Grade 13 credits are offered for admission to the University.

**Other Canadian Provinces and Countries**

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:

- 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: Third Year Certificate from Prince of Wales College
- Quebec: Senior High School Leaving Certificates First Year CEGEP programme
- Saskatchewan: Senior Matriculation (Grade 12)
- England and Wales: The General Certificate of Education with passes in at least five subjects, two of which must be at Advanced Level.
- West Indies, East and West Africa: The Scottish Certificate of Education
- Scotland: High School Graduation plus an additional year of formal study in subjects comparable to Ontario Grade 13.

**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. The expenses involved in administering the test must be borne by the applicant. Applicants from other countries should have received entry to the country either on a student visa or through landed immigrant status.
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 programme which applicants wish to 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 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 Faculty of Arts
c) and if the appropriate Faculty of Arts department recommends that such courses be credited to a student's programme.

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

Registration
September 8, 9, 10, 11, 1970

Fees
Refer to Section 12 page 458.

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 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, Year 3, and those with fifteen or more, Year 4.
1. Final Examinations

a) The Faculty constitutes the examining body for all examinations. Appeals against faculty decisions made under these regulations may be made in writing to the Examinations and Standings Committee of the Arts Faculty Council. Final written examinations for all years are held in April and May; 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 are used, in part, in determining standing. 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 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. 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 after the examination should have been written.

2. Standing

a) Letter grades signify the following standings in individual courses:

- A: Excellent
- B: Good
- C: Average
- D: Poor but passing
- F: Failure

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:

- A+: 14
- B+: 11
- C+: 8
- D+: 5
- F+: 2
- A: 13
- B: 10
- C: 7
- D: 4
- F: 1
- A-: 12
- B-: 9
- C-: 6
- D-: 3
- F-: 0

c) Over-all standing is determined by the cumulative average of grades assigned for all courses taken at the University (at any time, whether passed or failed) 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></td>
<td>Conditional</td>
</tr>
<tr>
<td>2.9 or below</td>
<td></td>
<td>Failure</td>
</tr>
</tbody>
</table>

Note: In cases where a failed course is repeated, both marks will be used in calculating the student's cumulative over-all 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 (as specified in a departmental Honours programme), but in not more than seven.

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 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 5.9 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 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 Arts programme, a student must maintain a cumulative over-all 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 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.

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 if the Faculty Council considers that he will not profit by further study.

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.

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

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 and of the Examinations and Standings Committee.
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:

- **Group A (i)** English, History, Philosophy
- **Group A (ii)** French, German, Greek, Italian, Latin, Russian, Spanish, Ukrainian (see Note)
- **Group A (iii)** Fine Arts, Religious Studies
- **Group B** 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, not both in the same subject in Group B. The student should note that Group A is further subdivided into Group A (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 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 24. 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 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 office of the Dean of Arts by letter or in person for additional clarification or information.

Note 1 Each student's programme must be approved on or before registration day by a faculty adviser from the Faculty of Arts.

Note 2 In year 1, a student must normally complete the introductory course in the department in which he will major in his later years.

Note 3 “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 21. 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
- German
- Political Science
- Economics
- Greek
- Psychology
- English
- History
- Religious Studies
- French
- Latin
- Russian
- Geography
- Philosophy
- Sociology
- Spanish

There are no double majors 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;

b) three other courses.

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 8 courses above the first year level;
- a minimum of 8 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.
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 222, 223)
Biology 231 (or a course in physical anthropology)
Two electives

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
Honours Programmes

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anthropology 101*/102*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Either Political Science 105*/106* or 115*/116*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>The equivalent of three other full courses</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>The equivalent of two full courses in Anthropology (one of which must be a course in ethnography)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>The equivalent of two full courses in Political Science (which must include 260)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>The equivalent of two other full courses</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>The equivalent of two full courses in Anthropology (one of which must be a course in theory)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>The equivalent of two full courses in Political Science (which must include either 220 or 320)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>The equivalent of two other full courses</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>The equivalent of two full courses in Anthropology</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>The equivalent of two full courses in Political Science (one of which must be at the 400 or 500 level)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>The equivalent of one other full course</td>
<td>3</td>
</tr>
</tbody>
</table>

Honours Economics

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Recommended Programme:</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Economics 101*/102*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>One of Political Science 105*/106* or 115*/116*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>English 101</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>History 100, or Philosophy 101 or equivalent</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>One elective†</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Economics 201*/202*†</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Economics 231*/232††</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>One of Economics 241*/242*, 256*/257*, 261*/262* or 320</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Two electives of which one must satisfy the Group A requirement.†††</td>
<td>6</td>
</tr>
</tbody>
</table>
Honours Programmes

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 202*/203*  
- Economics 201*/202*, 231*/232*  
- Two other electives

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 9 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 (which must include 260)  
- The equivalent of one other full course
Honours Programmes

**Year 3**
- Economics 300  
  3
- One of Economics 330, 340, 370, or 380  
  3
- The equivalent of three full courses in Political Science (which must include either 220 or 320)  
  9
- The equivalent of one other full course  
  3

**Year 4**
- The equivalent of at least one further full course in Economics  
  3
- The equivalent of at least one further full course in Political Science (which must be at the 400 or 500 level)  
  3
- The equivalent of three other full courses  
  9

**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.)

**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, 231, and 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 117.

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*, 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
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 259) and eleven other courses.

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 380, 451, 456, 341*, 342*, 343*, 344*, 314*, 315*
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*

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*
Honours Programmes

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 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 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 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*, 314*, 315*
Three other approved English full course equivalents
(See Note)

History Requirements
History 100 or 110
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)

**Philosophy Requirements**
- Philosophy 221*/222* 280*/281*, 282*/283*
- Philosophy 331, 399
- Two other Philosophy full course equivalents

**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 Russian

**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

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

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 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 190, 250, 350, 450
Four other approved Spanish full course equivalents at the 200 level or above (See Note 2)

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
Honours Programmes

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 com-
        plete 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
        Two more courses

Note 1  The student may take the two required Social Sciences 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 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 20 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 chairmen 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
Honours Programmes

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 courses 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 20 of the Calendar.

Note 2 Before graduation, the student must complete a minimum of eight full courses (or 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 Hours
French 100 3
Either Political Science 105*/106* or 115*/116* 3
The equivalent of three other full courses 9

Year 2 The equivalent of two full courses in French (which must include 250) 6
Either Political Science 220 or 320 3
Political Science 260 3
The equivalent of two other full courses 6

Year 3 The equivalent of two full courses in French (which must include 350) 6
The equivalent of two full courses in Political Science (which should include 330) 6
The equivalent of two other full courses 6

Year 4 The equivalent of two full courses in French (which must include 455*/456*) 6
The equivalent of two full courses in Political Science (one of which must be at the 400 or 500 level) 6
The equivalent of one full other full course 3

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
Honours Programmes

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 in the first
        year.

Note 2  Before graduation, students must complete a minimum of eight full
        courses (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 24 of the Calendar.

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 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 4 For the student wishing to concentrate his studies all or part of the sequences of specialized geography courses below in 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 Programmes

Honours Geography and
Geology

Core courses in Physical Geography
102* Intro to Physical Geography
300* Geomorphology
400 Advanced Geomorphology

Course Electives in Earth Science
130 Introductory Geology
231* Mineralogy
232* Petrography
238* Historical Geology
334 Paleontology
335 Stratigraphy and Sedimentation
340 Structural Geology
437 Crustal Evolution

Note 1 Students selecting this programme must obtain the approval of the department and arrange their courses in consultation with the one of: 334, 335, 340, and 347.

Note 2 Those interested in Secondary School teaching of Geography and/or Geology should elect Earth Science 130, 231*, 232*, 238*, one of: 334, 335, 40, and 437.

Note 3 Those interested in broadening their background in Physical Geography in preparation for graduate study in Geography should elect Earth Science 130, 232*, 238*, 335, and 340.

Note 4 In each case the core courses in Physical Geography and the electives in Earth Science will form part of an overall programme which closely resembles the regular programme in Honours Geography (page 34).

Honours Geography and
History

Year 1 Recommended Programme
Geography 101*/102*
History 100 or 110
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.
Honours Programmes

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 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 24 of this Calendar.

Note 3 With the permission of the departments the student may spend his year enrolled in a university in 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
One more course

Note 1 Before graduation students must complete the requirements for Honours Courses as described on page 24 of this Calendar.

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

Honours History

Year 1 Any first-year programme that fulfills the general faculty requirements, normally including an introductory course in History (see page 23) 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 (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 Honours History courses in addition to History 100 or 110 which,
a) to insure sufficient breadth must include at least one full course from each of the following groupings. (In certain circumstances other full courses offered by the Department may fulfill one or more of these group requirements.)

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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</thead>
<tbody>
<tr>
<td>255</td>
<td>262</td>
<td>265*</td>
<td>277</td>
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<tr>
<td>258</td>
<td>355*</td>
<td>285</td>
<td>282*</td>
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<td>260</td>
<td>356*</td>
<td>295*</td>
<td>291*</td>
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<td>269*</td>
<td>357*</td>
<td>296*</td>
<td>292*</td>
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<td>363</td>
<td>358*</td>
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<td>353*</td>
<td>359*</td>
<td>383*</td>
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<td>354*</td>
<td>360*</td>
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<td>397*</td>
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<td>398*</td>
<td>362</td>
<td>387*</td>
<td>376</td>
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<td>364</td>
<td>388</td>
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<tr>
<td>368</td>
<td>390</td>
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<tr>
<td>392</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>393</td>
<td></td>
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</tr>
</tbody>
</table>

b) to insure development must include at least four courses in the 300 or 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.

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 who have already completed the second and third years of the previous Honours History programme will make the change to the new programme in consultation with the Department in order to clarify their remaining requirements.

Honours History and Philosophy

Year 1 Recommended Programme
One of Philosophy 221*/222* or 280*/281*
History 100 or 110
Three other courses to fulfill the general requirements (see page 23)
Honours Programmes

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
Philosophy 346
Two Honours History courses (see note 2).
One additional course

Year 4  
Two Philosophy courses
Two of History 400 to 455

Note 1  
Students who decide on their Honours programme on entry into Year 2 should take both Philosophy 221*/222* and 280*/281* during that year, and should consult the Department concerning rearrangement of their courses.

Note 2  
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
Either History 100 or 110
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 (which must include 260)
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 (which must include either 220 or 320)
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)
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  
Those wishing to qualify for admission to the Type A course at a College of Education in Ontario should use two of the electives for additional courses in Honours History.
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  Programme A (For students electing Philosophy in first year)

Year 1  Recommended Programme  Hours
One of Philosophy 221*/222* or 280*/281* 3
English or History 3
One of French, German, Latin or Greek 3
Two electives 6

Year 2  Philosophy 240 or 340, 282*/283* and
One of Philosophy 221*/222* or 280*/281* 7-9
Three electives 6-9

Year 3  Three Philosophy courses (including 399) 7-9
Two electives 4-6

Year 4  Three Philosophy courses (including 499) 10
One elective 3

Programme B. (For entering at the beginning of Year 2)

Year 1  Philosophy 100 or two of Philosophy 125*
135*, 140*, or 150* 3
English or History 3
One of French, German, Latin or Greek 3
Two electives 9

Year 2  Philosophy 221*/222*, 280*/281* 9
One of Philosophy 240 or 282*/283* 3
Three electives 4-6
Year 3  
One of Philosophy 240 or 282*/283*  
Two other Philosophy courses (including 399)  
Two electives

Year 4  
Three Philosophy courses (including 499)  
One elective

Honours Philosophy and Literature

Year 1  
Recommended Programme
One of Philosophy 221*/222* or 280*/281*  
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 1)  
(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 399, 331 and one other Philosophy course  
French: Minimum of two full courses or equivalent (see note 1)  
(or German 351*/352*; 361*/362*; 381*/382*)  
One elective

Year 4  
Three Philosophy courses  
French: Minimum of two full courses or equivalent (see note 1)  
(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 1  
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*.

Note 2  
Students who decide on their Honours programme on entry into Year 2 should take both Philosophy 221*/222* or 280*/281* during that year, and should consult the Department concerning
Joint Philosophy—Choice of Degree
Mathematics Programme

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 240, 340, 358*/9*, 280*/1*, 282*/3*
Two others, one of which is in a value area

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

Further Requirements for the degree B.Math.
(Mathematics and Philosophy) cf. page 116
Further Requirements for the degree B.A.
(Philosophy and Mathematics)
6 more courses, including: A and B requirements for an Arts Degree

Honours Philosophy and Political Science

Year 1 Recommended Programme

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of Philosophy 221*/222* or 280*/281*</td>
<td>3</td>
</tr>
<tr>
<td>Either Political Science 105*/106* or 115*/116*</td>
<td>3</td>
</tr>
<tr>
<td>The equivalent of three other full courses</td>
<td>9</td>
</tr>
</tbody>
</table>

Year 2

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of Philosophy 221*/222* or 280*/281*</td>
<td>3</td>
</tr>
<tr>
<td>Philosophy 282*/283*</td>
<td>3</td>
</tr>
<tr>
<td>Philosophy 240 or alternatively 140*</td>
<td>3</td>
</tr>
<tr>
<td>and another half course in Philosophy</td>
<td></td>
</tr>
<tr>
<td>The equivalent of two full courses in Political Science (which must include 260)</td>
<td>6</td>
</tr>
<tr>
<td>The equivalent of one other full course</td>
<td>3</td>
</tr>
</tbody>
</table>

Year 3

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philosophy 399</td>
<td>1</td>
</tr>
<tr>
<td>Philosophy 327* and another half course in Philosophy</td>
<td>3</td>
</tr>
<tr>
<td>The equivalent of three full courses in Political Science</td>
<td>9</td>
</tr>
<tr>
<td>The equivalent of one other full course</td>
<td>3</td>
</tr>
</tbody>
</table>

Year 4

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philosophy 325*/326* or one other full course or equivalent</td>
<td>3</td>
</tr>
<tr>
<td>The equivalent of one full course in Political Science (which must be at the 400 or 500 level)</td>
<td>3</td>
</tr>
<tr>
<td>Either Philosophy 499 or Political Science 499</td>
<td>1</td>
</tr>
<tr>
<td>The equivalent of two other full courses</td>
<td>6</td>
</tr>
</tbody>
</table>
Honours Programmes

**Note** Students who decide on their Honours programmes on entry into Year 2 should take both Philosophy 221*/222* and 280*/281 during that year, and should consult the Department concerning rearrangement of their courses.

### Honours Philosophy and Psychology

**Year 1**

<table>
<thead>
<tr>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of Philosophy 221*/222* or 281*/282*</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 101*/102*</td>
<td>3</td>
</tr>
<tr>
<td>Three more courses</td>
<td>9</td>
</tr>
</tbody>
</table>

**Year 2**

<table>
<thead>
<tr>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of Philosophy 221*/222* or 281*/282*</td>
<td>3</td>
</tr>
<tr>
<td>One of Philosophy 240 or 340 or 282*/283*</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 283*/284*</td>
<td>3</td>
</tr>
<tr>
<td>One full course in Psychology (see note 1 under Honours Psychology)</td>
<td>3-3</td>
</tr>
<tr>
<td>Two more courses</td>
<td>4-6</td>
</tr>
</tbody>
</table>

**Year 3**

<table>
<thead>
<tr>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of Philosophy 240 or 340 or 282*/283*</td>
<td>3</td>
</tr>
<tr>
<td>Philosophy 399</td>
<td>3</td>
</tr>
<tr>
<td>Two full courses in Psychology (see note 1 under Honours Psychology)</td>
<td>6-3</td>
</tr>
<tr>
<td>Two more courses</td>
<td>4-6</td>
</tr>
</tbody>
</table>

**Year 4**

<table>
<thead>
<tr>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two full courses in Philosophy (see note 2 under Honours Psychology)</td>
<td>4-6</td>
</tr>
<tr>
<td>Senior Honours Essay (Philosophy 499 or Psychology 499)</td>
<td></td>
</tr>
</tbody>
</table>

**Note 1** Students who decide on the Honours Programme on entry into Year 2 should take both Philosophy 221*/222* and 280*/281 during their second year and should consult the Department concerning rearrangement of their courses.

### Honours Political Science

**Year 1**

<table>
<thead>
<tr>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Either Political Science 105*/106* or 115*/116*</td>
<td>3</td>
</tr>
<tr>
<td>The equivalent of four other full courses</td>
<td>12</td>
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</tbody>
</table>

**Year 2**

<table>
<thead>
<tr>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>The equivalent of three full courses in Political Science (which must include 260)</td>
<td>9</td>
</tr>
<tr>
<td>The equivalent of two other full courses</td>
<td>6</td>
</tr>
</tbody>
</table>

**Year 3**

<table>
<thead>
<tr>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>The equivalent of three full courses in Political Science (which must include either 220 or 320 if not taken in the second year)</td>
<td>9</td>
</tr>
<tr>
<td>The equivalent of two other full courses</td>
<td>6</td>
</tr>
</tbody>
</table>
Honours Programmes

**Year 4** The equivalent of three full courses in Political Science (at least two of which must be at the 400 or 500 level) 9
The equivalent of two other full courses 6

**Honours Political Science and Psychology**

**Year 1** *Recommended Programme*  
Hours  
Either Political Science 105*/106* or 115*/116* 3  
Psychology 101*/102* 3  
The equivalent of three other full courses 9

**Year 2** The equivalent of two full courses in Political Science (which must include 260) 6  
Psychology 283*/284* 3  
The equivalent of one other full course in Psychology (see note 1 under Honours Psychology) 3  
The equivalent of two other full courses 6

**Year 3** The equivalent of two full courses in Political Science (which must include either 220 or 320) 6  
The equivalent of two full courses in Psychology (see note 1 under Honours Psychology) 6  
The equivalent of two other full courses 6

**Year 4** The equivalent of two full courses in Political Science (one of which must be at the 400 or 500 level) 6  
The equivalent of two full courses in Psychology (see note 2 under Honours Psychology) 6  
Either Political Science 499 or Psychology 499 3

**Honours Political Science and Sociology**

**Year 1** *Recommended Programme*  
Hours  
Either Political Science 105*/106* or 115*/116 3  
Sociology 101*/102* 3  
The equivalent of three other full courses 9

**Year 2** The equivalent of two full courses in Political Science (which must include 260) 6  
The equivalent of two full courses in Sociology (which must include 202*) 6  
The equivalent of two other full courses 6

**Year 3** The equivalent of two full courses in Political Science (which must include either 220 or 320) 6  
The equivalent of two full courses in Sociology (which must include 321*/322*) 6  
The equivalent of two other full courses 6
Year 4  The equivalent of two full courses in Political Science (one of which must be at the 400 or 500 level)  6
The equivalent of two full courses in Sociology (which must include 425*/426*)  6
The equivalent of one other full course 3

Honours Psychology

Year 1  Recommended Programme  Hours
Psychology 101*/102*  3
Four more courses  12

Year 2  Psychology 283*/284*  3
One full course in Psychology 3  3
(see Note 1)
Three more courses  9

Year 3  Two full courses in Psychology  4-6  3
(see Note 1)
Three more courses  9

Year 4  Psychology 499
Two full courses in Psychology  4-6
(see Note 2)
Two more courses 6

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 of the following groups:

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Group 2</th>
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<tbody>
<tr>
<td>293*</td>
<td>393*</td>
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<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  Hours
Psychology 101*/102*  3
Mathematics 129 3
Mathematics 130  3
Two more courses 6
(see Note 2)
### Year 2
- **Psychology 283*/284* or Mathematics 233**
- (see Note 3)
- **One full course in Psychology**
- (see Note 1 under Honours 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**

<table>
<thead>
<tr>
<th>Year</th>
<th>Recommended Programme</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Lectures</td>
</tr>
<tr>
<td><strong>Year 1</strong></td>
<td>Psychology 101*/102*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Sociology 101*/102*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Three more courses</td>
<td>9</td>
</tr>
<tr>
<td><strong>Year 2</strong></td>
<td>One course in Statistics</td>
<td>3</td>
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<tr>
<td></td>
<td>(see Note 1 below)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One full course in Sociology</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>One full course in Psychology</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>(see Note 1 under Honours Psychology)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One full course in Sociology or</td>
<td>2-3</td>
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<tr>
<td></td>
<td>Psychology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Two more courses</td>
<td>4-6</td>
</tr>
<tr>
<td><strong>Year 3</strong></td>
<td>Sociology 321*/322*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>One full course in Sociology</td>
<td>2-3</td>
</tr>
<tr>
<td></td>
<td>Two full courses in Psychology</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>(see Note 1 under Honours Psychology)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Two more courses</td>
<td>4-6</td>
</tr>
<tr>
<td><strong>Year 4</strong></td>
<td>Psychology 499 or Sociology 499</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Two full courses in Sociology</td>
<td>4-6</td>
</tr>
<tr>
<td></td>
<td>Two full courses in Psychology</td>
<td>4-6</td>
</tr>
<tr>
<td></td>
<td>(see Note 2 under Honours Psychology)</td>
<td></td>
</tr>
</tbody>
</table>

**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**

<table>
<thead>
<tr>
<th>Year</th>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lectures</td>
</tr>
<tr>
<td><strong>Year 1</strong></td>
<td>Any first year programme that fulfils the general requirements of the Faculty of Arts. A 100-level RS course should be included.</td>
<td></td>
</tr>
<tr>
<td><strong>Year 2</strong></td>
<td>Religious Studies 210*/211*</td>
<td>4-6</td>
</tr>
<tr>
<td></td>
<td>Religious Studies 223G*/224G*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Religious Studies 237*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One other half-course in Religious Studies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Three electives</td>
<td></td>
</tr>
<tr>
<td><strong>Year 3</strong></td>
<td>Religious Studies 336P, 231J, or 331J</td>
<td>4-6</td>
</tr>
<tr>
<td></td>
<td>Religious Studies 301*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One and a half other courses in Religious Studies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Two electives</td>
<td></td>
</tr>
<tr>
<td><strong>Year 4</strong></td>
<td>Three courses in Religious Studies at the 400 level</td>
<td>4-6</td>
</tr>
<tr>
<td></td>
<td>Two electives</td>
<td></td>
</tr>
</tbody>
</table>

**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.*
**Honours Programmes**

**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
- Two more courses

**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 24 of the Calendar.

**Honours Sociology**

**Year 1** *Recommended Programme*

- Sociology 101*/102*
- Four elective full year courses (or equivalent half courses)  
  
- Hours

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

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

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

**Honours Sociology and Anthropology**

*Recommended Programme*

**Year 1**
- Sociology 101*/102*
- Anthropology 101*/102*
- Three elective full year courses (or equivalent half courses)
  
- Hours
Year 2  Sociology 202*  
One and one-half courses in Sociology  1 ½ 
Two full courses in Anthropology (including a 
course in Ethnography)  4 ½ 
Two elective full year courses (or equivalent 
half courses)  6 

Year 3  Sociology 321*/322*  
One full or two half courses in Sociology  3 
Anthropology 370*  1 ½ 
One and one-half courses in Anthropology  4 ½ 
Two elective full year courses (or equivalent 
half courses)  6 

Year 4  Sociology 425*/426*  
One full or two half courses in Sociology  3 
Two full courses in Anthropology (or 
equivalent half courses)  6 
One full elective or two half courses 
(See Note)  3 

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 
Middle East.
Honours Programmes

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 International Studies. The following first-year Arts option is offered to students academically enrolled in Renison College who may wish to proceed to advanced studies in this area: History 125R; Politics 180R or Economics 120R; Geography 120R; one of French 100, German 101*/102*, Italian 110J, Russian 101*/102*, or Spanish 110; and at least one first-year elective course from Anthropology, Economics, English, Fine Arts, History, Mathematics, Philosophy, Political Science, Psychology, Religious Studies, and Sociology.

Social Science (Applied). The following first-year Arts option is offered to students academically enrolled in Renison College who may wish to proceed to advanced studies in this area: Sociology 120R; Social Work 120R; Psychology 120R; Religious Studies 120R; and at least one first-year elective from Anthropology, Biology, Economics, English, Fine Arts, French, Geography, German, History, Italian, Mathematics, Philosophy, Physical Education and Recreation, Political Science, Russian, and Spanish.

Further details concerning these two options and concerning the courses in them may be obtained from Renison College.

Graduate Studies

In addition to the general University graduate requirements set forth on page 168 graduate degree candidates in the Faculty of Arts must conform to certain other regulations set down by the Faculty.

1) At least half 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 a Bachelor's degree.
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 1970 convocation: April 24, 1970
  - Fall 1970 convocation: September 18, 1970
  - Spring 1971 convocation: April 23, 1971

- **M.Phil.**
  - Spring 1970 convocation: April 17, 1970
  - Fall 1970 convocation: September 11, 1970
  - Spring 1971 convocation: April 16, 1971

- **Ph.D.**
  - Spring 1970 convocation: March 27, 1970
  - Fall 1970 convocation: August 21, 1970
  - Spring 1971 convocation: March 26, 1971


*A View of the Arts Quadrangle*
3 The Faculty of Engineering
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 and development of professional competence. The Co-operative Engineering Course 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 course 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 courses 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 course 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 course brings a student into direct contact with industrial 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 co-operative 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
The Co-operative Engineering Course

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 have a clear understanding of the relationship of their profession to industry and society.

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 courses entail five years of undergraduate study on the co-operative programme.

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, the particular courses in graduate work in the various departments listed in Chapter 9.

Co-operative Programme

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

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Winter</td>
<td>Spring</td>
<td>Fall</td>
<td>Winter</td>
<td>Fall</td>
</tr>
<tr>
<td>Stream</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;A&quot;</td>
<td>First</td>
<td>Second</td>
<td>Work</td>
<td>Third</td>
<td>Work</td>
</tr>
<tr>
<td>Term</td>
<td>Term</td>
<td>Period</td>
<td>Term</td>
<td>Period</td>
<td>Term</td>
</tr>
<tr>
<td>Stream</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;B&quot;</td>
<td>First</td>
<td>Work</td>
<td>Second</td>
<td>Work</td>
<td>Fourth</td>
</tr>
<tr>
<td>Term</td>
<td>Period</td>
<td>Term</td>
<td>Period</td>
<td>Term</td>
<td>Term</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 course and graduate together. Between the first and last terms, the diagram shows that each class is split into two approximately even groups for continuity 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 course and the other having a double academic term at the end of the course. 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
The Co-operative Engineering Course

Students should read Section 14 for details of operation of the co-operative programmes.

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

Admission Requirements

General Application for admission to the Faculty of Engineering 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 Early Final Admission must apply before April 1, 1970. All other applicants must apply and have submitted all the necessary documents by August 1, 1970. Persons applying after these dates cannot be guaranteed consideration of their application.

Because of limited capacity the Engineering programme is limited in its enrolment. Therefore most admissions are made early. Interested applicants are urged to apply for Early Final Admission rather than wait for the August 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 1970.

Application Documents All applicants must submit an application form, certified transcripts of secondary or post-secondary education, and at least one letter of reference. Applicants enrolled in Ontario Grade 13 in the 1969-70 academic year must apply on the “General Application for Admission to University” form which is available from the secondary school. All other applicants must apply on forms available from the Office of the Registrar. All educational institutions attended by the applicant must be accounted for on certified documents. In addition, applicants from non-English speaking countries must arrange to submit certified English translations of their academic documents.

Admission to Year 1

Ontario Applicants from the Province of Ontario are required to have completed Ontario Grade 13 showing a minimum overall average of 60% in the seven required credits. For applicants who have taken more than one year to complete the work of Grade 13, a somewhat higher average may be required.

Standing is required in seven Ontario Grade 13 credits as follows:

- Five credits from Chemistry (1)
- Physics (1)
- Mathematics A(2)
- Mathematics B(1)

Two additional credits. (2)
Additional credits can be selected from any of the optional subjects offered at the Grade 13 level with the qualification that no more than one of the following may be counted as an “additional” credit; Accountancy Practice, Art, Home Economics, Mathematics of Investment, Music, or Secretarial Practice. The marks received in one of these subjects will be included in the computation of the applicant’s average. Standing with the Royal Conservatory of Music in Grade VIII practical and Grade II theory will be considered as “one additional credit” on the same terms as these subjects except the marks received will not be computed in the average.

**Note 1** If English is not chosen as a Grade 13 subject offered for admission, applicants must have standing in English at the Grade 12 level.

**Note 2** The University will use the following definition of credits for admission purposes:
- 3 credits Mathematics A and Mathematics B combined
- 2 credits All language subjects, Mathematics A
- 1 credit All other subjects

The University will consider other systems of credit definition from Ontario secondary schools.

**Note 3** A number of secondary schools in Ontario are engaged in innovative programmes. The University will consider courses for admission purposes which are not formally listed in the Ontario Department of Education Circular H.S.I. Applicants should confirm with their secondary school’s guidance officials that new courses and programmes have been approved by the University for admission purposes.

**Early Final Admission - Ontario**

Students enrolled full time in Ontario Grade 13 will be considered for Early Final Admission. To be eligible for consideration, applicants must arrange to have the “General Application for Admission to University” form submitted by April 1, 1970. Consideration of candidates for Early Final Admission will be based on the Secondary School record, the Principal’s recommendation, and the results of the Canadian Scholastic Aptitude Test and specified Achievement Tests. Successful applicants may expect to be notified after June 11, 1970 of their acceptance and will be asked to indicate their decision by June 26, 1970. Those applicants who are not offered Early Final Admission will be considered on the basis of the Grade 13 final results and will be notified as soon as possible after the release of the Grade 13 results.

Students from other than Ontario Grade 13 are also eligible for admission at any time. Successful applicants will be notified any time after June 11, 1970. Places in Engineering are filled on a “first come” basis when entry qualifications are equal.

**Note** All applicants will be required to complete Grade 13 to the satisfaction of the Secondary School principal.

**Aptitude and Achievement Tests**
- OACU—Ontario Tests for Admission to College and University
- SACU—Service for admission to College and University

Applicants will be required to write the Canadian Scholastic Aptitude Test (CSAT) and the appropriate (OACU) Achievement Tests in English, Mathematics and Physics if the corresponding
Other Canadian Provinces and Countries

For 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:

- 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: Third Year Certificate from Prince of Wales College
- Quebec: Senior High School Leaving Certificates
- Saskatchewan: Senior Matriculation (Grade 12)
- England and Wales, West Indies, East and West Africa: Senior Matriculation (Grade 12)
- Scotland: The General Certificate of Education with passes in at least five subjects, two of which must be at Advanced Level
- United States of America: High School Graduation plus an additional year of formal study in subjects comparable to Ontario Grade 13

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. The expenses involved in administering the test must be borne by the applicant. 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.

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. 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 completed, giving equivalent to the subjects he wishes.
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 8, 9, 10, 11, 1970.

Fees

Refer to Section 12, Page 458.

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 follows:

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 be 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 symbol “F”. All promoted students will be shown as having obtained, First, Second or Third Class Honours according to the following table:
Examinations and Promotions

**Rounded Average**

<table>
<thead>
<tr>
<th>Percentage</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></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 First Year will be required to repeat the second term, except that readmissions 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:

<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 decisions. 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 they relate to 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 synthesis. It should be noted that the first year of the engineering course 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 must be 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 of Mechanical Engineering in 2nd year.)

All Year 1 students enrolling in General and Chemical Engineering must register in Mathematics 12, Mathematics 21, Physics 11 Chemistry 11, G.E. 001, and G.E. 000 tutorial.


Students in Systems Design have an entirely separate programme as described on page 427 under the Department of Systems Design. They must register for the courses as described in Year 1 Systems Design.

<table>
<thead>
<tr>
<th>Course Arrangement</th>
<th><strong>First Term lab.</strong></th>
<th><strong>Second Term lab.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lect.</td>
<td>prob.</td>
</tr>
<tr>
<td>Math 12 Calculus 1</td>
<td>2</td>
<td>3*</td>
</tr>
<tr>
<td>Math 21 Algebra and Solid Geometry</td>
<td>2</td>
<td>3*</td>
</tr>
<tr>
<td>Physics 11 Physics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Chem. 11 GE21 Graphics 1</td>
<td>2</td>
<td>3*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gen. Eng. 11 GE22 Graphics 2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ch.E. 10 GE23 Measurement</td>
<td>3*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gen. Eng. 000 Tutorial</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Gen. Eng 001 Introduction to Social Sciences and Humanities</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
Asterisks signify a course given on alternate weeks. Detailed course descriptions commence on page 176.

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 on 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 course offered by the Department of Chemical Engineering is 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. A certain degree of specialization is available in the final three semesters through options oriented towards the biochemical, extractive metallurgical or polymer industries, 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 carefully planned and developed to enable the students to obtain maximum experience in industry.

A. Core Programme

a. Mathematics and Science Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Lect.</th>
<th>Lab. or Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 22</td>
<td>Calculus 2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Math. 23</td>
<td>Numerical Methods</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Math. 31</td>
<td>Differential Equations</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Math. 32</td>
<td>Numerical Analysis</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Chem. 22</td>
<td>Analytical Chemistry</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 26</td>
<td>Organic Chemistry 1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Chem. 36</td>
<td>Organic Chemistry 2</td>
<td>3</td>
<td>3*</td>
</tr>
</tbody>
</table>
b. Engineering Courses

G.E.  61 Philosophy of Science  3
E.E. 10 Introduction to Electrical Engineering  3  3
Ch. E. 10 Chem. Process Principles 1  4  6
Ch. E. 12 Chem. Process Principles 2  3  2*
Ch. E. 16 Inorganic Chemistry 1  3
Ch. E. 17 Applied Mathematics 1  3
Ch. E. 18 Engineering Statistics  2  3
Ch. E. 21 Fluid-Mechanics (Transport Processes 1)  3  3
Ch. E. 22 Transport Processes 2  3
Ch. E. 23 Transport Processes 3  3
Ch. E. 31 Physical Chemistry 1  3
Ch. E. 32 Physical Chemistry 2  3  2*
Ch. E. 33 Chemical Engineering Thermodynamics  3
Ch. E. 35 Electrochemistry  3  3*
Ch. E. 36 Physical-Chemical Laboratory  3
Ch. E. 41 Reaction Kinetics 1  3
Ch. E. 42 Reaction Kinetics 2  3
Ch. E. 51 Process Dynamics and Control 1  3
Ch. E. 61 Engineering Economics  3
Ch. E. 62 Process Systems Design  2  3
Ch. E. 71 Chemical Engineering Lab. 1  4
Ch. E. 72 Chemical Engineering Lab. 2  6
Ch. E. 95 Seminar  1

B. Elective Courses  
A minimum of 6 courses must be chosen in addition to the core courses listed above to fulfill the requirements of the Chemical Engineering programme. One course (three hours) may be chosen from non-technical electives in the humanities or social sciences. The equivalent of five courses are to be technical electives, and at least three of these are to be selected from any one of the optional groups listed below. The other electives can be chosen from other Chemical Engineering courses or from other science or engineering courses lists according to interest, but this choice must be approved by the Department.

Optional Groups
1) Chemical Engineering Science
   Ch. E. 535 Estimation of Physical Properties of Gases and Liquids  
   Ch. E. 543 Reactor Design and Catalysis  
   Ch. E. 554 Chem. Eng. Analysis

2) Polymer Science
   Ch. E. 80 Polymer Chemistry  
   Ch. E. 81 Physical Chemistry of Polymers  
   Ch. E. 82 Polymer Processing

3) Extractive and Process Metallurgy
   Ch. E. 85 Introduction to Extractive Metallurgy  
   Ch. E. 86 Metallurgy Chemistry  
   Ch. E. 87 Principles of High Temperature Extractive Metallurgy
4) Systems Option
Ch.E. 554 Chem. Eng. 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 are recommended if more than three courses in this option are desired.
5) Biochemical Engineering
Ch.E. 590 Fermentation & Food Process Engineering
Ch.E. 591 Industrial Microbiology
Ch.E. 543 Reactor Design and Catalysis or
Ch.E. 592 Applied Biochemistry
6) Research Project
Ch.E. 98 Research and Design Project 1 (3 hours)
Ch.E. 99 Research and Design Project 2 (6 hours)

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Engineering</td>
<td></td>
</tr>
<tr>
<td>Math. 22</td>
<td>Chem. 22</td>
</tr>
<tr>
<td>Math. 23</td>
<td>Chem. 26</td>
</tr>
<tr>
<td>E.E. 10</td>
<td>Ch.E. 31</td>
</tr>
<tr>
<td>Non-Technical elective</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 2B. Fall 1970 and Spring 1971</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 31</td>
</tr>
<tr>
<td>Math. 32</td>
</tr>
<tr>
<td>Chem. 36</td>
</tr>
<tr>
<td>Non-Technical elective</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 3A. Winter 1971 and Spring 1971</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch. E. 12</td>
</tr>
<tr>
<td>Ch.E. 17</td>
</tr>
<tr>
<td>Ch.E. 18</td>
</tr>
<tr>
<td>Non-Technical elective</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 3B. Fall 1970 and Winter 1971</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch.E. 22</td>
</tr>
<tr>
<td>Ch. E. 33</td>
</tr>
<tr>
<td>Ch.E. 35</td>
</tr>
<tr>
<td>Tech. elect.</td>
</tr>
<tr>
<td>Non-Technical elective</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 4A. Fall 1970 and Spring 1971</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch.E. 23</td>
</tr>
<tr>
<td>Ch.E. 51</td>
</tr>
<tr>
<td>Ch.E. 61</td>
</tr>
<tr>
<td>Ch.E. 72</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 4B. Winter 1971</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.E. 61</td>
</tr>
<tr>
<td>Ch.E. 62</td>
</tr>
<tr>
<td>Elective</td>
</tr>
</tbody>
</table>
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 in fulfilling these demands, spend well over a tenth of our total national income—more money than 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 and Dynamics
M.E. 15 Structure and Properties of Materials 1
M.E. 50 Thermodynamics
G.E. 61 History and Philosophy of Science
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. 452 Environmental Health Engineering
C.E. 471 Soil Engineering
C.E. 481 Engineering Law
C.E. 498 Seminar
C.E. 499 Seminar
C.E. 500 Systems 4 (Project)

B. Elective Courses
The technical electives may be selected from the list below in consultation with a Civil Engineering faculty advisor.
C.E. 403 Reinforced Concrete 2
C.E. 404 Design of Steel Structures
C.E. 501 Approximate Analysis of Structures
C.E. 502 Failure in Metal Assemblies
C.E. 507 Advanced Analysis of Structures
C.E. 510 Advanced Mechanics of Deformable Solids
C.E. 520 Computer Applications to Engineering Problems
C.E. 522 Engineering Analysis 2
C.E. 530 Fundamentals of Experimental Mechanics
C.E. 531 Introduction to Experimental Strength Analysis
C.E. 540 Highway Engineering (Planning and Design)
C.E. 541 Pavement Materials
C.E. 542 Pavement Structural Design
C.E. 546 Geometric Design
C.E. 560 Mechanical Behaviour of Materials
C.E. 572 Topics in Waste Treatment

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)

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

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

<table>
<thead>
<tr>
<th>Year 3A</th>
<th>Lectures (hrs./week)</th>
<th>Labs or Problems (hrs./week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 303 Structural Analysis 1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 305 Structure and Properties of Materials 2</td>
<td>2</td>
<td>3 +</td>
</tr>
<tr>
<td>C.E. 321 Statistics</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>C.E. 350 Fluid Mechanics</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 361 Urban Planning</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>C.E. 371 Geology for Engineers</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 398 Seminar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 3B</th>
<th>Lectures (hrs./week)</th>
<th>Labs or Problems (hrs./week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 304 Structural Analysis 2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 322 Engineering Analysis</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 351 Hydraulics</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>C.E. 362 Transportation Engineering</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>C.E. 372 Soil Mechanics</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 399 Seminar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 4A</th>
<th>Lectures (hrs./week)</th>
<th>Labs or Problems (hrs./week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.E. 61 History &amp; Philosophy of Science</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 400 Systems 3 (Project)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 401 Structural Steel</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 402 Reinforced Concrete 1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 451 Water Resources &amp; Sanitary Engineering</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 471 Soil Engineering</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>C.E. 498 Seminar</td>
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</table>
Electrical Engineering

Year 4B

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>C.E. 452</td>
<td>Environmental Health Engineering</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 481</td>
<td>Engineering Law</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 499</td>
<td>Seminar</td>
<td></td>
</tr>
<tr>
<td>C.F. 500</td>
<td>Systems 4 (Project)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Three Technical electives</td>
<td>7</td>
</tr>
</tbody>
</table>

+ 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.

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 (see page 62), the technical programme in Electrical 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 (apart from the 3B term in Fall 1970, Winter 1971) 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 59).

The normal rules of the cooperative programme will apply. By special permission the number of cooperative work terms may be reduced, but a student must complete at least 4 work terms (including that done in his first year)—unless he is a student admitted to advanced standing, as defined in the Calendar, see page 58.

The student must register his courses, electives, etc., at the beginning of each term.
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 59) and the student will be examined on the basis of the courses for which he is registered at the time of examination.

**Programme**  
*a) Core (Years 2 and 3)*

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</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. 241</td>
<td>Electric Networks 1</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 261</td>
<td>Electromechanics</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 271</td>
<td>Electric &amp; Magnetic Fields</td>
<td>2</td>
<td>3*</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 316</td>
<td>Probability &amp; Statistics</td>
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<td>E.E. 342</td>
<td>Electric Networks 2</td>
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<tr>
<td>E.E. 351</td>
<td>Electronics 1</td>
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<td>E.E. 352</td>
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<tr>
<td>E.E. 362</td>
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<tr>
<td>E.E. 372</td>
<td>Electromagnetic Theory &amp; Applications</td>
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<table>
<thead>
<tr>
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<th>Lect.</th>
<th>Lab.</th>
<th>Sem.</th>
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<tbody>
<tr>
<td>E.E. 380</td>
<td>Introduction to Systems &amp; Control</td>
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<td>G.E. 31</td>
<td>Thermodynamics</td>
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<td>Math. 22</td>
<td>Calculus 2</td>
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(b) Technical Electives *

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<tr>
<td>E.E. 425</td>
<td>System Simulation</td>
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<td>E.E. 426</td>
<td>Switching Systems</td>
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<td></td>
<td>Signal Systems</td>
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<td>E.E. 428</td>
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<tr>
<td>E.E. 434</td>
<td>Magnetic Materials and Quantum Electronics</td>
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<tr>
<td>E.E. 435</td>
<td>Semiconductor Devices 1</td>
<td>2</td>
<td>0</td>
<td>2</td>
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<tr>
<td>E.E. 436</td>
<td>Semiconductor Devices 2</td>
<td>2</td>
<td>0</td>
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<td>E.E. 453</td>
<td>General Electronic Circuits</td>
<td>2</td>
<td>0</td>
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<tr>
<td>E.E. 454</td>
<td>Pulse and Switching Circuits</td>
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<td>E.E. 463</td>
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<td>E.E. 464</td>
<td>Power Apparatus</td>
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<td>E.E. 499B</td>
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<td>E.E. 543</td>
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<tr>
<td>E.E. 546</td>
<td>Algebra of Linear Systems 1</td>
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<td>Math. 44</td>
<td>Complex Variables</td>
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*With the approval of the Department, students may take technical
(c) Non-Technical

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<td>E.E. 202</td>
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<td>E.E. 301</td>
<td>Seminar</td>
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<tr>
<td>E.E. 302</td>
<td>Seminar</td>
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<td>E.E. 401</td>
<td>Seminar</td>
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<tr>
<td>E.E. 402</td>
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<tr>
<td></td>
<td>1 non-technical elective per term</td>
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1 non-technical elective per term

Normal Academic Programmes for each term (1970-71)

Electrical Engineering

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

G.E. 31; Math 22; E.E. 201; E.E. 241; E.E. 271; non-technical elective.

2B Term: Summer 1970, Fall 1970, Summer 1971
Math. 35; Phys. 15; E.E. 202; E.E. 217; E.E. 261; non-technical elective.

3A Term: Winter 1971, Summer 1971
E.E. 301; E.E. 316; E.E. 342; E.E. 351; E.E. 362; non-technical elective.

3B Term: Fall 1970, Winter 1971
E.E. 302; E.E. 324; E.E. 332; E.E. 362 (In place of non-technical elective); E.E. 372; E.E. 380.

4A Term: Summer 1970, Fall 1970, Summer 1971
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.

4B Term: Winter 1971

*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 throughout Canada. He is required in the field of power generation 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 basic fundamental 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 the 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) 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.

Students can structure curricula for specialization in combustion and energy conversion, internal flows with heat and mass transfer, turbomachinery and fluid control systems or for a broader exposure to these and other areas.

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.
**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, oceanography, ocean engineering, weather modification, pollution problems or related fields.

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 Code</th>
<th>Course Title</th>
<th>Lect.</th>
<th>Lab. or Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.E. 12</td>
<td>Electricity and Magnetism 1</td>
<td>2</td>
<td>3*</td>
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<tr>
<td>E.E. 14</td>
<td>Electromagnetics</td>
<td>2</td>
<td>3*</td>
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<td>E.E. 32</td>
<td>Electronics</td>
<td>3</td>
<td>3*</td>
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<tr>
<td>C.E. 201</td>
<td>Mechanics of Deformable Solids 1</td>
<td>2</td>
<td>2</td>
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<tr>
<td>M.E. 1</td>
<td>Advanced Calculus</td>
<td>3</td>
<td>2*</td>
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<td>M.E. 3</td>
<td>Differential Equations</td>
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<tr>
<td>M.E. 5</td>
<td>Applied Analysis</td>
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<td>M.E. 10</td>
<td>Systems Dynamics</td>
<td>3</td>
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<td>M.E. 12</td>
<td>Dynamics</td>
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<tr>
<td>M.E. 15</td>
<td>Structure and Properties of Matter 1</td>
<td>3</td>
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<td>M.E. 20</td>
<td>Mechanics of Deformable Solids 2</td>
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<td>M.E. 21</td>
<td>Mechanics of Machinery</td>
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<td>3</td>
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<tr>
<td>M.E. 30</td>
<td>Structure and Properties of Matter 2</td>
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<td>M.E. 50</td>
<td>Thermodynamics</td>
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<td>M.E. 51</td>
<td>Fluid Mechanics 1</td>
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<td>M.E. 53</td>
<td>Heat Transfer 1</td>
<td>3</td>
<td>3*</td>
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<tr>
<td>M.E. 60</td>
<td>Control Theory</td>
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<tr>
<td>Math. 23</td>
<td>Numerical Methods</td>
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<td>Math. 32</td>
<td>Numerical Analysis</td>
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#### b) Non-Credit Courses

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<td>M.E. 200</td>
<td>Introduction to Mechanical Engineering 1</td>
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<td>M.E. 300</td>
<td>Introduction to Mechanical Engineering 2</td>
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<tr>
<td>M.E. 400</td>
<td>Introduction to Mechanical Engineering 3</td>
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</table>

### B. Elective Course

#### a) Non-technical electives: Students entering the programme on or after September 1969 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*

M.E. 54 Thermodynamics 2  
M.E. 56 Heat Transfer 2  
M.E. 58 Internal Combustion Engines  
M.E. 59 Energy Conversion  
M.E. 62 Fluid Mechanics 2  
M.E. 64 Industrial Aerodynamics  
M.E. 555 Thermodynamics 3  
M.E. 557 Combustion 1  
M.E. 561 Fluid Control Systems  
M.E. 563 Turbomachines  
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 Applied Fluid Power Engineering

*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. 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 to Polymer Science  
Ch.E. 81 Physical Chemistry of Polymers  
M.S. 201 Foundations of Probability Theory  
M.S. 202 Foundations of Statistical Inference  
M.S. 301 Elements of Industrial Engineering  
M.S. 401 Operations Research in Production  
M.S. 402 Operations Research in Resource Allocation  
M.S. 404 Industrial Psychology
d) Engineering Materials Option

M.E. 32 Physical Metallurgy 2
M.E. 33 Materials Science Laboratories
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)
C.E. 611 Elementary Mechanics of Continua

e) Geophysical (Environmental) Fluid Dynamics Options

M.E. 62 Fluid Mechanics 2
M.E. 69 Introduction to the Environmental 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

Academic Programmes for Each Term (1970-71)

Year 2A Fall 1970 and Winter 1971

M.E. 1
M.E. 200
Math. 23
E.E. 12

Year 2B Summer 1970 and Fall 1970

M.E. 3
M.E. 20
Math. 32

Year 3A Summer 1970 and Winter 1971

M.E. 5
M.E. 10 (Winter 71 only)
M.E. 20 (Summer 70 only)
M.E. 21
Systems Design

**Year 3B Fall 1970 and Winter 1971**
M.E. 53  2 technical electives
M.E. 60  1 non-technical elective
E.E. 32

**Year 4A Summer 1970 and Fall 1970**
M.E. 82 or 2 technical electives
M.E. 90 or 1 technical elective
G.E. 61 or 1 non-technical elective
2 technical electives
M.E. 400

**Year 4B Winter 1971**
M.E. 82 or 2 technical electives
3 technical electives
1 non-technical elective

**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 Expo '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 in Systems Design Engineering. The first three semesters of this programme will be available in the academic year 1970-71.

**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 interdependence. 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 distinguishing characteristic of system theory is its generality.

Systems Design Engineering is the study of complex systems for the purposes of analysis, simulation, optimization and ultimately design. Within the last decade the tools for these tasks have become more powerful thus allowing the systems designer to successfully study larger and more complex systems. These recent developments include an increasing awareness of the theories of Communication, progress in the areas of Human Systems Engineering, Social and Economic Systems, developments in the Theories of Design and Planning, and, of course, the tremendous impact of electronic computing systems.

The undergraduate programme in Systems Design Engineering at Waterloo has been created to provide the student with a broad background and capability in:

a) Systems Analysis, Simulation, Optimization and Design
b) Human and Environmental Systems Engineering
and

c) Social and Economic Systems.
This programme is specifically oriented towards developing graduates who can solve problems lying at the interface of technology and the human environment. Systems Design will therefore be attractive to students who are technically oriented and also have a strong parallel interest in social and human problems.

The organization and presentation of the Systems Design programme are also unique in that it makes use of integrated problem sessions and advanced teaching techniques. There is also considerable flexibility within the programme so that the student can choose a number of technical and non-technical courses and thus follow his own individual interests and capabilities.

It is intended that many of the students in Systems Design will continue their studies to the Master's level upon completion of their undergraduate studies.

A. Core Programme

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Lect.</th>
<th>Lab/Prob.</th>
<th>Tut.</th>
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</thead>
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<td>S.D. 13</td>
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<td>S.D. 81</td>
<td>Applied Electronics</td>
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<tr>
<td>Math. 31</td>
<td>Differential Equations</td>
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<td></td>
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<tr>
<td>E.E. 13</td>
<td>Electricity and Magnetism</td>
<td>2</td>
<td>3**</td>
<td>1</td>
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<tr>
<td>G.E. 31</td>
<td>Thermodynamics</td>
<td>2</td>
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<td>G.E. 41</td>
<td>Mechanics of Deformable Solids</td>
<td>2</td>
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<td></td>
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<tr>
<td>G.E. 42</td>
<td>Dynamics</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 in each semester; a special General Studies Series of courses is being developed for this purpose.
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 organizational unit of Graduate Divisions cutting across departmental boundaries. The Solid Mechanics Division is the first such division, arising out of the need of modern technology 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. The principal areas of activity are: mathematical method and computation, finite element analysis, structural dynamics, random 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)
H.B. Poorooshab, B.Sc. (Manchester), Ph.D. (Cambridge)
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. 611 Mechanics of Continua
M.E. 622 Mechanical Design 4
M.E. 625 Experimental Mechanics
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
M.E. 739 Dislocation Theory
M.E. 749 Metallurgy and Plasticity in Metal Fabrication
C.E. 600 Theories of Design
C.E. 601 Theory of Plates and Shells 1
C.E. 602 Theory of Inelastic Structures 1
C.E. 603 Theory of Inelastic Structures 2
C.E. 604 Prestressed Concrete
C.E. 609 Stability of Elastic Structures
C.E. 611 Mechanics of Continua
C.E. 621 Energy Methods in Applied Mechanics
C.E. 629 Mathematical Methods in Applied Mechanics
C.E. 630 Engineering Photoelasticity
C.E. 632 Physical Basis of Mechanical Model Studies
C.E. 660 Fracture Behaviour of Materials
C.E. 701 Advanced Topics in the Theory & Design of Structures
C.E. 702 Structural Synthesis and Case Histories
C.E. 703 Theory of Plates & Shells 2
C.E. 704 Reinforced Concrete 3
C.E. 710 Advanced Topics in Mechanics of Continua
C.E. 715 Finite Element Method in Continuum Mechanics
C.E. 716 Plasticity
C.E. 717 Elasticity
C.E. 724 Mathematical Analysis of Stability of Electo-Mechanical Systems
C.E. 725 Nonlinear Dynamics
C.E. 726 Advanced Analytical Mechanics
C.E. 729 Error Analysis of Numerical Methods in Applied Mechanics
C.E. 730 Advanced Topics in Experimental Mechanics
C.E. 731 Experimental Stress Analysis
C.E. 733 Advanced Photoelasticity 1
C.E. 734 Advanced Photoelasticity 2
C.E. 735 Special Problems in Experimental Mechanics
C.E. 750 Earth Structures
C.E. 751 Advanced Soil Mechanics
C.E. 752 Advanced Topics in Soil Mechanics and Geotechnical Engineering
C.E. 760 Advanced Topics in the Behaviour of Materials
C.E. 761 Fatigue Behaviour of Materials
C.E. 762 Cyclic Deformation Behaviour of Materials

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)
D.C. Ferguson, B.A.Sc. (Toronto)
T.M. Fraser, M.D., Ch.B. (Edinburgh), M.Sc. (Ohio State), L.M.C.C., F.A.C.P.M.
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)
T.E. Unny, B.E., M.Tech., Dr. Ing. (Dresden)
L.Y. Wei, B.S., M.S., Ph.D. (Illinois)
M.M. Yavanovich, B.Sc., M.S., M.E., Sc.D. (MIT)
4 Division of
Environmental Studies
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 in its organization to a regular Faculty, such as Arts, Science, Engineering and so on, but is unique in its outlook. It concentrates on all modes of knowledge needed to attack one particular problem area, that of 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:

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

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 disciplines 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 will be fostered, and joint appointments of faculty members with other Faculties and Schools are being made. Students will not only be free to, but will be encouraged to choose courses from across the whole university.

The Department of Man-Environment Studies

This Department is a completely new attempt to structure a programme of honours-level education focussed on an area of study, rather than on an academic discipline. Many leading academics have called for this, many famous universities have discussed how it might fit into the conventional university form; the University of Waterloo has now created the new structure needed to accommodate this new interdisciplinary approach to studying man's environment.

The Department is staffed with as wide as possible a range of scholars who have the interaction of man and his environment as their primary area of work, including anthropologists, biologists, earth scientists, economists, engineers, geographers, philosophers and political scientists, among others.

The programme of Man-Environment Studies has a dual focus; on man, and on the environment. The student will study man, and his social institutions and processes of social change; he will study the environment in its natural and man-made forms. Most impor-
tantly, he will constantly be required to investigate the mutual interaction of all of these. To do this, considerable academic innovation will be necessary. Team teaching and seminar “learning cells” will likely be important developments. Professor and students will, in many cases, together be developing the new insights and understanding in a spirit of incisive inquiry embracing all academic disciplines of relevance to the problem.

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 can thus be considered both a natural and social science and flourishes best in an academic organization where the interdisciplinary approach is emphasized. The new Bachelor of Environmental Studies (B.E.S.) programme in Honours Geography will provide 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 to suit his particular needs, whether he is interested in physical or human geography.

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 programmes 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 the most relevant Geography courses.

The Department of Geography has both Master’s and Ph.D. graduate programmes. At the graduate level the course work and research is 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 School of Urban and Regional Planning

The School of Urban and Regional Planning has evolved out of the Planning Programme of the former Department of Geography and Planning. The emphasis in the School is on integrated planning of entire regions, including both the urban and rural components. 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 goal formulation, survey and analysis, design, action programmes, and implementation. The broad educational 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 environ-
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 Masters 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 School of Architecture

Architecture is the art of communicating 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. Pursuit of Architecture is based on a dedication to a more meaningful life. The overriding task we are addressing ourselves to is to help the students become sensitive to the needs of mankind and to the changes in these needs commanded by science and technology. The school must explore a wide variety of disciplines to equip the students with a correlated understanding of these disciplines to Architecture.

The school must strive to be a centre for research in order to generate new knowledge and understanding of Architecture. The school must bridge the gap between the humanities and the engineering sciences. The concepts of systems engineering and applied computer science must be part and parcel of the new generation of Architects as they strive to solve the realities of human societies. Creative imagination superimposed on such a system understanding will give these Architects their excellence.

The School of Architecture now located in the new Division of Environmental Studies is in the mainstream of academic endeavour, interacts with other environmental disciplines, and draws upon the strengths of the 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. Courses are organized around six major themes: (1) the studio/workshop; (2) design theories and methods; (3) quantitative methods of analysis and measurement; (4) ecological topics; (5) cultural and historical factors in the human environment; (6) physical and material sciences.

The main present research activities of Architectural faculty members are computer generated architectural layout, design protocol analysis, and environmental perception.

Degrees

The Division of Environmental Studies offers a Bachelor of Environmental Studies (B.E.S.), Master of Arts (M.A.) and a Ph.D. Degrees may be obtained in the following areas:
Admissions and Registration

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

At present, Masters programmes in Architectural and Spatial Design are being supervised in the Department of Systems Design by Architectural faculty members, but the establishment of a regular programme in the School of Architecture is under review.

The student should choose the unit most suited to his interests, but in fact he will 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 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 and who wish to be considered for Early Final Admission must apply before April 1, 1970. All other applicants must apply and have submitted all necessary documents by August 1, 1970. Persons applying after these dates cannot be guaranteed consideration of their application.

Since many of the programmes offered at the University have limited enrollment, 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 1970.

Application Documents All applicants must submit an application form, certified transcripts of secondary or post-secondary education, and at least one letter of reference. Applicants enrolled in Ontario Grade 13 in the 1969-70 academic year must apply on the “General Application for Admission to University” form which is available from the secondary school. All other applicants must apply on forms available from the Office of the Registrar. All educational institutions attended by the applicant must certify the accuracy of their records.
Admissions and Registration

In addition, applicants from non-English speaking countries must arrange to submit certified English translation of their academic documents.

**Admission to Year 1**

**Ontario**

Applicants from the Province of Ontario are required to have completed Ontario Grade 13 showing a minimum overall average of 60% in the seven required credits. For applicants who have taken more than one year to complete the work of Grade 13, a somewhat higher average may be required.

- School of Urban and Regional Planning
- Department of Geography
- Department of Man-Environment Studies
  - Seven Ontario Grade 13 credits

- School of Architecture
  - 3 credits from Mathematics A (2)
  - Physics (1)
  - 4 additional credits

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.

Additional credits can be selected from any of the optional subjects offered at the Grade 13 level with the qualification that no more than one of the following may be counted as an "additional" credit: Accountancy Practice, Art, Home Economics, Mathematics of Investment, Music, or Secretarial Practice. The marks received in one of these subjects will be included in the computation of the applicant's average. Standing with the Royal Conservatory of Music in Grade 8 practical and Grade 2 theory will be considered as "one additional credit" on the same terms as these subjects except the marks received will not be computed in the average.

**Note 1**

*If English is not chosen as a Grade 13 subject offered for admission, applicants must have standing in English at the Grade 12 level.*

**Note 2**

*The University will use the following definition of credits for admission purposes:*

- 3 credits: Mathematics A and Mathematics B combined
- 2 credits: All language subjects, Mathematics A
- 1 credit: All other subjects

*The University will consider other systems of credit definition from Ontario secondary schools.*

**Note 3**

*A number of secondary schools in Ontario are engaged in innovative programmes. The University will consider courses for admission purposes which are not formally listed in the Ontario Department of Education Circular H.S.I. Applicants should confirm with their secondary school's guidance officials that new courses and programmes have been approved by the University for admission purposes.*
Early Final Admission  
Ontario  

Students enrolled full time in Ontario Grade 13 will be considered for Early Final Admission. To be eligible for consideration, applicants must arrange to have the "General Application for Admission to University" form submitted by April 1, 1970. Consideration of candidates for Early Final Admission will be based on the Secondary School record, the Principal's recommendation, and the results of the Canadian Scholastic Aptitude Test and specified Achievement Tests. Successful applicants may expect to be notified after June 11, 1970 of their acceptance and will be asked to indicate their decision by June 26, 1970. Those applicants who are not offered Early Final Admission will be considered on the basis of the Grade 13 final results and will be notified as soon as possible after the release of the Grade 13 results.

Note  *All applicants will be required to complete Grade 13 to the satisfaction of the Secondary School principal.*

Aptitude and Achievement Tests  

OACU—Ontario Tests for Admission to College and University  
SACU—Service for Admission to College and University

Applicants will be required to write the Canadian Scholastic Aptitude Test (CSAT) and the appropriate (OACU) Achievement Tests in English, Mathematics and Physics if the corresponding Grade 13 credits are offered for admission to the University.

Other Canadian Provinces and Other Countries

For 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:

- 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  
  - Third Year Certificate from Prince of Wales College

- Quebec  
  - Senior High School Leaving Certificates
  - First Year CEGEP programme

- Saskatchewan  
  - Senior Matriculation (Grade 12)

- England and Wales, West Indies, East and West Africa  
  - The General Certificate of Education with passes in at least five subjects, two of which must be at Advanced Level.

- Scotland  
  - 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.

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 Test."
Examinations and Standings

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. The expenses involved in administering the test must be borne by the applicant. Applicants from other countries should have received entry to the country either on a student visa or as a landed immigrant.

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 programme to which applicants wish to 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.

c) and if the appropriate Division of Environmental Studies department recommends that such courses be credited to a student’s 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 8, 9, 10, 11, 1970.

Fees

Refer to Section 12, page 458.

For information concerning admission to the School of Architecture see page 86.

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 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 sixteen, Year 3, and those with sixteen or more, Year 4.

1. Final Examination

a) Appeals against faculty decisions made under these regulations may be made in writing to the Examinations and Standings Committee of the Division Council. The form of examination is at the discretion of the individual faculty 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.

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 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.

c) 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 after the examination should have been written.

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>14</td>
</tr>
<tr>
<td>A-</td>
<td>12</td>
</tr>
<tr>
<td>B</td>
<td>11</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>3</td>
</tr>
<tr>
<td>F</td>
<td>2</td>
</tr>
<tr>
<td>F-</td>
<td>0</td>
</tr>
</tbody>
</table>

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>14</td>
</tr>
<tr>
<td>A-</td>
<td>12</td>
</tr>
<tr>
<td>B</td>
<td>11</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>3</td>
</tr>
<tr>
<td>F</td>
<td>2</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 (at any time, whether passed or failed) 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>9-11.99</td>
<td>Second Class Honours</td>
<td>B</td>
</tr>
<tr>
<td>6-8.99</td>
<td>Third Class Honours</td>
<td>C</td>
</tr>
<tr>
<td>3-5.99</td>
<td>Conditional</td>
<td></td>
</tr>
<tr>
<td>2.99 or below</td>
<td>Failure</td>
<td></td>
</tr>
</tbody>
</table>
**Examinations and Standings**

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

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 not 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 not 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 falls 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 student must maintain a cumulative over-all average of at least 9 (B-) 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 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 if the Division Council considers that he will not profit by further study.

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.

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

**Examinations and Promotions**

To pass from one term in the Environmental Studies programme 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 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 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 1970, 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.

d) Failure to write an examination is considered a failure to pass. A student who fails to write a make-up examination, except for a properly 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 1 week after the examination should have been written.

**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 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 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

Nature of the Programme

The Department of Man-Environment Studies offers a four-year honours programme. The overriding objective of the programme is to promote the integrated study of the environment of the human community with particular emphasis on the interactions between components involved. This view conditions the design of study themes, in part by developing new courses which innovate in their groupings of topics around the central problem area, and in part by permitting streams of studies incorporating new groupings of existing disciplinary studies which buttress the central problem area.

The primary objectives can be stated 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 at large.

From the student's point of view, the programme would attempt to fill a need for a four-year honours-level educational experience which would be an integrative programme of studies of contemporary man and his milieu; human communities and social institutions. It would not be primarily intended for those who desire a programme with sufficient technical input to satisfy a professional qualification, but rather would serve students who wish to study those elements of the basic disciplines of humanities, social and natural sciences that are of relevance to the understanding of issues which have as their core the interaction of man and his contemporary environment. It contains elements of those studies necessary to the understanding of individuals, their behaviour and aspirations, their perception of environment, their role in social groups with particular emphasis on mutual impacts of society and environment in the natural and other aspects. It leads the student through studies of social institutions and the processes of social action and change. It contains important exposure to the human
and technical issues involved in man's shaping of his environment, and to the viewpoint of the professional persons who deal with them. The processes of decision-making and change mechanisms, regarding human community issues especially, are covered with a view to equipping the student to become creatively involved (as a non-professional) in them. The structure of the programme is significantly different from existing structures of most existing programmes, in the sense that it permits a specialization of study focussed on the interactive problems involved with man in his environment, as outlined above, rather than on one or two disciplines. It also is the intent to foster a truly cohesive “community of scholars” approach to learning through transdisciplinary and interdisciplinary teaching methods, mutual faculty-student exploration of lengthy “workshop” type problems, and a continuing search for new approaches to the study of man in his environment in which the students are encouraged to participate.

From the point of view of the Division of Environmental Studies, the Man-Environment programme serves two vital functions. The first and most obvious is to provide a course of study to that group of students concerned non-professionally with the area, in the manner just outlined above. The second, and potentially most vital function of the Department is to serve as the mechanism whereby the professional Schools within the Division are kept in tune with the mainstream of academic life of the University by ensuring that professional programme students are constantly stimulated to form and view their ideas and goals in the more general context of man and his environment.

The objectives with regard to the university community can also be stated in two ways. Firstly, the Department would make its course offerings available as electives to students of other programmes who might wish to acquire them. In this way, its particular environment-oriented outlook could be shared with students whose primary goal is still education in particular disciplines. In its second function, it serves as a focus for relating scholarly work dealing with man’s environment going on presently in many departments in several faculties.

The objectives from the point of view of society at large would be to provide one educational route through which a portion of the demand of younger elements of society for a “relevance-oriented” restructuring of their University experience may be met. Well-educated persons with a broad understanding of man-environment interactions would find their most natural employment at policy-making levels of the public and private sector, where an understanding both of the professional viewpoint and that of society are important for success.

Curriculum

The curriculum of Man-Environment Studies will be divided into three parts: foundation studies, methodological studies, and specialized studies.

The foundation group of studies will have the aim of providing an integrated view of man, the environment of man, and the human community—historically philosophically, and in relation to social institutions, natural ecological potentials and constraints. Courses in this part of the curriculum will be grouped under the following themes:
1) Man: His Function and Behaviour
2) Man, Society
3) Man and the Ecosystem
4) Man and Settlements
5) Man and Environmental Perception
6) Man and His Arts

Courses on these themes will be presented mainly in the first two years of the four-year programme, with each of these themes being available to students in the first year of the programme.

The student will be free to select among these themes, taking courses offered by the Department or from other programmes, both within and outside the Division.

The methodological group of studies will be concerned with tools relevant to the analysis of problems of environment and to community decision-making. At least five kinds of tools may be identified:

1) Mathematics and statistics
2) Environmental research methods
3) Environmental systems analysis
4) Communications—verbal and non-verbal
5) Generalized decision theory

In part, this subject matter will be acquired by enrolling in courses currently taught in the Faculties of Mathematics, Arts, Science, etc., and in part, owing to the distinctive uses to which the methods are to be put, it will be acquired through specially constituted courses within the Division. Students' work on this group of studies will run through the entire four-year programme with emphasis varying in accordance with the interests and leanings of individual students.

The specialized group of studies will provide an opportunity, in the upper years of the Man-Environment Studies programme for the student to pursue the study of different aspects of the human community. These might be expressed in terms of major functions, such as:

1) The environment of shelter,
2) The environment of work and commerce,
3) The environment of leisure,
4) The environment of communications and transportation.

In this group, the programme will be essentially integrative, with each discipline contributing towards an understanding of the selected area of specialization. For example, under the first of the above, housing may be studied from the point-of-view of climatological criteria, human activity patterns, social trends, economic factors, aesthetics and patterns of city development.

These streams will prepare the way for students who may wish to proceed to graduate programmes leading to a Master's Degree in Environmental Studies, with research specialization in areas such as Housing, Recreation, Communications and so on, or to a Master's degree in some related discipline or profession.

The programme consists of six courses per semester in the first year and five courses per semester in subsequent years. No more than two courses per semester will be specified, one of which will be a major Seminar/Workshop. This will be a series of seminars,
sessions supporting and integrating the work in other courses: The Seminar/Workshop would have a stated theme during each semester and be under the direction of a faculty co-ordinator, but would involve all of the faculty members of the Department who are teaching courses to the same group that semester, plus other faculty within and without the Division, as appropriate. Special topics benefitting from a trans-disciplinary approach would be treated, and the students and faculty together would have the opportunity to explore themes of their mutual interest to considerable depth. At appropriate times, students would join their colleagues in the Geography, Architecture and Planning programmes for mutual study of particular problems, as well. It is hoped to foster through this Seminar/Workshop experience both a unique spirit of inquiry and approach to environmental issues, and a high level of faculty-student rapport.

Honours Man-Environment Studies

<table>
<thead>
<tr>
<th>Studies Required programme:</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year 1</strong></td>
<td></td>
</tr>
<tr>
<td>M-EN 190* Seminar-Workshop</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fall term</strong></td>
<td></td>
</tr>
<tr>
<td>M-EN 100* Geological Foundations of the Environment</td>
<td>2 - 2</td>
</tr>
<tr>
<td>M-EN 120* Man's Function and Behaviour 1</td>
<td>3</td>
</tr>
<tr>
<td>Geog. 101* Introduction to Human Geography</td>
<td>2 - 2</td>
</tr>
<tr>
<td>Anthro. 101* Origins of Man and Culture</td>
<td>3</td>
</tr>
<tr>
<td>One elective course</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>17 - 4</td>
</tr>
</tbody>
</table>

| Winter term:              |       |
| M-EN 191* Seminar-Workshop| 4     |
| M-EN 110* Environmental Perception 1 | 3     |
| M-EN 121* Man's Function and Behaviour 2 | 3     |
| Geog. 102* Introduction to Physical Geography | 2 - 2 |
| One elective course from Fine Arts or a related course chosen with approval of the Department | 3     |
| One elective course       | 3     |
|                           | 18 - 2 |

(*indicates half-year course)

**Note 1** The elective courses may be chosen from any regular university courses available to the student.

**Note 2** The course M-EN 100*, Geological Foundations of the Environment, will be mounted by the Earth Sciences Department and is cross-listed by that Department as Earth Science 100*.

**Note 3** Courses M-EN 120* and 121* will be mounted by the Psychology Department and are cross-listed with Architecture as Arch 120 and Arch 220, respectively.

**Note 4** Additional courses may be offered by the Department of Man-Environment Studies which students might choose as electives. Their descriptions will be submitted for approval as they become available.

**Note 5** All Man-Environment Studies courses except M-EN 190* and 191* are open to students in other programmes.

**Note 6** Programmes for Years 2, 3 and 4 will be published at an early opportunity.
Nature of the Programme

Honours Bachelor of Environmental Studies in Geography

The Honours Geography programme provides a well-rounded sound 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 a discipline: physical, economic-urban, or cultural-regional geography. Advanced elective 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 the geography programme is offered to all students in the University. Students taking geography 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 and
Geography 275*—Air Photo Interpretation or
Geography 375—Quantitative Methods
Two courses chosen after consultation with the Department
Year 3
Geography 260*—Cartography
Geography 275*—Air Photo Interpretation or
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 Environmental Studies (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
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
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); 357* (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); 331* and 332* (Special Topics in Cultural Geography 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 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 Calendar.

Note 7
Since many departments doing graduate work in Geography demand proficiency in a foreign language, students intending 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*—Subfields of Geography
One and one-half courses of Geography electives
Three courses selected in consultation with the Department

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

Note 2 A minimum of five geography courses constitutes a Geography Major but up to seven Geography courses may be taken in this programme.

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. Previously the programme was presented through the Department of Geography and Planning in the Faculty of Arts.

Although the administrative setting of the programme is changed, there has been no change in the nature of the programme and its philosophy. It continues to provide a broad liberal education plus an understanding of planning principles and techniques. The emphasis is on providing 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 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, resource economics and transportation engineering.

Students are encouraged to gain planning office experience during summer vacation period. The School, with the assistance of the Department of Coordination and Placement, endeavours to help the student find a suitable position.

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*
Geography 101*/102*
Sociology 101*/102*
Economics 101*/102*
Philosophy 125* (or other Philosophy)

*Electives*, one and a half courses, from Quantitative methods: introductory Mathematics or Computer Science. French, Fine Arts, Music or Drama, Biology, Earth Sciences, Anthropology, Man-Environment courses, etc.

**Year 2** Planning 255*; 256; and 200*
Geography 270*; 202*: 322*; (or Planning 222*)

*Electives*, two and a half courses, from economic issues:
Economics 201*/202, Geography 203*; introductory courses in Political Science, courses in Man-Environment studies, etc.

**Year 3** Planning 332*, 357*, 358*, 375, 391*

*Electives*, two courses from, economic issues: Geography 310*/311*
social issues: Sociology 210*
urban issues: Geography 350*/351*
Planning 314
recreation issues: Geography 410*
Planning 344*
Philosophy 425*, Man-Environment courses, etc.

**Year 4** Planning 456, 480, 490 and 333*

*Electives*, two and a half courses, from Quantitative methods: Planning 404*/405*

economic issues: Economics 450
social issues: Sociology 212*
urban issues: Planning 414
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.

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.

School of Architecture

The needs, problems and solutions inherent in the structuring of the man-built environment are interacting across architecture, planning and a multitude of environmental aspects. All these should be pursued in a common framework of the academic programme and reflect some commonalities between these disciplines as we are striving to establish a base for future interdisciplinary environmental communication. However, such interdisciplinary commonality must not replace professional knowledge. We are not seeking to create an Architect who in himself has competence in many disciplines but rather has ability for team-work where these can be communicated.

The following five basic principles have guided the academic programme in Architecture.

1) The student should be exposed to a general environmental education before going into highly specialized or sophisticated architectural studies. For this purpose the cooperative pre-architectural programme leading to a degree of Bachelor of Environmental Studies/Architecture has been structured.

2) The student should obtain a good portion of his professional skills such as drafting, experience and construction knowledge outside the University during his work term. The office experience gained should count towards experience required for professional registration.

3) After his Environmental Studies programme the student must spend another additional four academic terms to obtain a professional degree of Bachelor of Architecture. This programme allows a great deal of individual development to make it possible to fulfil the need to educate architects for the various aspects of the architectural profession.

4) Many other courses which are normally offered in Architectural schools will only be provided as continuing education jointly by the
professional institutes and schools subsequent to academic studies but prior to professional registration.

5) An advisory board has been appointed from professional and business communities in Canada and the U.S. to help determine the performance criteria for the new programme.

**Degrees**

Environmental studies consist of six terms of pre-professional studies leading to the Degree of Bachelor of Environmental Studies (B.E.S.). This degree is considered as appropriate preparation for four subsequent terms of study leading to the professional degree of Bachelor of Architecture (B.Arch.)

**B.E.S. Architecture Programme**

The purpose of the architectural B.E.S. Programme is to educate future architects to understand the various interactions and the whole complex of rules and values that surround the creation of almost any artifact. He must recognize the extent to which the man-built environment brings on changes. He must understand that continuing studies will help the future architect become sensitive to the needs of mankind and to the changes in these needs commanded by science and technology.

The programme consists of six broad study themes:

1) the studio-workshop
2) design theories
3) quantitative methods of analysis and measurement
4) ecological topics
5) cultural and historical factors in the human environment
6) physical and material sciences

Courses are arranged as shown on the accompanying chart.

**Bachelor of Architecture Programme**

With a Bachelor of Environmental Studies behind him, an architectural student will spend four academic terms and two 8-month work terms to pursue his education leading to the degree of Bachelor of Architecture. This will resemble a graduate programme where each student will be assigned to a faculty advisor who will approve his course, and select from the various courses offered to him with respect to his own suitability and specialization. This time will be spent concentrating more deeply in a few Environmental Elective course programmes, city and regional planning, structural synthesis, and related mechanical engineering. Studio work in Architectural Design and Parametric Design (systems and computer-aided design and analysis) will be given maximum emphasis.

The overall aim is to equip a student of architecture for understanding and dealing with new technologies, for example application of computer science to the process of architectural design. 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 in association or arrangement with the Ontario Architectural Association, or other professional organizations prior to professional registration.

The general arrangement of courses is shown on the accompanying chart.

**Cooperative Programme**

The programme provides six terms of study, one (four-month) self work term and three (four-month) co-op work terms* (it is the student’s responsibility to find his own employment for this self work term) during the Bachelor of Environmental Studies programme. The subsequent Bachelor of Architecture programme con-
School of Architecture

consists of four terms of study and two (eight-month) co-op work terms. These are arranged as shown in the diagram below.

Students should refer to Section 14 of the calendar for details of operation of the cooperative programmes.

**Bachelor of Environmental Studies**

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<thead>
<tr>
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<tbody>
<tr>
<td><strong>Fall</strong></td>
<td><strong>Winter</strong></td>
<td><strong>Fall</strong></td>
<td><strong>Winter</strong></td>
</tr>
<tr>
<td><strong>First Term</strong></td>
<td><strong>Second Term</strong></td>
<td><strong>Self Work Term</strong></td>
<td><strong>Third Term</strong></td>
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<tr>
<td><strong>Term</strong></td>
<td><strong>Term</strong></td>
<td><strong>Term</strong></td>
<td><strong>Term</strong></td>
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<tr>
<td><strong>Fifth Term</strong></td>
<td><strong>Co-op Work Term</strong></td>
<td><strong>Fourth Term</strong></td>
<td><strong>Co-op Work Term</strong></td>
</tr>
<tr>
<td><strong>Sixth Term</strong></td>
<td><strong>Co-op Work Term</strong></td>
<td><strong>Term</strong></td>
<td><strong>Term</strong></td>
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</tbody>
</table>

**Bachelor of Architecture**

<table>
<thead>
<tr>
<th>1974</th>
<th>1975</th>
<th>1976</th>
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<tbody>
<tr>
<td><strong>Winter</strong></td>
<td><strong>Spring</strong></td>
<td><strong>Winter</strong></td>
</tr>
<tr>
<td><strong>Co-op Work Term</strong></td>
<td><strong>Co-op Work Term</strong></td>
<td><strong>Third Term</strong></td>
</tr>
<tr>
<td><strong>Term</strong></td>
<td><strong>Term</strong></td>
<td><strong>Term</strong></td>
</tr>
<tr>
<td><strong>Fourth Term</strong></td>
<td><strong>Term</strong></td>
<td><strong>Term</strong></td>
</tr>
</tbody>
</table>

**Terms Available in 1970-71** In 1970-71 the first through fifth terms in the B.E.S. programme will be available. In subsequent years further terms will be added. Admission on the basis of advanced standing is considered only for entry to the second and third terms.
5 Programme of Integrated Studies
Programme of Integrated Studies

Professorial Associate  J.R. Gray
Associate Professor  A. Koller, A.B. (Akron), M.A., Ph.D. (Radcliffe)
Assistant Professor  K.A. Rowe, B.A. (Toronto), M.S. (Wisconsin), Ph.D. (Illinois)

The Interfaculty Programme of Integrated Studies was established in 1969 in order to provide an opportunity for independent and unstructured study at the University of Waterloo. Unit one is now in operation; further units may be established if warranted. Each unit is autonomous and independent academically. A student in Integrated Studies sets his own educational goals and proceeds toward them by whatever means he deems fit, such as independent research, course work, seminars and tutorials, special projects and field work, or by any combination of the above. The programme is largely student initiated and student oriented.

In addition to the Resource People in the Unit in which he is enrolled the Integrated Studies student has available to him all of the resources of the University, subject only to the limitations affecting all students, namely the capacity of the physical resources and the time which individual faculty members have or are willing to make available.

To gain admission to a Unit of Integrated Studies a student applies in such a manner and meets such criteria as the Unit shall deem fit. The admissions requirements are flexible. Usually a personal interview is required, and often submission of written work is required. An applicant to Integrated Studies needs to demonstrate desire and capacity for independent study and the maturity necessary to undertake it. Admission procedure information may be obtained by writing directly to the Assistant Registrar for Integrated Studies.

Integrated Studies is a degree programme. However the mechanism for the awarding of degrees and the nature of the degree has not yet been determined. It is hoped that students applying for Integrated Studies will have only a minimum interest in the earning of a degree. Nevertheless, it is expected that the mechanism will be as flexible and the choice of degrees will be as wide as possible.
6 The Faculty of Mathematics
The Faculty of Mathematics

The Faculty of Mathematics of the University of Waterloo was inaugurated as a separate faculty in 1966. General and Honours programmes in Mathematics have 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 entering students come in with additional secondary school background, and the enrollments in classical areas of pure and applied mathematics are rapidly increasing at almost the same rate as enrollments 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, even students specializing in this area are required to obtain a wide knowledge of other 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 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 programme (the General Course) or a four-year programme (the Honours Course). The Co-operative Mathematics course 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 321 to 337 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.

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 regular programmes (not co-operative) through St. Jerome's College.
Admission Requirements

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 Early Final Admission must apply before April 1, 1970. All other applicants must apply and have submitted all the necessary documents by August 1, 1970. Persons applying after these dates cannot be guaranteed consideration of their application.

Since many of the programmes offered at the University have limited enrollment, 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, 1970.

Application Documents

All applicants must submit an application form, certified transcripts of secondary or post-secondary education, and at least one letter of reference. Applicants enrolled in Ontario Grade 13 in the 1969-70 academic year must apply on the “General Application for Admission to University” form which is available from the secondary school. All other applicants must apply on forms available from the Office of the Registrar. All educational institutions attended by the applicant must be accounted for on certified documents. In addition, applicants from non-English speaking countries must arrange to submit certified English translations of their academic documents.

Admission to Year 1

Ontario

Applicants from the Province of Ontario are required to have completed Ontario Grade 13 showing a minimum overall average of 60% in the seven required credits. For applicants who have taken more than one year to complete the work of Grade 13, a somewhat higher average may be required.

Standing is required in seven Ontario Grade 13 credits as follows:

- Normally three credits from Mathematics A (2)
- Mathematics B (1)

Four additional credits chosen wherever possible in accordance with the student’s proposed major field of study.

Students entering the Co-operative programme must have a minimum of 66% in three credits from Mathematics.

Students wishing to take Science electives should present Chemistry and/or Physics among their additional credits.

Additional credits can be selected from any of the optional subjects offered at the Grade 13 level with the qualification that no more than one of the following may be counted as an “additional” credit: Accountancy Practice, Art, Home Economics, Mathematics of Investment, Music, or Secretarial Practice. The marks received in one of these subjects will be included in the computation of the applicant’s average. Standing with the Royal Conservatory of Music in Grade 8 practical and Grade 2 theory will be considered as “one additional credit” on the same terms as these subjects except the marks received will not be computed in the average.

Note 1 If English is not chosen as a Grade 13 subject offered for admission, applicants must have standing in English at the Grade 12 level.
Admission Requirements

Note 2 The University will use the following definition of credits for admission purposes:

- 3 credits Mathematics A and Mathematics B combined
- 2 credits All language subjects, Mathematics A
- 1 credit All other subjects

The University will consider other systems of credit definition from Ontario secondary schools.

Note 3 A number of secondary schools in Ontario are engaged in innovative programmes. The University will consider courses for admission purposes which are not normally listed in the Ontario Department of Education Circular H.S.I. Applicants should confirm with their secondary school's guidance officials that new courses and programmes have been approved by the University for admission purposes.

Early Final Admission

Ontario Students enrolled full time in Ontario Grade 13 will be considered for Early Final Admission. To be eligible for consideration, applicants must arrange to have the “General Application for Admission to University” form submitted by April 1, 1970. Consideration of candidates for Early Final Admission will be based on the Secondary School record, the Principal's recommendation, and the results of the Canadian Scholastic Aptitude Test and specified Achievement Tests. Successful applicants may expect to be notified after June 11, 1970 of their acceptance and will be asked to indicate their decision by June 26, 1970. Those applicants who are not offered Early Final Admission will be considered on the basis of the Grade 13 final results and will be notified as soon as possible after the release of the Grade 13 results.

Note All applicants will be required to complete Grade 13 to the satisfaction of the Secondary School principal.

Aptitude and Achievement Tests

OACU—Ontario Tests for Admission to College and University
SACU—Service for admission to College and University

Applicants will be required to write the Canadian Scholastic Aptitude Test (CSAT) and the appropriate (OACU) Achievement Tests in English, Mathematics and Physics if the corresponding Grade 13 credits are offered for admission to the University.

Other Canadian Provinces and Countries

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:

Alberta Senior Matriculation (Grade 12)
British Columbia Senior Matriculation (Grade 12)
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 Third Year Certificate from Prince of Wales College
Quebec Senior High School Leaving Certificates
Saskatchewan First Year CEGEP programme
Senior Matriculation (Grade 12)
England and Wales, West Indies, East and West Africa  
*The General Certificate of Education with passes in at least five subjects, two of which must be at Advanced Level.*

Scotland  
*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.*

### 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. The expenses involved in administering the test must be borne by the applicant. Applicants from other countries should have received entry to the country on a student visa or as a landed immigrant. Applicants wishing admission to one of the co-operative programmes are strongly recommended to acquire landed immigrant status prior to application.

### 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.

### Admission as a Part-time Student

Any candidate wishing to enroll as a part-time student may be allowed to take a maximum of two courses per session as a non-degree student. 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. Any student thus admitted would be required to repeat a minimum of four work terms.

### 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
Examinations and Promotions

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.

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 8, 9, 10, 11, 1970.

Fees
Refer to Section 12, page 458.

Examinations and Promotions

The Faculty constitutes the examining body for all examinations. The time normally allowed for each examination is three hours.

The following regulations govern the practice of the Faculty of Mathematics 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 the Faculty Council.

After the results have been considered by these bodies, they are issued to individual students by the Registrar.

2) Standings in individual subjects will be granted by letter grade as follows:

<table>
<thead>
<tr>
<th>Range of Marks</th>
<th>Letter Grade</th>
</tr>
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<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, supplemental allowed</td>
<td>S</td>
</tr>
<tr>
<td>Below 50, no supplemental allowed</td>
<td>F</td>
</tr>
</tbody>
</table>

3) To pass his year clear in an Honours course, a student must pass in all subjects and obtain an over-all average of 60%.

4) To pass his year clear in the General course, a student must pass in all subjects and have 60% average in Mathematics.

5) An over-all standing in each year will be assigned based on the average of the results of the final examinations in the course. It will not be altered by marks obtained in supplemental examinations.

<table>
<thead>
<tr>
<th>Range of Average Mark</th>
<th>Honours Course</th>
<th>General Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>75-100</td>
<td>First Class Honours</td>
<td>A</td>
</tr>
<tr>
<td>66-74.9</td>
<td>Second Class Honours</td>
<td>B</td>
</tr>
<tr>
<td>60-65.9</td>
<td>Third Class Honours</td>
<td>C</td>
</tr>
<tr>
<td>50-59.9</td>
<td></td>
<td>D</td>
</tr>
</tbody>
</table>

6) In cases where a student has obtained 60% in an Honours course or 50% in a General course, but has failed certain examinations, he may be granted supplemental privileges.

7) Supplemental examinations will be held in July for students in the regular programme. Applications for supplemental examinations...
must be filed by the end of June, 1970 on forms provided by the Office of the Registrar. Fees for supplemental examinations must accompany the application. If the student subsequently decides not to write the examination, the fee is not refunded.

8) A student who has failed to obtain a clear pass after the supplemental examinations will have his case reviewed by the Committee on Standings and Promotions. He may be permitted to proceed to the next year, conditioned in one subject, if it is not a prerequisite. If two subjects are failed, the student fails his year.

9) A student who has been promoted with a condition in a subject from a previous year must clear that condition before being promoted further. If the subject is not compulsory, the student may, with permission of the Dean, substitute another subject for one in which he is conditioned.

10) The Committee on Standings and Promotions may require a student in the General Course to write a Special Examination in one mathematics paper to improve his average in mathematics.

11) Failure to write an examination is considered a failure to pass. A student who defaults a final examination, except for a properly certified reason, has no supplemental examination privilege and must repeat the work in class. If a student fails to write 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.

12) All examinations which receive a failing grade are automatically re-read.

13) In cases where a student fails his year, he is normally permitted to repeat. However, if Faculty Council considers that a student will not profit by further study, he is required to withdraw from the Faculty of Mathematics.

14) 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.

15) Continuation in the co-operative programme is contingent upon acceptable performance on the job.

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**Academic Programmes, Regular and Co-operative**

**Regular Programmes**

**First Year**

The first year programme is common to all General or Honours courses in Mathematics.

Students will take Mathematics 129, Mathematics 130, Mathematics 132 and three other courses.

Students interested in Science electives normally choose Physics 121*/*122*, Chemistry 121*/*122, and a third elective.

Students interested in Arts electives normally choose English 101, Philosophy 100 or two of the half courses Philosophy 125, 135, 140, 150, Psychology 101/102.

The groupings shown above are not compulsory. The requirements for first year are Mathematics 129, Mathematics 130, Mathematics 132 and any three full courses chosen from other faculties.
The General Programme in Mathematics

*First Year* Common to General and Honours programmes.

*Second Year* Mathematics 229, 237 and one other mathematics course. Two electives other than mathematics.

*Third Year* Three mathematics courses and two electives other than mathematics.

Mathematics 229 and 237 are required courses but it is permissible for General students to take one of them in Year 2 and the other in Year 3. Students must take three mathematics courses in each of Years 2 and 3.

The following specialized third year programmes are to be noted:

**Applied Analysis and Computer Science Programme**

Three mathematics courses including Mathematics 240 if not taken in second year

One or two of Mathematics 334, 340

Two electives from outside mathematics.

**Combinatorics and Optimization Programme**

Three mathematics courses including Mathematics 243

One or two of Mathematics 351 or 352

Two electives from outside Mathematics.

**Teaching Programme**

Mathematics 446

Two of Mathematics 236, 239, 240, 243, 300, 329, 334, 340, 352

Two electives from outside Mathematics. It is recommended that one of these electives be Psychology 241/242.

**Honours Programmes in Mathematics**

Recommended programmes are shown but students should consult the general notes following these programmes.

*First Year* Common to General and Honours Programme.

Students in Year 1 of the Faculty of Mathematics not receiving an average of at least 70% in the three mathematics courses should consider proceeding in the General Mathematics programme rather than in the Honours Mathematics programme.

*Second Year* Mathematics 229, 233, Mathematics 231, 232; or Mathematics 237 and one of Mathematics 234, 240. Three elective courses, one of which may be another Mathematics course. At the completion of the second year, students are required to select a programme within which they will continue their studies.

**Note 1** Students proceeding to Pure Mathematics will normally take Mathematics 231, 232.

**Note 2** Students proceeding to Applied Mathematics will normally take Mathematics 234, 237.

**Note 3** Students proceeding to Computer Science will normally take Mathematics 240.

**Note 4** Students taking Actuarial Science will normally take Mathematics 235.
Academic Programmes, Regular and Co-operative

Note 5 Students proceeding to Combinatorics and Optimization will normally take Mathematics 239.

Note 6 Students desiring minor fields of specialization should normally include the following choices among their electives:

- **Physics Minor:** Physics 252*/253*, 255*/256*
- **Biology Minor:** Biology 131, 231, 235
- **Chemistry Minor:** Chemistry 231, 235
- **Philosophy Minor:** Philosophy 221/2 or 280/1
- **Philosophy 240 or 282/3**
- **Other Minors:** Consult the Dean of the Faculty and the chairman of the Department concerned.

The following are recommended programmes for students entering Year 3

**Actuarial Science Programme**

*Third Year* Five mathematics courses.
Mathematics 329, 332, 336
One of Mathematics 333, 334, 335, 338, 350, 352
Two electives from outside Mathematics.

*Fourth Year* Mathematics 437
Four other mathematics courses
(Mathematics 435 and 461 are suggested.)
Two electives from outside Mathematics.

**Applied Mathematics Programme**

*Third Year* Mathematics 329, 332, 363
One of Mathematics 360, 361
One other mathematics course
Two electives from outside Mathematics.

*Fourth Year* Five mathematics courses including Mathematics 462, 470
Two electives from outside Mathematics.

**Applied Analysis and Computer Science Programme**

*Third Year* Five mathematics courses including Mathematics 329, 332 and at least
One of Mathematics 334, 340, 363
Two electives from outside Mathematics.

*Fourth Year* Five mathematics courses to be chosen in consultation with the Department Chairman
Two electives from outside Mathematics.

**Combinatorics and Optimization Programme**

*Third Year* Five mathematics courses including Mathematics 329, 332 and at least
One of Mathematics 345, 351, 352.
Two electives from outside Mathematics.
Fourth Year  Five mathematics courses including
Three or more of Mathematics 451, 452, 453
454, 455, 457, 458, 460
Two electives from outside Mathematics.

Pure Mathematics Programme

Third Year  Mathematics 341, 342, 343, 344, and
one and a half full year courses chosen from 330a,
330b, 360a, 360b, 361a, 361b, 334, 338,
351, 352, 363, 399.
Two electives from outside Mathematics.

Fourth Year  Five mathematics courses including
One of Mathematics 432, 433
One of Mathematics 410, 411, 412.
Two electives from outside Mathematics.

Statistics Programme

Third Year  Mathematics 329, 332, 338.
Two additional mathematics courses
Two electives from outside Mathematics.

Fourth Year  Mathematics 438, 439, 440.
Two additional mathematics courses.
Two electives from outside Mathematics.

Teaching Programme

Third Year  Five mathematics courses including
Mathematics 329, 332.
Two electives from outside Mathematics. (†)

Fourth Year  Five Mathematics courses including
Mathematics 446
One of Mathematics 425, 444, 436
One of Mathematics 427, 451, 452, 453, 454, 455, 457.
Two electives from outside Mathematics (†)
(†) Students in the Teaching Option should choose as electives
Psychology 241/242, Philosophy 311/312 and Sociology 207G.
somewhere in their programmes.

Honours Mathematics—Choice of Degree

Philosophy Programme

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 240, 340, 358/9,
280/1, 282/3
Two others, one of which is in a value area.
Mathematics 129, 130, 229.
Mathematics courses approved by one of the departments in the Mathematics Faculty.
See Notes 1 to 6 (page 114) for department requirements.

231 and 232 or
237 and one of 233, 234, 239, 240†.
Two others.
Other—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 above. They must pass at least seven further

Further Requirements for the degree B.A. (Philosophy and Mathematics)
Please refer to page 42.
†Mathematics 132 is a prerequisite for Mathematics 240, and should be taken in Year 1 by students wishing to specialize in Computer Science.

Honours Mathematics and Economics Programme

Year 1
Economics 101/102 or 103/104.
Mathematics 129, 130, 132
Two electives.†
(!) Students registered in the Faculty of Arts should choose English 101 and one language or culture civilization course.

Year 2
Economics 201/202 or 203/204.
Economics 230 or 205/206.
Mathematics 229, 233, 237.
Two electives.

Year 3
Economics 330 and 340.
One other course in Economics (except Economics 300).
Mathematics 240, 352.
One other mathematics course to be chosen in consultation with Department Chairman.
One other elective.

Year 4
Economics 400 and 460.
One other Economics course chosen with the consent of the Department.
Mathematics 338, 452.
One other mathematics course chosen with the consent of the Department.
One elective.

†See also Honours Economics and Mathematics Faculty of Arts.
† See note end of Honours Statistics and Psychology.
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, 237.  
Physics 252*/253*, 255*, 256*  
Two electives. 

Year 3  Mathematics 332, 363, 360a*, 442*.  
Physics 362*/363*, 355*, 358*/359*  
One elective. 

Year 4  Mathematics 329, 361b*  
Two of Mathematics 462, 470, 434.  
Physics 434, 441, 435*  
One elective.  
*indicates a one term course.

Honours Statistics and Psychology

Year 1  Psychology 101/2.  
Mathematics 129, 130, 132.  
Two electives. 

Year 2  Psychology 290  
Psychology elective.  
Mathematics 229, 233 (substituted for Psychology 280).  
Mathematics 237.  
One elective. 

Year 3  Psychology 360.  
Psychology elective.  
Mathematics 332, 338.  
One Mathematics elective.  
One other elective. 

Year 4  Psychology 430.  
Psychology 499.  
Psychology elective.  
Mathematics 438 or 440.  
Mathematics 439.  
Mathematics elective.  
See also Honours Psychology and Statistics, Faculty of Arts 
*The joint honours programme for  
Honours Mathematics and Economics  
Honours Mathematics and Psychology are presently being re-organized. A joint honours programme for  
Honours Mathematics and Geography is being developed.  
Information concerning these programmes may be obtained from the Dean's Office, Faculty of Mathematics.
The Co-operative Programme
in Honours Mathematics

Year 1
(Actuarial, Computer Science, Combinatorics and Optimization, Statistics, and Teaching Options)

Students will take Mathematics 129, 130, 132 and three other courses.

Students interested in Science minors normally choose Physics 121*/122*, Chemistry 101.

Students interested in Arts minors normally choose English 16/17, two of Philosophy 125, 135, 140, 150 and Psychology 101/2.

The groupings shown above are not compulsory. The requirements for first year are Mathematics 129, Mathematics 130, Mathematics 132, and any three full courses from other faculties.

Year 2
Mathematics 229, 233, 237, 240
One of Mathematics 235, 239.
Two elective subjects.

*Students in the Optimization Option should choose Mathematics 239.

*Students in Teaching Option should choose Psychology 241/242 as electives.

Year 3
Actuarial Science: Mathematics 329, 332, 334, 335, 336.
Two electives.

Computer Science: Five mathematics courses including Mathematics 329, 332, 334, 340.
Two electives.

Combinatorics and Optimization: Five mathematics courses including Mathematics 329, 332, 352, or 351.
Two electives.


Two electives.

Teaching Option: Five mathematics courses including Mathematics 300, 329, 332,
Two of Mathematics 334, 340, 351, 352.
Two electives from outside Mathematics.

Students in Teaching Option should choose as electives Psychology 241/242, Philosophy 311/312 and Sociology 207G somewhere in their programmes.

Year 4
Actuarial Science: Five mathematics courses including Mathematics 437, 461.
Two electives.

Computer Science: Five mathematics courses chosen in consultation with the Department Chairman.
Two electives.

Combinatorics and Optimization: Five mathematics courses including two of Mathematics 451, 452, 454, 455.
Two electives.

Two electives.
Teaching Option: Five mathematics courses including Mathematics 446.
One of Mathematics 425, 434, 436.
One of Mathematics 427, 451, 452, 453, 454, 455, 457.
Two electives from outside Mathematics.

Chartered Accountancy Option
Beginning in September 1970, it will be possible for students enrolled in the Co-operative Mathematics Programme to choose their non-mathematics electives courses in such a manner that they may be able to write their final chartered accountancy examinations within a few months of graduation. This programme is being developed in co-operation with the Institute of Chartered Accountants of Ontario. A brochure which describes the programme and outlines the professional opportunities open to graduates in this programme may be obtained from the Faculty of Mathematics, University of Waterloo.

Students who enroll in this programme will select the following courses in Year 1:
Mathematics 129, 130, 132.
Economics 101, 256, in A term.
Economics 102, 257, in B term.
One elective.

Electives
In each academic term students are required to take two non-mathematics electives. These electives may be chosen from the Faculty of Science—Physics, Chemistry, etc., or from the Faculty of Arts—Economics, Philosophy, Psychology, Political Science, etc.

Efforts are being made to develop these elective courses in certain areas into a constructive sequence rather than a scattered choice.

The Economics Department offers a number of business-oriented courses which are available to Mathematics students. By selecting a proper sequence of these courses as electives, mathematics students can complete the equivalent of a major in Applied Economics, by the time they graduate.

The recommended sequence of courses is as follows:

Year 1  Economics 101/102—Introduction to Economics
Year 2  Economics 256/257—Introduction to Financial and Managerial Accounting
Year 3  Economics 365—Corporate Finance
Year 4  Two additional courses in the areas of Finance, Production Theory, Marketing, and Labour and Industrial Relations.

Further details concerning the organization of Co-operative Mathematics are available in the brochure described on page 108.

Students should read Section 13 of the Calendar for details of the operation of the Co-operative Programmes.

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 great shortage of people qualified to work in the area of Computer Science. The great demand for qualified personnel is reflected in the large enrollment 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 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. So 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 and broad mathematical background. In the fourth year, the student is exposed to typical applications of Mathematics to problems in 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. 131, Phys. 131, 232, 234/6, 334, 335. For those students who wish a greater emphasis in physics, the Department offers the programme “Honours Applied Mathematics with Physics Minor”.

Combinatorics

The Department of Combinatorics and Optimization

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 to-day'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 to-day 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, 345, 351, 352, 451, 452, 453, 454, 455, 457, 458, 459, 460.

Department of Pure Mathematics

The Department of Pure Mathematics continues to place considerable emphasis on the preparation of undergraduate students for graduate studies in this and other universities. To this end, the department encourages the development of a coherent undergraduate curriculum in the core subject areas.

Students entering year 3 should either have M231 and M232, or have a good standing in M237. In third year, basic courses in algebra, real analysis, complex analysis, and general topology are taken by all students. With this background, students are prepared to take on a variety of mathematical disciplines, either pure or applied. In their final year they are allowed flexibility in course selection. Of five mathematics courses required in year 4, one algebra and one analysis must be taken, and the other three can be chosen from several Pure Mathematics courses offered, or from the courses in another department. The fourth year courses usually include three algebra courses, two analysis courses, number theory, logic, lattice theory, algebraic topology, and differential geometry.

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:

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:
7 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 1969 over 1600 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 including Earth Sciences offer post-graduate programmes and research facilities and these are listed in Section 10 of this Calendar—Course Descriptions. The new M.Sc. programme in Earth Sciences offers specialization in the area of Environmental Geology. General regulations governing post-graduate studies are set forth in Section 9. 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 149.

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 14 for further information on the Co-operative 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 9.
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 Grade 13 and who wish to be considered for Early Final Admission must apply before April 1, 1970. All other applicants must apply and have submitted all the necessary documents by August 1, 1970. 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 1970.

Application Documents
All applicants must submit an application form, certified transcripts of secondary or post-secondary education, and at least one letter of reference. Applicants enrolled in Ontario Grade 13 in the 1969-70 academic year must apply on the “General Application for Admission to University” form which is available from the secondary school. All other applicants must apply on forms available from the Office of the Registrar. All educational institutions attended by the applicant must be accounted for on certified documents. In addition, applicants from non-English speaking countries must arrange to submit certified English translations of their academic documents.

Admission to Year 1
Ontario
Applicants from the Province of Ontario are required to have completed Ontario Grade 13 showing a minimum overall average of 60% in the seven required credits with a minimum overall average of 60% in all credits presented in mathematics and science. For applicants who have taken more than one year to complete the work of Grade 13, a somewhat higher average may be required.

Standing is required in seven Ontario Grade 13 credits as follows:

Four credits from Chemistry, (1)
Physics, (1)
Mathematics A, (2)

Three additional credits should be chosen from English, a language other than English, Geography, History, Biology or Mathematics B.

The Faculty of Science does not recommend but will accept no more than one of the following subjects as an “additional” credit: Accountancy Practice, Art, Home Economics, Mathematics of Investment, Music or Secretarial Practice. The marks received in one of these subjects will be included in the computation of the applicant’s average. Standing with the Royal Conservatory of Music in Grade 8 practical and Grade 2 theory will be considered one “additional credit” on the same terms as these except the marks received will not be computed in the average.

In addition to the overall averages stated above, students intend-
Admission Requirements

ing to take the Honours programme in Cooperative Applied Physics should have a minimum of 70% in the credits presented in Mathematics and Physics.

Note 1 If English is not chosen as a Grade 13 subject offered for admission, applicants must have standing in English at the Grade 12 level.

Note 2 The University will use the following definition of credits for admission purposes:
- 3 credits Mathematics A and Mathematics B combined
- 2 credits All language subjects, Mathematics A
- 1 credit All other subjects

The University will consider other systems of credit definition from Ontario secondary schools.

Note 3 A number of secondary schools in Ontario are engaged in innovative programmes. The University will consider courses for admission purposes which are not normally listed in the Ontario Department of Education Circular H.S.I. Applicants should confirm with their secondary school's guidance officials that new courses and programmes have been approved by the University for admission purposes.

Early Final Admission Ontario Students enrolled full time in Ontario Grade 13 will be considered for Early Final Admission. To be eligible for consideration, applicants must arrange to have the "General Application for Admission to University" form submitted by April 1, 1970. Consideration of candidates for Early Final Admission will be based on the Secondary School record, the Principal's recommendation, and the results of the Canadian Scholastic Aptitude Test and specified Achievement Tests. Successful applicants may expect to be notified after June 11, 1970 of their acceptance and will be asked to indicate their decision by June 26, 1970. Those applicants who are not offered Early Final Admission will be considered on the basis of the Grade 13 final results and will be notified as soon as possible after the release of the Grade 13 results.

Note All applicants will be required to complete Grade 13 to the satisfaction of the Secondary School principal.

Aptitude and Achievement Tests OACU—Ontario Tests for Admission to College and University
SACU—Service for admission to College and University

Applicants will be required to write the Canadian Scholastic Aptitude Test (CSAT) and the appropriate (OACU) Achievement Tests in English, Mathematics and Physics if the corresponding Grade 13 credits are offered for admission to the University.

Other Canadian Provinces and Countries 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:

Alberta Senior Matriculation (Grade 12)
British Columbia Senior Matriculation (Grade 13)
Newfoundland  Year 1 Memorial University
Nova Scotia  Senior Matriculation (Grade 12)
Prince Edward Island  Third Year Certificate from Prince of Wales College
Quebec  Senior High School Leaving Certificates
        First Year CEGEP programme
Saskatchewan  Senior Matriculation (Grade 12)
England and Wales, West Indies, East and West Africa  The General Certificate of Education with passes in at least five subjects, two of which must be at Advanced Level.
Scotland  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.

**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. The expenses involved in administering the test must be borne by the applicant. Applicants from other countries should have received entry to the country on a student visa or as a landed immigrant. Applicants wishing admission to one of the co-operative programmes are strongly recommended to acquire landed immigrant status prior to application.

**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. Each application will be considered on its merits by the Admissions Committee.

**Admission to Advanced Years**

An application 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 courses (including D's) passed, but with
Examinations and Standings

a cumulative average based on all courses attempted, whether passed or failed.

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 8, 9, 10, 11, 1970.

Fees

Refer to Section 12, page 458.

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, Year 3, and those with fifteen or more, Year 4; Year 5 students will exist only in 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) *Students in individual courses* will be reported in numerical grades in the scale 0 to 100 and as well a letter grade designation will be assigned. These may be interpreted as follows:

<table>
<thead>
<tr>
<th>Numerical Range</th>
<th>Grade</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 Average</td>
</tr>
<tr>
<td>60-65</td>
<td>C</td>
<td>Fair, Average</td>
</tr>
<tr>
<td>50-59</td>
<td>D</td>
<td>Passing</td>
</tr>
<tr>
<td>Below 50</td>
<td>F</td>
<td>Failure</td>
</tr>
</tbody>
</table>

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.

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
Examinations and Standings

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, 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 Standings 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 subsequent years.

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>60.0-65.9</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 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 of 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. No Honours degree may be taken completely on a part-time or reduced-programme basis and at least two of the upper three “years” must be taken on a full-time (full programme) basis. 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. In particular:

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 averages, 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.
Examinations and Standings

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 students in good standing but only in a limited number of deserving cases according to the following general principles:

I) 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).

II) In failed courses for students in their graduating year where only one or two such courses remain to be completed for a degree.

III) 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.

IV) In any case where failure to pass is attributable to extraordinary circumstances, especially medical or health-related problems.

In all cases regarding make-up examinations the student must have satisfied all term work requirements in the course and must have the permission of the Examinations and Standings Committee (who must be 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 IV).

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 cooperative 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 subsequently decides not to write the examination, the fee is not refunded.

Except in extraordinary circumstances, (e.g. IV above), when a make-up examination is passed, the course will count as a course passed towards 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.

Note Regarding transfer of present students on the “year-system” to the credit system

Effective September 1969, all Year 1 Science students are on the credit system described above. All students graduating in 1970 will be assessed on the “year-system” and will not be transferred to the credit system—however, the Examinations and Standings Committee will assess all cases involving possible supplementals or failing years; if the student would have received his degree on the credit system it will be granted; since all such students required 6 courses in their original Year 1 programmes, 16 or 21 courses (depending on programme) will be required for the General B.Sc. All other Science students will be given the opportunity to transfer to this system under rules and regulations to be published separately in 1970. Details are not recorded here.

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.

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
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.

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 whose 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 of 5 will have one less elective to take in one of the upper years, or else may enrich their programme with extra courses.

First Year Science Programmes (Regular and Co-operative)
### 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*-122* or 132</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* or 132</td>
<td>Physics 101*-102*; or 121*-122* or 163*-163*</td>
</tr>
<tr>
<td>Chemistry</td>
<td>Mathematics 130, Chemistry 121*-122* or 132</td>
<td>Physics 121*-122* or 162*-163*</td>
</tr>
<tr>
<td>Chemistry (Mathematics Option)</td>
<td>Mathematics 130, 131</td>
<td>Mathematics 131</td>
</tr>
<tr>
<td>Chemistry (Physics Option)</td>
<td>Mathematics 130, Physics 121*-122* or 162*-163*; Chemistry 121*-122* or 132</td>
<td>Physics 121*-122* or 162*-163*</td>
</tr>
<tr>
<td>Earth Sciences</td>
<td>Earth Sciences 130, Chemistry 121*-122* or 132</td>
<td>Physics 101*-102*; or 121*-122* or 162*-163*</td>
</tr>
<tr>
<td>Optometry</td>
<td>Mathematics 130, Physics 121*-122* or 162*-163*; Psychology 101*-102*</td>
<td>Biology 132, Chemistry 121*-122* or 162*-163*</td>
</tr>
<tr>
<td>Physics (see Note 2)</td>
<td>Mathematics 130, Physics 121*-122* or 162*-163*</td>
<td>Biology 132, Chemistry 121*-122* or 162*-163*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Options Recommended</th>
<th>Options Recommended in Year 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology</td>
<td>Mathematics 130, 131</td>
</tr>
<tr>
<td>Biology and Chemistry</td>
<td>Mathematics 130, Chemistry 121*-122* or 162*-163*</td>
</tr>
<tr>
<td>Chemisty</td>
<td>Mathematics 130, Chemistry 121*-122* or 162*-163*</td>
</tr>
<tr>
<td>Earth Sciences</td>
<td>Mathematics 130, Physics 121*-122* or 162*-163*; Psychology 101*-102*</td>
</tr>
<tr>
<td>Optometry</td>
<td>Mathematics 130, Physics 121*-122* or 162*-163*</td>
</tr>
<tr>
<td>Physics (see Note 2)</td>
<td>Mathematics 130, Physics 121*-122* or 162*-163*</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* or 162*-163*</td>
<td>Mathematics 131, Mathematics 130, Physics 121*-122* or 162*-163*</td>
</tr>
<tr>
<td>Applied Physics (see Note 3)</td>
<td>Mathematics 130, Physics 121*-122* or 162*-163*</td>
<td>Mathematics 131, Physics 121*-122* or 162*-163*</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 upper year Physics courses.

### 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"—fall 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 101 and Physics 162*-163* or 121*-122* to fulfill the requirement of two Science courses in first year.

### Note 4
The Ontario Department of Education has strongly recommended that all students who are preparing to teach science in high school should take Grade 13 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.

**Faculty of Arts Courses**

Usually selections are made from the introductory courses offered in various Departments. English 116* and 117* for Co-operative students and English 130 for Regular students 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 100* and 101*, German 101* and 102*, History 100, Philosophy 100 or any of Philosophy 125*, 135*, 140*, 150*, Political Science 105* and 106*, Russian 101* and 102*, Sociology 101* and 102* 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.

**Faculty of Science Courses**

Introductory courses are offered in Biology, Chemistry, Earth Sciences and Physics. Courses from two of these areas must be selected. Although there are several first year courses available in Chemistry and Physics there is sufficient overlapping of material that only one of the full-year sequences in either Department may be chosen, i.e. only one of Physics 101*-102*, 121*-122*, 162*-163* and one of Chemistry 101, 121*-122*, 132.

**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 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**

Chemistry 101 General Chemistry (2 lectures, 1 tutorial, 3 hours laboratory, two terms)
Chemistry 121* Chemical Structure (3 lectures, 3 hours laboratory, fall term)
Chemistry 122* Chemical Reaction (3 lectures, 3 hours laboratory, winter term)
Chemistry 132 Chemical Structure and Reaction (3 lectures, 3 hours laboratory,
fall and winter terms)—only for students interested in pursuing an Honours Science programme and having 75% or better standing in Grade 13 Chemistry and Mathematics A with Mathematics B desirable.

Chemistry 101 is for all Co-operative students desiring to take Chemistry in Year 1. Chemistry 121*-122* or 132 are for all Regular students and are not available to those in Co-operative programmes.

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, 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, 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. 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 of 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

The following Honours Programmes are available.
(For Year I, see page 137)

<table>
<thead>
<tr>
<th>Year 2</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 233</td>
<td>Vertebrate Zoology</td>
<td>2</td>
</tr>
<tr>
<td>Biology 234</td>
<td>The Plant Kingdom</td>
<td>2</td>
</tr>
<tr>
<td>Biology 235</td>
<td>Fundamentals in Microbiology</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 236</td>
<td>Organic Chemistry 1</td>
<td>2</td>
</tr>
</tbody>
</table>
Two-non-Biology electives (one of which is strongly recommended to be Physics 222*-223* if Physics 121*-122* or 161*-163* taken in Year 1) as specified

**Year 3†**
- Biology 333 Invertebrate Zoology 2 3
- Biology 334 The Vascular Plants; Cytogenetics and Morphogenesis 2 3
- Biology 335 Microbiology 1 2 3
- Biology 337 General Physiology 2 3
- Chemistry 337 Biochemistry 1 2 3

One non-Biology Elective as specified

† All Honours Biology students who have completed their third year are expected 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.

**Note regarding electives** A listing of Science and other electives is found on page 138. While this list was prepared for the General Science programme many of the courses would be suitable here. Other Honours level courses in Chemistry, Physics or Psychology should also be considered.

**Honours Biology and Chemistry** (For Year 1, see page 137)

<table>
<thead>
<tr>
<th>Year 2</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 231 Chemistry Bonding and Structure</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 232 Analytical Chemistry</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry 236 Organic Chemistry 1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Elective (Mathematics 236 recommended) as specified</td>
<td>as specified</td>
<td></td>
</tr>
<tr>
<td>Two of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology 233 Vertebrate Zoology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 234 The Plant Kingdom</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 235 General Microbiology</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 3</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 325 Physical Chemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 336 Organic Chemistry 2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 337 Biochemistry 1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<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>
<tr>
<td>Two of:</td>
<td></td>
<td></td>
</tr>
<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>
<tr>
<td>Biology 335 Microbiology 1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 337 General Physiology</td>
<td>2</td>
<td>3</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 4</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 341 Inorganic and Nuclear Chemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 437 Biochemistry 2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Elective</td>
<td>as specified</td>
<td></td>
</tr>
<tr>
<td>Three of: Any 400-level courses offered in Biology</td>
<td>as specified</td>
<td></td>
</tr>
</tbody>
</table>
Honours Biology and Psychology
This programme is being phased out and is no longer available to new students. Students now enrolled in it will be allowed to complete their programme as noted. Students entering Year 2 with strong interests in both Biology and Psychology may be allowed to take an Honours Biology programme enriched in Psychology upon consultation and approval of the Chairman of the Biology Department.

Year 4 (1970-71 only)

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 431 Ecology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 434 Genetics</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 442 Animal Physiology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 499 Senior Honours Essay</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>or Biology 499 Senior Honours Project as required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two electives (at least one of which must be a 300 or 400 level Psychology course)</td>
<td>as required</td>
<td></td>
</tr>
</tbody>
</table>

Honours Chemistry
(For Year 1, see page 137)

Year 2

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 231 Chemical Bonding and Structure</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 232 Analytical Chemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 235 Physical Chemistry 1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 236 Organic Chemistry 1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 236 Elementary Differential Equations</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>One elective (Physics 222*-223* recommended) as specified</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Year 3

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 331 Inorganic Chemistry 1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 335 Physical Chemistry 2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 336 Organic Chemistry 2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 355 Laboratory in Physical Chemistry</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Two electives (subject to availability and compatibility with the timetable, the following are suggested: Physics 226*-227*, Mathematics 229, 240, 243, Chemistry 337, 400*, 405*, 415*, 425*)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Year 4

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 431 Inorganic Chemistry 2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 435 Physical Chemistry 3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 436 Organic Chemistry 3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 439 Advanced Laboratory</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Two electives (subject to availability and compatibility with the timetable, the following are suggested: Physics 352*-353*, Mathematics 450, Chemistry 337, 437, 440, 400*, 405*, 415*, 425*)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note
An elective means a full-year course; two term courses (labelled *) are equivalent to a full-year course. Other suitable Arts, Mathematics or Science courses may be chosen subject to Departmental approval.
### Honours Chemistry (Mathematics Option)

**(For Year 1, see page 137)**

<table>
<thead>
<tr>
<th>Year 2</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 231</td>
<td>Chemical Bonding and Structure</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 232</td>
<td>Analytical Chemistry</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 235</td>
<td>Physical Chemistry 1</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 236</td>
<td>Organic Chemistry 1</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics 236</td>
<td>Elementary Differential Equations</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics 240</td>
<td>Applications in Computer Science</td>
<td>2</td>
</tr>
</tbody>
</table>

**One of:**

- Mathematics 233 Probability and Statistics | 2 | 1 |
- Mathematics 243 Statistics for the Sciences | 2 | 1 |
- Physics 222*-223* Electricity and Magnetism | 2 | 3* |

**Year 3**

<table>
<thead>
<tr>
<th>Year 3</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 331</td>
<td>Inorganic Chemistry 1</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 335</td>
<td>Physical Chemistry 2</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 336</td>
<td>Organic Chemistry 2</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 355</td>
<td>Laboratory in Physical Chemistry</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 229</td>
<td>Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 237</td>
<td>Differential &amp; Integral Calculus</td>
<td>3</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>Year 4</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 431</td>
<td>Inorganic Chemistry 2</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 435</td>
<td>Physical Chemistry 3</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 436</td>
<td>Organic Chemistry 3</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics 329</td>
<td>Abstract Algebra</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics 343</td>
<td>Complex Variable Theory</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics 434</td>
<td>Differential Equations of Mathematical Physics</td>
<td>2</td>
</tr>
</tbody>
</table>

**One of:**

- Chemistry 437 Biochemistry 2 | 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 137)**

<table>
<thead>
<tr>
<th>Year 2</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 231</td>
<td>Chemical Bonding and Structure</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 232</td>
<td>Analytical Chemistry</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 235</td>
<td>Physical Chemistry 1</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 236</td>
<td>Organic Chemistry 1</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics 236</td>
<td>Elementary Differential Equations</td>
<td>2</td>
</tr>
<tr>
<td>Physics 222*-223*</td>
<td>Electricity and Magnetism</td>
<td>2</td>
</tr>
<tr>
<td>Physics 226*-227*</td>
<td>Optics</td>
<td>2</td>
</tr>
</tbody>
</table>
### Year 3

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 331</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 335</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 336</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 355</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Mathematics 237</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 352*-353*</td>
<td>2</td>
<td>3*</td>
</tr>
<tr>
<td>Physics 324*-325*</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

### Year 4

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Chemistry 431</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 435</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 436</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 450</td>
<td>2</td>
<td>0</td>
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<tr>
<td>Physics 362*-363*</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 435*</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

**One of:**
- Chemistry 337 Biochemistry 1
- Chemistry 440 Polymer Chemistry
- Chemistry 439 Advanced Laboratory

**Note**
Other Physics courses may be substituted for the Physics courses listed, subject to the approval of the Chemistry Department.

### Co-operative Applied Chemistry (Honours)

(For Year 1, see page 137)

#### Year 2A

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics 31*</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Electives (2 required):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry 209*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics 256*</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 23*</td>
<td>3</td>
<td>3*</td>
</tr>
</tbody>
</table>

**Electives (2 required):**
- Technical Literature (recommended)
- Optics (recommended)
- Numerical Methods (only if Mathematics 132 not taken previously)

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 235</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Arts elective</td>
<td></td>
<td>as specified</td>
</tr>
</tbody>
</table>

#### Year 2B

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 201*</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 205*</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

**Electives (3 required):**
- Radiochemistry (recommended)
- Electricity and Magnetism (recommended)
- Probability and Statistics (recommended)

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 235</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Arts elective</td>
<td></td>
<td>as specified</td>
</tr>
</tbody>
</table>

#### Year 3A

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 301*</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 306*</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 308*</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

### Academic Programmes

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Academic Programmes

Electives (2 required):

- Physics 243* (if not taken previously)
- Physics 352*
- Electronics
- Engineering elective
- Non-Chemistry Science elective

<table>
<thead>
<tr>
<th>Year 3B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 302* Modern Organic Analysis</td>
</tr>
<tr>
<td>Chemistry 305* Applied Physical Chemistry</td>
</tr>
</tbody>
</table>

Electives (3 required):

- Chemistry 303* Introductory Polymer Chemistry | 3 | 3 |
- Chemistry 307* Introductory Biochemistry | 3 | 3 |
- Chemistry 318* Instrumental Measurements | 1 | 3 |

Arts, Engineering or Science elective as specified

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* Physical Chemistry of Polymers as specified |
- Chemistry 405* Surface Chemistry | 3 | 0 |
- Chemistry 407* Applied Biochemistry | 3 | 3 |
- Chemistry 408* Instrumentation 1 | 1 | 3 |

Arts, Engineering or Science elective as specified

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 |
- Chemistry 415* Catalysis | 3 | 0 |
- Chemistry 418* Instrumentation | 1 | 3 |

Arts, Engineering or Science elective as specified

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 Chemistry and Physics

This programme is being phased out and is no longer available to new students. Students now enrolled in it will be allowed to complete their programme as noted. Students entering Year 2 with strong interests in both Chemistry and Physics should select one of the programmes Honours Chemistry (Physics Option) or Honours Physics (with Chemistry).

Year 4 (1970-71 only)

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Year 4 (1970-71 only)</td>
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<tr>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>Chemistry 341 Inorganic and Nuclear Chemistry</td>
</tr>
<tr>
<td>Chemistry 336 Organic Chemistry 2</td>
</tr>
<tr>
<td>Physics 352* - 353* Electronics</td>
</tr>
<tr>
<td>Physics 360* Intermediate Laboratory</td>
</tr>
</tbody>
</table>

All electives chosen must be from those offered, compatible with the timetable. Choice of electives must be approved by the Chemistry Department.

Only two of the Chemistry electives in terms 4A and 4B will be offered each year according to demand.
### Academic Programmes

<table>
<thead>
<tr>
<th>Option A (Chemistry)</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 434</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introductory Quantum Mechanics</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 435</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Chemistry 3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>One of:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry 337</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biochemistry 1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 440</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polymer Chemistry</td>
<td>2</td>
<td>0</td>
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<tr>
<td>one Arts elective</td>
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</table>

<table>
<thead>
<tr>
<th>Option B (Physics)</th>
<th>Lectures</th>
<th>Labs</th>
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</thead>
<tbody>
<tr>
<td>Physics 435*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solid State Physics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>one Arts or Science elective</td>
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<td>as specified</td>
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</table>

### Honours Earth Sciences (Geology Option)

#### Year 2

<table>
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<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
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</thead>
<tbody>
<tr>
<td>Earth Sciences 231*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mineralogy</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 232*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Petrography</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 237*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Geology</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Earth Sciences 238*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Historical Geology</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 240*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geomorphology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Earth Sciences 241*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optical Mineralogy</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 241</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principles and Applications of Chemical Bonding</td>
<td>2</td>
<td>1</td>
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<tr>
<td>Arts Elective</td>
<td></td>
<td></td>
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<tr>
<td>One of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics 132</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to Computer Science</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics 243</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statistics for the Sciences</td>
<td>2</td>
<td>1</td>
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</tbody>
</table>

#### Year 3

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Sciences 330</td>
<td></td>
<td></td>
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<tr>
<td>Igneous and Metamorphic Petrology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 334</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paleontology</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 335</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stratigraphy and Sedimentation</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Earth Sciences 340</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structural Geology</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Arts Elective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology 333</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invertebrate Zoology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Physics 250*-251*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Solar System—The Stellar System</td>
<td>3</td>
<td>0</td>
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<tr>
<td>or other Science elective</td>
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<tr>
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#### Year 4

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Sciences 430</td>
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<td></td>
</tr>
<tr>
<td>Economic Geology</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 436</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thesis</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Earth Sciences 437</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crustal Evolution</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Non-Earth Sciences Elective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two courses* from:</td>
<td></td>
<td></td>
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<tr>
<td>Earth Sciences 368*-369*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geophysics 1 and 2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Earth Sciences 431</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geochemistry</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 432*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precambrian Geology</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 434*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biostratigraphy</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 438*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering Geology</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Earth Sciences 439*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater Geology</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Earth Sciences 440*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quaternary Geology</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

*Courses marked * are half courses; two of these make the equivalent of one course selection.
Honours Physics
(For Year 1, see page 137)

Basic Programme
The basic Honours Programme is in the form of a core of required courses, plus three or four other courses as follows:

Year 2

<table>
<thead>
<tr>
<th>Core</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 260*-261*</td>
<td>Laboratory</td>
<td>0</td>
</tr>
<tr>
<td>Physics 252*-253*</td>
<td>Electricity and Magnetism 1 and 2</td>
<td>2</td>
</tr>
<tr>
<td>Physics 256*</td>
<td>Optics (first term)</td>
<td>3</td>
</tr>
<tr>
<td>Physics 255*</td>
<td>Quantum Physics (second term)</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 237</td>
<td>Differential and Integral Calculus</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 31*</td>
<td>Elementary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>Electives:</td>
<td>Courses totalling $5\frac{1}{2}$ lecture hours.†</td>
<td></td>
</tr>
</tbody>
</table>
| Mathematics 31* may be replaced by Mathematics 236.

Year 3

<table>
<thead>
<tr>
<th>Core</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 360*</td>
<td>Intermediate Laboratory</td>
<td>0</td>
</tr>
<tr>
<td>Physics 362*-363*</td>
<td>Classical Mechanics 1 and 2</td>
<td>3</td>
</tr>
<tr>
<td>Physics 355*</td>
<td>Nuclear and Particle Physics</td>
<td>3</td>
</tr>
<tr>
<td>Physics 358*</td>
<td>Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>Physics 359*</td>
<td>Statistical Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>Electives:</td>
<td>Courses totalling $8\frac{1}{2}$ lecture hours.†</td>
<td></td>
</tr>
</tbody>
</table>

Year 4

<table>
<thead>
<tr>
<th>Core</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 434</td>
<td>Introductory Quantum Mechanics</td>
<td>2</td>
</tr>
<tr>
<td>Physics 441</td>
<td>Electromagnetic Theory</td>
<td>2</td>
</tr>
<tr>
<td>Electives:</td>
<td>Courses totalling 12 lecture hours.†</td>
<td></td>
</tr>
</tbody>
</table>

†Note When choosing electives, three hours of laboratory is considered equivalent to one lecture hour.

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*, 250*, 270*-271*, Mathematics 240, 250*, 259*
Year 3 Physics 352*-353*, 364*-365*, 371*, Arts Elective
Year 4 Physics 432*, 433, 435*, 436,
[Two of: Physics 442*, 443*, 444*, 445*]
Elective
Ex. 2 Honours Physics (especially suitable as preparation for high school teaching)
Core plus: Year 2 Chemistry 231, Mathematics 229, 240 or Physics 250*-251*
Year 3 Physics 352*-353*, 368*-369*, 371*, Chemistry 325
Year 4 Physics 364*-365*, 433, 435*, Science 400, Arts Elective

Ex. 3 Honours Physics (with Biophysics)
Core plus: Year 2 Mathematics 51*, Chemistry 205*, 206*, Physics 259*
Year 3 Physics 380*, 381*, 352*-353*, 364*-365*
Year 4 Physics 435*, 444*, 480*, 481*, Chemistry 337, Biology 337

Ex. 4 Honours Physics (with Computing)
Core plus: Year 2 Physics 259*, Mathematics 240, Arts Elective
Year 3 Physics 352*-353*, 364*-365*, Mathematics 51*, 334, 340
Year 4 Physics 352*-353*, 435*, E.E. 25*, two Mathematics courses at the third or fourth year level, Elective

Ex. 5 Honours Physics (with Chemistry)
Core plus: Year 2 Chemistry 231, 235, Mathematics 240
Year 3 Physics 352*-353*, 364*-365*, Chemistry 236
Year 4 Physics 432*, 435*, Chemistry 335, 341, Elective

Ex. 6 Honours Physics (with Astrophysics)
Core plus: Year 2 Physics 250*, 251*, 270*, 271*, Mathematics 240
Year 3 Two of: Physics 350*, 351*, 449*, 450*, 451*
Two of: Physics 352*-353*, 364*-365*, 371*,
Arts elective
Year 4 Three of: Physics 350*, 351*, 449*, 450*, 451*
One or two of: Physics 431, 435*, 436, 443*, 444*

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*, Mathematics 229, one elective course
Year 3 Physics 364*-365*, Mathematics 333, one and one-half elective courses
Or Mathematics 333 and 369, two elective courses
Year 4 Physics 431, 435*, 437*, plus either: Physics 436 plus electives totalling 3 lecture hours Or Mathematics 343 and 434 plus one elective course

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 468. 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 137)

<table>
<thead>
<tr>
<th>Core</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 260* Laboratory</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Physics 252* Electricity &amp; Magnetism 1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Physics 256* Optics</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 237 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 4 lecture hours.

### Year 2B

<table>
<thead>
<tr>
<th>Core</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 261* Laboratory</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Physics 253* Electricity and Magnetism 2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Physics 255* Quantum Physics</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 237 Differential &amp; Integral Calculus</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Electives: Courses totalling 7 lecture hours.

### Year 3A

<table>
<thead>
<tr>
<th>Core</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 358* Thermodynamics</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 360* Intermediate Laboratory</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Physics 362* Classical Mechanics 1</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Electives: Courses totalling 9 lecture hours.

### Year 3B

<table>
<thead>
<tr>
<th>Core</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 355* Nuclear and Particle Physics</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 359* Statistical Mechanics</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 363* Classical Mechanics 2</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Electives: Courses totalling 8 lecture hours.

### Year 4A

<table>
<thead>
<tr>
<th>Core</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 434 Introductory Quantum Mechanics</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 441 Electromagnetic Theory</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Electives: Courses totalling 12 lecture hours.
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

Ex. 1 Co-op Applied Physics (Solid State)
Core plus: Year 2A Physics 270*, Mathematics 240, Arts Elective
Year 2B Physics 259*, 271, Chemistry 200*, Mathematics 240
Year 3A Physics 352*, 364*, E.E. 42*, or Chemistry 201*
Year 3B Physics 353*, 365*, Chemistry 301*
Year 4A Physics 433, 435*, 436, Mathematics 334, E.E. 44*
Year 4B Physics 432*, 433, 436, Mathematics 334, E.E. 81*

Ex. 2 Co-op Applied Physics (Biophysics)
Core plus: Year 2A Chemistry 206*, Elective
Year 2B Physics 259*, 380*, Mathematics 51*
Year 3A Physics 352*, 364*, Chemistry 205*
Year 3B Physics 353*, 365*, Chemistry 307*
Year 4A Physics 433, 435*, 480*, Elective
Year 4B Physics 381*, 481*, 433, 444*

Ex. 3 Co-op Applied Physics (and Chemistry)
Core plus: Year 2A Chemistry 206*, Arts Elective
Year 2B Chemistry 200*, 205*, Physics 259*
Year 3A Physics 352*, 364*, Chemistry 301* or 306*
Year 3B Physics 353*, 365*, 371*, Chemistry 305*
Year 4A Physics 433, 435*, 436, Chemistry 400*, 403*
Year 4B Physics 432*, 433, 436, Chemistry 303*, 307*

Ex. 4 Co-op Applied Physics (with Computing)
Core plus: Year 2A Mathematics 229, 240
Year 2B Mathematics 229, 240, Physics 259*
Year 3A Mathematics 340, Physics 352*, 364*
Year 3B Mathematics 340, Physics 353*, 365*, 371*
Year 4A Mathematics 243, 334, 352, Physics 435*, 436
Year 4B Mathematics 243, 334, 352, Physics 436, Elective
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. It is expected that graduate studies in the School of Optometry will be available by 1970.

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 127. 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.

**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 137. This Pre-Optometrical year is the normal Year 1 programme of the Faculty of Science with Mathematics 130, Physics 121*.-122* or 162*-163*, Psychology 101*.-102* required. Recommended options are Biology 132 and Chemistry 121*.-122* or 132.)

<table>
<thead>
<tr>
<th>Year 2</th>
<th>Lectures</th>
<th>Labs</th>
<th>Clinics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 210</td>
<td>Anatomy, Histology and Embryology (fall term — full course)</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry 216*</td>
<td>Introduction to Organic and Biochemistry</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 256*</td>
<td>Optics</td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td>Psychology 205*</td>
<td>Sensory Processes</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Psychology 206*</td>
<td>Perceptual Processes</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Optometry 200*</td>
<td>History and Orientation</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Optometry 211*</td>
<td>Physiological Optics</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Optometry 214</td>
<td>Anatomy of the Eye and Associated Structures (winter term — full course)</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Optometry 216*</td>
<td>Advanced Geometrical Optics</td>
<td>3</td>
<td>3</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>Vertebrate Physiology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 283*</td>
<td>Statistical Methods in Psychology</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Psychology 284*</td>
<td>Experimental Design</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Optometry 301*-311*</td>
<td>Physiological Optics</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>
</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 will be 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 will be 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 Science Programme

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 have the necessary course selection and standing required for a major field.

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, although no official major field designation will be recorded in the three-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 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).

Note In 1970-71 only: Students eligible to enrol in Year 3 of the old three-year major programmes will be allowed to complete their studies as begun. Consult Year 3 of the four-year programme as well as your Departmental advisor for the correct course selection. Since Year 1 of this programme was a compulsory 6 courses, 16 courses total will be required for graduation.

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 137).

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.
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 138).

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*, 206*, 236; one of Chemistry 202*, 232, 242; 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. Students must also have any necessary prerequisites listed before attempting upper year courses; these are listed in the Departmental descriptions.

Science courses recommended (other than Year 1 courses)

Biology 231, 233, 234, 235
333, 334, 335, 337
but not 110*, 131, 201, 301, 302

Chemistry 236, 241, 242
325, 337, 341
but not 209*, 216*

Earth Sciences 231*, 232*, 237*, 238*, 240*, 241*
330, 334, 335, 340, 368*-369*

Physics 222*-223*, 226*-227*, 250*-251*
324*-325*, 352*-353*, 358*-359*,
368*-369*, 380*-381*

Science 400
but not 201*-202

Mathematics courses recommended

Mathematics 130, 131, 132 (if not taken in Year 1); 236, 240, 243

Arts courses recommended

The listings shown here are not comprehensive but are a guide to either 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*, 222, 234*-235*
Economics 101*-102*, 241*-242*
English 116*-117* or 130, 190*, 211*-212*, 236*-237*, 240, 311*
French 100, 265*-266*, 365*-366*
Geography 100*-101*, 251*, 321*-322*, 341
German 101*-102*, 201*-202*
History 100, 301*-302*, 305*-306*
Philosophy 100 or any 2 of 125*, 135*, 140*, 150*; 221*-222, 240
Political Science 105*-106*, 260
Psychology 101*-102*, 203*, 211*, 241*, 242*, 253*, 271*
Russian 101*-102*, 201*-202*
Sociology 101*-102*, 210*-212*, 240*, 241*, 250*, 251*
Religious Studies courses as desired
or any other courses from Arts areas not mentioned (e.g. Classics, Fine Arts, Italian, Spanish, etc.)

**General Science—Four-year Majoring Programmes**

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 Sciences 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 Programmes**

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.

**Biology Major**

*Year 1* Including Biology 132 and Chemistry 121*-122* or 132 (see page 137).

*Year 2* Two of: Biology 233, 234, 235
Chemistry 236
Two non-Biology electives
Year 3  Two or 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 from the above list.

Note  Some possible electives are shown in the list under the three-year programme. These courses would be suitable choices here.

Chemistry Major

Year 1  Including Chemistry 121*–122* or 132 and Mathematics 130 (see page 137).

Year 2  Chemistry 236, 242
Three electives †

Year 3  Chemistry 241, 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 235, Physics 222*-223* (Year 2); Mathematics 243, Biology 231, 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*–122* or 132 (see page 137).

Year 2  Two of: Earth Sciences 231* 232*, 237*, 238*, 240*, 241*
Two of: Chemistry 241, Biology 231, Mathematics 243, Physics
Elective, Arts Elective

Year 3  Two or three of: Earth Sciences 330, 334, 335, 340
One or two of: Chemistry 242, 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 137).

Year 2  Physics 222*-223*, 226*-227*  
One of: Mathematics 132, 236, 237  
One of: Chemistry 231, 236, Biology 231, Earth Sciences 130 or 231*-241*  
Elective

Year 3  Physics 324*-325*  
One or two of: Physics 250*-251*, 352*-353*, 358*-359*, 368*-369*, 380*-381*  
Two or one of: Mathematics 229 or 243; Chemistry 231 or 325  
Arts or Mathematics Elective

Year 4  Two or three of: Physics 250*-251*, 352*-353*, 358*-359*, 362*-363*, 364*-365*, 368*-369*, 480*-481*, 441  
Two or one non-Physics Science courses  
Arts or Mathematics Elective
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 the co-operative basis.

The co-operative programme has been designed to provide professional 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 programme in Kinesiology meets 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' interm Type "A" Certificate from the Youth and Recreation Branch of the Department of Education of Ontario.

The co-operative programme 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 in the calendar for further details of operation of the co-operative programmes.

The academic programme in Kinesiology emphasizes the biological sciences. Extensive laboratory facilities permit the senior students to encounter at first hand the problems inherent in human physical activity. Features of the programme include a camping skills school and a ski school.

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.

Degrees

Upon successful completion of the co-operative programme the honours degree of Bachelor of Physical Education and Recreation (B.P.E.R.) is awarded by the University.

Co-operative Programme

The eight terms of study and six terms of employment provided in the course are arranged as shown in the diagram below:
Admission Requirements

<table>
<thead>
<tr>
<th>1970</th>
<th>1971</th>
<th>1972</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Winter</td>
<td>Fall</td>
</tr>
<tr>
<td>First Term</td>
<td>Second Term</td>
<td>Work Period</td>
</tr>
<tr>
<td>Work Period</td>
<td>Third Term</td>
<td>Work Period</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1973</th>
<th>1974</th>
<th>1975</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter</td>
<td>Fall</td>
<td>Winter</td>
</tr>
<tr>
<td>Fifth Term</td>
<td>Work Period</td>
<td>Sixth Term</td>
</tr>
<tr>
<td>Work Period</td>
<td>Seventh Term</td>
<td>Eighth Term</td>
</tr>
</tbody>
</table>

All Year 1 students enrol in September. Year 2 students are required to attend the Camping Skills School conducted in September prior to the commencement of the regular academic programme. Precise dates for the beginning and end of the various terms are shown in the academic calendar for the year.

Admission Requirements

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 and who wish to be considered for Early Final Admission must apply before April 1, 1970. All other applicants must apply and have submitted all the necessary documents by August 1, 1970. 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 1970.

Application Documents

All applicants must submit an application form, certified transcripts of secondary or post-secondary education, and at least one letter of reference. Applicants enrolled in Ontario Grade 13 in the 1969-70 academic year must apply on the “General Application for Admission to University” form which is available from the secondary school. All other applicants must apply on forms available from the Office of the Registrar. All educational institutions attended by the applicant must be accounted for on certified documents. In addition, applicants from non-English speaking countries must arrange to submit certified English translations of their academic documents.
Admission to Year 1

Ontario

Applicants from the Province of Ontario are required to have completed Ontario Grade 13 showing a minimum overall average of 60% in the seven required credits. For applicants who have taken more than one year to complete the work of Grade 13, a somewhat higher average may be required. Standing is required in seven Grade 13 credits as follows:

a) A minimum of Four credits chosen from:
   - English (2)
   - One language other than English (2)
   - Mathematics (2)
   - Three additional credits chosen wherever possible in accordance with the student's proposed major field of study.

or

b) Five credits from Chemistry (1)
   - Physics (1)
   - Mathematics A (1)
   - Mathematics B (1) or Biology (1)

Two additional credits should be chosen from English, languages other than English, Geography, History or, if not chosen above, Biology or Mathematics B.

Additional credits can be selected from any of the optional subjects offered at the Grade 13 level with the qualification that no more than one of the following may be counted, as an "additional" credit: Accountancy Practice, Art, Home Economics, Mathematics of Investment, Music, or Secretarial Practice. The marks received in one of these subjects will be included in the computation of the applicant's average. Standing with the Royal Conservatory of Music in Grade 8 practical and Grade 2 theory will be considered at "one additional credit" on the same terms as these subjects except the marks received will not be computed in the average.

Note 1 If English is not chosen as a Grade 13 subject offered for admission, applicants must have standing in English at the Grade 12 level.

Note 2 The University will use the following definition of credits for admission purposes:
   - 3 credits Mathematics A and Mathematics B combined
   - 2 credits All language subjects, Mathematics A
   - 1 credit All other subjects

The University will consider other systems of credit definition from Ontario secondary schools.

Note 3 A number of secondary schools in Ontario are engaged in innovative programmes. The University will consider courses for admission purposes which are not normally listed in the Ontario Department of Education Circular H.S.I. Applicants should confirm with their secondary school's guidance officials that new courses and programmes have been approved by the University for admission purposes.

Early Final Admission—Ontario

Students enrolled full time in Ontario Grade 13 will be considered for Early Final Admission. To be eligible for consideration, applicants must arrange to have the "General Application for Admission to University" form submitted by April 1, 1970. Consideration of candidates for Early Final Admission will be based on the Secondary School record, the Principal's recommendation, and
the results of the Canadian Scholastic Aptitude Test and specified Achievement Tests. Successful applicants may expect to be notified after June 11, 1970 of their acceptance and will be asked to indicate their decision by June 26, 1970. Those applicants who are not offered Early Final Admission will be considered on the basis of the Grade 13 final results and will be notified as soon as possible after the release of the Grade 13 results.

**Note** All applicants will be required to complete Grade 13 to the satisfaction of the Secondary School principal.

**Aptitude and Achievement Tests**

OACU—Ontario Tests for Admission to College and University
SACU—Service for admission to College and University

Applicants will be required to write the Canadian Scholastic Aptitude Test (CSAT) and the appropriate (OACU) Achievement Tests in English, Mathematics and Physics if the corresponding Grade 13 credits are offered for admission to the University.

**Other Canadian Provinces and Countries**

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:

- Alberta: Senior Matriculation (Grade 12)
- British Columbia: Senior Matriculation (Grade 12)
- Manitoba: Senior Matriculation (Grade 13)
- New Brunswick: Senior Matriculation (Grade 13)
- Newfoundland: Year 1 Memorial University
- Nova Scotia: Senior Matriculation (Grade 12)
- Prince Edward Island: Third Year Certificate from Prince of Wales College
- Quebec: Senior High School Leaving Certificates First Year CEGEP programme
- Saskatchewan: Senior Matriculation (Grade 12)
- Scotland: The General Certificate of Education with passes in at least five subjects, two of which must be at Advanced Level.
- England and Wales, West Indies, East and West Africa: The Scottish Certificate of Education. High School Graduation plus an additional year of formal study in subjects comparable to Ontario Grade 13.

**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. The expenses involved in administering the test must be borne by the applicant. Because of the nature of the co-operative programmes of study with four months of related work experience, it is an advantage to have not less than a year of recognized education in English.
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 programme to which applicants wish to study at University. 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 were taken and the standing in each course. 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.

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 8, 9, 10, 11, 1970.

Fees

Refer to Section 12, page 458.

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 159. 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</td>
<td></td>
</tr>
<tr>
<td>Allowed</td>
<td>F</td>
</tr>
<tr>
<td>Below 50</td>
<td></td>
</tr>
<tr>
<td>No Supplemental Allowed</td>
<td></td>
</tr>
<tr>
<td>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</th>
<th>Honours Class</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 at 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.

7) If a student has failed to clear the supplemental examination in a single subject not required as a prerequisite for further study, he may be permitted to continue in course for one year, but must clear the condition before proceeding further.

8) Failure to write an examination is considered a failure to pass. A student who defaults a final examination, except for a properly certified reason, has no supplemental examination privilege.

9) A student may not repeat a given year or term more than once. Degree requirements must be fulfilled in not more than 11 terms of resident study.

10) Any student may be required to withdraw at any time if, in the opinion of the Faculty Council he is unlikely to profit from further study.

Academic Programmes

Honours Kinesiology
Year 1, Term 1A (Fall)

*(An asterisk (*) following a course indicates a term course).*

Kinesiology 102*, 185*
Psychology 101*
Physics 103*
One of Kinesiology 140*, 160* Recreation 102*
Two electives
Year 1, Term 1B (Winter)  
Kinesiology 103*, 186*  
Biology 110*  
One of Kinesiology 141*, 161*, 171*  
Two electives

Year 2, Term 2A (Fall)  
Kinesiology 200*, 216*, 280*, 285*  
Three electives

Year 2, Term 2B (Spring)  
Kinesiology 217*, 221*, 222*, 230*, 240*, 286*  
Psychology 211*

Year 3, Term 3A (Winter)  
Kinesiology 330*, 340*, 385*  
Biology 301  
Three electives

Year 3, Term 3B (Fall)  
Kinesiology 300*, 320*, 342*, 386*  
Biology 301  
Two electives

Year 4, Term 4A (Spring)  
Kinesiology 400*, 420*, or 422*, 440*, 450*, 480*, 485*  
Psychology 212*

Year 4, Term 4B (Winter)  
Kinesiology 401*, 430*, 445*, 470*, 485  
Two electives

Note 1  
The student must choose seven electives from the Faculties of Arts, Science or Mathematics. For those students entering the teaching profession they would be advised to take either: (1) five full courses in one subject area and two in another or (2) four full courses in one subject area and three in another. The selection of courses for these minor areas will be determined by the entrance background of the student and in consultation with the departments concerned.

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*, 102*  
Psychology 101*, 102*  
Biology 131  
English 16*-17*  
Geography 101*  
Planning 156*  
Kinesiology 185*-186*

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 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*
Sociology 241*
Recreation 300*
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
9 Graduate Studies
Graduate Studies

Degrees

Courses leading to the degree of Arts (M.A.) are offered in 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 Science (M.Sc.) are offered in Biology, Chemistry, Earth Sciences and Physics.

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, Russian, 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,
Minimum Requirements for the M.Phil. Degree

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. 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.

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.

Minimum Requirements for the Ph.D. Degree

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 appoints an Examining Committee consisting of at least four members, 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 Examining 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 University Graduate Office where it is available for examination by any member of the University for four weeks. The University 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
Admission Requirements

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 examination. If he has any reason to feel that the acceptance of the thesis is open to dispute, he will take the matter before the Graduate 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 or 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 graduate study. All, or part, of their programme will consist 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**
Graduate students from other universities who spend a resident period at Waterloo but are not candidates for a Waterloo degree will pay fees as per regular graduate students.

**Note 3**
Classification of graduate students is made by the Graduate Admissions Committee for each respective Faculty.

**Admission 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
Definitions

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 subjects.

<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 "Credit", or "No credit".

Fees
Refer to Section 12 Page 460.

Registration (Fall Term)
September 11, Friday, Graduate Studies.
All students are required to register at the commencement of each session at the time and place designated by the Associate Registrar, Graduate Studies.
10 Course Descriptions
Undergraduate, Graduate
School of Architecture

Associate Professor and Director
T.E. Bjornstad, B.Arch (Iowa State), AIA, MRAIC

Associate Professor
J.B. Ellis, B.A.Sc. (Toronto), D.I.C., M.Sc. (Imperial College, London), Ph.D. (Michigan State)

Associate Professor
S. Schultz, B.S.M.E. (New Hampshire)

Associate Professor
W.M. Smale, B.Arch. (Toronto), FRAIC

Assistant Professor
E.M. Pallett, B.S., M.Music (Oregon), Ph.D. (Michigan State)

Assistant Professor
R.M. Schuster, B.S., M.S. (North Dakota State), Ph.D. (Iowa State)

Assistant Professor
F. Thompson, B.Arch., M.Arch. (Toronto)

Visiting Professor
S.K. Gupta, B.Sc., M.Sc. (Punjab), M.A., Ph.D. (Toronto)

Lecturer
R.M. Mukerjea, B.Arch. (I.I.T. Kharagpur), M.A.Sc. (Waterloo)

Lecturer
L. Sobkowski, Dr.Arch. (Polytechnic Institute of Torino)

Lecturer
J.C. Somfay, B.Arch. (N.S.W. Sydney), M.Arch. (Toronto)

Undergraduate Architecture Courses

1) Quantitative and Behavioural Studies

B.E.S. Program

100 Calculus
Elementary differential and integral calculus, applications to problems involving rates of change, areas, volumes, centroids, moments of inertia.

101 Vector Geometry and Finite Mathematics
Introductory vector geometry in two and three dimensions; set theory, probability theory, expectation, simple distributions.

200 Linear Algebra
Linear algebra and transformations; matrix methods and simple Markov chains.

201 Statistics
Elementary hypothesis testing; descriptive statistics, sampling, curve fitting; regression and correlation; emphasis on the description of environmental processes through observational data.

300 Social Architecture
Study of social systems properties that are most interdependent with physical system properties. Consider several levels of territoriality (personal, home, public, etc.) and the nature of individual and group activities that occur on each of these levels.

301 Economics
Discussion of the economic structure of the urban environment. The functioning of a mixed capitalistic enterprise system. The dynamic process of economic interactions between the various levels of governments and the private enterprise sectors in the shaping of this environment.

Computer Science

110 Introduction to Programming 1
An introduction to algorithms, stored-programme computers and programming languages; FORTRAN IV. Computer assignments.

111 Introduction to Programming 2
Concept and properties of an algorithm, language and notation for describing algorithms; analysis of problems and development of algorithms for their solution. Computer assignments.

210 Architectural Plotting
Data structures and effective procedures for generating and plotting architectural plans from a minimum of coordinate information.

310 Design Synthesis Introduction to computer generated architectural design.


2) Environmental Studies

120 Human Ecology 1 The structure and function of man in relation to systems design; the relationship of biology and human physiology to architecture; biological concepts, biological variation; the cell as a microsystem; man as a complex of systems and subsystems.


220 Human Ecology 2 The attributes, assets and liabilities of man within a spatial system; man's characteristics as a component of a system; human factors in spatial design.

221 Sociology of Neighbourhoods Basic concepts of sociology, occupational and concomitant social adjustments of society in response to forces of urbanization and industrialization.

320 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.

321 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.

3) Cultural History

Cultural and historical context of a problem is one of the inputs to be considered in order to arrive at a workable solution. A normal freshman student out of the Ontario high school system, like others in North America, has scarcely been released from his immediate cultural context. There is no intellectual discipline to illuminate the organic view of culture and to realize the interrelationship of human activities. A useful course should awaken a student to other cultural contexts introducing free movement among a number of traditions bequeathed to us by both past and present. The study will be broken down into six phases:

140 Convention The complex of rules and values surrounding the creation of the artifact.

141 Iconography A survey of the symbolic nature of the environment.
178

Undergraduate Architecture Courses

240, 241, 340, 341 Sense of Periods
Involving mediaeval, renaissance enlightenment and romanticism, and the new liberalism of the first half of the 20th Century.

4) Physical and Material Sciences

160 Rational Mechanics
Rigid body statics; kinematics and dynamics.

161 Structural Materials
Metals, masonry, timber, plastics, glass, soils.

260 Strength of Materials 1

261 Strength of Materials 2

360 Structural Analysis 1
Statically determinate structures: beams, trusses, frames, arches, tri-dimensional structures, cable structure, deflections.

361 Structural Analysis 2

371 Mechanical Engineering 1
An introduction to thermodynamics, heat transfer, aerodynamics, illumination, acoustics and combustion. A reflection on the similarity of the physical criteria which govern their behaviour.

5) Studio A

180, 181, Design Fundamentals
Confrontation with media limited to flat, two-dimensional representation, in black and white only. Basic elements, complementary elements, resolving tensions between positive and negative; organizational factors; groupings, contrasts, similarity, patterns, rhythm, continuity, etc. Variations in shape, size, position, directions; perception and generation of alternative relationships.

Two-dimensional media extended to colour, opaque and transparent; relief modelling, textured surfaces, low, middle and high relief; three-dimensional character, environmental relief. Higher orders of organizational factors extended to three-dimensional configurations. Communication media which are completely three and multi-dimensional in character. Environmental sculpture, protruding forms and environment, monolithic mass, absolute form, concave convex-mass, penetrated mass. Higher degrees of organization, from basic elements to multi-dimensional expression, micro and macro structures.

†The above Design Fundamentals consist of two half-courses given in the fall and winter terms of the first year.

Design Concepts
A design concept or design philosophy course implemented by means of lectures and studio seminars. A link between architecture and the design concepts as developed by systems design and engineering oriented programmes.

280 Design Concepts 1
A study of the fundamentals of planning and the design process and its application to organization of architectural work and design.
281 Design Concepts 2  A study of particular design concepts oriented to the design process in the field of space layout.

380 Design Concepts 3  A study of design concepts oriented to the design process in the fields of building systems.

381 Design Concepts 4  A study of day-to-day problem solving, decision making and long range planning processes used in business and service organizations.

Studio B

The idea of a studio is one of involvement of analysis and synthesis in the total physical environment that is related to the shelter of man; an awareness of the main inherent physical characteristics and limitations of media and material. The objectives of the studio are:

1) to guide the student in observing aspects of the environment; to find, categorize and associate the information into fundamental structures or patterns of relationship.
2) to apply theories generated in the lecture courses to situations in the physical environment. This will be implemented by categorizing the courses into three:
   a) behaviour of materials and structures
   b) behaviour of man
   c) communications
3) to establish a relationship between faculty members and students where all faculty members are considered as consultants to the students.
4) to provide a vehicle for faculty members from different disciplines to converse in open discussion with the student group on the same problem from their own point of view.
5) to make the students aware of the different "techniques" that can assist them in analysis and synthesis in problems of the physical environment.

190 Studio 1 To understand the relationship between two dimensional media and to be able to communicate simple messages by use of those media. To be able to communicate with pen, and pencil, both freehand and with instruments. To understand orthographic and perspective projection techniques. To be able to express ideas generated in the design theory labs. Photography.

191 Studio 2 To observe and communicate about:
   a) the action an dreaction of materials in the environment
   b) the individual response both physiologically and psychologically to objects in the physical environment
   c) methods of communicating specific messages from man to man by means of graphic media.
   To design a product that reflects the total aspect of our problem, introducing rules, strategies, goals, in relation to a two-dimensional problem.

290 Studio 3 To observe and communicate about:
   a) the nature of man-made and natural structures
   b) the behaviour of man in extreme conditions
c) the use of language to communicate about three-dimensional environments
To design a three-dimensional product that introduces elements of structure and behaviour of man.

291 Studio 4 To experiment and design in
a) the use of materials in the environment, the nature of structures, modelling techniques for structures.
b) the behaviour of man within specific activity spaces, cultural aspects of expression.
c) serial vision (the language of motion within the physical environment.)
To design a building.

390 Studio 5 To analyse and explore the relationships that exist between physical, social, political and economic systems within our total environment. To observe particular aspects of this relationship that can be defined as patterns of interaction. To explore modelling techniques used to understand the interaction. To experience an operational game on a city or community.
The studios are taught in sequential order for the B.E.S. programme during the first six study terms.

The Studios are taught in sequential order for the B.E.S. programme during the first six study terms.

B.Arch. Programme

1) Environmental Electives These can be selected from any course given by the University which is relevant to the students' academic pursuit. The object of these courses will be based on a better orientation and dedication towards a more meaningful profession. The inherent problems and solutions of man-made environmental structure do interact with architecture and planning, man and his environment. Hence a study of such courses is to achieve interdisciplinary environmental communication giving rise to meaningful parametric design and planning.

2) Architectural Studio (A) Building Construction Course provides knowledge and understanding about constructional details, materials and their workability, constructional techniques and systems.

Architectural Studio (B) The studio is an involvement of analysis and synthesis in the total process of architectural design. The concept of a studio is to guide the students in their observation of environmental aspects, structures of relationships and application of theories to achieve architectural design and correlation. Maximum effort will be spent in the studio. The studio work will be spread over all the five terms—term 7, 8, work term, term 9 and term 10. In term 7 a student will apply himself on architectural design and correlation. A thesis project will be chosen with the approval of the faculty advisor and a thesis programme will be written up in term 8. All the research work regarding the thesis is to be finished during the work term. The work place is to be arranged such that the work
pursue can be compatible and integrated with the nature of the thesis project. Term 9 will be spent on a thesis design. In term 10 a student will be required to analyse his thesis design, perhaps by computer, and evaluate its validity and success as a solution for the established needs and constraints of his project prior to obtaining his degree of Bachelor of Architecture.

3) Parametric Design
A sophisticated approach to Architectural Design. This incorporates systems and computer-aided design and analysis. Design parameters, their definitions and evaluation, data and their handling capacities and related design procedures are scientific ways of approach to modern design. The introduction and application of computer systems can potentially execute more effectively and creatively at least 90% of what has up to now been the exclusive endeavour of the architects. This calls for the systems design and analysis concurrently.

4) Philosophy and Methodology of Urban and Regional Planning
Historical developments of the discipline of planning; current trends in the philosophy and methodology.

5) Trends in Contemporary Architecture
Study provides a background of the development of contemporary architecture. Architecture essentially is of the society, for the society and by the society. The course enlightens the relationship of Architecture to development and evolution of society and cultural aspects. A background of the dependency of Architecture on period and vice versa is established for better understanding of architectural design process.

6) Structural Analysis Workshop

Structural Synthesis
Design of members and simple structures in steel, reinforced concrete and timber for strength, stiffness and stability. Design philosophy and codes of practice. Working stress and ultimate load methods. Application to typical systems (continuous beams, frames, multi-storey buildings, trusses, arches, slabs, floors, bearing-wall systems, etc.).

7) Mechanical Engineering 2
a) Thermodynamics and Heat Transfer:
   —psychometrics
   —cooling load calculations
   —heat loss calculations
   —periodic heat transfer in buildings
b) Radiation, illumination, Acoustics:
   —common formalism for calculating intensity distributions (including geometrical acoustics), analogue methods, modelling
   —material properties
   —diffraction of low frequency sound
c) Aerodynamics:
   —calculations arising from Mechanical Engineering 1.
### Diagramatic Schedule

**Bachelor of Environmental Studies/Architectural Programme**

<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>Quantitative and</td>
<td>Mathematics</td>
<td>Mathematics</td>
<td>Mathematics</td>
<td>Mathematics</td>
<td>Social Architecture</td>
<td>Economics (E)</td>
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<tr>
<td>Behavioural Studies</td>
<td>Arch 100</td>
<td>Arch 101</td>
<td>Arch 200</td>
<td>Arch 201</td>
<td>Arch 300</td>
<td>Arch 301</td>
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<td>Computer Science</td>
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<td>Computer Science</td>
<td>Computer Science</td>
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<tr>
<td></td>
<td>Arch 110</td>
<td>Arch 111</td>
<td>Arch 210</td>
<td>Arch 211</td>
<td>Arch 310</td>
<td>Arch 310</td>
</tr>
<tr>
<td>Environmental Studies</td>
<td>Human Ecology 1 (E)</td>
<td>Ecology and the Ecosystem (E)</td>
<td>Human Ecology 2 (E)</td>
<td>Arch 220</td>
<td>Sociology of Neighbourhoods (E)</td>
<td>Planning (E)</td>
</tr>
<tr>
<td></td>
<td>Arch 120</td>
<td>Arch 121</td>
<td>Arch 220</td>
<td>Arch 221</td>
<td>Arch 320</td>
<td>Arch 321</td>
</tr>
<tr>
<td>Cultural History</td>
<td>Convention</td>
<td>Iconography</td>
<td>Sense of Periods &amp; Styles</td>
<td>Sense of Periods &amp; Styles</td>
<td>Sense of Periods &amp; Styles (E)</td>
<td>Sense of Periods &amp; Styles(E)</td>
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<td></td>
<td>Arch 140</td>
<td>Arch 141</td>
<td>Arch 240</td>
<td>Arch 241</td>
<td>Arch 340</td>
<td>Arch 341</td>
</tr>
<tr>
<td>Physical &amp; Material</td>
<td>Rational Mechanics</td>
<td>Structural Materials</td>
<td>Strength of Materials</td>
<td>Strength of Materials</td>
<td>Structural Analysis Structural Analysis</td>
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<tr>
<td>Sciences</td>
<td>Arch 160</td>
<td>Arch 161</td>
<td>Arch 260</td>
<td>Arch 261</td>
<td>Theory Theory</td>
<td>Theory</td>
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<tr>
<td></td>
<td>Arch 180</td>
<td>Arch 181</td>
<td>Arch 280</td>
<td>Arch 281</td>
<td>Arch 380</td>
<td>Arch 381</td>
</tr>
<tr>
<td></td>
<td>Design B Studio 1</td>
<td>Studio 2</td>
<td>Studio 3</td>
<td>Studio 4</td>
<td>Studio 5</td>
<td>Studio 6</td>
</tr>
<tr>
<td></td>
<td>Arch 190</td>
<td>Arch 191</td>
<td>Arch 290</td>
<td>Arch 291</td>
<td>Arch 390</td>
<td>Arch 391</td>
</tr>
</tbody>
</table>

*(E) after a course title indicates that the course may be replaced by an elective course in the same theme area with the approval of the School.*
### Diagramatic Schedule

**Bachelor of Architecture Programme**

<table>
<thead>
<tr>
<th>Course Work</th>
<th>Term 7 Hrs./Week</th>
<th>Term 8 Hrs./Week</th>
<th>Work Term</th>
<th>Term 9 Hrs./Week</th>
<th>Term 10 Hrs./Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Environmental Electives</td>
<td>4 hrs</td>
<td>6 hrs</td>
<td></td>
<td>5 hrs</td>
<td>5 hrs</td>
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<tr>
<td></td>
<td>Building Constr.</td>
<td>Building Constr.</td>
<td></td>
<td>Design</td>
<td>Design Analysis</td>
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<tr>
<td></td>
<td>8</td>
<td>8</td>
<td></td>
<td>11 hrs</td>
<td>&amp; Evaluation 9</td>
</tr>
<tr>
<td>3. Parametric Design</td>
<td>2 hrs</td>
<td>2 hrs</td>
<td></td>
<td>2 hrs</td>
<td>2 hrs</td>
</tr>
<tr>
<td>4. The Philosophy and Methodology of Urban and Regional Planning</td>
<td>2 hrs</td>
<td>2 hrs</td>
<td></td>
<td>Trends in Contemporary Architecture</td>
<td>2 hrs</td>
</tr>
<tr>
<td>5. Trends in Contemporary Architecture</td>
<td>2 hrs</td>
<td>2 hrs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Structural Synthesis</td>
<td>Structural Analysis</td>
<td>2 hrs</td>
<td></td>
<td>Structural Synthesis</td>
<td>3 hrs</td>
</tr>
<tr>
<td></td>
<td>Structural Workshop</td>
<td>2 hrs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Mechanical Engineering</td>
<td>2 hrs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Arts

Undergraduate Course Description

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.
(Group B elective)

The following courses are administered by Conrad Grebel College.

120*/121*G 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.

300G 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, computer science, 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.
Department of Biology

Professor and
Chairman of Department
H.B.N. Hynes, Ph.D., D.Sc. (London), A.R.C.S.

Professor
R.S. Dorney, M.Sc., Ph.D. (Wisconsin)

(Geography and Biology)
Professor
C.I.I. Fernanda, B.Sc. (Ceylon), D.Phil. (Oxford), F.R.E.S.
Professor
A.D. Harrison, M.Sc., Ph.D. (Cape Town)
Professor
J.K. Morton, B.Sc., Ph.D. (Durham)
Associate Professor
E.B. Dumbroff, M.Forestry, Ph.D. (Georgia)
Associate Professor
H.C. Duthie, B.Sc., Ph.D. (Wales)
Associate Professor
H.R.N. Eydt, M.Sc., Ph.D. (McMaster)
Associate Professor
W.E. Inniss, M.S.A. (Toronto), Ph.D. (Michigan State)
Associate Professor
A.G. Kempton, M.S.A. (Toronto), Ph.D. Michigan State)
Associate 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
Assistant Professor
A.M. Charles, M.Sc., Ph.D. (Manitoba)
Assistant Professor
N.N. Kapoor, M.Sc. (Punjjab), Ph.D. (McMaster)
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)
Lecturer
R.H. Downer, B.Sc., M.Sc. (Queen's University, Belfast)

Undergraduate Course Descriptions

By special arrangement, courses labelled (*) may be taken in 2 sequential halves by students in co-operative programmes. Students registered for one or more of the courses 431, 433, 437, 438 and 441 (all marked with *) are expected to participate in an off-campus field course held in September preceding their final year.

All Honours Biology students who have completed their third year are expected to participate in an off-campus field course held in April.

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 the structure (anatomy) and function of animals with particular reference to mammals (and man).
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.
2 lectures, 3 hours laboratory
(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.)

231† Genetics and Evolution

The principles, methods and application of genetics. The basis and implications of the modern evolutionary theory. The modern approach and social implications will be discussed.

3 lectures.

(Primarily for students in the General programme and those from other departments.)

(Not available for students whose major field is Biology except as an extra course.)

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 110, 131 or 132.

2 lectures, 4 hours laboratory (20 laboratory periods)

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

Prerequisite: Biology 131 or 132.

2 lectures, 3 hours laboratory

b) Vascular Plants

Winter term

Prerequisite: Biology 131 or 132.

2 lectures, 3 hours laboratory

235† General Microbiology

Introduction to fundamental theories, principles and methods of general microbiology. Structure, systematics, growth and functions of microorganisms.

Prerequisite: Grade 13 Chemistry mandatory and Chemistry 101 or 121*-122* or 132 desirable.

2 lectures, 3 hours laboratory

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).

302 Vertebrate Physiology

A study of the basic physiological phenomena; integrative and vegetative systems of the body.

Prerequisites: Biology 131 or 132 or 201

2 lectures, 3 hours laboratory

(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 235
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 transfer, and environmental effects.
Prerequisites: Biology 131 or 132, Chemistry 236
2 lectures, 3 hours laboratory

431‡ Ecology
An analysis of the freshwater, farine 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, 3 hours laboratory

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-relationships; 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

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 334
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 study of digestion, metabolism, excretion, hormone action, circulation, muscle contraction, nerve conduction and the physiology of major organ systems in animals.
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 235
2 lectures, 3 hours laboratory

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:
Bacterial macromolecular synthesis, the transport mechanism
across the cellular membranes of 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. The ecology of peat bogs together with their palynology and the plant 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 fluviatile 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 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.

Ontogeny of bottom fauna and plankton of lakes.

Helminths of freshwater fishes.

Fauna and flora of Pleistocene ponds of the Toronto area.

Mineral nutrition of higher plants and mechanisms of seed dormancy.

Cytology and development of lower plants.

602 Fisheries Biology A lecture and seminar course dealing with the basic techniques of fisheries biology and reviewing the significant literature in the field.

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.

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.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>610</td>
<td>Evolution and Biosystematics</td>
<td>An advanced study of living organisms in relation to evolutionary processes and classification.</td>
</tr>
<tr>
<td>612</td>
<td>Advanced Animal Physiology 1</td>
<td>Critical discussion of selected topics in animal physiology.</td>
</tr>
<tr>
<td>613</td>
<td>Mycology</td>
<td>Critical discussion of selected mycological topics—taxonomy, ecology, plant pathology.</td>
</tr>
<tr>
<td>615*</td>
<td>Limnology for Engineers</td>
<td>A lecture, seminar and practical course providing a study of the aquatic environment with special reference to the effects of modern man. 1 term.</td>
</tr>
<tr>
<td>618</td>
<td>Advanced Microbial Physiology</td>
<td>Discussion of selected topics in microbial physiology.</td>
</tr>
<tr>
<td>620</td>
<td>Advanced Cytology</td>
<td>Selected approaches to the biochemical and structural organization of cells.</td>
</tr>
<tr>
<td>621</td>
<td>Advanced Animal Physiology 2</td>
<td>Critical discussion of selected topics in animal physiology.</td>
</tr>
<tr>
<td>622</td>
<td>Advanced Plant Physiology 2</td>
<td>Critical discussion of selected topics in plant physiology.</td>
</tr>
<tr>
<td>625</td>
<td>Limnology 2</td>
<td>An advanced discussion of selected topics in limnology. Prerequisite: Biology 605 or equivalent.</td>
</tr>
<tr>
<td>632</td>
<td>Statistical Procedures for Biologists</td>
<td>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.</td>
</tr>
<tr>
<td>667</td>
<td>Molecular Biology</td>
<td>A critical consideration of statistical techniques used in the design and analysis of biological experiments.</td>
</tr>
<tr>
<td>699</td>
<td>Thesis.</td>
<td></td>
</tr>
</tbody>
</table>
10 Chemical Process Principles 1
Units and dimensions. Stoichiometry—mass balances, simple energy balances, equilibrium. Free hand sketching and blue print reading, concepts of synthesis. Introductory chemical engineering laboratories including experiments in measurement.
2 lectures, 3 hours lab.—two terms.

12 Chemical Process Principles 2
Equilibrium between phases; the equilibrium stage concept. Cascades of stages with and without reflux; examples of their analysis when used to separate components by distillation, extraction, absorption and leaching. Small solids; their description in quantitative terms; separation by differences of size and density. Thickening.
3 lectures, 2 hours problems, alternative weeks.

16 Inorganic Chemistry
Introduction to the periodic classification and electronic structure of the elements.
Prerequisite: Chem. 2
3 lectures, 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.

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.

22 Transport Processes 2  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: G.E. 21.

3 lectures, one term.

23 Transport Processes 3  Diffusion and mass transfer by molecular and turbulent action. Interrelationship of momentum, energy and mass transport phenomena. The performance of apparatus for carrying out diffusional operations.

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.


Prerequisite: Chemical Engineering 31.

3 lectures, 2 hours problems, alternate weeks.

33 Chemical Engineering Thermodynamics  Technical thermodynamic processes; power plant cycles, refrigeration cycles, high pressure equilibria, analysis of flow processes.

Prerequisite: Chemical Engineering 31, 32.

3 lectures.


3 lectures, one term.

36 Physical-Chemical Laboratory  A laboratory to demonstrate physical chemical principles and techniques of physical measurement. Concurrently with Ch.E. 31.

3 lectures, one term.
41 Reaction Kinetics  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: Chemical Engineering 31.*
   3 lectures, one term.

42 Reactor Design 1  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: Chemical Engineering 41.*
   3 lectures, one term.

51 Process Dynamics and Control 1  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.

62 Process System Design  The undergraduate curriculum is co-ordinated and brought together to accomplish the basic objective of the process engineer, the design of an integrated chemical process.
   *Prerequisites: All Chemical Engineering required courses.*
   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. 13, 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: Chem. Eng. 51.*
   4 hours laboratory every week, 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.
81 Physical Chemistry of Polymers  
Polymer solutions, molecular characterization of polymers, molecular weight distributions, morphology and crystallinity in polymers, reaction kinetics and mechanisms of addition and condensation polymerization, polymer structure and physical properties.  
Prerequisite: Ch.E. 80.

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. Basic principles of pyrometallurgy, electrolymetallurgy 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 and includes a discussion of the chemical nature of ores, as well as important intermediates. Emphasis is on the application of theory to practice.  
3 lectures, one term.

86 Metallurgical Chemistry  
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 stags, slag metal reactions; converting, refining and fused 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  
3 hours, one term.

99 Research and Design Project 2  
Prerequisite: Ch. E. 98.  
6 hours, one term.

535 Estimation of Properties of Gases and Liquids  
The activities of the chemical or process engineer have often been referred to as “molecular engineering”. One of his basic needs is reliable quantitative data on the physical, chemical and thermodynamic properties of pure substances and mixtures. This course is intended to familiarize the student with the most up-to-date methods available for the estimation of certain of the more important 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 2 Kinetics of heterogeneous and catalytic recreations; design and sale up of heterogeneous reactors.
Prerequisite: Ch. E. 42.
3 lectures, one term.

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 More rigorous treatment of vector and matrix algebra, integral transform techniques for solution of equations describing physical systems, applications to chemical processes.
Prerequisite: Permission of Instructor.
3 lectures, one term.

590 Introduction to Biochemical Engineering Aspects of microbiology and biochemistry of interest to the fermentation and food industries. Classification and growth characteristics of micro-organisms. Physico-chemical properties of biological compounds. Metabolism and biochemical kinetics.
Prerequisite: Ch. E. 36.
3 hours lectures and laboratory, one term.

591 Fermentation Engineering Methods of solving processing problems imposed by both physical and biological factors in the food industries. A fundamental approach to manufacturing and preservation methods: blending, extrusion, emulsification, heating, dehydration, irradiation, refrigeration, etc. Biological waste treatment.
Prerequisite: Ch. E. 22.
3 hours lectures and laboratory, one term.

592 Food Process Engineering Methods of solving processing problems imposed by both physical and biological factors in the food industries. A fundamental approach to manufacturing and preservation methods: blending, extrusion, emulsification, heating, dehydration, irradiation, refrigeration, etc.
Prerequisite: Ch. E. 22.
3 hours lectures and laboratory, one term.

Graduate Course Descriptions

The Department of Chemical Engineering offers courses of study leading to the degree of Master of Applied Science and Doctor of Philosophy. The Master of Applied Science programme may be followed in either one of two directions: a “professional” option, which requires course work and an engineering report; and a “research” option, which requires less course work, and the completion of a research project. 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 hours/week of other work is also being done, a student may be required to carry fewer units.

Either option in the M.A.Sc. programme may also be carried out on a part-time of full-time 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, four units of which must be Ch.C. 600, 642, 650 and 672. 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 one of the courses ChE. 600, 642, 650 and 672, selected on the basis of his major research interest.

The Ph.D. Programme

The Ph.D. degree is awarded primarily for the successful performance 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 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 control 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, condensing vapour heat transfer, microwave heating, frequency response methods, diffusion studies, etc.

5 Polymer Science
Diffusion through modified membranes, radiation graft polymerization, emulsion polymerization, stress relationships in elastomers, physical properties of polymers, etc.

6 Extractive Metallurgy
Hydrometallurgical processes, solid state reactions, mineral beneficiation, powder and solids handling technology, pelletization, reactivity of solids.

Details of Graduate Courses
All courses are one term and except for those listed under "Special Topics" are normally given every year.

600 Theory and Application of Transport Phenomena
Evaluation of molecular transport properties, equations of mass heat and momentum transport, boundary layer and turbulence theory, application to analysis of flow systems, heat transfer equipment, and mass transfer operations.
3 lectures, one term. Fall.

602 Processing and Properties of Solids
Particle and pore size analysis, conveying of solids in fluids, heat and mass transfer in beds of solids, behaviour of dense beds of fine solids.
3 lectures, one term. Winter.

624 Liquid-fluid Transfer Processes
An advanced survey of gas-liquid and liquid-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, transfer processes in two-phase tube flow, packed column behaviour, mass and heat transfer during mixing, boiling and condensation phenomena.
3 lectures, one term. Summer.

634 Statistical Theory of Matter
Introduction to statistical methods, statistical description of systems of particles, statistical thermodynamics, techniques and results of statistical mechanics with application, kinetic theory of transport, irreversible processes.
3 lectures, one term. Fall.

635 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. Winter.
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. Winter.

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. Fall.

650 Process Optimization  
3 lectures, one term. Winter.

672 Advanced Mathematics in Chemical Engineering  
Review of fundamental concepts and methods of mathematical analysis with applications in Chemical Engineering. Topics covered 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. The emphasis will be placed on the general usefulness of the methods in a wide variety of research and design problems.  
Prerequisite: Permission of Instructor.  
3 lectures, one term. Fall.

673 Advanced Mathematics in Engineering Research  
Generalizes and extends the techniques of Ch.E. 672 to more general (Banach) spaces with applications to problems in process analysis and control theory.  
Prerequisite: Ch. E. 672.  
3 lectures, one term. Winter.

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 homobeneous and heterogeneous systems, chemical reactions of polymers. Theory and experimental methods for the molecular characterization of polymers.  
3 lectures, one term. Fall.

681 Polymer Synthesis and Characterization  
Prerequisite: Ch. E. 680.  
3 lectures, one term. Summer.

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 the kinetic
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. Summer.

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.
3 lectures, one term. Fall.

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. Winter.

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. Summer.

689 Topics in Solvent Extraction and Ion Exchange
The physico-chemical principles of the extraction of metals from aqueous solutions by liquid organics and by solid ion exchangers.
3 lectures, one term. Winter.

690 Biochemical Engineering Operations 1
3 lectures, one term. Fall.

691 Biochemical Engineering Operations 2
3 lectures, one term. Winter.

Special Topics (Given only when justified by demand)

Group A—(Topics in Transport Theory)

705. Particle-Fluid Dynamics
707. Non-Newtonian Flow and Heat Transfer
715. Radiant Heat Transfer
724. Use of Transient and Frequency Response to measure Physical Quantities
725. Gas-Liquid Mass Transfer Processes
726. Dissolution and Crystallization

Group B—(Topics in Thermodynamics and Chemical Kinetics)
Department of Chemical Engineering

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. Residence Time Distributions, Reactor Flow Models and Reactor Stability
749. Flow Through Porous Media

Group C—(Topics in Control Theory and Applied Mathematics)
754. Mathematical Modelling of Chemical Processes
755. Analysis of Non-linear Processes
756. Control of Complex Processes
757. Optimization Problems in Chemical Processes
765. Basic Statistics in Engineering
766. Topics in Advanced Process Control
767. Special Topics in Analysis of Processes
768. Advanced Statistics in Engineering

801. Oral Examination of the Thesis for the Ph.D.
802. Research Proposal for Ph.D.
803. Comprehensive Examination
804. Russian or German language proficiency for Ph.D.
805. Graduate Seminar. Every M.A.Sc. and Ph.D. candidate is expected to present a seminar on his research work before submission of a thesis.
807. Engineering Report. Every professional student is expected to complete the solution of, and prepare a report on, a major problem in process design or evaluation. Problems may be suggested by the student or by the staff.

808. Research Thesis for M.A.Sc. Degree
809. Research Thesis for Ph.D. Degree
Department of Chemistry

Professor and Chairman of Department
L.W. Reeves, B.Sc., Ph.D., D.Sc. (Bristol)

Adjunct Professor
R.H.F. Manske, M.Sc. (Queen's), Ph.D., D.Sc. (Manchester), D.Sc. (McMaster), F.R.S.C.

Professor
H.G. McLeod, M.A., Ph.D. (Toronto)

Professor
W.A.E. McElyde, M.A., (Toronto), Ph.D. (Virginia)

Professor (Chemistry and Physics and Dean of the Faculty of Science)
W.B. Pearson, M.A., D.Sc. (Oxon), D.F.C., F.R.C.S.

Professor
A. Rudin, B.Sc. (Alberta), Ph.D. (Northwestern)

Professor
H.D. Sharma, M.Sc. (Delhi), Ph.D. (California)

Professor
T. Viswanatha, M.Sc., (Ph.D. (Mysore)

Professor and Associate Dean of the Faculty of Science
R.G. Woolford, M.Sc. (Western), Ph.D. (Illinois)

Associate Professor
G.F. Atkinson, M.A., Ph.D. (Toronto)

Associate Professor
D.A. Brisbin (Mrs.), B.Sc. (Alberta), Ph.D. (Toronto)

Associate Professor
J.B. Capindale, M.A., D.Phil. (Oxford)

Associate Professor
A.J. Carty, B.Sc., Ph.D. (Nottingham)

Associate Professor
W.L. Elsdon, M.Sc. (Western), Ph.D. (McGill)

Associate Professor
R.M. Guest, M.A. (Western), Ph.D. (McGill)

Associate Professor
D.E. Irish, B.Sc. (Western), M.Sc. (McMaster), Ph.D. (Chicago)

Associate Professor
F.W. Karasek, B.S. (Elmhurst), Ph.D. (Oregon State)

Associate Professor
J.L. Koppel, B.A., Ph.D. (Toronto)

Associate Professor
D. Mackay, B.Sc., Ph.D. (Aberdeen)

Associate Professor
A.D. Maynes, M.A., Ph.D. (Toronto)

Associate Professor
J.B. Moffat, B.A., Ph.D. (Toronto)

Associate Professor
G.J. Palenik, B.Sc. (Illinois), Ph.D. (Southern California)

Associate Professor
J.G. Smith, B.A., M.A., Ph.D. (Toronto)

Assistant Professor
A. Balasubramanian, M.Sc. (Madras), Ph.D. (Indian Institute of Science)

Assistant Professor
L.J. Brubacher, B.A. (Goshen College, Indiana), PhD. (Northwestern)

Assistant Professor
B. Budesinsky, B.Sc. (Prague), Ph.D. (Pardubice)

Assistant Professor
B.O. Fraser-Reid, M.Sc. (Queen's), Ph.D. (Alberta)

Assistant Professor
R.J. Friesen, M.Sc. (Manitoba)

Assistant Professor
T.E. Gough, B.Sc., Ph.D. (Leicester)

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)

Teaching Post-doctoral Fellow
K.N. Shaw, B.Sc. (Wellington, N.Z.), Ph.D. (British Columbia)

Instructor
W.J. Byars, H.N.C. (Dundee Technical College)

Instructor
W.A. Cameron, H.N.C. (Hendon Technical College)

Instructor
M.C. Michael (Miss), B.Sc. (Waterloo)

Instructor
G. Tomlinson, G.R.I.C. (North Staffordshire College of Technology)

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 137.

Prerequisites for course are a reliable guide to the background necessary for the course. In lieu of the specific courses listed, an equivalent background from Waterloo or elsewhere is acceptable. With consent of the instructor, prerequisites may be waived in exceptional cases.
11 General Chemistry
3 lectures, 3 hours laboratory alternate weeks, two terms.

16 Introductory Organic Chemistry
An introduction to organic chemistry for Physical Education students.
3 lectures, one term.

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.

31 Elementary Chemical Spectroscopy
3 lectures, one term.

36 Organic Chemistry 2
An introduction to the important classes of hetercyclic 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.

37 Biochemistry
Carbohydrates, lipids, proteins, hormones, nucleic acids, and vitamins. Metabolism of these groups of compounds. Physico-chemical aspects of biochemistry. Prerequisite: Chemistry 16 or 36.
3 lectures, one term.

41 Nuclear and Radiochemistry
3 lectures, one term.

101 General Chemistry
An elementary study of the states of matter, changes of state and the solution laws; stoichiometry; chemical kinetics; chemical equilibria; the chemical bond. Prerequisite: Grade 13 Chemistry, Math A.
2 lectures, 1 tutorial, 3 hours laboratory for two terms. For Co-operative Science and Mathematics students.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>121*</td>
<td>Chemical Structure</td>
<td>An introduction to atomic structure and bonding, stoichiometry. Suggested for Regular Science students who do not have the prerequisites necessary for Chemistry 132, or for Regular Mathematics students interested in a Science minor. Prerequisite: Grade 13 Chemistry, Math A. 3 lectures, 3 hours laboratory (tutorials will be incorporated into the laboratory), fall term.</td>
</tr>
<tr>
<td>122*</td>
<td>Chemical Reaction</td>
<td>Equilibria, energetics and mechanisms of reactions. Suggested for Regular Science students who do not have the prerequisites necessary for Chemistry 132, or for Regular Mathematics students interested in a Science minor. Prerequisite: Chemistry 121*. 3 lectures, 3 hours laboratory (tutorials will be incorporated into the laboratory), winter term.</td>
</tr>
<tr>
<td>132</td>
<td>Chemical Structure and Reaction</td>
<td>An introduction to atomic and molecular structure, equilibria, energetics and mechanisms of reaction. Suggested for students interested in pursuing an Honours Science Program. Prerequisites: 75% or better standing in both Grade 13 Chemistry and Math A; Math B desirable. 3 lectures, 3 hours laboratory for both fall and winter terms (tutorials will be incorporated into the laboratory).</td>
</tr>
<tr>
<td>200*</td>
<td>Radiochemistry</td>
<td>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 101 or 121*-122* or 132. 2 lectures, 3 hours laboratory, one term.</td>
</tr>
<tr>
<td>201*</td>
<td>Introductory Inorganic Chemistry</td>
<td>Descriptive chemistry of the elements and their compounds based on the periodic table with special reference to metallurgical and other industrial processes. The laboratory will illustrate various methods of preparation of metals, non-metals and their compounds. Prerequisite: Chemistry 101 or 121*-122* or 132. 3 lectures, 3 hours laboratory, one term.</td>
</tr>
<tr>
<td>202*</td>
<td>Analytical Chemistry</td>
<td>Theory and practice of analytical chemistry stressing wet methods in common use today. Treatment of analytical data to obtain meaningful information. Prerequisite: Chemistry 101 or 121*-122* or 132. 3 lectures, 8 hours laboratory, one term.</td>
</tr>
<tr>
<td>205*</td>
<td>Introductory Physical Chemistry</td>
<td>Introduction to transport processes and reversible thermodynamics; reaction kinetics and phase equilibria. Thermodynamics of ideal gases. Diffusion, thermal conductivity and viscosity. Rates of simple reactions. Liquid-vapour equilibria. Prerequisites: Chemistry 101 or 121*-122* or 132; and Mathematics 130. 3 lectures, 3 hours laboratory, one term.</td>
</tr>
</tbody>
</table>
206* Introductory Organic Chemistry

Basic chemistry and structure of the important classes of aliphatic and aromatic compounds.

Prerequisite: Chemistry 101 or 121*-122* or 132.

3 lectures, 3 hours laboratory, one term.

209* Technical Literature

Searching the chemical literature; use of libraries; abstracts and trade literature; chemical patents; technical report writing; technical business letters; special topic assignments.

2 hours lectures, one term.

216* 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.

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.

231 Chemical Bonding and Structure

Classical and wave theories of the electronic structure of atoms developed and applied to the rationalisation of the periodic table and the problems of chemical bonding. The formation and properties of the covalent bond; bonding in ionic and metallic solids; methods for the establishment of the shapes of molecules.

Prerequisite: Chemistry 101 or 121*-122* or 132.

2 lectures, 3 hours laboratory. (Laboratories to be taken only by Honours Chemistry students.)

232 Analytical Chemistry

Theory and practice of quantitative inorganic analysis. Representative classical and instrumental techniques will be carried out and studied with relation to the chemical phenomena which makes them possible and to the general principles which they exemplify. A knowledge of ionic equilibria will be assumed and extended.

Prerequisite: Chemistry 101 or 121*-122* or 132.

2 lectures, 6 hours laboratory.

235 Physical Chemistry 1

A study of the thermodynamics of ideal systems, the chemical kinetics of simple systems, and a short introduction to the phase rule.

Prerequisites: Chemistry 101 or 121*-122* or 132; and Mathematics 130.

2 lectures, 1 hour problems.

236 Organic Chemistry 1

The properties, preparations, reactions, and basic structural theory of the common classes of aliphatic and aromatic compounds. A laboratory course on preparative organic chemistry accompanies the lectures.

Prerequisite: Chemistry 101 or 121*-122* or 132.

2 lectures, 3 hours laboratory.

241 Principles and Application of Chemical Bonding

Classical and wave theories of the electronic structure of atoms developed and applied to the rationalisation of the periodic table and the problems of chemical bonding. Application to the systematic chemistry of the non-transition elements.

Prerequisite: Chemistry 101 or 121*-122* or 132.

2 lectures, 1 hour problems.
242 Chemical Analysis  The determination of inorganic chemical species by volumetric, gravimetric and selected instrumental procedures. The role of analysis as a service function will be stressed.  
*Prerequisite: Chemistry 101 or 121*-122* or 132.  
2 lectures, 6 hours laboratory.

301* 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*.  
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*.  
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 polymerization; states of aggregation of polymers; isomerism in polymeric structures; free radical chain-growth polymerization and copolymerization; ionic polymerization.  
*Prerequisites: Chemistry 205*, 206 or equivalent.  
3 lectures, 3 hours laboratory, one term.

*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*.  
3 lectures, 3 hours laboratory, one term.

307* Introductory Biochemistry  Carbohydrates; proteins; nucleic acids; lipids; metabolism of these compounds.  
*Prerequisite: Chemistry 206.  
3 lectures, 3 hours laboratory, one term.

308* Instrumental Measurements 1  Introduction to the use of instruments to obtain accurate measurements of physical and chemical properties of materials.  
*Prerequisites: Chemistry 202*, 205*.  
1 lecture, 3 hours laboratory, one term.

318* Instrumental Measurements 2  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, thermo-
dynamics, electrochemistry, kinetics, molecular structure, surface phenomena, phase equilibria and macromolecules. A knowledge of calculus is assumed.

Prerequisites: Chemistry 101 or 121*-122* or 132; and Mathematics 130.
2 lectures, 3 hours laboratory.

331 Inorganic Chemistry 1
Systematic inorganic chemistry of the non-transition elements based on the principles established in Chemistry 231; introduction to nuclear-and radiochemistry. 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. Electrochemistry and the thermodynamics of electrolytic solutions.

Prerequisites: Chemistry 235 or 325; and Mathematics 236 or 31*.
2 lectures; for General students, 3 hours laboratory.

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.
2 lectures, 3 hours laboratory.

337 Biochemistry 1
Carbohydrates, lipids, proteins, hormones, nucleic-acids, and vitamins. Metabolism of these groups of compounds. Physico-chemical 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).

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 solutions; electrode potentials: the measurement of pH; metallic corrosion.

Prerequisite: Chemistry 305*.
3 lectures, 3 hours laboratory alternate weeks, one term.

403* Physical Chemistry of Polymers
Polymerization reactions; effects of monomer structure, stereo-regularity; polymer solutions; degradation and stabilization of polymers; network polymers and polymerization reactions; polymer elasticity.
Prerequisites: 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 materials.  
Prerequisite: Chemistry 307*.  
3 lectures, 3 hours laboratory, one term.

408* Instrumentation 1  
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.

425* Chemical Kinetics, Theory and Practice  
Prerequisite: Chemistry 305*.  
2 lectures, one term.
429 A 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, magnetoochemistry; interpretation of electronic spectra. Organometallic chemistry; chemistry of metal carbonyls, and related compounds. Prerequisite: Chemistry 331. 2 lectures.

435 Physical Chemistry 3

Introduction to quantum chemistry and statistical thermodynamics. Applications to kinetics, surface chemistry, and spectroscopy. 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: Chemistry 236; 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

Department of Chemistry
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; continuous analysis by spectrophotometric or electroanalytical techniques; complex ion systems useful in analysis; application of physical methods e.g., ion exchange, solvent extraction, 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; structure determination by X-ray diffraction methods; solutions of metals in molten salts and other non-aqueous media; 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 general and especially the synthesis and decomposition of peroxy and azo-compounds; studies on heterocyclic compounds; synthesis of natural products (especially alkaloids) and N-heteroaromatic substances; spectroscopic studies (using infrared, ultraviolet, e.s.r. and n.m.r. techniques) of molecular conformation and hydrogen bonding; synthesis and characterization of film-forming polymers; photochemistry; carbohydrate chemistry.

**Biochemistry** Effects of radiation on proteins and amino acids as studied by electron spin resonance and other techniques; synthetic and degradative studies on enzymes, peptides and proteins; nature of materials excreted by algae.

**Physical Chemistry** Studies in molten salt chemistry, especially mass transport phenomena; kinetics of polymer reactions; experimental and theoretical studies of surfaces, surface reactions and catalysis; quantum chemical calculations, methods and the physical nature of the chemical bond; electrochemistry and especially 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.


Details regarding these programmes and the faculty members engaged in them are to be found in a booklet prepared by the Chemistry Department. 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

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.

625* 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.

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 Hückel method. Ligand field theory. Application to complex inorganic and organometallic molecules. Prerequisite: Chemistry 640* or its equivalent.
<table>
<thead>
<tr>
<th>Course Code</th>
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</thead>
<tbody>
<tr>
<td>642</td>
<td>Chemical Instrumentation</td>
<td>Instrument components and optimum application; rudiments of design; electrical, spectral, migrational and other methods.</td>
</tr>
<tr>
<td>645*</td>
<td>Molecular Quantum Mechanics</td>
<td>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.</td>
</tr>
<tr>
<td>647*</td>
<td>Regulatory Mechanisms in Biological Systems</td>
<td>Induction, repression and feedback. Inhibition of enzymes; allosteric proteins; regulation of RNA synthesis; chemistry and function of antibiotics.</td>
</tr>
<tr>
<td>651*</td>
<td>Physical Methods in Inorganic Chemistry</td>
<td>Optical, nuclear magnetic resonance, moussbauer, nuclear quadrupole and mass spectroscopy and their uses in inorganic chemistry.</td>
</tr>
<tr>
<td>655*</td>
<td>Chemical Kinetics</td>
<td>Statistical methods applied to the kinetic molecular theory and to the treatment of interacting systems. The kinetics of homogenous reactions in gases with emphasis on unimolecular reactions, and of reactions in condensed phases.</td>
</tr>
<tr>
<td>656*</td>
<td>Synthetic Methods of Organic Chemistry</td>
<td>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.</td>
</tr>
<tr>
<td>657*</td>
<td>Topics in Physical Biochemistry</td>
<td>Thermodynamics of biological systems; ultracentrifugation; kinetics of enzyme catalyzed reactions; optical rotatory dispersion, etc.</td>
</tr>
<tr>
<td>661*</td>
<td>Synthetic Methods in Inorganic Chemistry</td>
<td>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.</td>
</tr>
<tr>
<td>662*</td>
<td>Colloquia on Current Topics in Analytical Chemistry</td>
<td>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.</td>
</tr>
<tr>
<td>666*</td>
<td>Organic Spectroscopy</td>
<td>Introduction to ultraviolet, infrared, and resonance spectroscopy, with emphasis on applications to studies of organic molecules.</td>
</tr>
</tbody>
</table>
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
The definition and properties of a surface. Methods for measuring such properties, their significance, and theoretical interpretation. Chemisorption and physical adsorption and their relationship to catalysis. Properties and use of catalysts. (This is a course which could be taken by non-physical chemists.)

691* 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.

695* Semi-empirical methods in Quantum Chemistry
The simple Hückel method, and self-consistent charge method. Pariser-Parr-Pople method. Extended Hückel method and modification for self-consistency. CNDO method. Ligand and crystal field methods. Critical analysis of approximations, assumptions, and errors introduced by such methods. Applications to inorganic and organic molecules. (This is a course which could be taken by non-physical chemists.)

699 Thesis.

705* Electrolyte Theory
Equilibrium and transport properties of electrolytes and their interpretation in terms of current theory.

785* Theoretical Physical Chemistry of Surfaces and Catalysts
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.
Department of Civil Engineering

Professor W.A. McLaughlin, B.Eng. (Saskatchewan), M.S., Ph.D. (Purdue)

Chairman of the Department


Professor M.Z. Cohn, C.Sc. (Bucharest).

Professor W.R. Drynan, B.A.Sc. (Toronto), M.Sc., Ph.D. (Texas).


Professor V.K. Handa, B.Sc. (Calcutta), B.Sc. (Eng.) (London), M.Sc. (Queen’s), M.A.Sc., Ph.D. (Waterloo).

Design and Civil Engineering

Professor B.G. Hutchinson, B.E. (Sydney), M.Sc. (Queen’s), Ph.D. (Waterloo).

Professor H.H.E. Leipholz, Dipl. Eng., Dr. Ing., Docent Habil, (Stuttgart).


Professor J.T. Pindera, Dr. of Tech. Sciences (Warsaw), Docent Habil, (Cracow).

Professor H.B. Poorooshab, B.Sc. (Manchester), Ph.D. (Cambridge),
(on leave of absence).

Professor T. Prasad, B.Sc., M.Sc. (Banaras Hindu Univ.), Ph.D. (Cambridge)

Dean of Engineering

Professor A.N. Sherbourne, B.Sc. (London), M.S. (Lehigh), M.A., Ph.D.

Professor T.H. Topper, B.A.Sc. (Toronto), Ph.D. (Cambridge).

Associate Chairman of the Department

Professor D.T. Wright, B.A.Sc. (Toronto), M.S. (Illinois), Ph.D. (Cambridge), (on leave of absence).

Associate Professor R. Green, B.Sc. (Eng.) (London), M.Sc. (Queen’s), M.Sc. (Waterloo), Ph.D. (Texas).

Associate Professor R.C.G. Haas, B.Sc., M.Sc. (Alberta), Ph.D. (Waterloo).

Associate Professor H.M. Hill, B.A.Sc., M.Sc. (Saskatchewan), D.Phil. (Oxford).

Associate Professor B. LeLievre, B.Eng. (West Australia), M.A.Sc., Ph.D. (Waterloo).

Associate Professor W.C. Lennox, B.A.Sc., M.Sc. (Waterloo), Ph.D. (Lehigh).

Associate Professor E.L. Matyas, B.A.Sc. (Toronto), D.I.C., Ph.D. (London),
(on leave of absence).

Associate Professor J. Roorda, B.A.Sc. (Waterloo), Ph.D. (London).

Associate Professor J. Schroeder, B.Eng., M.Eng. (McMaster), Ph.D. (Waterloo).

Associate Professor J. Shortreed, B.Eng., Sc. (Western), M.Sc. (Queen’s), Ph.D. (Northwestern).

Associate Professor T.E. Unny, B.E. (Madras), M.Tech. (Kharagpur), Dr. Ing. (Dresden).

Assistant Professor E.F.P. Burnett, B.Sc. (Cape Town), D.I.C., M.S. (London), Ph.D. (London)

Assistant Professor G.M. Cornwall, B.A.Sc. (Toronto), M.Sc. (Northwestern)

Assistant Professor G.J. Farquhar, B.A.Sc., M.A.Sc. (Waterloo), Ph.D. (Wisconsin)

Assistant Professor D.E. Grierson, B.A.Sc., M.A.Sc., Ph.D. (Waterloo)

Assistant Professor I. Holubec, B.A.Sc., M.A.Sc. (Toronto), Ph.D. (Waterloo)

Assistant Professor N. Kouwen, B.A.Sc., M.A.Sc. (Waterloo)

Assistant Professor G.M. McNeice, B.A.Sc. (Waterloo), Ph.D. (London)

Assistant Professor V.S. Srinivasan, B.E. (Mysore), M.Sc. (Madras), Ph.D. (Waterloo)

Assistant Professor O.L. White, B.Sc. (Melbourne), M.A.Sc. (Toronto), Ph.D. (Illinois)

Research Assistant Professor C.V.B. Gowda, B.E. (Mysore), M.E. (I.I.Sc.), Ph.D. (Waterloo)

Research Assistant Professor P.W. Kneen, B.E. (Melbourne), Ph.D. (Waterloo)

Research Assistant Professor S.G. Krishnasamy, B.E. (Madras), M.Sc. (Bangalore), Ph.D. (Waterloo)

Research Assistant Professor J.C. Thompson, B.A.Sc. (Toronto), M.S., Ph.D. (Illinois)

Research Assistant Professor D.S. Weaver, B.A.Sc., M.A.Sc. (Toronto), Ph.D. (Waterloo)

Special Lecturer J.E. Leisch, B.E. (John Hopkins)
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 superposition, 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.


<table>
<thead>
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<tr>
<td>321 Statistics</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>322 Engineering Analysis</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>350 Fluid Mechanics</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>361 Urban Planning</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>371 Geology for Engineers</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>400 Systems 3 (Project)</td>
<td>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</td>
<td></td>
</tr>
</tbody>
</table>
Department of Civil Engineering

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.

**403 Reinforced Concrete 2**

**404 Design of Steel Structures**

**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.

**452 Environmental Health Engineering**

**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.

**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.

**498, 499 Seminar**

**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

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 PLI. 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


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.

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.

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 concentrate on practical approaches to the solution of waste treatment problems not amenable to classical design procedures. Topics for discussion include: waste characterization, water reuse, and other inplant procedures, chemical and biological treatment, sludge handling and laboratory procedures.

**Prerequisite:** CE 451.

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 Mechanics 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 courses are available for graduate study in other fields of engineering, mathematics, computer programming, urban and regional planning, economics, geography, hydrology, chemistry, sociology, operations research, earth sciences and biology.

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 and dynamics, large deflections of membranes, elastic and inelastic continua, structural response to random excitation hydroelasticity analysis and design of reinforced and prestressed concrete structures, structural optimization, computer aided design of structures, strength and safety of structures, analysis of latticed space structures, strength of pressure vessels, plastic behaviour of shells, mechanisms of fatigue failure in materials, long-wave photoelasticity techniques in fatigue and flow problems, and nonlinear stochastic processes.

**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 of 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


601 Theory of Plates and Shells 1


602 Theory of Inelastic Structures 1


603 Theory of Inelastic Structures 2


604 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

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
Role of stress analysis in engineering; methods of experimental stress analysis; deformation, stress and strain in solid bodies; viscoelastic behaviour; creep indicator; theory and design of polariscopes, response of photoelastic systems; major photo-elastic measuring techniques; engineering applications.

632 Physical Basis of Mechanical Model Studies
Department of Civil Engineering

experiments. Creep indicators. Typical transfer functions. Examples of typical model studies of engineering problems.

641 Civil Engineering Systems 1

642 Civil Engineering Systems 2

643 Urban Transportation Planning 1

644 Urban Transportation Planning 2

651 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.

658 Soil Engineering (Case Histories)
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.

660 Fracture Behaviour of Materials

671 Physical Processes of Sanitarly Engineering 1
Principles of mixing, aeration and gas transfer, solid-liquid separation, sludge handling, flow through porous media, flocculation.

672 Biological Waste Treatment
Principles and design of biological processes including activated sludge, trickling filters, stabilization ponds and sludge digestion.

673 Sanitary Chemistry

674 Physical Processes of Sanitary Engineering 2
Design applications of principles presented in CE 671. An integration of unit processes and operations into a composite design.
### Department of Civil Engineering

**685 Operational Techniques in Water Resources Design**
Operational hydrology, sensitivity analysis, stream assimilation functions.

**686 Engineering Hydrology**

**687 Hydraulic Structures**

**688 Sediment Transport**

**689 Open Channel Hydraulics**

### Course Codes
- 701 Advanced Topics in the Theory & Design of Structures
- 702 Structural Synthesis and Case Histories
- 703 Theory of Plates & 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 Linear and Nonlinear Pollution Control
Advanced Topics in Hydraulics and Hydroelasticity
Fluid Elasticity
Hydraulic Transients
Evaluation of Water Resources Alternatives
Advanced Topics in Water Resource Systems
Oari examination of the Thesis for the Ph.D. degree
Comprehensive examination (as determined by the Department)
Language requirement for the Ph.D. degree (as determined by the department)
Engineering Project
Research thesis for the M.A.Sc. degree
Research thesis for the Ph.D. degree

Engineering Graphics Laboratory
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 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. McKegney, 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. Binamé, Lic. en Phil. rom., Agrégé (Brussels)
Associate Professor E. Grey, B.A. (Texas Western), M.A. (Colorado), Ph.D. (Harvard)
Associate Professor P. Keresztes, M.A. (Toronto), Ph.D. (Graz)
Associate Professor J Z.T. Ralston, C.R., B.A. (Western), M.A. (Laval)
Ph.D. (Catholic U. of America)
Assistant Professor J.R. Dugan, B.A., M.A. (Toronto), Ph.D. (Yale)
Assistant Professor J. Dumont, Licence-ès-Lettres (Neuchâtel)
Assistant Professor J E. Evans, Laurea in pedagogia (Padua)
Assistant Professor C.M. Fernandez (Mrs.), Lic. en Arq. (Madrid), M.A. (Tulane)
Assistant Professor J. Lafrance (Miss), B.Paed., M.A. (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)
Lecturer P. Forsyth (Mrs.), A.B. (Mount Holyoke), M.A. (Toronto)
Lecturer H.S. Fournier, (Mrs.), B.A. (Toronto), M.A. (Western)
Lecturer R.J. Fournier, B.A., M.A. (Western)
Lecturer P.J. Gold, B.A. (Oxford)
Lecturer S. Haag (Mrs.), B.A., M.A. (Queen's), M.Phil. (Toronto)
Lecturer (part-time) R C.C. Abbott (Mrs.), B.A., M.A. (Ohio State)
Lecturer (part-time) M. Gold (Mrs.), B.A. (Oxford)
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 1970 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)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>251*</td>
<td>Near Eastern and Greek History</td>
<td>A survey of the civilizations of the Near East and of Greece, emphasizing their political, military, social and economic aspects. <em>Three lectures. Fall term.</em></td>
</tr>
<tr>
<td>252*</td>
<td>Roman History</td>
<td>A military, political, social, economic survey of Rome from earliest times to the Empire's fall. <em>Three lectures. Winter term.</em></td>
</tr>
<tr>
<td>255*</td>
<td>Mediaeval Civilization</td>
<td>Study of mediaeval literature, art, architecture, music and other expressive forms. The periods from late antiquity to the High Middle Ages will be studied. <em>Three lectures. Fall term.</em></td>
</tr>
<tr>
<td>256*</td>
<td>Mediaeval Civilization</td>
<td>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. <em>Three lectures. Winter term.</em></td>
</tr>
<tr>
<td>265*</td>
<td>Classical Literature in Translation 1</td>
<td>Greek and Roman Epic and Tragedy. <em>Fall term.</em></td>
</tr>
<tr>
<td>350</td>
<td>Classical Art and Archaeology</td>
<td>A survey of art and architecture from the Aegean age through the Roman Empire. <em>Three lectures. Year course.</em></td>
</tr>
<tr>
<td>365*</td>
<td>Problems in Greek History 1</td>
<td>A detailed study of a selection of problems in Greek History. <em>Prerequisite, Class. Civ. 251. Fall term.</em></td>
</tr>
<tr>
<td>371*</td>
<td>Myth and Religion</td>
<td>Deities, myths and sagas correlated with literature, religion and philosophy from the 6th century B.C. to the 4th century A.D. <em>Three lectures. Fall term.</em></td>
</tr>
<tr>
<td>372*</td>
<td>Christianity and the Roman Empire</td>
<td>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. <em>Three lectures. Winter term.</em></td>
</tr>
<tr>
<td>375*</td>
<td>Problems in Roman History 1</td>
<td>A detailed study of a selection of problems in Roman History. <em>Prerequisite, Class. Civ. 252. Fall term.</em></td>
</tr>
<tr>
<td>376*</td>
<td>Problems in Roman History 2</td>
<td>A detailed study of a selection of problems in Roman History. <em>Prerequisite, Class. Civ. 252. Winter Term.</em></td>
</tr>
<tr>
<td>495</td>
<td>Mediaeval Civilization</td>
<td>Senior Essay. <em>Fall term.</em></td>
</tr>
</tbody>
</table>
Greek

100 Introductory Greek *Four lectures. Year course.*

190 Epic and Philosophy (to Plato). Homer *Iliad*, I, VI, IX; Plato, *Apology* and *Crito*; prose composition and sight translation. 
*Prerequisite: Grade 13 Greek, Greek 100 or permission.* 
*Four lectures. Year course.*

265* History and Historicography 
Selections from Herodotus. 
*Fall term. Not offered 1970-71.*

266* Lyric and Elegiac Poetry 
Selections from Lyric and Elegiac Poets. 

365* History and Historicography 
Selections from Thucydides. 
*Fall term. Not offered in 1970-71.*

366* Tragedy 
Euripides, *Medea* and other selections. 

375* Drama 1 
Selections from Aeschylus. 
*Fall term.*

376* Drama 2 
Selections from Sophocles and Aristophanes. 
*Winter term.*

*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 or Latin 100 or 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 Historicography 
Livy, 21, 22; *Res Gestae*. 
*Fall term. Not offered in 1970-71.*

366* Cicero 
*Pro Caelio, Pro Marcello, Caesar, De Bello Civili.* 
*Winter term.*
375* Lyric Poetry  Selections from Horace’s Odes.  

376* Elegiac Poetry  Selections from Tibullus, Propertius and Ovid.  

385* Silver Age 1  Seneca, Medea, selections from the Letters; Petronius, and Cena Trimalchionis.  

386* Silver Age 2  Apuleius, Apologia, selections from the Metamorphoses.  

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).  
Fall term.

466* Satire  Horace, Satires, (selections); Juvenal, Satires (selections).  
Winter term.

475* Comedy  Plautus, Rudens; Terence, Phormio.  
Fall term.

476* Historiography and Literary Criticism  Tacitus. Annals 11-16 (selections); Quintilian 10.  
Winter term.

485* Historical Monograph 1  Sallust, Catiline; Seneca, Apocolocyntosis.  

486* Historical Monograph 2  Tacitus, Agricola; Suetonius, Caligula.  

490 Senior Seminar  On selected topics such as epigraphy, remains of old Latin, Roman 
law and society.  
Year course.

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, exercises in 
comprehension, and conversation. Literature—weekly lectures on 
the texts being studied.  
Prerequisite: Grade 13 French or permission  
Year course.
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* Existentialist French Literature of the Twentieth Century  Selected texts from Camus, Sartre, Malraux, etc.  
*Fall term.*

331* Twentieth Century  To be announced.  
*Winter term.*

*Prerequisite: French 250.*  
*Year course.*

360 French Literature of the Enlightenment  Offered in summer school and/or post-degree programme only.
365* French Canadian Novel
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.

366* French Canadian Poetry and Theatre
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.

370 Romanticism, Realism and Symbolism in French Literature
To be offered in summer school and/or post-degree programme only.

420 The Novel in French Canada
Special emphasis on contemporary novels.
Year course.

425* Mediaeval French Language and Literature
An introduction to the problems of mediaeval French language and readings from the major literary texts of the period.
Fall term.

435* French Prose of the Renaissance
Readings in the conteurs Rabelais, and Montaigne, etc.
Fall term.

436* French Poetry of the Renaissance
Readings in Marot, the Pléiade, the baroque poets, etc.
Winter term.

455* Linguistics, Advanced Grammar and Composition
An introduction to the study of general linguistics and French phonetics, with advanced grammar, composition, translation and oral practice.
Prerequisite: French 350.
Fall term.

456* Stylistics, Advanced Grammar and Composition
An introduction to the problems of comparative French and English stylistics, with advanced grammar, composition, and oral practice. This course is not a repetition of French 455.
Prerequisite: French 350.
Winter term.

480 Modern French Literature
Offered in summer school and/or post-degree programme only.

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.

460* The Comedy of Seventeenth Century France
Selected texts from Molière, Corneille, Racine, etc.
Fall term.

470* Literary Criticism
A study of various critical methods and points of view in French literary criticism.
Fall term.
471* The Religious Impulse  Selected texts in French literature from the 17th to the 20th centuries. 
Winter term.

**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.*

*3 lectures and laboratory.*
*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 prose and poetry. Study of one novel, “Il Piccolo Mondo”. One semester devoted to the “Divina Commedia”.
*Prerequisite: 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.
*3 lectures.*
*Year course.*

**250 Composition and Conversation**  Selections from representative works of major Spanish authors. Oral practice and composition.
*Prerequisite: Spanish 190.*
*Year course.*
275* The Enlightenment in Spanish Literature
A study of the works of Luzán, Feijoo, Jovellanos, and Cadalso.  
*Fall term.*

276* Drama of the Nineteenth Century
A study in the development of the drama from the Duque de Rivas to Echegaray.  
*Winter term.*

295* The Novel of the Nineteenth Century
A study of the literary currents of the past century such as the costumbrista movement, realism and naturalism.  
*Fall term.*

296* Galdós
Intensive study of the novels and the theatrical works of Galdós.  
*Winter term.*

315* Spanish Lyrics from Garcilaso to Góngora
Conceptism and Culteranism.  
*Fall term.*

316* The Theatre of the Golden Age
Dramatic theory and practice. The innovations of Lope.  
*Winter term.*

325* The Prose of the Golden Age
A study of the Quijote and other major works of Cervantes.  
*Fall term.*

326* The Picaresque Novel
Intensive study of the major picaresque novels from Lazarillo de Tormes to La Picara Justina.  
*Winter term.*

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.*

385* 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 Cortés letters 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 Prose of the Generation of '98
A study of philosophical essays from Ganivet to Zubiri.  
*Fall term.*

416* Drama and Poetry of the Generation of '98
A general view of Spanish poetry and drama from Antonio Machado to Juan Ramón Jiménez.  
*Winter term.*

425* Twentieth Century Movements in Spanish Poetry
A study of poetical works from Garcia Lorca to Rafael Alberti.  
*Fall term.*
426* Contemporary Spanish Novel  
The development of Spanish fiction from Cela to Sender.  
*Winter term.*

450 Senior Spanish Composition and Conversation  
This course will provide intensive practice in spoken Spanish on the advanced level.  
*Year course.*

440 Mediaeval Spanish Literature and Linguistics  
Readings in texts from the beginning to the end of the fifteenth century. The *jarchas*, Gonzalo de Berceo, *Libro de Buen Amor*, *Romancero*, and *La Celestina*.  
*Year course.*

495* The Novel in Mexico  
Principal stress will be placed on novels dealing with the Mexican Revolution.  
*Fall term.*

**Graduate Courses**

*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
- 610-619 Renaissance Literature
- 620-634 17th Century Literature
- 635-649 18th Century Literature
- 650-664 19th Century Literature
- 665-679 20th Century Literature
- 680-689 French Canadian Studies
- 690-698 Criticism, Language and Linguistics
- 699 Thesis

Reading courses will be assigned numbers consecutively in the 700 range as they occur.
Department of Earth Sciences

Professor
P.F. Karrow, B.Sc. (Queen's), Ph.D. (Illinois)

Chairman of the Department
Associate Professor
E.C. Appleyard, B.Sc. (Western), M.Sc. (Queen's), Ph.D. (Cambridge)

Assistant Professor
C.R. Barnes, B.Sc. (Birmingham), Ph.D. (Ottawa)

Assistant Professor
D.E. Lawson, B.Sc. M.Sc. (New Brunswick)

Assistant Professor

Assistant Professor
D.L. Salter, B.Sc., Ph.D. (Southampton)

Sessional Faculty Appointments
W. Chesworth, M.Sc. (Manchester), Ph.D. (McMaster)

R.N. Farvolden, M.Sc. (Alberta), Ph.D. (Illinois)

O.L. White, B.Sc. (Melbourne), M.A.Sc. (Toronto)

Undergraduate Course Descriptions

Details of the undergraduate programmes offered by the Faculty of Science are to be found on page 137.

Earth Sciences 130 is prerequisite for all later courses in Earth Sciences with the exception of Earth Sciences 231* and 368*. 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
2 hours lecture, 2 hours lab alternate weeks. Fall term.
Identical to Man-Environment 100*. Not available to students in Regular Science programmes.

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, 2 hours laboratory, fall 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.
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.

240* Geomorphology
2 lectures, 3 hours laboratory, fall term.

241* Optical Mineralogy
Crystallography and stereographic projection. Principles of optical crystallography and the optical identification of minerals.
Prerequisite: Earth Sciences 231*.
2 lectures, 2 hours laboratory, winter term.

330 Igneous and Metamorphic Petrology
Prerequisite: Earth Sciences 231*-241*.
2 lectures, 2 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.

335 Stratigraphy and Sedimentation
2 lectures, 3 hours laboratory.

340 Structural Geology
Primary and induced structures in igneous, sedimentary, and metamorphic rocks. The physical properties of rocks and the effect of stress on them. The relationship between major and minor structures. Introduction to the methods and interpretation of petrofabrics.
2 lectures, 2 hours laboratory.

368* Geophysics 1
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*.)
Prerequisite: Earth Sciences 368*.
2 lectures, second term.
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, ore deposits, and history of the Canadian Precambrian Shield. Other Precambrian rocks in North America and other shield areas throughout the World.
2 lectures, 2 hours laboratory, fall 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. Types of paleontological zones. 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, winter term.

439* Groundwater Geology Groundwater hydrology. The location, exploitation, and conservation of groundwater resources.
2 lectures, 1 hour problems, fall 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.

Graduate and Research Programmes

The Department of Earth Sciences offers graduate work leading to the M.Sc. degree. All graduate courses are one term in length.

The emphasis in graduate work in this department will be in the area of Environmental Geology, and will include specialization.
in groundwater geology, engineering and urban geology, industrial mineral and construction materials, geology of the Great Lakes and limnogeology, lower Paleozoic biostratigraphy, and Quaternary geology. Present members of staff work in some of these areas and new faculty are being added. Faculty in allied fields make possible arrangements for interdepartment work in Civil Engineering (soil mechanics, engineering geology, sediment transport), Biology (palynology, invertebrate ecology), Chemistry (silicate geochemistry), Geography (geomorphology) and Anthropology (Paleo-Indian archeology).

At present the following are fields in which research is in progress in the Department:

**Lower Paleozoic Biostratigraphy:** Conodont biostratigraphy, especially the Middle Ordovician of Ontario and Quebec and the Ordovician of the Arctic region; the ultrastructure of conodonts; stratigraphy and carbonate petrology of the Middle Ordovician in Ontario and Quebec.

**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.

**Mineralogy:** Clay Mineralogy; X-ray diffraction identification techniques applied to clay minerals; clay mineralogy of Paleozoic, Cretaceous and Quaternary sediments. Mineralisation of Paleozoic dolomites.

**Petrology:** The occurrence and genesis of syn-orogenic alkaline gneisses, especially those in eastern Ontario and west Finnmark, Norway; the metasomatic origin of nepheline gneisses and the differentiation and evolution of igneous alkaline rocks. Petrology of igneous and metamorphic rocks of the Canadian Shield.

**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:** Sedimentology of the Torridonian (Precambrian) rocks of northwest Scotland; rudaceous sediments; coastal and near shore sedimentation; the origin and environmental significance of primary structures in clastic sediments; modern sediments of the fluvial and lacustrine environments.

**Structural Geology:** Structural analysis of polyphase deformation in rocks of the Grenville tectonic province; the structural setting of syn-orogenic alkaline rocks in eastern Ontario and northern Norway.

**Graduate Courses**

**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 2
Selected topics in paleontology will be studied in depth with emphasis on micropaleontology and paleoecology. The paleontology of conodonts, scolecodonts, radiolarians, chitinozoans, acritarchs and other micro-fossils will be included together with an outline of paleoecology with reference principally to the invertebrates. Methods and techniques of paleontological study will be covered in the laboratory.

610 Sedimentology 2
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 2
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 2
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.

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 and nomenclature of clay minerals. Identification of clay minerals by X-ray diffractometry, with emphasis on the identification of clay mineral assemblages from argillaceous sediments. Ancillary identification techniques. Optical, ion exchange and absorption properties of clay minerals. Genesis and environmental significance of clay minerals. Uses of clay minerals. Laboratory work to include the preparation of samples, running of diffractograms and their interpretation.

640 Quaternary Geology 2
Selected topics in the study of the Quaternary, with emphasis on the direct and indirect effects of glaciation. The interdisciplinary aspects of the Quaternary.
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.

690 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 integral part of the course.

691 Special Studies

Special topics may be studied in the fields of specialization of the faculty of the Department, by special arrangement with the faculty member concerned.

699 Thesis

Visitors to the Museum
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)

Visiting Professor F. Seton, M.A., D.Phil. (Oxford)

Associate Professor L.P. Fletcher, B.Comm. (Mount Allison), A.M., Ph.D. (Brown)

Associate Professor S.K. Ghosh, B.Sc., M.Sc. (Calcutta), M.S., 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 J. 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)

Deputy Chairman

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 R.R. Kerton, B.Comm. (Toronto), M.A. (Carleton), Ph.D. (Duke)

Assistant Professor M. Siguenza, Lic.Econ. (Universidad de Deustsa), Ph.D. (Colorado)

Lecturer F.J. Carmone Jr. B.S., M.B.A. (Pennsylvania)

Lecturer (part-time) D. Cianci, B.Ap.Sc. (New Brunswick)

Lecturer (part-time) W.M. Lawson, B.Sc. (McGill), M.B.A. (Western), M.A.Sc. (Waterloo)

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.

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 fiscal and monetary policy, international trade and finance, and current economic problems.

3 lectures.
201* Intermediate Price Theory 1
Theory of consumer demand; production theory; resource pricing and allocation under perfect and imperfect competition.
Prerequisite: Economics 101. 3 lectures.

202* Intermediate Price Theory 2
Economic method; dynamic micro theory; distribution theory, general equilibrium; welfare economics.
Prerequisite: Economics 201. 3 lectures.

203* General Equilibrium Theory 1
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.
Prerequisite: Economics 101.

204* General Equilibrium Theory 1
Theory of price formation; the transition to dynamics. Some aspects of welfare economics.
Prerequisite: Economics 203.

205* General Equilibrium Theory 2
Theory of capital and investment; theories of general equilibrium of employment, output, price and money; processes of adjustments to changes in parameters and relationships.
Prerequisite: Economics 102.

206* General Equilibrium Theory 2
Theories of business fluctuations; models of growth and technological change.
Prerequisite: Economics 205.

231* National Income Determination
National income measurement, and the theory of money, income and employment.
Prerequisite: Economics 101, 102.

232* Employment and Public Policy
Further exploration of the topics developed in Economics 231* within a Canadian setting.
Prerequisite: Economics 231.

241* Economic History of Canada
The economic development of Canada to 1914.
Prerequisite: Economics 101, 102. Lectures and seminars.

242* Economic History of Canada
Canadian economic development since 1914; regional and national economic problems and policies.
Prerequisite: Economics 241. Lectures and seminars.

256* Introduction to Accounting 1
Recording transactions; preparation and analysis of financial statements; accounting for inventories, fixed assets, liabilities, and shareholders' equity.
2 lectures, 2 hours laboratory.

257* Introduction to Accounting 2
Systems of Cost Accounting, analysis of cost variances, budgeting, break-even analysis, the problem of changing price levels.
Prerequisite: Economics 256.
2 lectures, 2 hours laboratory.

261* 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.
Department of Economics

262* 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
A brief introduction to FORTRAN IV; 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.
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, money value items, capital determination and presentation, and accounting for internal management.
Prerequisite: Economics 356.
**358*/359* Cost Accounting**  
*Prerequisite: Economics 257. (Not offered in 1970-71.)*

**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**  
History of trade unionism; theories of the labour movement; collective bargaining—institutions and models; wages and employment theory; economic demography; investment in man.  
*Prerequisite: Economics 201, 202.*

**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 Organizations 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. 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.*

**390 Advanced Economic Theory**  
An advanced treatment of selected topics in economics.  
*Prerequisite: Economics 201, 202, 231, 232.*

**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. 3 lectures.*

**440 History of Economic Thought**  
A survey of the historical development of economic theory.  
*Prerequisite: Economics 201, 202, 231, 232.*

**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 structural parameters in simultaneous-equation systems; efficiency of estimating techniques; statistical estimation of supply and demand functions; forecasting, testing of hypotheses and related problems.  
*Prerequisite: Economics 201, 202, 231, 232 or equivalent. 3 lectures.*
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 1970-71.)

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, 232. 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, 232, 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.
10 Introduction to Electrical Engineering


Prerequisite: Physics 11.

3 lectures, 3 hours alternate seminar and laboratory, one term.

12 Electrical Circuits


Prerequisites: Math 12, Math 21.

2 hours lectures, 3 hours laboratory every alternate week, 2 hours seminar, one term.
Prerequisite: EE 12. 
3 lectures, 2 hours seminar, 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 12, 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.

241 Electric Networks 1 Lumped circuits and Kirchoff's laws; circuit elements and simple circuits; first order circuits; second order circuits; linear time invariant circuits; sinusoidal steady state; coupling elements and coupled circuits. 
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, Chebychev'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, flip-flops and registers. Computer operation, control unit, instruction sequencing, arithmetic unit. Storage organization. Operating systems, compilers, assemblers. Multiprogramming, multiprocess- ing and time-sharing.
Prerequisite: EE 217 or equivalent.
2 lectures and 2 hours seminar, 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.
Prerequisite: EE 351 or equivalent.
2 lectures, 3 hours laboratory, 1 seminar, one term.

362 Energy Conversion
Survey of sources and uses of power. Energy conversion problems with emphasis on transducers used in electrical and mechanical power production. Principles of direct energy conversion.
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.

425 System Simulation
2 lectures, 1 hour seminar every week,
3 hours laboratory every 3rd week, one term.

426 Switching Systems
2 lectures, 3 hours laboratory every third week, 1 hour 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 454, or equivalents.
2 lectures and 2 seminar/laboratory periods per week, one term.

428 Communication Theory
2 lectures, 2 hours seminar, one term.

434 Magnetic Materials and Quantum Electronics
Prerequisites: EE 271, EE 351 or equivalent.
2 lectures, 2 hours seminar, one term.
Prerequisite: EE 351 or equivalent. 
2 lectures, 2 hours seminar, one term.

Prerequisite: EE 351 or equivalent. 
2 lectures, 2 hours seminar, 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 hours seminar, 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. Quasi-static generalized theory of all forms of energy conversion. 
Prerequisite: EE 362 or equivalent. 
2 lectures, 2 seminars, one term.

Prerequisite: EE 463. 2 lectures, 2 seminars, one term.

473 Microwave Engineering 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. 
Prerequisite: EE 372 or equivalent. 2 lectures, 3 hours laboratory every third week, 1 seminar, one term.
474 Antenna and Propagation Engineering
Prerequisite: EE 372 or equivalent.
2 lectures, 2 seminars, one term.

481 Control Systems
Classification of systems into types 0, 1, 2; error coefficients. Stability of linear systems, analytical design techniques, compensation techniques, control system components.
Prerequisite: EE 380 or equivalent. 2 lectures, 3 hours laboratory every third week, 1 seminar, one term.

499A, 499B Project
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.

529 Communication of Information
Information measure in discrete signals; redundancy and entropy. Markov models for message sources, encoding and code transformation. Digital channels, mutual information, block codes and error correction; channel capacity. Applications to digital computer and communication systems.
Prerequisite: EE 428 or equivalent.
2 lectures, 2 hours seminar, one term.

543 Electric Networks 3
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.
Prerequisite: EE 342 or equivalent.
2 lectures, 2 seminars, one term.

546 Algebra of Linear Systems 1
Continuous and discrete linear systems; linear transformations; matrix algebra; system eigenvalues and decomposition; finite field theory, polynomials over finite fields.
Prerequisite: EE 380 or equivalent.
2 lectures, 2 seminars, one term.

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. programme 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 a student may be required to withdraw from the programme if he 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, demonstration of reading knowledge in a foreign language 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, 809, 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.

The foreign language requirement, 804, is satisfied by demonstrating proficiency in reading and translating into English, technical literature in either German, Russian or French.

**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)*

*This number was used for another course in 1969/70 Calendar. The asterisk will be dropped in the 1972/73 Calendar.*

**621 Electronic Computing Machines**


*(Old number EE 660)*
622 Digital Systems Engineering
Computer organization, synchronous and asynchronous systems. Modular systems design, single and multi-register processors, stack 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 factor 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)*

*This number was used for another course in 1969/70 Calendar. The asterisk will be dropped in the 1972/73 calendar.*

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, step recovery diodes, field effect transistors. (Old number EE 626)

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 canonical forms; synthesis of passive n-ports. (Old number EE 601)

642 Topics in Network Synthesis

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
Time-variable systems, series approximations, harmonic linearization, describing functions, potential functions, Lyapunov's direct method, canonical forms, operator methods for stability. (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 masking, metalization. Integrated circuit design procedures. Design of integrated bipolar logic circuits. Design of MOS arrays. Two phase 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)*

65 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 analysis, coherent and incoherent limits, interferometer and linear array applications.  
(Old number EE 645)

682 Advanced Control Systems  Continuous and discrete state space concepts; time domain solution of vector matrix differential equations, discrete time systems, difference equation formulations; impulse sampling; z-transform and relation to difference equations; data reconstruction; sampled data feedback system. Optimization gradient method.  
(Old number EE 582)

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)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>(Old number)</th>
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<tbody>
<tr>
<td>762</td>
<td>Topics in High Vacuum Technique</td>
<td>EE 752</td>
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<tr>
<td>763</td>
<td>Power Electronics and Control Devices</td>
<td>EE 753</td>
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<tr>
<td>764</td>
<td>Advanced Topics in High Voltage Engineering</td>
<td>EE 754</td>
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<td>765</td>
<td>Power System Protection and Control</td>
<td>EE 755</td>
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<td>733</td>
<td>Radio Propagation Studies</td>
<td>EE 741</td>
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<tr>
<td>774</td>
<td>Microwave Engineering 2</td>
<td>EE 742</td>
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<tr>
<td>775</td>
<td>Approximate Methods in Electromagnetic Theory</td>
<td>EE 743</td>
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<tr>
<td>780</td>
<td>Advanced Topics in Control Theory</td>
<td>EE 731</td>
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<tr>
<td>785</td>
<td>Optimal Control 2 (also listed as SD 785)</td>
<td>EE 732</td>
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<tr>
<td>801</td>
<td>Oral Examinations for Ph.D.</td>
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<td>803</td>
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<td>804</td>
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<td>807</td>
<td>Engineering Project for Master's Degree</td>
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<td>808</td>
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<td>809</td>
<td>Research Thesis for the Ph.D.</td>
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</tbody>
</table>

*Co-operative Electrical Engineering Student on Work Term Assignment*
Department of English

Professor, Acting Chairman
Department of English

C.F. MacRae, B.A. (Western), M.A. (McMaster), Ph.D. (Toronto)

Professor


Professor

J.C. Gray, B.A. (Washington State), M.A. (Connecticut), Ph.D. (Syracuse)

Professor

K. Ledbetter, A.B. (Central College, Mo.), M.A., Ph.D. (Illinois)

Professor

W.R. Martin, M.A., D.Litt. et Phil. (South Africa)

Professor, Acting Dean of the Faculty of Arts

W.U. Ober, B.A. (Washington and Lee), Ph.D. (Indiana)

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

H.M. Logan, A.B. (Franklin and Marshall), Ph.D. (Pennsylvania)

Associate Professor

J.S. Stone, M.A. (British Columbia)

Associate Professor

H. Tuyn, 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

P.M. Hinchcliffe, B.A. (British Columbia), M.A., Ph.D. (Toronto)

Assistant Professor

N.C. Hultin, B.A. (Concordia), M.A. (Chicago), Ph.D. (Johns Hopkins)

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. (Chesent Hill), M.A. (Villanova), Ph.D. (Illinois)

Assistant Professor

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

C.S. Hedges, B.A. (Northeastern, Okla.), M.F.A. (Art Inst. of Chic.)

Lecturer

D.L. Hedges, B.A. (Northeastern, Okla.), M.A. (Arkansas)

Lecturer

D.S. Keppel-Jones, B.A. (Natal), M.A. (Queen's)

Lecturer

D. Letson, B.A. (Waterloo), M.A. (McMaster)

Lecturer

R. Lister (Mrs.), B.A., M.A. (Toronto)

Lecturer

M.G. Thysell (Mrs.) M.A. (Montana)

Lecturer

K.J.R. Wylie, B.A. (British Columbia)

English Honours Programmes

For programmes in Honours English, Honours English (Drama), Honours English and French, Honours English and German, Honours English and History, Honours English and Latin, Honours English and Philosophy, Honours English and Russian, and Honours English and Spanish, see pages 27 to 31.
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 130 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 130: English 105*, 108*, 116*-117*, 190*, 211-212*, 230*-231*. 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.

Restrictions: English 190 is not open to students in English programmes. English 240, 335, and courses in theatre (English 223*, 224*, 225, 228*, 325, 326*, 327*, 328*, 329, 425, 428*, and 430*) 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. See also Honours English (Drama) Programme (page 28).

Note 1 W. K. Thomas' Form and Substance is 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 1970-71.

101 Introduction to Literature
As an introduction to the study of literature, this course aims to give students an understanding of the various historical periods and of the major genres and forms of English literature. Emphasis will also be given to the writing of effective essays and the techniques of research papers.†

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. Some examples of themes the student may encounter in this course are “The Hero”, “Utopian Literature”, “Themes of Love and Death in Literature”, “Literature of Revolution”, “Literature and Morality”, “The Problems of Freedom and Choice in Literature”, “The Role of the Artist”.†

116* Themes and Types of Literature 1
Similar to 130 below, emphasizing poetry and drama.†

117* Themes and Types of Literature 2
Similar to 130 below, emphasizing fiction.†

130 Themes and Types of Literature
An examination of the themes of love and war in literature, exploring the various ways in which writers have communicated their ideas. Most of the lectures are presented to small groups by means of television, so that various audio-visual aids may be used to support the study of literary texts, and are then followed up immediately by discussion within the groups, led by the group leaders.†
190* Shakespeare  A study of selected plays. Designed for students in programmes other than English.†

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.†

223* Introduction to the Theatre 1 The role of theatre as a major art. Contributions 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: English 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.

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 I. 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 I, with special emphasis on its two chief contributors: Sidney and Spenser. Reserved to special attention is Spenser's epic poem glorifying Elizabeth and England—The Faerie Queene. English 281* is recommended but not required.

290* American Literature A survey of major American authors from Edward Taylor to Stephen Crane.

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.


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, Macaula, Trevelyan.

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: English 225 or consent of instructor.
326* Special Studies in Drama 1
Production participation and the study of selected problems of a major production.†
*Prerequisite: English 325 or consent of instructor.

327* Special Studies in Drama 2
Production participation and the study of selected problems of a major production.†
*Prerequisite: English 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.†

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. Enrolment 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.†

341* Early American Literature
An examination of the American character as shaped in the seventeenth and eighteenth centuries, with some attention to selected works.†
*Prerequisite: English 290 or consent of instructor.

342* The American "Renaissance"
A consideration of the so-called "American Renaissance", with particular attention to the works of Hawthorne and Melville.†
*Prerequisite: English 290 or consent of instructor.

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 or consent of instructor.

344* Recent American Literature
A survey of major American writers since World War 1, especially Frost, Eliot, Hemingway, and Faulkner.†
*Prerequisite: English 290 or consent of instructor.

350 Seventeenth Century Non-Dramatic Literature
A study of the non-dramatic literature of the Jacobean, Caroline, and Interregnum periods, with special attention to Milton's major works.†

361* 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.†

362* 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.†

363* Shakespeare 2
A study of those plays of Shakespeare written after 1600, including the late comedies and the major tragedies.†

364* 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.†
365 Selected Studies  Designed to provide a study in depth of problems and/or authors selected by the instructor. May be repeated for credit.†  
Prerequisite: consent of instructor.

370 The Augustan Age  An historical and critical study of the drama, poetry, novels, and other writings of the Restoration and 18th century.†

373 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.†

375 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.†

380 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.†

390 Beowulf  A literary and linguistic study of the Old English epic Beowulf (and the Finnsburg Fragment, with an investigation of its origin in history and mythology.†  
Prerequisite: English 261.

425 Elizabethan Stage Production  Different methods of staging in the various types of Elizabethan theatre; representative plays of the period. Includes practical work in the theatre.†

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: English 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.†

430* Dramatic Criticism 2  Practice in analysis and criticism of all aspects of dramatic performances.†  
Prerequisite: English 429*.

451 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.†
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 in History 456 and to direct and concentrate his studies accordingly.

460 Twentieth-Century British Literature
A critical study of Shaw, Conrad, Yeats, Eliot, Joyce, Lawrence, and others of the modern period.

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 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
<table>
<thead>
<tr>
<th>705 Studies in Medieval Literature</th>
<th>705A* Beowulf</th>
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<tbody>
<tr>
<td>705B Studies in the Exeter Book</td>
<td>705C Chaucer</td>
</tr>
<tr>
<td>705D* Piers Plowman</td>
<td>705E* Mediaeval Drama</td>
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<tr>
<th>710 Studies in Renaissance Drama</th>
<th>710A Shakespeare: Comedies</th>
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<tbody>
<tr>
<td>710B Shakespeare: Histories and Tragedies</td>
<td>710C* Jacobean Drama</td>
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<tr>
<th>715 Studies in Renaissance Thought and Poetry</th>
<th>715A* Spenser</th>
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<tbody>
<tr>
<td>715B* Donne, Jonson, and their Followers</td>
<td>715C Milton</td>
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<tr>
<th>720 Studies in the Restoration and Eighteenth Century</th>
<th>720A* Drama of the Restoration</th>
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<tbody>
<tr>
<td>720B* Neoclassical Satire</td>
<td>720C* The Periodical Essay in the Eighteenth Century</td>
</tr>
<tr>
<td>720D* Fielding</td>
<td>720E* Johnson and his Circle</td>
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<tr>
<td>720F* Sterne and Smollet</td>
<td>720G* Sterne and Smollet</td>
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<tr>
<th>725 Studies in Romanticism</th>
<th>725A* Blake</th>
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</thead>
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<tr>
<td>725B Wordsworth and Coleridge</td>
<td>725C* Shelley</td>
</tr>
<tr>
<td>725D* Keats</td>
<td>725E* Byron</td>
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<tr>
<td>725F* Jane Austen: Novelist</td>
<td>725G* Jane Austen: Novelist</td>
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<th>730 Studies in Victorian Literature</th>
<th>730A Victorian Poetry</th>
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<tbody>
<tr>
<td>730B Victorian Minor Poetry</td>
<td>730C Expository Prose of the Victorian Age</td>
</tr>
<tr>
<td>730D The Victorian Novel</td>
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<tr>
<th>735 Studies in Modern British Literature</th>
<th>735A* Yeats</th>
</tr>
</thead>
<tbody>
<tr>
<td>735B Lawrence</td>
<td>735C Twentieth-Century British Novel</td>
</tr>
<tr>
<td>735D Twentieth-Century British Poetry</td>
<td>735E* The Bloomsbury Group</td>
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| 750 Studies in Colonial American Literature | |
|---------------------------------------------||
| 755B* American Transcendentalists           |            |

<table>
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<tr>
<th>760 Studies in Twentieth-Century American Literature</th>
<th>760A Twentieth-Century American Fiction</th>
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<tbody>
<tr>
<td>760B* American Naturalists</td>
<td>760C* Contemporary American Fiction</td>
</tr>
<tr>
<td>760D* Twentieth-Century American Poetry</td>
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<table>
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<th>770 Studies in Canadian Literature</th>
<th>770A* Modern Canadian Poetry</th>
</tr>
</thead>
<tbody>
<tr>
<td>770B Studies in Canadian History and Letters</td>
<td>770C* Canadian Novelists</td>
</tr>
<tr>
<td>770D* Early Canadian Literature</td>
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<tr>
<th>775 Studies in Commonwealth Literature</th>
<th>775A* Studies in Australian Poetry</th>
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<tbody>
<tr>
<td>775A* Studies in Australian Poetry</td>
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</table>
Director Karl Wylie sitting in the balcony of the new Humanities Theatre.
Fine Arts

Assistant Professor N.L. Patterson (Mrs.), B.A. (Washington)
Acting Chairman
Assistant Professor J A.M. MacQuarrie, B.A. (Acadia), M.A. (Toronto)
Assistant Professor G H. Martens (Miss), B.A., M.A. (Minnesota), Ph.D. (Columbia)
Lecturer (part-time) I. Spree, Dipl. (Hochschule Fuer Gestaltung, Ulm., Germany)
Lecturer (part-time) J. Uhde, M.A. (J.E. Purkyne Univ., Brno, Czechoslovakia)

Note 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.

130* 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.

131* 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 discussions 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.

172 Art Criticism Students will endeavour to develop an understanding of and analytical attitude toward visual art by examining theories of visual perception and the dynamics of visual form, the role in art of function, expression, and signification, and the development of contemporary art from its western and non-western sources. Given in summer term only.

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.

216* Primitive Art A study of prehistoric world art (Paleolithic, Mesolithic, and Neolithic), the art of Africa, the Americas, and Oceania, and European folk art (both continental and colonial).

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* or permission. 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 or permission. 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* or permission. 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.

230* Advanced Film Making 1: The Media
A critical examination of film as a medium: film as art; film and literature, visual art, music; film and audience; experimental film forms, film and television. Extended study and practice of film forms and techniques: characteristics of feature film, documentary film, experimental film, teaching film, etc.; different techniques, formats, methods, etc., as well as specifications. Production of scripts, essays, short experimental audio visual projects.
*Prerequisite: Fine Arts 130* and 131* (or equivalent). Will not be offered 1970-71.

231* Advanced Film Making 2: Production
Examination of production methods in film industry and television. Production of a film, 16 mm. Team work, practice from scriptwriting to distribution. Topic and film form will be determined by participants.
*Prerequisite: Fine Arts 130*, 131*, (or equivalent), 230*.
Will not be offered 1970-71.

232* Documentary Film Making 1
A studio course in which students will produce 8 mm sound documentary films. This course emphasizes techniques and aesthetics of documentary film making and the application of documentary means to art film.
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*.

233* 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.

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.

The following courses are administered by Conrad Grebel College:

102*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. Special emphasis will be placed upon reasons for stylistic changes.

151*G Introduction to Music 2  
Same as above.  
Prerequisite: 150*G or consent of the instructor.

250*G The History of Music 1  
From its earliest beginnings to 1750. Will not be offered 1970-71.

251*G The History of Music 2  
From 1750 to the present. Will not be offered 1970-71.

300*G Stratford Festival Seminar  
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.
**301G Continuation of Fine Arts 300G**

*Offered Summer Only.*

*Prerequisite: An introductory course in Music, Drama, or Speech, or consent of instructor.*

**350G Bach to Beethoven**

The development of cantata, oratorio, mass and opera, concerto and symphony in the compositions of Bach, Haydn, Mozart, and Beethoven.

**351G Music of the Romantic Period (1800 to 1900)**

A study of the compositions of Wagner, Chopin, Schumann, Schubert, Wolf, and others. Particular attention is placed on the affinity between music and literature.

**352G Music of the twentieth century**

A study of representative musical compositions of the twentieth century and their relationship to social, literary and political movements.

*Prerequisites: Music 150G and 151G, or consent of the instructor.*

*The following courses are administered by St. Jerome's College.*

**240J Studies in the Contemporary Cinema**

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.*

**340J Fellini**

A study in detail of the director's work from *Luci del Varieta* to *Satyricon*, 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.*

*Fall Term.*

**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 of his class professor, will be available).*

**001 Fundamentals of Scientific Thought**
Introduction to cosmology; current theories of stellar, galactic and cosmic evolution; development of life; man as a biological-psychological creature.

*2 hours per week, lectures and tutorial sessions.*

**11 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 hour lectures, 1 hour tutorial*

**21 Graphics**
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.*

**22 Graphics 2**
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.*

**23 Measurement**
First term Measurement Laboratory. Use of design morphology in development of measures techniques for specific problems illustrating other Year 1 courses:

*3 hours laboratory, alternate weeks.*


*2 lectures.*
61 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.
Department of Geography

Associate Professor R.M. Irving, B.A., M.A. (Toronto), Ph.D. (Minnesota)
Chairman of Department
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)
Associate Professor J.M. Crowley, B.A. (Ag) (Idaho), M.S., Ph.D. (Minnesota)

(Planning and Geography)
Associate Professor L.H. Russwurm, B.A., M.A. (Western), Ph.D. (Illinois)
Associate Professor H.D. Steiner, M.Sc., Ph.D. (Zurich)
Assistant Professor J.H. Bater, B.A., M.A. (U.B.C.), Ph.D. (London)
Assistant Professor B.A. Bullock, B.A.M.A. (Belfast), Ph.D. (London)
Assistant Professor G. 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. (British Columbia), M.A. (Wisconsin)
Assistant Professor G. Priddle, B.A. (Western), M.A. (Clark)
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)

Undergraduate Geography Courses

Note 1 All courses are open to any student from any Faculty or School of this University whenever prerequisites are met.

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. 2 lectures, 2 hours discussion—lab.
(Given in fall term and normally precedes Geography 102*.)

102* Introduction to Physical Geography
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 discussion—lab.
(Given in winter term and normally follows Geography 101*.)

195* Geography and Environmental Problems
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.
3 lectures (fall term).

Note Geography 101*/102* remain the prerequisites for most second year courses in Geography; Geography 195* can be taken as an elective by geography students but is intended mainly for non-
Principles of plant and animal geography, biogeography, and ecology. This course is the same as Planning 200*.
Prerequisite: Geography 102* or consent of instructor.
2 lectures, 2 hour lab. (fall term).

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, climatic 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*.
2 lectures, 2 hour lab. (winter term).

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).

The basic concepts of regional and cultural geography introduced in Geography 101* will be further developed. The approach of the regional geographer will be illustrated in the analysis of one or more world regions. Other topics to be investigated will include regions as cultural entities, political, social, and historical processes in geography, diffusion models, and man's perception of his environment.
Prerequisite: Geography 101*.
2 lectures, 2 hour lab. (winter term).

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 occupancy and utilization of urban and rural land, and the effects of man's tools, techniques, and institutions on the earth's surface.
Prerequisite: Geography 101*.
2 lectures, 2 hour lab. (year).

Analysis of man's use of the earth's surface as revealed by a geographic study of selected examples of cultures, cultural areas and cultural landscapes.
Prerequisite: Geography 101*.
3 lectures (fall term).

No prerequisite.
3 lectures (winter term).
Department of Geography

251* Introduction to Urban Geography
Processes and problems of urban development in North America. 
No prerequisite.
3 lectures (fall term).

260* Cartography
Cartographic principles, techniques, and basic mapping procedures; scales, map projections and design analysis for cartographic presentation.
Prerequisite: Geography 101*/102* or consent of instructor.
3 hours seminar and/or lab. (winter term).

270* Introduction to Cartography and Air Photo Interpretation
An introduction to the basic equipment, skills and uses of cartography and air photos.
Prerequisite: Geography 101*/102* or consent of instructor.
2 lectures, 2 hour lab. (fall term).

Note Not available to Honours Geography students.

271* Introduction to Quantitative Research Methods
An introduction to the geographer's use of scientific method, descriptive and inferential statistics, and computers.
Prerequisite: Geography 101*/102* or consent of instructor.
2 lectures, 1 hour tutorial (winter term).
Not available to Honours Geography or Honours Planning students

275* Introductory Air Photo Interpretation
The technique of air photo interpretation as applied primarily in the field of geography and resources inventory. Interpretation of landforms, geological features, soils, natural vegetation, drainage patterns, and rural and urban land use.
Prerequisite: Geography 101*/102* or consent of instructor.
2 lectures, 2 hour lab. (fall term).

300* Geomorphology
An evaluation of past and contemporary positions of this sub-discipline. The basic geomorphologic 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: Honours Geography or Honours Planning students, or consent of instructor.
2 lectures, 2 hours lab. (winter term—normally this course will follow Geography 300*).

301* Advanced Economic Geography 1
Theoretical and empirical studies focusing upon natural resources management and development problems.
Prerequisite: Geography 202* or consent of instructor.
3 lectures (fall term).

311* Advanced Economic Geography 2
Theoretical and empirical studies in economic geography within the subfields of the geography of manufacturing, transportation and diffusion.
Prerequisite: Geography 202* or consent of instructor.
3 lectures (winter term).
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Prerequisite</th>
<th>Lectures</th>
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<tr>
<td>321*</td>
<td>Regional Geography of The United States</td>
<td>Introduction to regional analysis and the study of the environmental ecosystem and its physical and human subsystems in the United States. Selected problems in land utilization, urbanization, regional and resource development.</td>
<td>No prerequisite</td>
<td>3 lectures (fall term).</td>
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<tr>
<td>322*</td>
<td>Regional Geography of Canada</td>
<td>Introduction to regional analysis and the study of the environmental ecosystem and its physical and human subsystems in Canada. Selected problems in land utilization, urbanization, regional and resource development.</td>
<td>No prerequisite</td>
<td>3 lectures (winter term).</td>
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<tr>
<td>323*</td>
<td>Geographical Study of a Selected Region</td>
<td>A geographical analysis of a selected region and its current problems. The region chosen in any given year will depend on the specialization knowledge of faculty available and will be a smaller region than the Selected World Regions—Geography 420-432.</td>
<td>No prerequisite</td>
<td>3 lectures (winter term).</td>
</tr>
<tr>
<td>331*</td>
<td>Special Topics in Cultural Geography 1</td>
<td>A detailed investigation of selected facets of man's cultural relations with the natural environment and with other men.</td>
<td>Prerequisite: One of Geography 203*, 231* or consent of instructor</td>
<td>3 lectures (fall term).</td>
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<tr>
<td>332*</td>
<td>Special Topics in Cultural Geography 2</td>
<td>Detailed study of selected topics of population geography.</td>
<td>Prerequisite: One of Geography 203*, 232* or consent of instructor</td>
<td>3 lectures (winter term).</td>
</tr>
<tr>
<td>340*</td>
<td>Introduction to Historical Geography</td>
<td>The approaches, concepts and methods of the historical geographer are developed and then applied and illustrated in selected regions.</td>
<td>No prerequisite</td>
<td>3 lectures (fall term).</td>
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<tr>
<td>341*</td>
<td>Historical Geography of Canada and the United States</td>
<td>The changing geographies of settlement and resource use from the Discoveries to the present. Emphasis upon Canada and Canadian-American interrelationships.</td>
<td>Prerequisite: Geography 203* or consent of instructor</td>
<td>3 lectures (year).</td>
</tr>
<tr>
<td>345*</td>
<td>Political Geography</td>
<td>A study of differences from place to place in political phenomena. Subjects covered include the interrelationships of states and nations, contripetal and centrifugal “forces” within states, electoral geography, boundary and frontier problems, the location of capital cities, internal organizations of states, external relations, and geopolitics.</td>
<td>No prerequisite</td>
<td>3 lectures (winter term).</td>
</tr>
<tr>
<td>350*</td>
<td>Advanced Urban Geography 1</td>
<td>Further study of the external structure of urban centres begun in Geography 202*.</td>
<td>Prerequisite: Geography 202*</td>
<td>3 lectures (fall term).</td>
</tr>
</tbody>
</table>
**351* Advanced Urban Geography 2**
Further study of the internal structure of urban centres begun in Geography 202*.
*Prerequisite: Geography 202*.
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. This course is the same as Planning 357*.
*Prerequisite: Honours Geography or Honours Planning students or consent of instructor.
3 lectures (winter term).

**375 Quantitative Research Methods**
The nature of scientific research; descriptive and inferential statistics as applied to problems in Geography and Planning. To complete the requirements for this course an approved research outline for Geography 490 is required from students intending to enrol in Geography 490. This course is the same as Planning 375.
*Prerequisite: Honours Geography or Honours Planning students or consent of instructor.
2 lectures, 1 hour lab. (year).

**381* The Nature of Geography**
The past traditions in geography. Modern trends in geographical research and teaching.
*Prerequisite: Any three Geography courses.
2 hours seminar (winter).
*Not available to Honours Geography students.*

**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 and consent of instructor.
2 hours seminar (fall term).

**400*-401* Special Topics in Geomorphology**
Advanced studies in glacial fluvial, tropical 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 term).

**403* Advanced Cartography**
Advanced study of numerical map analysis and computer mapping techniques.
*Prerequisite: Geography 260*, 375 or consent of instructor.
2 hours seminar and/or tutorial (winter term).

**404* Advanced Quantitative Methods 1**
Multivariate statistics and their application in geography and planning. This course is the same as Planning 404*.
*Prerequisite: Geography 375 or Planning 375 or consent of instructor.
3 hours seminar and/or tutorial (fall term).
405* Advanced Quantitative Methods 2
Special techniques and their application in geography and planning e.g. gravity models, trend surface analysis, Markov chains, linear programming, simulation. This course is the same as Planning 405*
Prerequisite: Geography 404* or Planning 404* or consent of instructor.
3 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 the normative behavioural aspects of amenity resources.
Prerequisites: One of Geography 310*, 311*, 351* or consent of instructor.
3 lectures (fall term).

411* Decision-Making in Resources Management
Comparative evaluation of institutional frameworks and decision-making processes governing the management of natural resources in selected countries, with particular attention to federal and provincial responsibilities in Canada.
Prerequisite: Geography 310* or consent of instructor.

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: 310*, 311* or consent of instructor.
(Fall term). Not given in 1970-71.

413* Behavioural Studies in Geography
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*, 351*, 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. The impact on and the interrelation with the natural ecosystem.
Prerequisite: Geography 311*, 351* or consent of instructor.
(Fall term).

420-432 Geographic Analysis of Selected World Regions
Detailed study of physical, cultural, economic and political geography; geographic basis of current problems.
Prerequisite: Honours Geography students, or consent of instructor
3 lectures.

420 Canada.
421 Europe and the Mediterranean.
423 Eastern Europe.
424 Soviet Union.
425 Middle East.
427 Latin America.
428 United States of America.
429  Asia.
430  Africa.
431  Polar Lands.
432  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). Not given 1970-71.

Prerequisite: Geography 200*/201 or consent of instructor.  
2 hours seminar (fall term).

452* Problems of Rural Land Use  The application of soil survey information and land classification techniques to rural land use problems.  
Prerequisite: Geography 451* or 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 Interpretation 2  Data gathering from air photos by interpretation and measurement with emphasis on agricultural and urban geography. Recent advances in remote sensing (satellite photography, thermal infrared and radar 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  
3 hours seminar and/or tutorial.

476 Special Readings and Seminar on Selected Topics  Prerequisite: Honours Geography students and consent of instructor  
3 hours seminar and/or tutorial.

480* 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.

3 hours seminar.

Graduate Courses in Geography

The Department offers training leading to the M.A. and Ph.D. degrees. Detailed information about these programmes can be obtained by writing to the Administrative Assistant, Division of Environmental Studies.

600 Geomorphology

Studies with emphasis on tropical geomorphology and geomorphology applied in the evaluation of terrain for various development projects, or studies with emphasis on glacial and fluvial processes and effects, will be offered.

Laboratory, field analytical techniques, and practical work will form a significant part of the programme.

601 Climatology

Advanced study of selected subfields of climatology. Emphasis on applied, local and urban climatology.

602 Air Photo Interpretation and Remote Sensing

Advanced Studies involving air photo interpretation of the physical environment, use of stereo plotting instruments and map production.

Advanced data gathering 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.

Applied research.

606* Advanced Cartography

Advanced Study of numerical map analysis and computer mapping techniques.

607 Advanced Quantitative Methods

Analysis of geographical data using multivariate statistical techniques and the computer.

Advanced study of selected models of locational structure and methods used in locational analysis.

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.

621-632 Regional Geography

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 Mediterranean.
623 Middle East.
624 Asia.
625 Oceania.
626 Africa.
627 Latin America.
628 United States of America.
629 Polar Lands.
630 Canada.
Department of Geography

631 Eastern Europe.
632 Soviet Union.

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.

645 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.

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.

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.

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 problems associated with agricultural land use in Canada and other selected areas. The role of land-use planning in agriculture, its technique and implementation. The role of geographical research in agriculture and other rural development problems. Original research projects.

662* Natural Resource Planning: Policies and Programmes
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.

663* Recreational Resource Planning (cross-listed Planning 653*)
Forecasting recreational demands; methods of classifying recreational resources; methods of recreational resource inventory; principles of recreational land management and conservation.

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.

665* Resource Conservation and Development (cross-listed as Planning 655*)
Appraisals 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.
675* Special Readings and Seminar on Selected Topics in Geography
Topic(s) to be negotiated on an individual basis with faculty members.

676 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 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.

Physics Department—Electronics Laboratory
Department of Germanic and Slavic Languages and Literature

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. Hoefert, B.A., M.A., Ph.D. (Toronto)
Deputy Chairman

Professor I. Levitsky, A.B. (Rochester), M.A. (Buffalo), Ph.D. (Duke)
Visiting Professor H. Boeschenstein, Ph.D. (Rostock)
Visiting Professor B.L.D. Coghlan, Ph.D. (Birmingham)
Associate Professor H. Fischer, Ph.D. (Munich)
Assistant Professor G. Firnau (Mrs.), Staatsexamen (Berlin), Ph.D. (Yale)
Assistant Professor M. Kuxdorf, B.A., M.A. (Waterloo), Ph.D. (Alberta)
Assistant Professor M. Richter, Staatsexamen (Berlin and Bonn), M.A. (Toronto)
Ph.D. (Toronto)
Assistant Professor W. Shelest, Diploma (Munich), M.A. (Ottawa), Ph.D. (Munich)
Assistant Professor J. Whiton, B.A., M.A., Ph.D. (Minnesota)
Assistant Professor A. Zweers, Candidaatsexamen, Doctorandus (Amsterdam)
Lecturer A. Donskov, B.A., M.A. (British Columbia)
Lecturer A.G. Jones, B.A. (Leeds), M.A. (McMaster)
Lecturer H.W. Panthel, B.A. (Waterloo), M.A. (Cincinnati)
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; 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 For students with little or no knowledge of German.
A. Arts Students: The elements of German grammar, oral practice, and composition. Introduction to German literature with reading of selected texts. 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' field of interest. Open to all university students.
One term. 4 hours for A; 3 hours for B.
102* First Year German
Course description as in German 101.
Prerequisite: German 101 or equivalent.

121* Introduction to German Literary Movements
Reading and interpretation of selected works by major German authors. Oral practice, composition, grammar. 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. One term. 3 hours (lectures and language lab.).

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 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 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.).
Prerequisite: German 102 or 122. Permission of instructor.

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, Jean Paul, Hölderlin, etc.). One term. 3 lectures.
Prerequisite: German 102 or 122. Permission of instructor.
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 (cf. p. 23 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.
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.
Prerequisite: German 102 or 122.

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, Gerstenberg, Lenz, Klinger, 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, Durrenmatt, 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.

461* 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 “Bluetezeit” 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, Bidermann, etc.).  
One term. 3 lectures.  
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 in 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 (cf. p. 23 or 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
(Aksamov, 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
(Chernyshevsky, Leskov, Dostoevsky, Saltov-Kedrin, Chekhov) Reading, interpretation, and critical analysis of selected fiction and drama. 
Prerequisite: Russian 101 and 102. One term. 3 lectures.
371* The Golden Age of Russian Literature
Reading and interpretation of prescribed prose, drama and poetry from Lomonosov to Pushkin.
Prerequisite: Russian 101 and 102.
One term. 3 lectures.

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.
One term. 3 lectures.
Prerequisite: Russian 461.

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 and Realism (Lomonosov, Derzhavin, Pushkin, Lermontov, Nekrasov, Fet, Tютчев, etc).
Prerequisite: Russian 101 and 102.
One term. 3 lectures.

482* Russian Poetry  A study of themes and forms of representative authors from Symbolism to the present (Blok, Esenin, Mayakovskiy, Akhmatova, etc.).
Prerequisite: Russian 101 and 102.
One term. 3 lectures.

495*-498* Reading Course in Approved Topics
Open for 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 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, Kotliarevs'ky, 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 Kotliarevs'ky 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. (Shashkevych, Wahylevych, Holavats'kyj, 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, Wahylevych, 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.
621* Recent German Literature.
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 courses.
Bachelor of Arts

a) Students majoring in History should consult the General Programme requirements listed on page 23. They will normally choose History 100 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 worked out in consultation with a departmental advisor.

b) History Honours students will normally follow the Honours History programme described on page 38. 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.

In proceeding to the degree by courses and a thesis the candidate will offer: History 565, or an alternative field if an equivalent undergraduate course has been taken previously (S), and

Assistant Professor

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 A.W. Rees, M.A. (Wales).


(Political Science and History)

Associate Professor M.T. Cherniavsky, M.A. (Oxford).
Associate Professor G W. Klaassen, B.A. (McMaster), D. Phil. (Oxford).
Associate Professor J.F. New, M.A. (Melbourne), Ph.D. (Toronto).
Associate Professor E.P. Patterson, B.A. (Baylor), M.A. (Kansas), Ph.D. (Washington).

Assistant Professor K.R. Davis, B.A. (Toronto), M.A. (Wheaton), Ph.D. (Michigan).
Assistant Professor P.E. Dembski, M.A. (Toronto).
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 R.C. MacGillivray, B.A. (Queen's), A.M., Ph.D. (Harvard).
Assistant Professor P.S. Smith, M.A. (Toronto), Ph.D. (New Mexico).
Assistant Professor J.M. Wahl, C.R., B.A. (Western), M.A., Ph.D. (St. Louis).

Lecturer F.L. Barron, B.A., M.A., M.Phil. (Waterloo).
Lecturer P.J. Harrigan, B.A. (Detroit), A.M. (Michigan).
Lecturer S.K. Johannesen, B.A. (Evangel College), M.A. (Missouri).
Lecturer D.E. Wright, B.A. (Cambridge), M.A. (McMaster).
field and (c) a major field (a thesis and a comprehensive examination of the period). The candidates will also be required to have a reading knowledge of an appropriate second language.

In proceeding to the degree without a thesis the candidate will offer: (a) History 565, or an alternative field if an equivalent undergraduate course has been taken previously (b) in consultation with the department either two minor fields and a cognate essay or three minor fields involving research essays. Subject to departmental approval, one of the fields may be selected from graduate offerings in another department. The candidate will also be required to have a reading knowledge of an appropriate second language.

Master of Philosophy

The general requirements for the degree of Master of Philosophy as indicated on page 169 apply to the degree in History. The programme of study for each student is defined in consultation with the department, to meet his individual needs and professional development.

Doctor of Philosophy

The Department hopes to mount a Ph.D. programme in 1970-71, at the earliest, or in the following year, pending approval from the Provincial Government.

Undergraduate Courses

Note 1 Unless otherwise indicated, courses in the History Department are open to both Honours and General students; to obtain credit as an Honours History course, the student must enrol in an Honours seminar within the course.

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

100 An Introduction To Western Civilization Designed especially for freshmen, this course examines a selected number of historical topics with the aim of introducing the student to the various ways historians analyze the development of the important ideas and institutions of Western Civilization.

2 lectures, 1 hour discussion groups.

110 An Introduction To Historical Method This course is designed to introduce the gifted freshman student to the concepts, methods and materials of historical study. Selected
Survey Courses

Group 1

The following courses have no prerequisites. They 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.  
3 hours. No prerequisite.

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-indepedence movements which culminate in the end of empire in the mid-twentieth century.  
3 hours. No prerequisite.

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.  
3 hours. No prerequisite.

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.  
3 hours. No prerequisite.

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.  
3 hours. No prerequisite.

224* Canadian History Since 1867
An analysis of selected issues: westward expansion, regionalism and the crisis of Canadian federalism, framing a foreign policy, French-Canadian nationalism, urbanization and the New Society.  
3 hours. No prerequisite.

225* American History to 1865
An analysis of selected issues in American history; from colony to nation; the era of Jefferson and Jackson; sectionalism, slavery, and secession; the Civil war impact and interpretations.  
3 hours. No prerequisite.

226* American History Since 1865
An analysis of selected issues in American history: Reconstruction and the New South; expansion and industrialization in the 1870's and 1880's; war with Spain and American Imperialism; the Progressive Movement, 1900-1914, Wilson and Versailles; Normalcy, Depression and the New Deal; the United States at home and abroad since 1945.  
3 hours. No prerequisite.

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.  
3 hours. No prerequisite.

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.  
3 hours. No prerequisite.
Group 2  The following courses normally have a prerequisite and may be
taken for either Honours or General credit. Honours History
students will be expected to participate in Honours seminars within
the course.

255 Ancient Civilizations  A survey of the social, political and economic history of Greece
and Rome with an introduction to the civilization of the Ancient
Near East.
3 hours, lectures and seminars.
Prerequisite: History 100, 110 or permission of the instructor.

258 History of Medieval Europe  The political, cultural, economic and ecclesiastical development
of Europe from 300 to 1300.
3 hours, lectures and seminars.
Prerequisite: History 100, 110 or permission of the instructor.

260 Renaissance and
Reformation  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.
3 hours, lectures and seminars.
Prerequisite: History 100, 110 or permission of the instructor.

262 Europe in the Eighteenth
and Nineteenth Centuries  The course will stress the social and ideological bases of the
Enlightenment, the impact of the French Revolution, and the
major ensuing movements—intellectual, social, economic and
political—of the nineteenth century.
3 hours, lectures and seminars.
Prerequisite: History 100, 110 or permission of the instructor.

269* 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 institu-
tional, developments will be examined. Honours students will be
expected to participate in seminars related to research papers.
3 hours.
Prerequisite: History 100, 110 or permission of the instructor.

270* British History Since 1603  A survey of the main stages in the development of Britain as a
commercial, industrial and imperial nation, and of the problems
encountered. Honours students will be expected to participate in
seminars related to research papers.
3 hours.
Prerequisite: History 100, 110 or permission of the instructor.

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 biogra-
phies and the development of communications; in the second,
sections on native peoples, colonial economics and the history of
the commonwealth ideal.
3 hours, lectures and seminars.
Prerequisite: History 100, 110 or permission of the instructor.
281* South Asian History  
Economic, social and political repercussions of contact with Europe since 1600. Emphasis will be on events in the Indian subcontinent.  
3 hours, lectures and seminars.  
Prerequisite: History 100, 110 or permission of the instructor.

282* East Asian History  
A study of the development of East Asia from the Ch'ing period (China) and the Tokugawa period (Japan) to the present, with emphasis on the Western impact and the Chinese and Japanese response.  
3 hours, lectures and seminars.  
Prerequisite: History 100, 110 or permission of the instructor.

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.  
3 hours, lectures and seminars.  
Prerequisite: History 100, 110 or permission of the instructor.

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.  
3 hours.  
Prerequisite: History 100, 110 or permission of the instructor.

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.  
3 hours.  
Prerequisite: History 100, 110 or permission of the instructor.

295* 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.  
3 hours.  
Prerequisite: History 100, 110 or permission of the instructor.

296* 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.  
3 hours, lectures and seminars.  
Prerequisite: History 100, 110 or permission of the instructor.

Group 3  
The following course is for Honours History students only.

265* Canadian History 1  
Selected topics in the period to 1867.  
3 hours, lectures and seminars.  
Prerequisite: History 100, 110 or permission of the instructor.

266* Canadian History 2  
Selected topics in the period since 1867.  
3 hours, lectures and seminars.  
Prerequisite: History 100, 110 or permission of the instructor.
Depth Courses

The following courses are open to all students above the First Year level, though they normally have a prerequisite. They may be taken for either Honours or General credit. For Honours credit students will be expected to participate in Honours seminars within the course.

353* Medieval Church History 3 hours, lectures and seminars.
From 312-1122
Prerequisite: History 100, 110 or permission of the instructor.

354* Medieval Church History 3 hours, lectures and seminars.
From 1122-1449
Prerequisite: History 100, 110 or permission of the instructor.

355* Russian History 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.
1613-1825
3 hours, lectures and seminars.
Prerequisite: History 100, 110 or permission of the instructor.

356* Russian History The course will focus on selected themes in Russia's development in the nineteenth and twentieth centuries, including the Soviet period.
Since 1825
3 hours, lectures and seminars.
Prerequisite: History 100, 110 or permission of the instructor.

357* German History 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.
1848-1900
3 hours, lectures and seminars.
Prerequisite: History 100, 110 or permission of the instructor.

358* German History Special attention will be given to the emergence of German nationalism within the Hapsburg monarchy and the Germanic lands, as well as other selected topics of political, social and economic history.
1648-1848
3 hours, lectures and seminars.
Prerequisite: History 100, 110 or permission of the instructor.

359* French History 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.
1715-1848
3 hours, lectures and seminars.
Prerequisite: History 100, 110 or permission of the instructor.

360* French History A study of France from 1848 to the beginning of World War 2 with particular emphasis on the social and intellectual forces that affected French society and the historical role of institutions in French society.
1848-1940
3 hours, lectures and seminars.
Prerequisite: History 100, 110 or permission of the instructor.

361 English History A study of achievements and crises in the Tudor and early Stuart periods.
1485-1660
3 hours, lectures and seminars.
Prerequisite: History 100, 110 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.
Prerequisite: History 100, 110 or permission of the instructor.

363 Medieval English History
A study of government, church and society.
3 hours, lectures and seminars.
Prerequisite: History 100, 110 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.

368 Europe in the Twentieth Century
3 hours, lectures and seminars.
Prerequisite: History 100, 110 or permission of the instructor.
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.
3 hours, lectures and seminars.
Prerequisite: History 100, 110 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 or Southern Africa in the second term.
3 hours, lectures and seminars.
Prerequisite: History 100, 110 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.
Prerequisite: History 100, 110 or permission of the instructor.

375 History of China
A study of Chinese historical development from the Ming period to the present. Particular attention will be devoted to (1) the development of peculiarly Chinese political and cultural concepts and the retention of these concepts in twentieth century Chinese civilization, and (2) the assimilation of Western political philosophy and its Sinification in the present Communist and non-Communist regimes.
3 hours, lectures and seminars.
Prerequisite: History 100, 110 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.
Prerequisite: History 100, 110 or permission of the instructor.
382 Regional Approach to Canadian History
The historical development of a selected region will be examined in relation to that of the rest of Canada and of neighbouring areas.
3 hours, lectures and seminars.
Prerequisite: History 100, 110 or permission of the instructor.

383* 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: History 100, 110 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: History 100, 110 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 cultural aspects of change. 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.

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. Previous courses in Canadian and American history are considered desirable, but are not a necessary prerequisite.
3 hours, lectures and seminars.
Prerequisite: History 100, 110 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: History 100, 110 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: History 100, 110 or permission of the instructor.

393 Latin America, National Period
A social 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 medieval 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 rootings 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: History 100, 110 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.

398* History of Public and Private Law to 1500
Selected topics in public and private law will be treated. Various lawyers and jurisprudents of the Middle ages will be studied in greater detail.
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

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 Modern English History
Prerequisite: a previous course in English history.

413 Senior Seminar in Modern French History
Prerequisite: 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: a previous course in Canadian history.

424 Senior Seminar in Canadian Labour History  
Prerequisite: a previous course in Canadian history.

427 Senior Seminar in Colonial American 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 Asian History  
Prerequisite: permission of the instructor.

452 Senior Seminar in the History of Science  
Prerequisite: permission of the instructor.

453 Senior Seminar in Modern International History  
Prerequisite: permission of the instructor.

Other Senior Courses

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.

491 Directed Studies in Special Topics  
Senior students only.
Special Seminar

495 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 Fields in History

565 The History and Theory of Historical Writing
600 The History and Theory of Historical Writing

Prerequisite: 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: Selected Regions
610 Colonial and Imperial History
611 African History
612 Indigenous Minorities
613 Latin American History
615 Early Modern English History
616 Modern English History 1
617 Modern English History 2
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
630 American Colonial History
631 Modern United States History

691-4 Directed Studies in Specific Fields
695 Cognate Essay
699 Thesis
Department of Kinesiology

Associate Professor
N. J. Ashton, B.Sc. (P.E.) (McGill), M.S. (Michigan)

Chairman of the Department
D. J. Pugliese, B.A., B.P.E. (McMaster), Ed. M. (Buffalo)

Assistant Professor
P. Davis (Miss), B.P.H.E. (Toronto), M.Ed. (North Carolina)

Assistant Professor
W. A. Delahey, B.A. (B.P.H.R.E.) (Western)

Assistant Professor
H. J. Green, B.A., B.P.H.E. (Queen's), M.A. (Alberta)

Assistant Professor
D. Hayes, B.Sc., B.P.E., M.Sc. (Springfield)

Assistant Professor
M. E. Houston, B.Sc. (Toronto), Ph.D. (Waterloo)

Assistant Professor
J. C. Nash, B.A. (Western), M.S. (Illinois), Ph.D. (Ohio State)

Assistant Professor
R. W. Norman, B.A., B.P.E. (McMaster), M.Sc. (Alberta)

Assistant Professor
R. E. Priddle (Mrs.), B.P.H.E. (Toronto)

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)

Lecturer
G. H. Baycroft, B.P.E., M.Sc. (Alberta)

Lecturer
P. J. Bishop, B.Sc., B.P.E. (Waterloo)

Lecturer
R. D. Graham, B.A. (Western)

Lecturer
P. Hopkins, B.A. (Carleton), B.P.E. (Waterloo)

Lecturer
S. Kemp (Miss), B.A. (Sir George Williams)

Lecturer
M. Lavelle, B.A. (Windsor), M.A. (Marquette)

Lecturer
R. McKillop, B.A., B.P.E. (Waterloo)

Lecturer
A. L. Powlesland (Miss), B.A., B.P.H.E. (Queen's)

Special Lecturer
P. Condon, B.A. (Western)

Course Descriptions

102* Kinesiology  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* Kinesiology  Current Developments in Kinesiology and Recreation
(103* 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* Kinesiology  Introduction to Health I
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.

141* Kinesiology  Introduction to Health II
An overview of marriage and family life. Also discussed are problems of environmental health and an examination of health agencies.
3 lectures.
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.

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.

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.

(A program 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.

5 hours, terms 1 to 6 inclusive.

Students will be given complete courses in canoeing, sailing, orienteering, and camping. Lectures in camp and waterfront administration will also be included.

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.

An introduction to organic chemistry.

Carbohydrates, lipids, proteins, hormones and vitamins. Metabolism of these groups of compounds in humans.

Anatomical, neural and mechanical considerations of human physical activity are examined.

3 lectures, 2 hours lab.

Statistical techniques applied to Kinesiology and Recreation. 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 and Recreation. 

2 hours lecture, 2 hours laboratory.
230* 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.

240* Health Foundations

An introduction to communicable and non-communicable diseases and malfunctions. The etiology, duration and severity of selected diseases are studied. Mass and individual immunization is considered.

3 lectures.

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.

285* Basic Skills

See Kinesiology 185.

286* Basic Skills

See Kinesiology 185.

300* 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.

320 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. "Normal" and "abnormal" movement patterns will be studied for insight into central nervous system mechanisms involved in skilled movement.

3 lectures, 2 hours lab.

325* 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.

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.
342* 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.

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.

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 the 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.

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* Health Foundations (Part 2)
The first phase of the course comprises a study of mental and emotional health and factors leading to maladjustment. The second phase examines the problems facing the family in to-day's complex and changing society.
3 lectures.

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.

450* 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.
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, gymnastics, basketball, football (M), hockey (M), wrestling (M), field hockey (W), dance W). 
5 hours.

Interpretive Dance Class
Department of Management Sciences

Professor
Donald J. Clough, B.A.Sc. (Toronto), M.B.A. (Toronto)

Chairman of the Department
K. D. Mackenzie, A.B. (U. C. Berkeley), Ph.D. (U. C. Berkeley)

Professor
S. D. Saleh, B.A. (Cairo), M.A., Ph.D. (Western Reserve)

Professor
S. S. Sengupta, M.A., D.Phil. (Calcutta)

Associate Professor
F. E. Burke, B.A. (London)

Associate Professor

Associate Professor
E. A. Silver, B.Eng. (McGill), Sc.D. (M.I.T.)

Assistant Professor
D. DeWerra, Dip.Eng. (Ecole Polytech. de Lausanne), Ph.D. (Ecole Polytechn. de Lausanne)

Special Lecturer
B. A. Brown, B.A. (Toronto), M.A. (Toronto)

Special Lecturer
J. R. Joseph, B.Tech. (Indian I. T.), M.A. (Brooklyn Polytech.)

Special Lecturer
W. P. McReynolds, B.A.Sc. (Toronto), M.Sc. (U.B.C.), Ph.D. (Toronto)

Ontario Institute for Studies in Education

Special Lecturer
J. B. Moore, B.A.Sc.(Toronto), M.A. (Waterloo)

Research Associate
F. H. Barron, B.S. (Davidson), Sc.M. (Brown)

Research Associate
J. P. Castle, B.Comm. (McGill), C.A.

Research Associate
N. J. McTavish, B.Sc. (Western)

Associated Faculty
Professor
J. S. Minas, B.A. (Wayne), Ph.D. (Illinois)

(Chairman of Philosophy)

Professor
P. M. Reilly, B.A.Sc. (Toronto), D.I.C., Ph.D. (Illinois), F.R.S.S.

(Chemical Engineering)

Associate Professor
R. N. Howard, B.Sc. (London), Ph.D. (London)

(Systems Design)

Visiting Faculty
(Chairman, Dept. of Marketing and International Commerce, U.C. Berkeley)

Irwin Bernhardt, B.A. (N.Y.U.), Ph.D. (U.C. Berkeley)

Activities and Scope

The Department of Management Sciences, Faculty of Engineering, was established in 1969. The Department is presently in its formative stage, so that the faculty list and the course descriptions shown here may not be complete at the 1970-71 dates of registration.

The two main activities of the department are complementary: (1) the pursuit of advanced research in selected fields 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 four 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 Research

Emphasis in Operations Research is placed on applications of 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, if he does not already have an acceptable knowledge of these fields. Minor studies may be taken in other departments, and particular attention is drawn to courses in the Departments of Applied Analysis and Computer Science, Combinatorics and Optimization, and Statistics in the Faculty of Mathematics.

The Programme in Applied Economics

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, and resource allocations within an enterprise. Studies include marketing 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 Behaviour

Emphasis in Organizational Behaviour is placed on theories of psychological and sociological behaviour within 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 or 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. Minor studies may be taken in other departments, and particular attention is drawn to courses in the Department of Psychology, Faculty of Arts.

The Programme in Resource Management

Emphasis in Resource Management is on the integration of theories, models, methods and techniques of various disciplines for the design, analysis and operational management of large or complex resource systems. The programme emphasizes problems of multi-agency decision-making, the determination and measurement of value, the coupling of subsystems models, organization for planning and implementation, cultural and political constraints, information uncertainty, benefit-cost analysis,
and the role of the professional management consultant or engineering consultant. One of the areas of concern is the management of scientific and technical resources to obtain technological change. Studies involve psychological, organizational and technical aspects of historical and present-day innovation processes.

Graduate and Research Programme

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 full-time student. Five units may be taken with special permission only. Students involved in a 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 Science, is awarded upon demonstration of individual accomplishment of a high professional and academic standard. The candidate, with approval of his advisor, may elect to submit either a research thesis as a portion of the requirements, or a project report of a professional calibre on an operational or theoretical problem.

A research thesis may be submitted for graduate credit. The topic of the thesis and the choice of a minimum of four units of graduate course work are arranged by the student and his Faculty Advisor. The student must remain registered without interruption in MS808 until the thesis is submitted. The research work leading to the thesis must be performed under the direction of the Advisor, and is finally accepted by him.

A Project Report may be submitted for graduate credit, under MS807. The topic of the report and a minimum of eight units of graduate course work are arranged by the student and his Faculty Advisor. 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 MS807 and MS808.

Academic performance must be sufficient that the student receives an average of B (66-74%) or more in the course-work portion of his approved study programme. At any time, a student may be required to withdraw from the programme if he receives a grade of C (60-65%) or less, in more than one course in Management Sciences or in more than a total of two course units, including minor fields.
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, 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.

Minimum registration requirements for the Ph.D. degree are of 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.

Preliminary Examinations

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 the entire set of 500-series courses described below.

Comprehensive Examination

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
MS507 Operations Research Models and Modelling
MS508 Micro-Economics
MS509 Industrial Psychology

600-series courses are regularly scheduled full-credit graduate courses.

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)
MS632 Operations Research in Process Industries
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
MS663 Managerial Economics
MS682 Network Methods
MS683 Markov Models and Dynamic Programming
MS688 Graph Theory and Applications
MS689 Decision Theory 1

700-series courses are irregularly scheduled as demands arise.

MS760 Topics in Corporate Finance
MS765 Topics in Corporate Law
MS784 Advanced Mathematical Programming 1
MS785 Advanced Mathematical Programming 2
MS786 Quantitative Economics and Econometrics
MS792 Topics in Public Sector Modeling
MS795 Evaluation of Current Research

800-series numbers apply to general graduate degree requirements.

MS801 Oral Examination for the Ph.D.
MS802 Preliminary Examinations for the Ph.D. and M.A.Sc.
MS803 Comprehensive Examination for the Ph.D.
MS804 Language Requirements for the Ph.D.
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

**Associate Professor**
J.B. Ellis, B.A.Sc. (Toronto), D.I.C., M.Sc. (Imperial College London), Ph.D. (Michigan State)

**Associate Professor (Planning and Man-Environment)**
J.T. Horton, B.A. (Wheaton), M.A. (Northwestern)

**Associate Professor**
W. Shalinsky, D.S.A. (Western Reserve), M.Sc., B.S.W., B.A. (McGill)

**Assistant Professor**
E. Marshall Pallett, B.A.Sc. (Oregon), M.Music (Oregon), Ph.D. (Michigan)

**Assistant Professor**
Douglas L. Wahlsten, B.S. (Michigan), Ph.D. (Colorado)

**Course Descriptions**

**190* Man-Environment Seminar-Workshop.** A series of seminars supporting work in the other courses; special emphasis on interdisciplinary treatment of environmental problems; discussion and field work as appropriate. 4 hours (fall term).

**191* Man-Environment Seminar-Workshop.** A continuation of course 190. 4 hours (winter term).

**110* Man-Environment Environmental Perception I.** 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 hours (winter term).


**120* Man-Environment Man's Function and Behaviour I.** Biological perspectives. Basic mechanisms and processes. Genetics; basic mechanisms, relation to behaviour. Evolution; basic principles, relation to behaviour. Physiology; endocrine functions, hormones and behaviour, central nervous system and learning and motivation. Genetics, evolution and physiology with respect to the nature and future of man; ethology and the nature of man. 3 hours (fall term). Cross-listed as Architecture 120.

**121* Man-Environment Man's Function and Behaviour 2.** 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: Man-Environment 120*. 3 hours (winter term). Cross-listed as Architecture 220.
240 Man-Environment

Small groups and Environment: The place of small groups in the world: Man-small group-society in interaction. Some basic elements of small group theory such as the setting of goals, interpersonal relations, group development, change and influence in and by groups, and communication. Different kinds of groups will be examined including the class as a group, gangs, groups in literature, interest-lobby groups, and work groups.

Prerequisite: Honours Man-Environment students only or consent of instructor.

2 hour seminar (winter term).

Course descriptions for Years 2, 3 and 4 will be published at an early opportunity.

Winter Scene—Student Village
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), Habilit. D. Sc. (Hungarian Academy of Science)

Professor
J.A. Brzozowski, M.A.Sc. (Toronto), Ph.D. (Princeton)

Professor
P.C. Fischer, M.B.A. (University of Michigan), Ph.D. (Massachusetts Institute of Technology), F.S.A.

Professor
C. Froese Fischer (Mrs.), M.A. (British Columbia), Ph.D. (Cantab.)

(Applied Mathematics, and Applied Analysis and Computer Science)

Professor and Director of Computing Centre
J.W. Graham, M.A. (Toronto)

Professor
H. Haruki, Ph.D. (Osaka)

Professor
M.A. McKiernan, M.A. (Loyola), Ph.D. (Illinois Institute of Technology)

(Applied Mathematics, and Applied Analysis and Computer Science)

Professor
T. Pietrzykowski, M.A. (Warsaw University), Ph.D. (Polish Academy of Sciences)

Associate Professor
P.L. Kannappan, B.Sc. (Annamalai), Ph.D. (University of Washington)

Associate Professor and Associate Dean of Graduate Studies
J.D. Lawson, B.A.Sc. (Toronto), Ph.D. (Waterloo)

Associate Professor
E.G. Manning, M.Sc. (Waterloo), Ph.D. (Illinois)

Assistant Professor
J.A. Baker, M.A. (Saskatchewan), Ph.D. (Waterloo)

Assistant Professor
R.S. Cohen (Mrs.), M.Sc. (Technion-Haifa), Ph.D. (Ottawa)

Assistant Professor
K. Culik, M.Sc. (Charles University, Prague), Ph.D. (Czechoslovakian Academy of Science), R.N.Dr. (Charles University, Prague)

Assistant Professor
W.M. Gentleman, B.Sc. (McGill), Ph.D. (Princeton)

Assistant Professor
J.G. Linders, M.A.Sc. (Toronto), Ph.D. (Imperial College)

Assistant Professor (Computing Centre and Mathematics)
D.J. McNaughton, B.Sc. (Waterloo), Ph.D. (Queen's)

Assistant Professor
R.B. Roden, M.A. (Toronto), Ph.D. (Cantab.)

Assistant Professor (Computing Centre and Mathematics)
J.C. Wilson, B.A.Sc. (Toronto), Ph.D. (Waterloo)

Assistant Professor (part-time)
J.H. Vellinga, B.A. (Western), M.A. (Waterloo)

Lecturer
P.C. Brilinger, B.Sc. (McMaster), M.A. (Waterloo)

Lecturer
D.J. Cohen, M.Sc. (Technion-Haifa)

Lecturer
V.A. Dyck, M.Math. (Waterloo)

Lecturer (part-time)
R. Kingsley, M.Math. (Waterloo)

Lecturer (part-time)
T.C. Wilson, M.Sc. (University or Chicago)

Lecturer (part-time)
C.R. Zarnke, M.A. (Waterloo)

Research Assistant
S. Aczel (Mrs.), M.A. (Szeged)

Instructor
J.E. Gentleman (Mrs.), M.S. (Chicago)

(Applied Mathematics, and Applied Analysis and Computer Science)

Post-Doctorate Fellow
A. Gabrielian, Ph.D. (Massachusetts Institute of Technology)

Post-Doctorate Fellow
P. Nath, B.A. (Punjab University), Ph.D. (Delhi University)

Post-Doctorate Fellow
V.A. Zankel, Ph.D. (Waterloo)
Department of Applied Mathematics

Associate Professor
C. Froese Fischer (Mrs.), M.A. (British Columbia),
Ph.D. (Cantab.)

Professor
M.A. McKiernan, M.A. (Loyola),
Ph.D. (Illinois Institute of Technology)

Professor
D.G. Wertheim, B.A. (McMaster), Ph.D. (Toronto)

Associate Professor
C.F.A. Beaumont, B.A. (McMaster), M.A. (Toronto)

Professor
H. Rund, Ph.D. (University of Cape Town)

Associate Professor
J. Cizek, R.N.Dr. (Charles University of Prague),
C.Sc. (Institute of Phys. Chem., Czechoslovakian Academy
of Science, Prague)

Associate Professor
S.G. Davison, Ph.D. (Manchester), A.Inst.P.

Associate Professor
D. Lovelock, Ph.D. (University of 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 of Prague), C.Sc. (Institute of Phys. Chem.,
Czechoslovakian Academy of Science, Prague)

Associate Professor
R.A. Wentzell, B.Sc. (Acadia), Ph.D. (Western)

Assistant Professor
D. W. Trim, M.Sc. (Waterloo)

Assistant Professor
F. Burkowski, M.Sc. (Waterloo)

Assistant Professor
D. I. MacLeod, M.A. (Waterloo)

Assistant Professor
B.J. Marshman (Mrs.), M.Sc. (Waterloo)

Associate Professor
V. M. Bobetic, M.A. (University of Zagreb, Yugoslavia)

Associate Professor
Z. Dvoracek, M.S. (Charles University, Prague),
Ph.D. (Czechoslovak Academy of Sciences, Prague),
R.N.Dr. (Charles University, Prague)

Post-Doctorate Fellow
M. Steslicka, Ph.D. (Warsaw)

Adjunct Professor
D. J. Henderson, B.A. (U.B.C.), Ph.D. (Utah), F. Inst. P.

Department of Combinatorics and Optimization

Professor
G. Berman, M.A., Ph.D. (Toronto)

Chairman of the Department
W.T. Tutte, Ph.D. (Cantab.), F.R.S.C.

Distinguished Professor
H.F. Davis, Ph.D. (Massachusetts Institute of Technology)

Professor
K.D. Fryer, B.A. (Western), Ph.D. (Toronto)

Associate Dean of the
Faculty of Mathematics
R.C. Mullin, B.A. (Western), Ph.D. (Waterloo)

Professor
C. St.J.A. Nash-Williams, Ph.D. (Cantab.)
### Faculty of Mathematics

**Associate Professor**
- C.E. Haff, B.S. (Stanford), Ph.D. (Waterloo)
- D.H. Younger, Ph.D. (Columbia)
- J.A. Bondy, D.Phil. (Oxon.)
- R.A. Honsberger, B.A. (Toronto), M.A. (Waterloo)
- U.S.R. Murty, M.A. (Osmania), Ph.D. (Indian Statistical Institute)
- R.N. Burns, B.Sc. (Toronto), M.A. (Waterloo)
- R.G. Dunkley, B.A. (Western)
- G.B. Faulkner, B.Sc. (Toronto), M.Sc. (Waterloo)
- W.I. Miller, B.A. (Queen's)
- T.A. Jenkyns, B.Sc. (University of Alberta), M.Sc. (University of Calgary)
- P.A.T. Kelly, B.Sc. (University of Windsor), M.Sc. (University of Calgary)
- J.K. Vranch, M.Sc. (Waterloo)
- P. Zima, M.Sc. Physics (Charles University, Prague)
- M.A. Economics (University of Economics, Prague, Czech.)
- J.A. Zimmer, M.A. (University of Nebraska)
- C. Cadogan, B.Sc. (Lond.-U.C.W.I.), Ph.D. (University of West Indies)
- P.N. Rathie, Ph.D. (Jodhpur University, India)

### Department of Pure Mathematics

**Professor**
- W. Benz, Ph.D. (Mainz)

**Chairman of the Department**
- H.H. Crapo, A.B. (Michigan), Ph.D. (Massachusetts Institute of Technology)

**Dean of Graduate Studies**
- G.E. Cross, M.A. (Dalhousie), Ph.D. (British Columbia)

**Professor**
- D.Z. Djokovic, Ph.D. (University of Beograd)
- D.B. Sumner, M.Sc. (Cantab.), D.Phil. (Witwatersrand)
- J.W. Tucker, B.Sc. (King's College, London), Ph.D. (Birbeck College, University of London)

**Associate Professor**
- Y. Chen, M.Ph. (University of Frankfurt), Ph.D. (U. of Bochum)
- G. Dankert, Dipl. Math. (T.U. Hanover), Ph.D. (University of Cologne)
- P. Hoffman, B.A. (Toronto), Ph.D. (Manchester)
- A. Kerr-Lawson, B.A. (Toronto), S.M. (Chicago), Ph.D. (McMaster)
- F.C.Y. Tang, B.Sc. (Hong Kong), M.S. (South Carolina), Ph.D. (Illinois)
- J.G. Anderson, M.Sc. (Durham), Ph.D. (Newcastle upon Tyne)
- S. Burris, Ph.D. (Oklahoma University)
- L.J. Cummings, Ph.D. (British Columbia)
- W.J. Gilbert, M.A. (Cantab.), D.Phil. (Oxon.)
- D. Higgs, B.Sc. Hon. (Witwatersrand), M.A. (Cantab.)
- J. Malzan, Ph.D. (Toronto)
- E.M. Moskal, B.A. (Toronto), Ph.D. (Illinois)
Assistant Professor D. Mowat, Ph.D. (Waterloo)
(St. Jerome's and Pure Mathematics)
Assistant Professor K.A. Rowe, B.A. (Toronto), M.S. (Wisconsin), Ph.D. (Illinois)
(On Leave of Absence, 1969-70)
Lecturer R.C. Wilton, M.Math. (Waterloo)

Department of Statistics

Professor D.A. Sprott, Ph.D. (Toronto)
(On Sabbatical Leave, 1969-70)
Chairman of the Department
Dean of the Faculty of Mathematics
Professor W.F. Forbes, D.I.C., Ph.D., D.Sc. (London)
Acting Dean of the Faculty of Mathematics
Professor V.P. Godambe, M.Sc. (Bombay), Ph.D. (London)
Professor J.S. Minas, B.A. (Wayne), Ph.D. (Illinois)

(Psychology and Statistics)
Associate Professor G.W. Bennett, Ph.D. (Adelaide)
(On Leave of Absence, 1969-70)
Associate Professor J. G. Kalbfleisch, B.Sc. (Toronto), Ph.D. (Waterloo)
Acting Chairman of the Department
Associate Professor K.R. Shah, M.A. (Bombay), Ph.D. (Indian Statistical Institute)
Associate Professor R.V. Thysell, B.S. (Montana), Ph.D. (State University of Iowa)

(Psychology and Statistics)
Associate Professor M.D. Vogel-Sprott, B.A. (McMaster) Ph.D. (Toronto)
(On Sabbatical Leave, 1969-70)
Assistant Professor M.A. Bennett, B.A. (Nottingham) A.S.A.
Assistant Professor W.H. Cherry, Ph.D. (Melbourne)
Assistant Professor J.C. Robinson, M.A.Sc., P.Eng., Ph.D. (Waterloo)
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)
Lecturer H.A.J. Allen, M.A. (Toronto)
Lecturer D.E. Clow, B.Math. (Waterloo)
Lecturer J.S. Huang, B.A. (Taiwan), M.B.A. (U. of Georgia)
Lecturer C.C. Springer, M.Sc. (McGill)
Lecturer V. Taht, M.A. (Toronto)
Instructor J.E. Gentleman (Mrs.), B.S.Math., M.S.Stat. (Chicago)
Instructor E. Haag, B.Sc. (Queen's), M.A. (Waterloo)
Adjunct Professor P. Robinson, Dipl.Math.Stat. (Cantab.), Ph.D. (Cape Town)
Post-Doctorate Fellow T.K. Rathinasamy, Ph.D. (Annamalai University, India)
Visitor, Summer 1969 J. Douglas, University of New South Wales
Visitor, Summer 1969 T.V. Hanurav, Indian Statistical Institute
Visitor, Summer 1969 D.J. Hudson, Bell Telephone Laboratories
Visitor, Summer 1969 R. Royall, Johns Hopkins University

Division of Mathematical Research

The Division of Mathematical Research is a trans-departmental organization within the Faculty of Mathematics which is responsible for the general direction, encouragement and coordination of research and 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 five such Research Sections, namely, Theory of Computing, Combinatorics, Functional Equations, Statistics and Biometry, 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 list of Visiting Professors for the academic year 1969-70 is as follows:

<table>
<thead>
<tr>
<th>Name</th>
<th>On Leave From</th>
</tr>
</thead>
<tbody>
<tr>
<td>V.D. Belousov</td>
<td>Mathematical Institute, Moldav, Academy of Science, Kishinev, Moldav, U.S.S.R.</td>
</tr>
<tr>
<td>Z. Daroczy</td>
<td>L. Kossuth University, Debrecen, Hungary</td>
</tr>
<tr>
<td>W. M. Fairbairn</td>
<td>University of Lancaster, Bailaigg, Lancaster, England.</td>
</tr>
<tr>
<td>B. Forte</td>
<td>University of Pavia, Pavia, Italy.</td>
</tr>
<tr>
<td>G. Haggard</td>
<td>University of California, Santa Cruz, California, U.S.A.</td>
</tr>
<tr>
<td>D.W. Hall</td>
<td>Harpur College, State University of New York, Binghamton, New York, U.S.A.</td>
</tr>
<tr>
<td>U. Melchior</td>
<td>Ruhr University, Bochum, West Germany.</td>
</tr>
<tr>
<td>R.S. Mishra</td>
<td>Banaras Hindu University, Varanasi, India.</td>
</tr>
<tr>
<td>F. Newman</td>
<td>University of J.E. Purkyne, Brno, Czechoslovakia.</td>
</tr>
<tr>
<td>F. Rado</td>
<td>Babes-Bolyai University, Cluj, Romania.</td>
</tr>
<tr>
<td>R.S. Varma</td>
<td>University of Delhi, Delhi, India.</td>
</tr>
</tbody>
</table>

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 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
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.
1 hour lecture, 2 hours problems, one term.

31 Differential Equations
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.
34 Integral Calculus
Prerequisites: Math. 21, 31. 
3 lectures, one term.

35 Advanced Calculus
(for Electrical Engineers)
2 hours lectures, 2 hours problems.

41 Applied Analysis
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.

51 Probability and Statistics
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 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.

81 An Introduction to Functions, Analytic Geometry, and Calculus

82 Introduction to Algebra

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.

129 Introductory Algebra  Logic, sets, and relations. Number systems. Matrices and linear equations. Polynomial ring, Euclidean algorithm. Introduction to vector spaces, examples from two and three dimensional geometry. 3 hours lectures.

130 Calculus  Functions and limits. The derivative. Differentiation of algebraic functions. Applications to tangents, rates, minima and maxima. Integration as the limit of a sum. Fundamental theorem of integral calculus with applications to areas, volumes, and moments. Power series. Partial differentiation. 3 lectures.

131 Algebra and Solid Geometry  The real and complex number systems. Polynomial functions. Theory of equations. Determinants. Vector and matrix notation. Elementary solid geometery, planes and lines, the standard quadratic surfaces. Co-ordinate systems. 2 lectures, one 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. 2 hours lectures, 2 hours problems.

229 Linear Algebra  Vector spaces, linear transformations. Matrix representations, similarity. Quadratic forms, the principal axis theorem. 3 hours lectures.


Prerequisite: First Year Physics or consent of Instructor.
235 (a) Actuarial Mathematics
Mathematics of Investment
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
Mathematics 236 is not a course for Honours Mathematics students.

237 Differential and Integral Calculus
3 lectures.

239 Introduction to Combinatorics and Optimization
A selection of topics from discrete mathematics including an introduction to graph theory, difference equations, generating functions, convex sets, finite geometries and partially ordered sets. The ideas are illustrated with examples from modern applications to such topics as network theory, queueing theory, random walks, linear programming, design of experiments, ranking problems and PERT.
2 hours lectures.

240 (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.
Prerequisite: Mathematics 132 or equivalent.

240 (b) Non-Numeric Applications in Computer Science
In Introduction to: Number Systems, Boolean algebra, concept of a list and elementary list processing techniques, sorting and searching algorithms, symbol manipulation.
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.

329 Abstract Algebra


2 hours lectures.

330 (a) Projective Geometry

30 (b) Non-Euclidean Geometry

Finite geometrics, Distance geometry, convex sets.

3 lectures.

332 Theory of Functions


3 lectures.

333 Differential Equations

First order differential equations; existence theorems; singular solutions; solution by Laplace Transforms; numerical methods of solutions; solution in series; hypergeometric, Bessel and Legendre functions; introduction to partial differential equations and integral equations.

2 hours lectures.

334 Numerical Analysis

A survey of various numerical procedures with emphasis upon their derivations and error analysis. In particular, the following topics are discussed: interpolation, curve fitting, computation with series, solution of non-linear equations, numerical integration, numerical solution of Ordinary Differential Equations, matrix operations and solution of systems of linear equations, problems in the solution of partial differential equations. A knowledge of the FORTRAN IV programming language is essential for the problem assignments.

2 hours lectures, 2 hours problems.

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.

336 Life Contingencies

(a) An advanced course on problems with single lives.

3 lectures, one term.

(b) An advanced course on problems with multiple lives; population and multiple decrement theory.

3 lectures, one term.
Prerequisite: Mathematics 233 or equivalent.
2 hours lectures.

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, multiprocessing, 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.

341 Abstract Algebra  Lattices; groups, Lagrange's Theorem, normal subgroups, homomorphisms, permutation groups; rings, ideals and integral domains; modules, tensor products; fields and extensions.
3 hours lectures.

342 Real Variable Theory  Real number system; metric space setting for ideas of continuity, uniform continuity, compactness, convergence, open sets, closed sets, connected sets. Cantor ternary set. Stone-Weierstrass theorem, uniform convergence, equi-continuity. Ascoli's theorem, fixed point theorems and applications, tangent spaces, differential forms, exterior differentiation, Stokes' Theorem. Introduction to Lebesgue integration. 2 hours lectures.

343 Complex Variable Theory  Complex numbers; continuity and differentiability, Cauchy-Riemann equations; solution of Laplace equation; bilinear transformations and conformal mapping; power series; integral theorems; Taylor and Laurent expansions; calculus of residues; series solution of differential equations by integrals.
2 hours lectures.

3 hours lectures.

345 Topics in Pure Mathematics for Combinatorial Mathematicians

351 Introduction to Graph Theory and Combinatorial Analysis  Graphs, paths, arcs, circuits, connected graphs, trees, spanning trees, digraphs, Euler paths, tournaments, complete paths in tournaments, factors of bipartite graphs, Menger's Theorem and flows in networks, theory of enumeration, generating functions, Ramsey's Theorem and applications, systems of distinct representatives, Latin squares, balanced incomplete block designs and (v.k.) configurations. Applications to practical problems and other areas of mathematics.

352 Mathematical Operations Research  Review of mathematical techniques frequently used in Operations Research: including difference-differential equations, Lagrange
Multipliers, generating functions, quadratic forms, minimax algorithms in directed graphs. Introduction to Linear programming, Dynamic programming, transport network theory. Applications to production planning, inventory problems, growth and survival models, scheduling problems, replacement policies and reliability optimization of complex systems.

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.

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.

361 (b) Mechanics 2

2 hours lectures, Winter term.

363 Differential Equations

2 hours lectures.

399 Reading in Mathematics

410 Rings and Modules

2 hours lectures.

411 Group Theory
Elementary properties of Abelian groups, solvable groups, nilpotent groups. Direct products and semi-direct products. Free groups and free products. Elements of group representations.

2 hours lectures.

412 Theory of Fields

413 Non-linear Differential Equations Riccati equation, conflict and pursuit problems, elliptic integrals and functions, phase plane, non-linear mechanics. Non-linear integral equations. 2 hours lectures.


426 Topology Continuation of general topology. Topological manifolds, a weak embedding theorem, classification of 1-manifolds. Triangulation, simplicial complexes, simplicial homology. Classification and homology groups of closed (triangulated) 2-manifolds. The fundamental group covering spaces, homotopy groups, the Hurewicz isomorphism theorem. 2 hours lectures.

428 Lattice Theory Ordered sets, lattices, Galois connections. Special attention is given to geometric lattices (matroid theory). 2 hours lectures.

429 Combinatorial Topology Homology theory of complexes. Theorems of invariance, covering, and duality. 2 hours lectures.


433 Measure and Integration Measure in Euclidean n-space, the Lebesgue integral, convergence theorems, the Fubini theorem, differentiability, absolute continuity. A study of Banach spaces. 2 lectures.


435 Laboratory Numerical problems arising in actuarial science and statistics. 2 hours laboratory.

436 Mathematical Logic An informal introduction to the logic of sentences and predicates, with emphasis on analogies with familiar mathematical structures. Syllogisms and algebra of sets related to predicate logic. Simplification, logical deduction, duality, consistency and completeness. The concepts of constant, variable, function, and set. Axiomatics. 2 lectures.
437 (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
2 hours lectures, 1 term.

438 Estimation and Hypothesis Testing
The mathematics and logic of estimation and hypothesis testing. Consistency, efficiency and sufficiency of estimates. Fiducial and confidence intervals, likelihood, Bayes' theorem, tests of significance.
2 hours lectures.

439 Theory of Experimental Design
The logic of experimental design with reference to randomization, experimental and sampling errors. Construction and analysis of various kinds of designs.
2 hours lectures.

440 Probability
Classical probability and introduction to stochastic processes with applications such as branching processes, epidemics, etc.
2 hours lectures.

441 Quantum Mechanics
2 lectures.

442 Theory of Relativity
Covariant and contravariant tensors. Riemannian space. Gaussian curvature. The Lorentz transformation and Einstein's special theory. Introduction to the general theory of relativity.
2 lectures, Winter term.

443 Electromagnetism
Applications of the Maxwell equations. Reflection and refraction. Introduction to wave guides and antennae.
2 lectures, Fall term.

444 Elasticity
2 lectures, Winter term.

445 Hydro-dynamics
2 hours lectures.

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.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>448</td>
<td>Differential Geometry</td>
<td>Curves in space, Gaussian curvature. Tensorial notation. Introduction to differentiable manifolds.</td>
<td>2</td>
</tr>
<tr>
<td>449</td>
<td>Experimental Design</td>
<td>Similar to Mathematics 439 but with more accent on the logic and methods than on the mathematics. Primarily for students in the Sciences.</td>
<td>2</td>
</tr>
<tr>
<td>451</td>
<td>Optimization</td>
<td>Discrete functions; continuous functions of n variables. Quadratic forms; convex functions. Equality constraints; Lagrange multipliers and generalizations. Inequality constraints; Kuhn-Tucker theorem. Steepest descent and gradient methods. Fibonacci search, successive approximations, simplex method and other techniques. Applications to the solution of equations and non-linear regression.</td>
<td>2</td>
</tr>
<tr>
<td>453</td>
<td>Queueing Theory</td>
<td>Input and Service-time distributions; Poisson process, Erlangian distribution. Single channel queue; differential-difference equations, integral equations. Complex queueing models. Monte Carlo techniques.</td>
<td>2</td>
</tr>
<tr>
<td>454</td>
<td>Game Theory</td>
<td>Classification of games. Zero-sum matrix games. Infinite zero-sum games, n-person co-operative and non-co-operative games.</td>
<td>2</td>
</tr>
<tr>
<td>455</td>
<td>Mathematical Programming</td>
<td>An introduction to the methods and applications of integer programming, non-linear programming and dynamic programming.</td>
<td>2</td>
</tr>
<tr>
<td>457</td>
<td>Applied Combinatorial Mathematics</td>
<td>May include any subset of the following topics: applications of combinatorial mathematics to optimization, selected topics from the Beckenbach book, structural models, graphs and electrical networks, graph theory and statistical mechanics, the Ising problem, percolation processes, the dimer problem, random walk, applications to chemistry, automata.</td>
<td>2</td>
</tr>
<tr>
<td>458</td>
<td>Graph Theory</td>
<td>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.</td>
<td>2</td>
</tr>
</tbody>
</table>
460 Combinatorics
Enumerative mathematics. Combinatorial properties of various mathematical structures (e.g. graphs, geometries, etc.).
2 hours lectures.

461 (a) Demography
2 hours lectures, 1 term.

461 (b) Actuarial Laboratory
A tutorial course for the advanced actuarial student.
2 hours lectures, 1 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.

463 Control Theory
2 hours lectures, Fall term.

464 Topics in Mathematical Physics
A selection of topics given by various members of the Applied Mathematics Department.
2 hours lectures, 2 terms.

470 Numerical Solution of Ordinary and Partial Differential Equations
2 hours lectures.

471a Switching Circuits
2 hours lectures, Fall term.

471b 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. Prerequisite: Switching Circuits.
2 hours lectures, Winter term.
472a Introduction to Automata Theory
2 hours lectures, Fall term.

472b Introduction to Turing Machines and Computability Theory
Prerequisite: Mathematics 427a or Consent of Instructor.
2 hours lectures, Winter term.

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, namely an IBM System/360 Model 75, and IBM System/360 Model 44, an IBM/360 Model 40, 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 40 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 Calendar pertaining to the Graduate Studies. Students proceeding to the M.Math. degree are encouraged to present theses. Those proceeding by course work must submit a substantial essay in connection with at least one of the 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*: Waterloo's WATFOR fast FORTRAN IV compiler is currently being used by over 200 System/360 Computing Centres throughout the world. Several installations are using a similar compiler developed in 1965 for 7040-7044 Series machines. (Comm. of the ACM, January 1967). Also under study is the 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 machines 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, and the problem of testing software.

*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, structure theory of sequential machines, and design of arithmetic units for residue number systems.

*Computability Theory*: Topics currently being studied are Turning machines, complexity classifications of computable functions, abstract models of digital computers and hierarchies of classes of recursive functions.

*Artificial Intelligence*: Among 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.

*Applied Analysis*: In Applied Analysis, among others, functional equations are studied, i.e. 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 modern disciplines including information theory, mathematical psychology and universal algebra.

*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.
tical 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.

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**


The Departments of Philosophy and Pure Mathematics have inaugurated a joint graduate programme for students interested in the foundations of mathematics and related problems.

**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 1969-1970 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.*
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.*
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.
867 Theory of Approximation.
869 Survey of Numerical Analysis.
870 Numerical Solution of O.D.E.*
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.
885 Time-Sharing Systems.*
886 Computer Systems.*
890 Computer Programming.*
891 The Theory and Construction of Compilers.*
892 Advanced Computer Techniques.*
893 Data Structures.*
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 Fault Diagnosis of Digital Systems.
909 Topics in Information Theory.
910 Introduction to Random variables.
911 Theory of Probability.
912 Stochastic Processes.
918 Seminar in Probability Theory.
919 Topics in Probability Theory.
925 Mathematical Genetics.
927 Topics in Probability and Biometry.*
929 Topics in Biometrical Statistics.*
930 Foundations of Statistics.*
931 Estimation and Hypothesis Testing.*
932 Advanced Statistics.*
934 Applied Statistics.
938 Seminar in Statistics.
939 Topics in Statistics.*
950 Complex Variable Techniques in Physical Problems.
951 Group Theory in Physical Problems.
954 Continuum Mechanics.
955 Fluid Mechanics.*
957 Mathematical Electrodynamics.*
958 Quantum Molecular Physics.*
959 Quantum Mechanics.*
960 Elementary Particles.*
961 Mathematical Theory of Relativity.
963 Statistical Mechanics.
965 Quantum Surface Physics.*
966 Control Theory.*
967 Quantum Crystal Physics.*
969 Topics in Applied Mathematics.*
970 Mathematical Optimization.
971 Directed Graphs and Applications.*
972 Mathematical Programming.
973 Network Programming.*
975 Mathematical Operations Research.
976 Seminar in Mathematical Operations Research.
978 Seminar in Optimization.*
979 Topics in Optimization.
981 Game Theory.*
990 Data Processing for Behavioural Scientists.
992 Mathematical Methods for Science and Engineering.*
994 Numerical Methods and Programming.
995 Seminar in Mathematics Education.
996 Topics in Mathematical Education.
999 Topics in the History of Mathematics.
M690 Literature and Research Studies.
M697 M. Phil. Thesis.
### Department of Mechanical Engineering

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Degrees/Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chairman of the Department</td>
<td>T.A. Brzustowski</td>
<td>B.A.Sc. (Toronto), A.M., Ph.D. (Princeton)</td>
</tr>
<tr>
<td>Professor</td>
<td>S.A. Alpay</td>
<td>Dipl. Ing., Dr. Ing. (Berlin)</td>
</tr>
<tr>
<td>Professor</td>
<td>D.J. Burns</td>
<td>B.S., Ph.D. (Bristol)</td>
</tr>
<tr>
<td>Graduate Officer</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>M.J. Hillier</td>
<td>B.Sc. (Eng.), B.Sc. (Gen.) (London), D.I.C., M.S. (Eng.) (London) (on leave of absence)</td>
</tr>
<tr>
<td>Professor</td>
<td>E.L. Holmes</td>
<td>B.Sc. (Bristol), M.A.Sc., Ph.D. (Toronto)</td>
</tr>
<tr>
<td>Associate Officer</td>
<td>G.F. Pearce</td>
<td>B.A.Sc. (British Columbia), M.A.Sc. (Toronto)</td>
</tr>
<tr>
<td>Visiting Professor</td>
<td>N.H. Polakowski</td>
<td>Dipl. Ing. (Lwow), Ph.D., D.Sc. (Wales)</td>
</tr>
<tr>
<td>Associate Professor</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>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>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 Dean of the Faculty of Engineering</td>
<td>M.H. Lewis</td>
<td>B.Sc. (Cardiff), D.Phil. (Oxford)</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>R.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. Piekarcki</td>
<td>Dipl. Ing. (London), Ph.D. (Cambridge)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>A. Plumtree</td>
<td>B.Sc., Ph.D. (Nottingham)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>R.F. Scrutton</td>
<td>B.Sc., M.Sc. (Melbourne)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>R. Skarecky</td>
<td>Ing. (Prague), C.Sc. (Brno)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>D.M.R. Taplin</td>
<td>B.Sc. (Aston), D.Phil. (Oxford)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>M.M. Yovanovich</td>
<td>B.Sc. (Queen's), M.S. (Buf.), M.E., Sc.D. (M.I.T.)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>G.M. Bragg</td>
<td>B.A.Sc. (Toronto), Ph.D. (Cambridge)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>R.N. Dubey</td>
<td>B.Sc. (Hons.) (Pata), B.Sc. (Eng.) (Bihar), Ph.D. (Waterloo)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>K.G.T. Hollands</td>
<td>B.A.Sc. (Toronto), Ph.D. (McGill)</td>
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<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>T.A. Ledwell</td>
<td>B.Eng., M.Eng. (Nova 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>G.D. Raithby</td>
<td>B.E.Sc., M.E.Sc. (Western), Ph.D. (Minnesota)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>P.R. Slawson</td>
<td>B.A.Sc., M.A.Sc., Ph.D. (Waterloo)</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., B.Sc. (Hons. Math. &amp; Phys.), Ph.D. (Adelaide)</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>Lecturer</td>
<td>R.J. Pick</td>
<td>B.A.Sc. (British Columbia), M.S. (Imperial College, London)</td>
</tr>
</tbody>
</table>
Department of Mechanical Engineering

Special Lecturer C.J. Beisingssner, B.Sc., M.A.Sc., Ph.D. (Toronto)
Special Lecturer R.G.R. Lawrence, Q.C.
Special Lecturer U.H. Mohaupt, B.A.Sc. (Waterloo)
Adjunct Professor D.G. McFadden, M.D. (orthopaedic surgeon)
Adjunct Professor D.R. McTavish, M.D., F.R.C.S. (C), F.R.S.C. (C)
Laboratory Director J.R. Cook, B.Sc. (Mt. Allison)

Undergraduate Programmes

Details of the undergraduate programme in Mechanical Engineering are to be found on page 72. All courses extended 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 73.

The only prerequisites are the core courses, unless otherwise specified.

Undergraduate Course Descriptions

1 Advanced Calculus Non-Cartesian co-ordinate systems. Partial differentiation: total derivatives; estimation of errors; chain rule geometrical applications; maxima and minima; Taylor's series; Jacobians.

Multiple integrals: areas, centroids, moments of inertia, surface areas, centres of gravity. Vector analysis; functions obtained from the vector differential operator; integral theorems. Series: absolute, conditional and uniform convergence; alternating and power series.

3 Ordinary Differential Equations A course on ordinary differential equations giving various methods of solution with emphasis on applications to engineering problems. Exact equations; integrating factor; separation of variables. Linear equations with constant coefficients. Simultaneous equations. Laplace transforms. Solution by series.

Introduction to partial differential equations.

5 Applied Mathematics for Engineers Any two of the following four half-term sections:
b) Partial differential equations: applications of parabolic, elliptic and hyperbolic equations in heat conduction, fluid mechanics, gas dynamics and other fields.
c) Complex variables: contour integration; conformal mapping; evaluation of real integrals.
d) Statistical methods: frequency distributions; standard deviation; probability; sampling; estimation of testing of significance; curve fitting; correlations.

12 Dynamics
3 lectures, 1 hour tutorial.

15 Structure and Properties of Materials 1
Interatomic bonding, crystal and amorphous structures, structural defects, phase equilibria, diffusion, non-equilibrium transformations, corrosion.

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 superposition, 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

43 Manufacturing Science 4
Die casting; thermal balance, thermal stability, pressure pulse effects. Other casting methods.


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.

3 hours lectures, 3 hours laboratory.

53 Heat Transfer 1 Introduction to heat transfer mechanisms. The formulation and solution of steady and transient heat conduction. Radiant heat transfer including exchange laws and view factors. Introductory convective heat transfer.

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.

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.

60 Control Theory
Block diagram algebra and signal flow techniques for open and closed loop systems. Transient and steady state response. Methods including log-decibel and Nyquist diagrams, stability criteria. Root locus methods. Introduction to non-linear systems. Application to fluid power and mechanical control systems.

62 Fluid Mechanics 2

64 Industrial Aerodynamics
Flow in ducts, furnaces, heat exchangers, reactors, etc. Air movements in and around buildings, wind loads. Cyclones and electrostatic dust precipitators, chimneys and chimney plumes. Atmospheric dispersion of pollutants.

69 Introduction to the Environmental Sciences

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 student's 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. Quantum theory of radiation; photons, empirical spectroscopy, de Broglie waves, atomic structure, energy quantization, absorption and 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.

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. Topics: rocket and space dynamics, inertia tensor and Euler’s Equations, energy methods, gyroscopic motion, generalized co-ordinates and Lagrange Equations, vibrations.

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.


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.

- The prediction of natural frequencies of Machine Tool elements.
- Iterative methods for the determination of natural frequencies.

- Factors affecting the stiffness of machine tool structures, effects of relative stiffness on accuracy, friction characteristics of slide- ways. 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, quasi-steady droplet burning theory.


**565 Gas Dynamics**  

**566 Turbulent Flow 1**  

**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.
576 Applied Fluid Power Engineering

Different approaches for the application of fluid power control systems in diverse types of industries: machine tool, aeronautical, paper, marine industries; press, road construction, agricultural machinery, conventional and nuclear power plants, assembly lines, etc.

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 kept in mind, however, that the list is only intended as a guide since 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 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 programme 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 admin-
istered 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 two weeks before the examination. The supervising committee, on the advice of the candidate's 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 coursework 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.

**Language Requirements**

The candidate must have an adequate knowledge of at least one foreign language as specified by the department. This requirement may be fulfilled either by direct language examination or by the completion of an approved language course with a final grade considered to be satisfactory. When the native tongue of the student is not English, its knowledge is not normally acceptable as satisfying the foreign language requirements, except when the native tongue is French, German or Russian.

**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 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 a continuous medium. Constitutive equations. Rheology.

622 Mechanical Design 4
Analysis of redundant mechanical systems, rings, frames, compound beams. Stiffness, flexibility and elastic stability considerations. Light weight 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 Instrumentation for Fluid Control 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.

One seminar will be given weekly.

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 multi-component 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

Organization and managements aspects of numerical control.

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, spectroscopy-visible and infra-red, gas chromatography, statistical 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.
Department of Mechanical Engineering

622 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, Tollmien Schlichting waves.

664 Turbulent Flow 2

665 Gas Dynamics 2

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).

710 Analytical Methods in Vibrations
Behaviour of systems, system response, weighting function, transfer function, Duhamel's integral. Principles of dynamics, strain energy virtual work, variational principle, Lagrange's equation. Discrete systems, eigenvalue problem, natural mode of vibration, solution of the characteristic determinant, approximate methods of solution. Continuous systems, formulation of the boundary value
problem, vibration of rods and membranes, Rayleigh's energy method, Rayleigh-Ritz method, Galerkin's method.

**720 Evaluation of Mechanical Systems and Design**
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.

**721 Mechanical Systems Analysis and Synthesis**
Analogs and models. Computers as a design tool. Design decision logic, design equations. Optimization. Legal restrictions, planning, economic considerations and decisions.

**731 Fluidic Control Systems**

**733 Fluid Modulators and Amplifiers**

**734 Seminar in Fluid Control Systems**
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.

**735 Analysis of Nonlinear Fluid Control Systems**

**736 Ductility and Fracture**

**737 Phase Transformations**
Phase diagrams, homogenous and heterogenous nucleation, diffusion, phase changes in metals and alloys. Diffusional growth processes, diffusional and shear transformations.

**738 Composite Materials**
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.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
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<tbody>
<tr>
<td>739</td>
<td>Dislocation Theory</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>Thermodynamics of Solids</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>Convective Heat Transfer</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>
<tr>
<td>754</td>
<td>Approximate Methods in Non-Linear Analysis</td>
<td>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.</td>
</tr>
</tbody>
</table>
761 Internal Aerodynamics of Turbomachines
Fundamental relationships for internal fluid flow with reference to stationary and rotating coordinate 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.

753 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.

801 Oral examination of the thesis for the Ph.D.
803 Comprehensive Examination
804 Language requirement for the Ph.D.
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

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**  
E.J. Fisher, B.A., M.A. (Toronto)  
D.Sc. (Penn. College of Optometry)

**Professor**  
C.W. Bobier, B.A. (Toronto), M.Sc. (Ohio),  
O.D. (College of Optometry)

**Professor**  
W.S. Long, B.A. (Toronto) O.D. (College of Optometry)

**Professor**  
W.M. Lyle, M.Sc. (Indiana), Ph.D. (Indiana),  
O.D. (College of Optometry)

**Professor**  
M.E. Woodruff, M.Sc. (Indiana), Ph.D. (Indiana),  
O.D. (College of Optometry)

**Associate Professor**  
T.P. Grosvenor, B.Sc., Ph.D. (Ohio State)

**Associate Professor**  

**Assistant Professor**  
A. Remole, B.F.A. (Manitoba), M.&z., Ph.D. (Indiana),  
O.D. (College of Optometry)

**Adjunct Professor**  
Irving Baker, O.D. (College of Optometry)

**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 Lunsky, M.Sc. (Indiana), O.D. (College of Optometry)

**Adjunct Professor**  
A. Nichols, B.A., Ph.D. (McGill)

**Adjunct Professor**  
B.B. Sparks, M.D. (Toronto)

**Adjunct Professor**  
G.W. Wyszzecki, Dip.Ing., Dr.Ing. (Tech. Univ., Berlin)

**Clinical Associate**  

**Clinical Associate**  
W.R. Andrews, O.D. (College of Optometry)

**Clinical Associate**  
R.R. Bock, O.D. (College of Optometry)

**Clinical Associate**  
E.L. Buchner, O.D. (College of Optometry)

**Clinical Associate**  
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**Clinical Associate**  
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**Clinical Associate**  

**Clinical Associate**  
Garry Grant, O.D. (College of Optometry)

**Clinical Associate**  
Ronald R. Hansford, O.D. (College of Optometry)

**Clinical Associate**  
Bruce Hawkins, O.D. (College of Optometry)

**Clinical Associate**  

**Clinical Associate**  

**Clinical Associate**  
Harvey Naftolin, O.D. (College of Optometry)

**Clinical Associate**  
R.D. Pellowe, O.D. (College of Optometry)

**Clinical Associate**  
John D. Price, O.D. (College of Optometry)

**Clinical Associate**  
Howard C. Thompson, B.A. (Toronto), O.D. (College of Optometry)

**Clinical Associate**  
Ronald B. Watson, O.D. (College of Optometry)

**Laboratory Assistant**  
Alan J. Baldock, O.D. (College of Optometry)

**Laboratory Assistant**  
Lorne S. Joyce, O.D. (College of Optometry)

**Laboratory Assistant**  
Robert Coles, O.D. (College of Optometry)

**Laboratory Assistant**  
J.D. Pollock, O.D. (College of Optometry)

**Ophthalmic Technician**  
Hartley Thompson

**Technician**  
Michael Kirby

## Course Descriptions

Optometry courses are available normally to non-Optometry students only with special permission of the School of Optometry.

### 200* History and Orientation

A brief history of the profession generally; a review of the development of visual science with emphasis on the history of optometry. The scope and nature of optometrical practice and the role of the profession in 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.

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).

216* Advanced Geometrical Optics  
An extension of geometrical optics given in Physics 256 dealing with the optics of surfaces, prisms, 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.

301* Physiological Optics  
Visual pathways; retinal correspondence; description and analysis of eye movements; the innervational systems of the intraocular and extraocular muscles; visual pigments; photoreception; electrical phenomena of the retina, visual pathways and cortex; light sensitivity; the psychic correlates of retinal stimulation.  
3 lectures, 3 hours laboratory, Winter term.

302* Clinical Optometry  
Lectures on clinical techniques for the 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.

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.

306* Optometrical Optics  
History and manufacture of glass, manufacture of ophthalmic lenses, design of ophthalmic lenses, classification and performance of ophthalmic lenses, problems and solutions in fitting ophthalmic lenses to the eyes. The laboratory course deals with processing all types of ophthalmic material,  
3 lectures, 2 hours laboratory, Fall term.

311* Physiological Optics  
A continuation of 301*.  
3 lectures, 3 hours laboratory, Winter term.
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.

315* General Pathology  A continuation of 305*.
3 lectures, 1 hour tutorial, Winter term.

316* Optometrical Optics  A continuation of 306*.
3 lectures, 2 hours laboratory, Winter term.

401* Physiological Optics  Binocular Vision and Visual Perception. The binocular sensory system; binocular integration and interaction; effects of disparate stimulation; perception of size, shape, direction, distance, motion, time, complex patterns and color. Recent developments in physiological optics.
3 lectures, 3 hour laboratory, Fall term.

402* Clinical Optometry  The sequence of testing in the clinical examination will be outlined. Stress will be on case history, tests of integrity of the visual system, tests of the refractive properties, and tests of binocular relations and the integration of these tests into a satisfactory clinical analysis and modes of treatment will constitute a large part of the course; 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; techniques of orthoptics and visual training by which a rehabilitation of vision can be attempted will be described and demonstrated.
3 lectures, 1 hour laboratory, Fall term.

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.

2 lectures, 1 hour tutorial, Fall term.

406* Optometrical Optics  The lecture course will deal with the problems involved in preparing ophthalmic materials. 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.
School of Optometry

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.

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  A continuation of 401*.
3 lectures, 3 hour laboratory, Winter term.

412* Clinical Optometry  A continuation of 402*.
2 lectures, 2 hours laboratory, Winter term.

414* Physiology of the Visual Systems  A continuation of 404*.
2 lectures, 2 hours laboratory, Winter term.

415* Ocular Pathology  A continuation of 405*.
2 lectures, 1 hour tutorial, Winter term.

416* Optometrical Optics  A continuation of 406*.
1 lecture, 2 hours laboratory, Winter term.

417* Optometrical Specialties  A series of lectures and laboratories on special techniques of clinical examination and on handling the visual problems encountered in optometric practice. These include contact lenses, subnormal vision aids, aniseikonia, pediatric optometry, biomicroscopy and gonioscopy.
3 lectures, 3 hours laboratory, Winter term.

418 Optometry Clinic  A continuation of 408*.
6 hours clinic, Winter term.

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.

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* or for Optometry 514*.
3 hours laboratory, Fall term.
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.

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.

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 interne performs the total work of an optometrist under the supervision and counsel of clinical faculty. Specialty clinics will be operated within the clinical organization to obtain facility of application of appropriate skills 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.

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.

510* Optometrical Jurisprudence and Praxis
A continuation of 500*.
2 lectures, Winter term.

511* Physiological Optics
A continuation of 501*.
3 hours laboratory, Winter term.

512* Advanced Clinical Optometry
A continuation of 502*.
3 lectures, Winter term.

514* Genetics
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.

518* Optometry Clinic
A continuation of 508*.
22 hours clinic, Winter term.

519* Public Health Optometry
A continuation of 509*.
2 lectures, 2 hours laboratory, Winter term.
Department of Philosophy

Professor and Chairman of the Department
L.L. Haworth, B.A. (Rollins), M.A., Ph.D. (Illinois)

Professor
L. Armour, B.A. (British Columbia), Ph.D. (London)
R.J. Butler, B.A., M.A. (New Zealand)
J.S. Minas, B.A. (Wayne), Ph.D. (Illinois)
P. Seligman, B.A., Ph.D. (London)
J.W. Tucker, B.Sc., B.A., Ph.D. (London)

Associate Professor
R.A. George, M.A., Ph.D. (Michigan State)
J.R. Horne, B.A., M.A. (Western Ontario), B.Th. (Huron), Ph.D. (Columbia)
D.D. Roberts, B.A. (Roosevelt), M.A., Ph.D. (Illinois)
W.R. Abbott, B.A. (Kenyon), Ph.D. (Ohio State)
E.J. Ashworth (Miss), B.A., M.A. (Cambridge), Ph.D. (Bryn Mawr)
E.F. Centore, B.Sc. (Canisius), M.A. (Maryland), Ph.D. (St. John's)
E.B. Gamble (Miss), B.A. (Victoria), M.A. (Columbia), B.R.E. (Emmanuel)
B.P. Hendley, B.A. (Marquette), M.A., Ph.D. (Yale)
A.C. Narveson (Mrs.), B.A. (Radcliffe), M.A., Ph.D. (Harvard)
J.W. Van Evra, B.A. (Valparaiso), M.A., Ph.D. (Michigan State)
J. Wubnig (Miss), B.A. (Swarthmore), M.A., Ph.D. (Yale)

Lecturer (part-time)
E.E. Brown, B.A. (Rockhurst College)
G.T. Campbell, B.A. (Western Ontario), Ph.L. (Laval)
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 150* as well as 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 40.)

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.

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.

125* 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 religions 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.

3 hours.
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.

223 Moral 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. Not open to students in Philosophy 221*/2* or 325*/6*.
3 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 280*/1*, or consent of instructor.
3 hours.
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.

321*-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 the immediately given, of art and beauty. A study of the basic problems with examples from historical and contemporary writers.
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 major works of religious philosophy. The writings chosen for consideration will be announced in advance each year.
Prerequisite: One full or two half Philosophy courses.
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.
Prerequisites: Philosophy 140*, or (preferably) Philosophy 240, or consent of instructor.
3 hours.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Description</th>
<th>Prerequisite</th>
<th>Credits</th>
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<tbody>
<tr>
<td>341*</td>
<td><strong>Decision and Value Theory</strong></td>
<td>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.</td>
<td>Prerequisite: Consent of instructor.</td>
<td>3 hours</td>
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<tr>
<td>346</td>
<td>Philosophy of History</td>
<td>Consideration of various possible views about the ultimate nature of history and historical knowledge. Both classical and contemporary views will be examined.</td>
<td>Prerequisite: One full or two half Philosophy courses.</td>
<td>3 hours</td>
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<tr>
<td>350</td>
<td>Epistemology</td>
<td>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.</td>
<td>Prerequisite: One full or two half courses in Philosophy. Students not taking Philosophy as their main subject should consult the instructor.</td>
<td>3 hours</td>
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<tr>
<td>358*</td>
<td><strong>Introduction to the Philosophy of Science</strong></td>
<td>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.</td>
<td>Prerequisite: One full or two half courses in Philosophy, or consent of instructor.</td>
<td>3 hours</td>
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<tr>
<td>359*</td>
<td>Philosophy of the Formal Sciences</td>
<td>A study of philosophical problems concerning mathematics. Topics discussed include formalism, intuitionism, logicism, the mathematical paradoxes, and other topics in foundations and metamathematics.</td>
<td>Prerequisite: Philosophy 358* or consent of instructor.</td>
<td>3 hours</td>
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<tr>
<td>362*</td>
<td>Philosophy of Social Science</td>
<td>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.</td>
<td>Prerequisites: Some previous work in a social science or in Philosophy.</td>
<td>3 hours</td>
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<tr>
<td>363</td>
<td>Analytic Philosophy</td>
<td>Contemporary philosophical literature is employed in the exploration of both formal and &quot;ordinary language&quot; analysis. This course should be especially useful for persons contemplating graduate study in Philosophy.</td>
<td>Prerequisite: Consent of instructor, or Honours status in Philosophy.</td>
<td>3 hours</td>
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</table>
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 or more of these will be offered each year as announced by the Department.

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-h)* Directed Reading in Special Areas

399 Tutorial for Honours Students

Students wishing to enrol in 399 should consult the Department.

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.

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.

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.

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 selected readings.  
Prerequisite: 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:

102J* Invitation to Philosophize 1  An attempt to state the various possible definitions of philosophy along with their strong and weak points. 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.  
3 hours, half course, Fall term.

103J* Invitation to Philosophize 2  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.  
No prerequisite.  
3 hours, half course, Winter term.

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 mathematical logic will be made clear.  
No prerequisite.  
3 hours, half course, Fall term.

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 (especially 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.

218J* 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.

300J* 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.

*No prerequisite.*

3 hours, half course, Fall term.

301J* The Western Philosophical Tradition (1600-present)

A continuation of 300J*.

*No prerequisite.*

3 hours, half course, Winter term.

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: 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: Consent of instructor.*

3 hours.
Department of Philosophy

476J*-479J* Special Topics/ Directed Readings
A series of readings and/or seminars on one or two topics or thinkers, with periodic reports and discussions.

*No prerequisite.

3 hours each, half courses, 476J* and 478J* Fall term;
477J* and 479J* Winter term.

The following courses are administered by St. Paul's College:

239P* Philosophies of Education
A study of theories, both religious and secular, of the nature and purpose of education. The thought of writers from antiquity to the present day will be considered.

3 hours.

336P Philosophical Sources of Contemporary Theology
The writings of selected contemporary theologians will be studied and their sources in the 19th century thought examined. Certain problems such as secularization and the 'death of God' will receive special attention.

3 hours.

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 un-restricted first order predicate calculus, including the theory of identity and theories of description.

*Prerequisite: Philosophy 140*, or (preferably) Philosophy 240, or consent of instructor.

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

696*(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

School of Optometry—Patient Examination
Department of Physics

Professor and Chairman of the Department

Professor
R.A. Aziz, B.A., M.A., Ph.D. (Toronto)

Professor
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)

Professor
I.A. Cowan, B.Sc. (Manitoba), M.A., Ph.D. (Toronto)

Professor
I.R. Dagg, B.Sc. (Manitoba), M.S. (Penn State), Ph.D. (Toronto)

Professor
J. Grindlay, B.Sc. (Glasgow), D.Phil. (Oxon)

Professor (Chemistry and Physics) and Dean of the Faculty of Science

Professor
H.E. Petch, B.Sc. (McMaster), M.Sc., Ph.D. (U.B.C.) F.R.S.C.

Associate Professor
S.G. Davison, B.Sc., M.Sc., Ph.D. (Manchester)

Associate Professor
P.C. Eastman, B.Sc., M.Sc. (McMaster), Ph.D. (U.B.C.)

Associate Professor
H.K. Ellenton, B.Sc. (Western), M.A. (Toronto)

Associate Professor
J.A.V. Fairbrother, B.Sc. (London), Ph.D. (Reading)

Associate Professor
N.R. Isenor, B.Sc. (Acadia), M.Sc., Ph.D. (McMaster)

Associate Professor
J.D. Leslie, B.A.Sc. (Toronto), M.S., Ph.D. (Illinois)

Associate Professor
C.C. Lim, B.A. (DePauw), M.A. (Nebraska), Ph.D. (Toronto)

Associate Professor
R.A. Moore, B.Sc., M.Sc. (McMaster), Ph.D. (Alberta)

Associate Professor
J.L. Ord, B.A.Sc. (Toronto), M.S., Ph.D. (Illinois)

Associate Professor
M.M. Pintar, B.Sc., M.Sc., Ph.D. (Ljubljana)

Associate Professor
A.D. Singh Nagi, B.A., B.Sc., M.Sc. (Panjab), Ph.D. (Delhi)

Associate Professor
H.J.T. Smith, B.Sc., Ph.D. (London)

Associate Professor
B.H. Torrie, B.A.Sc. (Toronto), Ph.D. (McMaster)

Assistant Professor
J.M. Corbett, B.A.Sc. (Toronto), M.Sc., Ph.D. (Waterloo)

Assistant Professor
A.E. Dixon, B.Sc. (Ml. Allison), M.Sc. (Dalhousie), Ph.D. (McMaster)

Assistant Professor
M.P. FitzGerald, B.Sc., M.Sc. (Toronto), Ph.D. (Case)

Assistant Professor
D. Hemming, B.Sc., Ph.D. (Bristol)

Assistant Professor
J. Kruuv, B.A.Sc., M.Sc. (Waterloo), Ph.D. (Western)

Assistant Professor
T.K. Mitra, B.Sc., M.Sc. (Calcutta), Ph.D. (Liverpool)

Assistant Professor
H.M. Morrison, B.Sc., Ph.D. (Edinburgh)

Assistant Professor
K.A. Woolner, B.Sc. (London)

Lecturer
K.A. Woolner, B.Sc. (London)

Instructor
D.L. Roberts, A.B. (Bowdoin College), Ph.D. (Case)

Instructor
A.B. Haner, B.Sc., M.Sc. (Waterloo)

Instructor
D. McVicar, B.Sc. (Waterloo)

Instructor
L. Young, B.Sc. (Waterloo)

Undegraduate Course Descriptions

Details of the undergraduate programmes offered by the Faculty of Science are to be found on page 137.
Note 1 Details of the undergraduate programmes offered by the Faculty of Science are to be found on page 137.

Note 2 All courses described are one-term courses unless otherwise designated. Such one-term courses are marked *.

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 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.

Motion 3 lectures, 3 hours laboratory, for two terms.

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.


3 lectures, winter term.

103* Mechanics in Human A special physics course for Kinesiology students.

Movement 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.

137* Descriptive Astronomy A survey course in descriptive astronomy intended for non-science students. The solar system, stars, the galaxy, galaxies and the universe.

No prerequisite.

3 lectures, for one term only.

162* Mechanics, Wave Motion 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.

and Heat 1 Prerequisites: At least a 75% average in Grade 13 Physics and Math A.

3 lectures, 3 hours laboratory or 2 hours tutorial, fall term.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Prerequisites</th>
<th>Credits</th>
</tr>
</thead>
</table>
| 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, addition enrichment topics such as quantum concepts.  
Prerequisite: Physics 162*.  
3 lectures, 3 hours laboratory or 2 hours tutorial, offered in winter and spring term. |                                                   | 371  |
| 222*        | Electricity and Magnetism 1                       | Electrostatics, D.C. circuits, magnetic fields.  
Prerequisites: Physics 121* and 122* or equivalent; Mathematics 130.  
2 lectures, 3 hours laboratory and 2 hours problems on alternate weeks, fall term. |                                                   | 23  |
| 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. |                                                   | 23  |
| 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. |                                                   | 23  |
| 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. |                                                   | 23  |
| 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. |                                                   | 23  |
| 243*        | Electricity and Magnetism                         | Electrostatics, D.C. circuits, magnetic fields, electromagnetic induction, A.C. circuits, electrical measurements.  
Prerequisites: Physics 121* and 122* or equivalent, Mathematics 130.  
3 lectures, 3 hours laboratory alternate weeks. offered in fall and spring terms. |                                                   | 371  |
| 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. |                                                   | 23  |
| 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. |                                                   | 23  |
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 (3 hours laboratory on alternate weeks for students not taking Physics 260*), offered in fall and winter terms.

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 (3 hours laboratory on alternate weeks for students not taking Physics 261*), offered in fall, winter and spring terms.

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.

256* Optics
Reflection and refraction at plane and curved surfaces; thin and thick lenses, optical instruments, The wave nature of light, interference, diffraction, slits and gratings, resolution. Polarization, optical activity, photometry.
Prerequisites: Physics 121* and 122* or 162* and 163*, Mathematics 130.
3 lectures, first term (3 hours laboratory alternate weeks for students not taking Physics 260*), offered in fall and winter terms.

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 (3 hours laboratory alternate weeks for students not taking Physics 260*), offered in fall, winter and spring terms.

260* Laboratory
Selected experiments in electricity and magnetism, optics, X-ray diffraction and astronomy.
3 hours laboratory, offered in fall and winter terms (for students who are taking Physics 252* and 256*).

261* Laboratory
A continuation of Physics 260*.
Prerequisite: Physics 260*.
3 hours laboratory, offered in fall, winter and spring terms.
270* Laboratory  Further selected experiments in electricity and magnetism, optics, X-ray diffractions, and astronomy. This course is recommended for students enrolled in Physics 250*, 251* and Physics 259*. 3 hours laboratory, offered in fall and winter terms.

271* Laboratory  A continuation of Physics 270*. 3 hours laboratory, offered in fall, winter and spring terms.

301* Physics for Biologists 1  A special course for Biology students.  
Prerequisite: a first year physics course, Mathematics 130.  
2 lectures, fall term.

302* Physics for Biologists 2  A special course for Biology students.  
Prerequisite: Physics 301*.  
2 lectures, winter term.

324* 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.

325* Atomic and Nuclear Physics 2  Nuclear structure, nuclear reactions, molecular and solid state physics.  
Prerequisite: Physics 324*.  
3 lectures, winter term.

337* Astronomy 2  This is a two-term course consisting of Physics 350* and Physics 351* for Correspondence and Summer School students only.

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.

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.

352* Electronics 1  A survey of tube, transistors and solid state devices. Basic A.C. circuit theory, power supplies, equivalent circuits, amplifiers and feedback.  
Prerequisites: Physics 252* - 253* or 243* and Mathematics 31*.  
3 lectures (3 hours laboratory, alternate weeks for students not taking Physics 360*), offered in fall, winter and spring terms.
353* Electronics 2 Applications of feedback to oscillators, operational amplifiers, analogue computers and multi-vibrators. Introduction to digital circuits.
Prerequisite: Physics 352*.
2 lectures (3 hours laboratory, alternate weeks, for students not taking Physics 371*), winter term.

Prerequisites: 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.

Prerequisite: Physics 358*.
3 lectures, winter term.

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.

Prerequisites: Physics 162* and 163*, Mathematics 130, 237 and 31*.
3 lectures, offered in fall and spring terms.

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.

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.

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*; 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*.
3 lectures, winter term.

**Prerequisites:** Physics 362*, 363*, 364* and 365*.
2 lectures 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 Cooperative Applied Physics Programme, and enrolment may be limited to twenty-five students.
6 hours laboratory, for two terms, fall and winter.

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 for two terms, fall and winter.

**Prerequisite:** Physics 259*.
3 lectures, fall term.
Prerequisite: Physics 364* and 365*.  
2 lectures, 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 2  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, 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, equilibrium diagrams, diffusion, solid state phase transformations.  
Prerequisite: Physics 259*.  
3 lectures, fall term.

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, winter 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, winter term.

449* Radio Astronomy  Radio telescopes. Radio sources including the sun. H 2 regions. H 1 regions. The galactic centre; pulsars; quasars; other extra-galactic sources; cosmological implications.  
Prerequisites: Same as Physics 350*.  
Offered in the fall term of even-numbered years to third and fourth year students. 3 lectures.

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 of cells and tissues; exposure calculations, mechanism of damage, repair theories, genetic effects, target theory; isotopic tracers in biophysical research.

Prerequisites: Physics 232 and Mathematics 236 or equivalent.
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.
3 lectures, winter term.

Graduate Studies and Research Programmes

See page 136 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.

Biophysics  Radiation biophysics of synchronized cell cultures. Thermodynamics of intra-cellular movement.

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, superconductivity, energy gap and Fermi surface determinations.

Microwave Research  Dielectric constant measurements. Field induced absorptions, microwave spectrometry.

Magnetic Resonance and Neutron Diffraction  Physical properties of solids, particularly ferroelectrics, are studied by these methods.

Spectroscopy  Raman and Brillouin scattering, far 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.

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.

†621 Quantum Mechanics 2
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.

630 Nuclear Physics

634 Advanced Classical Mechanics
Review of elementary mechanics, Lagrangian formulation, variational principles, Hamiltonian formulations; 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. Prerequisite: Physics 441 or equivalent.

636 Electromagnetic Theory Selected Topics.

642 Electron Microscopy and Electron Diffraction 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.

645 Statistical Mechanics 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.

646 Advanced Statistical Mechanics Applications of the principles of statistical mechanics to classical and quantum many-body systems.

647 Low Temperature Physics 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.

648 Solid State Physics 1 Waves in lattices. Static elastic, thermal, dielectric and magnetic properties of solids. Fermi surface. Prerequisite: Physics 435 or equivalent.


651 Imperfections in Crystals 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.


653 Inert Gas Solids Theory of crystal lattices; quantum mechanical basis, interatomic potentials, stability, dynamics of cubic closepacked lattices, thermodynamics of ideal crystals, anharmonicity. Experimental properties.
654 Advanced Quantum Theory of Solids
Application of quantum field theory to phonons and electrons, many-body techniques, electron-phonon interactions, and selected topics.

655 Optical Properties of Semiconductors
Reflection and refraction of electromagnetic waves at dielectric and conducting interfaces. Dispersion, absorption processes, photo effects, magneto-optical effects, emission of radiation.

656 Magnetism
Introduction to the theory of magnetic phenomena in metals and non-metals. Relevant experimental work will also be discussed.

657 Principles of Magnetic Resonance

658 Crystal Physics
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.

659 Green's Function Method
Review of essential quantum field theory; zero and finite temperature; Green's functions. Applications to Fermi liquids, electron-phonon problem, superconductivity and magnetic impurities.

660 Selected Topics in Physics

661 Advanced Nuclear Magnetic Resonance of Solids
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. Prerequisite: Physics 657 or equivalent. Winter term.

662 Superconductivity
Macroscopic properties and phenomenological theories. Electron-phonon interaction, Cooper pairs and BCS theory. Applications of BCS theory especially to electron tunnelling.

663 Quantum Optics
Theory of optical coherence; quantum electronic processes and devices.

665 Cellular Biophysics
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.

666 Biophysics of Organ Systems
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.

668 Molecular Biophysics
Physical methods of determining macromolecular structure; energetics, intramolecular and intermolecular forces, information storage, DNA and RNA, recognition and rejection of foreign molecules.
669 Radiation Biophysics  
Physical properties and biological effects of different kinds of radiation; action of radiation on various cellular constituents; target theory, genetic effects, repair of radiation damage, physics of radiology and radiotherapy, isotopic tracers.

670 Special Topics in Biophysics 1  
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.

671 Special Topics in Biophysics 2  
Selected subjects for advanced study.

672 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.

674 Advanced Radiation Biophysics  
Radiation problems with tissue cultures and related topics.

675 General Relativity and Cosmology  

680 Galactic Structure  

681 Celestial Mechanics 1  

682 Celestial Mechanics 2  
The three-body and n-body problems. Surfaces of constant velocity, libration points for circular orbits. Theory of perturbations. The lunar theory. Application to satellite orbits.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>683</td>
<td>Astrophysics</td>
<td>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.</td>
</tr>
<tr>
<td>685</td>
<td>Selected Topics in Astronomy</td>
<td></td>
</tr>
<tr>
<td>686</td>
<td>Selected Topics in Astrophysics</td>
<td></td>
</tr>
<tr>
<td>688</td>
<td>Stellar Interiors and Evolution</td>
<td>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.</td>
</tr>
<tr>
<td>698</td>
<td>M.Sc. Thesis</td>
<td></td>
</tr>
<tr>
<td>699</td>
<td>Ph.D. Thesis</td>
<td></td>
</tr>
</tbody>
</table>
Department of Political Science

Visiting Professor and Acting Chairman of the Department
H.W. Parris, M.A. (Oxford and Leeds), Ph.D. (Leicester)

Professor
J.E. Kersell, B.A., M.A. (Queen's), Ph.D. (London)

Professor
T.H. Qualter, B.A. (New Zealand), Ph.D. (London)

Visiting Professor

Associate Professor
S. Andracki, LL.M. (Poznan), M.Sc. (London), Ph.D. (McGill)

Associate Professor
L.K.D. Kristof, B.A. (Reed), M.A., Ph.D. (Chicago)

Associate Professor
A.D. Nelson, A.B., A.M., Ph.D. (Chicago)

Associate Professor
J.M. Wilson, B.A., M.A. (Toronto)

Assistant Professor
J.E. Anderson, B.A. (Manitoba), M.A. (Princeton)

Assistant Professor
R.V. Edington, B.A. (San Francisco State), M.A., Ph.D. (Washington)

Assistant Professor
L.G.E. Edmondson, B.Soc.Sc. (Birmingham), M.A. (Queen's)

Assistant Professor
C.H. Grant, B.A., M.A. (Leicester), Ph.D. (Edinburgh)

Visiting Assistant Professor
R.J.C. Preece, B.A. (Leicester)

Undergraduate Programmes

The Department of Political Science offers a series of undergraduate programmes designed to meet the needs of students with varying interests.

1 General Programme
Students choosing a three-year General programme in Political Science (see the University's requirements for the General Programme on page 23) must complete, before graduation, Political Science 260 and one of Political Science 220 or 320.

2 Honours Programme
Students choosing an Honours Programme in Political Science (see page 43) must complete, before graduation, a course in International Politics, Political Science 260, and one of Political Science 220 or 320. Honours students may elect to pursue a series of connected courses in a related discipline such as Economics, 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 who wish to obtain a broad training in related disciplines. These are:

a) Honours Anthropology and Political Science (page 25)
b) Honours Economics and Political Science (page 26)
c) Honours French and Political Science (page 33)
d) Honours History and Political Science (page 39)
e) Honours Philosophy and Political Science (page 42)
f) Honours Political Science and Psychology (page 44)
g) Honours Political Science and Sociology (page 44)

Joint honours programmes other than those specified 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 first year 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  Students in upper years in Faculties other than Arts are encouraged to consult with the Department in arranging first courses in Political Science, which need not necessarily be at the 100 level.

105* Introduction to the Political Process 1  A study of political ideas and processes, democratic and other. 3 hours, fall term.

106* Introduction to the Political Process 2  An introduction to modern political systems.  Prerequisite: Political Science 105*. 3 hours, winter term.

115* Introduction to Politics 1  A study of the ideas, concepts, and processes of the modern political system. 3 hours, fall term.

116* Introduction to Politics 2  A study of selected aspects of government and politics.  Prerequisite: Political Science 115*. 3 hours, winter term.

202* Quantitative Analysis  An introduction to the use of quantitative methods in Political Science. No special knowledge of mathematics is required.  Open only to students majoring in Political Science. 3 hours, winter term.

220 The History of Political Theory  A history of the development of western political theory from the time of Socrates to the present day.  No prerequisite for students in upper years. 3 hours.

251* Comparative Politics  An introduction to comparative methods in, and alternative approaches to, the study of politics.  Prerequisite: An introductory course in Political Science or equivalent. 3 hours, fall term.

252* West European Government and Politics  A comparative study of selected aspects of government and politics in west Europe.  Prerequisite: Political Science 251*. 3 hours, winter term.

260 Canadian Government and Politics  A critical examination of the institutions and practices of the Canadian political system.  No prerequisite for students in upper years. 3 hours.
261* British Government and Politics
An examination of the uniquely British characteristics of the British political system.
No prerequisite for students in upper years.
3 hours, winter term.

264* American Government and Politics
The theory and practice of the American political system as revealed by the institutions and operations of American national government.
No prerequisite for students in upper years.
3 hours, winter term.

265* Soviet Government and Politics
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.
Prerequisite: An introductory course in Political Science or equivalent.
3 hours, fall term.

266* Problems in Soviet Politics
A study of the sources and formulation of selected Soviet policies including an analysis of Soviet foreign policy.
Prerequisite: Political Science 265*.
3 hours, winter term.

267* French Government and Politics
A critical examination of the theory and practice of government and politics in France.
Prerequisite: An introductory course in Political Science or equivalent.
3 hours, fall term.

281* International Politics 1
Sovereignty and interdependence. The concept of the International System. Political change in the contemporary world.
Prerequisite: An introductory course in Political Science or equivalent.
3 hours, fall term.

282* International Politics 2
Institutional framework of international co-operation in economic and social fields. The functional pattern and the regional pattern. Economic underdevelopment and international politics.
Prerequisite: Political Science 281* or consent of instructor.
3 hours, winter term.

320 Problems in Political Philosophy
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.
Admission by consent of instructor.
3 hours.

321* Socialism: Marxist and non-Marxist 1
A comparative study of the thought of the founders of anarchism and of "utopian" and Marxian socialism.
Admission by consent of instructor.
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, organization, and political and judicial control of the administrative process. Admission by consent of instructor. 3 hours.

340 Urban Politics An analytical study of the responses of various urban political systems to contemporary metropolitan problems. Admission by consent of instructor. 3 hours.

341* Provincial Politics A comparative study of the structure and practices of the various provincial political systems in Canada. Admission by consent of instructor. 3 hours, fall term.

350 The Politics of the Developing Areas An analysis of political systems and processes in the transitional societies of Africa, Asia, and Latin America. Admission by consent of instructor. 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. Admission by consent of instructor. 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. Admission by consent of instructor. 3 hours, winter term.

375* Theories of Integration and Disintegration A study of the requirements for the development of an adequate conceptual framework for the analysis of political movements relative to societal integration. Admission by 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: facism and populism; together with case studies of a number of nationalist political movements in Europe. Prerequisite: Political Science 375*. 3 hours, winter term.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Admission</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>380</td>
<td>Theory and Practice of International Relations</td>
<td>An examination of the concepts of international relations and the study of International Relations as a discipline. A treatment of foreign policy analysis with special emphasis on components of national power and methods and trends in the pursuit of national and collective interests.</td>
<td>Admission by consent of instructor. 3 hours.</td>
<td>3</td>
</tr>
<tr>
<td>421*</td>
<td>The State and Economic Life</td>
<td>An analytical and comparative study of the growth of government intervention in the economic process, and of the development of the welfare state.</td>
<td>Admission by consent of instructor. 3 hours, fall term (not offered, 1970-71)</td>
<td>3</td>
</tr>
<tr>
<td>422*</td>
<td>Liberalism, Socialism, and the Welfare State</td>
<td>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.</td>
<td>Admission by consent of instructor. 3 hours, winter term (not offered, 1970-71)</td>
<td>3</td>
</tr>
<tr>
<td>423*</td>
<td>The Federalist Papers</td>
<td>An examination of the political thought expressed by Hamilton, Madison and Jay in the Federalist Papers.</td>
<td>Admission by consent of instructor. 3 hours, fall term (not offered, 1970-71)</td>
<td>3</td>
</tr>
<tr>
<td>434*</td>
<td>Canadian Constitutional Law</td>
<td>The purpose of this course is to introduce students of Canadian political science to the main constitutional problems. The course will emphasize the role of the judiciary in the Canadian federal process and show that the major current constitutional problems can be traced back to the founding. In addition to studying the leading constitutional decisions of both the Privy Council and the Supreme Court of Canada, the course will consider the writings of the leading Canadian constitutional authorities.</td>
<td>Admission by consent of instructor. 3 hours, winter term.</td>
<td>3</td>
</tr>
<tr>
<td>442*</td>
<td>Politics in Ontario</td>
<td>A critical examination of the distinctive elements of government and politics in the province of Ontario.</td>
<td>Admission by consent of instructor. 3 hours, winter term.</td>
<td>3</td>
</tr>
<tr>
<td>444*</td>
<td>The Politics of French Canada</td>
<td>A study of the principles, practices and personalities of French Canadian politics.</td>
<td>Admission by consent of instructor. 3 hours, winter term.</td>
<td>3</td>
</tr>
<tr>
<td>454*</td>
<td>African Politics</td>
<td>An intensive study of the political systems of selected African countries.</td>
<td>Admission by consent of instructor. 3 hours, winter term.</td>
<td>3</td>
</tr>
<tr>
<td>455*</td>
<td>Comparative Politics in the &quot;Old&quot; Commonwealth</td>
<td>An analytical comparison of institutions and processes as they have developed in various systems of the &quot;old&quot; Commonwealth, such as Britain, Canada and Australia.</td>
<td>Admission by consent of instructor. 3 hours, fall term.</td>
<td>3</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Description</td>
<td>Credits</td>
<td>Term</td>
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<tr>
<td>456*</td>
<td>Comparative Politics in the “New” Commonwealth</td>
<td>An analytical comparison of politics in some of the “new” systems of the Commonwealth such as India, Pakistan and Nigeria. Admission by consent of instructor. 3 hours, winter term.</td>
<td>3</td>
<td>Winter</td>
</tr>
<tr>
<td>458*</td>
<td>The Third World</td>
<td>This course deals with the Third World primarily in the international context. As the problems of this group of countries are on a vary large scale and very diverse, they will be examined on a comparative basis. Admission by consent of instructor. 3 hours, winter term.</td>
<td>3</td>
<td>Winter</td>
</tr>
<tr>
<td>463*</td>
<td>Japanese Politics</td>
<td>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.</td>
<td>3</td>
<td>Fall</td>
</tr>
<tr>
<td>470*</td>
<td>Political Behaviour</td>
<td>An examination of the objectives, characteristics and problems of contemporary research on political behaviour, with emphasis on democratic electoral behaviour. 3 hours.</td>
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<tr>
<td>472*</td>
<td>Voting Behaviour</td>
<td>A comparative study of the motivations underlying electoral choice in Canada, Great Britain and the United States. Admission by consent of instructor. 3 hours, winter term.</td>
<td>3</td>
<td>Winter</td>
</tr>
<tr>
<td>480*</td>
<td>An Introduction to International Law</td>
<td>A systematic survey of the concepts and rules of International Law. Admission by consent of instructor. 3 hours.</td>
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<tr>
<td>487*</td>
<td>Theories of International Politics</td>
<td>A critical examination of alternative approaches to the study of international politics. Admission by consent of instructor. 3 hours, fall term (not offered, 1970-71)</td>
<td>3</td>
<td>Fall</td>
</tr>
<tr>
<td>488*</td>
<td>International Organizations</td>
<td>A study of the nature and functions of International Organizations, and an evaluation of the League of Nations and the United Nations systems. Admission by consent of instructor. 3 hours, winter term.</td>
<td>3</td>
<td>Winter</td>
</tr>
<tr>
<td>490*</td>
<td>Senior Research Seminar</td>
<td>Admission by consent of instructor. 3 hours.</td>
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<tr>
<td>491*-498*</td>
<td>Special Subjects</td>
<td>In any year one or more subjects may be offered as special seminars. Course descriptions will be announced at the time of registration.</td>
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<tr>
<td>499</td>
<td>Senior Honours Essay</td>
<td>Students wishing to register in Political Science 499 should consult the Department.</td>
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</tbody>
</table>

**Senior Undergraduate and Graduate Courses**

*Note* Courses at the 500 level are open to senior undergraduates and to students in qualifying programmes 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, fall 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 contract 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 (not offered, 1970-71)

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, fall 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.

571* The Election Process
An analytical and comparative treatment of electoral machinery and law, voting systems, and redistribution problems.
3 hours, fall 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

Chairman of the Department
Professor J.A. Dyal, B.A. (Oklahoma), Ph.D. (Illinois)

Professor R.K. Banks, B.A., M.A., Ph.D. (Toronto)
Professor G.T. Barrett-Lennard, B.Sc., B.A. (Western Australia), Ph.D. (Chicago)
Professor M.P. Bryden, S.B. (Massachusetts Institute of Technology), M.Sc., Ph.D. (McGill)
Professor J.M. Butler, B.S., Ph.D. (Minnesota)
Professor K.D. Mackenzie, A.B., Ph.D. (University of California, Berkeley)

(Management Sciences and Psychology)
Professor R.K. Penney, B.A. (Wayne State), Ph.D. (Iowa)
Professor D.A. Sprott, B.A., M.A., Ph.D. (Toronto) F.S.S.

(Statistics and Psychology)
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 W.W. Dick, B.Th. (University of Manitoba), B.A., B.D. (University of Toronto)

(Counselling and Psychology)
Associate Professor W.D. Fenz, B.A. (Southern Missionary), M.A., B.D. (St. Andrew's), M.Sc. (Hawaii), Ph.D. (Massachusetts)
Associate Professor J.G. Kalbfleisch, B.Sc. (Toronto), M.Sc., Ph.D. (Waterloo)

(Statistics and Psychology)
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 P.M. Rowe, B.A. (Toronto), M.A. (Dalhousie), Ph.D. (McGill)
Associate Professor R.R. Ross, B.A., M.A., Ph.D. (Toronto)
Associate Professor R.A. Steffy, B.A. (Albright), M.A., Ph.D. (Iowa)
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)
Assistant Professor D.M. Amoroso, B.A., M.A. (Toronto), Ph.D. (Waterloo)
Assistant Professor P.E. Bowers (Mrs.), B.A. (Rosemont), M.A., Ph.D. (Illinois)
Assistant Professor M. Breidenbaugh (Mrs.), B.A. (Wittenburgh), Ph.D. (Vienna)
Assistant Professor M. Brown, B.Sc., M.Sc. (McGill), Ph.D. (Michigan)
Assistant Professor M. Coltheart, B.A., M.A. (Sydney), Ph.D. (Monash)
Assistant Professor G.R. Engel, B.A., M.A., Ph.D. (Queen's)
Assistant Professor A.C. Firetto, C.R., B.A. (Western), M.A. (St. Louis), Ph.D. (Loyola)
Assistant Professor A.H. Miller, B.E.S., M.A. (Michigan)
Assistant Professor J.A. Van Evra (Mrs.), B.A. (Valparaiso), M.A., Ph.D. (Michigan State)
Assistant Professor J.C. Firetto, C.R., B.A. (Western), M.A. (St. Louis), Ph.D. (Loyola)
Assistant Professor G.A. Griffin, B.A. (Colgate), M.A., Ph.D. (Wisconsin)
Assistant Professor W.C. Horne, B.A., M.A., Ph.D. (Iowa)
Assistant Professor W.J. Hudspeth, B.A., M.A. (San Jose State), Ph.D. (Claremont)
Assistant Professor F.D. Kemp, B.A. (Texas Christian), Ph.D. (Harvard)
Assistant Professor R.D. Lambert, B.A., M.A. (McMaster), Ph.D. (Michigan)

(Sociology and Psychology)
Assistant Professor D. Meichenbaum, A.B. (City College of New York), M.A., Ph.D. (Illinois)
Assistant Professor P.M. Merikle, B.A. (Knox), M.A., Ph.D. (Virginia)
Assistant Professor A.H. Miller, B.E.S., M.A. (Michigan)
Assistant Professor R.D. Seim, B.A. (Queen's), Ph.D. (Waterloo)
Assistant Professor (part-time) J.A. Van Evra (Mrs.), B.A. (Valparaiso), M.A., Ph.D. (Michigan State)
Department of Psychology

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 D.S. Barnes, B.A., M.D. (Western Ontario)
Adjunct Professor A.J. Cawley, D.V.M., D.V.Sc. (Toronto)
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 L.E. Tauber, B.S. (Union College), M.A. (University of Kentucky), Ph.D. (Purdue)
Adjunct Professor D.J. Torney, B.A., M.A. (Western Ontario), Ph.D. (Waterloo)

Undergraduate Offerings

A course in Introductory Psychology (Psychology 101*) is a 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*, 395*, 397*

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.
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
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.

241* Educational 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.
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: 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: One of Psychology 205*, 206* or 207*.
3 hours.

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: 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 285*.
3 hours.

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.

350J 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.

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: 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 253*.
3 hours.

397* 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: One of Psychology 331*, 355* or 357*.

410 History and Systems
An examination of current theoretical approaches to psychological problems present in a historical context.
2 hours.

449 Experimental Design
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

451* Senior seminar in Learning.
Admission by consent of instructor.
2 hours.

452* Senior seminar in Perception.
Admission by consent of instructor.
2 hours.

453* Senior seminar in Developmental Psychology.
Admission by consent of instructor.
2 hours.

454* Senior seminar in Educational Psychology.
Admission by consent of instructor.
2 hours.

455* Senior seminar in Social Psychology.
Admission by consent of instructor.
2 hours.

456* Senior seminar in Personality.
Admission by consent of instructor.
2 hours.

457* Senior seminar in Clinical Psychology.
Admission by consent of instructor.
2 hours.

458* Senior seminar in Cognitive Processes.
Admission by consent of instructor.
2 hours.

459* Senior seminar in Motivation.
Admission by consent of instructor.
2 hours.

461* Senior seminar in Physiological Psychology.
Admission by consent of instructor.
2 hours.

462* Senior seminar in Animal Behaviour.
Admission by consent of instructor.
2 hours.

463* Senior seminar in Special Topics.
Admission by consent of instructor.
2 hours.

464* Senior seminar in Special Topics.
Admission by consent of instructor.
2 hours.

465* Senior seminar in Special Topics.
Admission by consent of instructor.
2 hours.
466* Senior seminar in Special Topics.  
Admission by consent of instructor.  
2 hours.

480 Directed 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 Offerings

Courses numbered 600-697 and 801 and above are offered on a half-year basis. Courses numbered 698-770 are full-year courses.  
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.  
Available major areas of specialization at the Ph.D. level are: perception and cognition, learning and motivation, biopsychology, child behaviour and development, social and personality, clinical, and counselling and human relations. Specific training programmes are constructed to suit the student's interests, goals and skills through consultation with his advisor. Candidates electing to major in clinical psychology or in counselling and human relations are required to complete internship training under conditions approved in advance by the Department.  
Students in the doctoral programme may, in most areas, receive the M.A. degree but the Department does not offer a Master of Arts programme as such.  
Students primarily interested in professional work in applied settings, for which they are seeking to qualify at the master's level, are advised to take the M.A.S. programme. This programme is organized on a co-operative plan and includes four full terms of on-campus study and two terms of employed practical work and training in field settings. Students enter the programme in mid-September and will go out for their first fieldwork (internship) term in the following January or May. The degree thus requires two calendar years beyond the honours bachelor degree in psychology or equivalent preparation.
Graduate Courses

601*-610* Special Topics in Clinical Psychology

"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. A critical evaluation of methodological and design problems in modification research is examined.

621* Basic Issues in Clinical Psychology
A critical evaluation of issues that have particular relevance for clinical psychology. Epistemological and methodological issues will be raised as well as problems in person perception, clinical judgment and behaviour change. This course will also include historical developments, ethical problems and role definition of clinical psychology.

622* Psychodynamics
This course deals with the theoretical structures upon which psychological treatment is based. Coverage ranges from orthodox psychoanalytic theory to current phenomenological and social-learning theories.

623* Personality Assessment
This course deals with the nature, validity and underlying assumptions of the major “diagnostic” clinical tests. Emphasis is placed on the more difficult “projective” tests.

624* Psychopathology
Traditional views and recent experimental approaches to psychopathological states are analyzed and contrasted. Course work is concerned with the definition and research of certain central concepts, mental illness, anxiety, defense mechanisms, unconscious processes, neurotic and schizophrenic reactions.

625* Psychotherapy
A detailed coverage of psychotherapeutical systems; their respective views of health-illness, their techniques of intervention, and related research are considered.

626* Psychotherapy Practicum
Students will conduct continuing psychatherapy under supervision of the staff. Theoretical and practical issues will be discussed. “Graded on a pass-fail basis”.

627* Seminar in Clinical Psychology 1
This seminar is designed to enable individual staff members to present their current points of view and research contributions.

628* Seminar in Clinical Psychology 2
Presentations by individual staff members supplementary to those given in 627*.

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 I.Q. tests and report writing.
"Graded on a pass-fail basis".

635* Clinical Fieldwork Practicum
Training and research and assessment procedures in clinical settings.
"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 procedure featuring projective tests, and instruction in neuropsychological assessment.
"Graded on a pass-fail basis".

640*-649* Selected Topics in 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
"May be graded on a pass-fail basis".

670*-679* Special Topics in Biopsychology
"May be graded on a pass-fail basis".

680*-689* Special Topics in Child Behaviour and Development
"May be graded on a pass-fail basis".

690*-697* Special Topics in Social and Personality
"May be graded on a pass-fail basis".

698 Internship

699 Thesis

701 Sensory and Perceptual Processes
A seminar series surveying some of the major contemporary problems in the area. Both human and animal research will be discussed.

702 Learning
This course is designed primarily for students who want a general broad grounding in Learning. A weekly two-hour course surveying contemporary research and theory in Learning.

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 development and psychological studies including experimental, comparative, cross-cultural, and studies of interactive processes will be considered. 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 to be covered will include those from the areas of: physiological, physiological chemistry, phylo- eny, ethology, and comparative psychology.

721, 741 Sensory and Perceptual Processes 2, 3
The senior seminar in Perception. A series of seminars focusing on a number of specific selected topics. In addition, research going on within the department will be discussed.

722, 732, 742 Learning 2, 3, 4
Twice weekly meetings. One session each week will be devoted to discussions of important general theoretical problems and controversies in Learning. All students and faculty in the Learning programme will attend these meetings. The second meeting of the week will be held in smaller research interest groups of faculty and students and will consist of students' reports of their research problems. Prerequisite: Consent of instructor. "May be graded on a pass-fail basis".

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. Open to all graduate students with permission of instructor.

730, 731, Counselling and Human Relations Seminar 1, 2
Advanced seminars, 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".

735 Individual Differences in Children
This course deals with the available psychological measuring instruments used in research exploring the behaviourial 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 series 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 specialisation; e.g., cognition, learning, motivation, perception. "May be graded on a pass-fail basis".

770 Instrumentation for the Behavioural Sciences

An introduction to the principles of electricity, relay circuiting, and biographical amplifiers.

Courses Principally for M.A.Sc. Candidates

801* Psychometric Theory

An examination of methods and issues in the construction, selection and evaluation of psychological tests.

Prerequisite: Psychology 631 or consent of instructor.

811* Personality Theory

A consideration of several major theories of personality and relevant areas of research. Applications will be made to case materials.

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.

813* Assessment of Personality 1

The development and use of objective personality and interest tests with reference to the theoretical foundations and research literature.

814* Assessment of Personality 2

An introduction to projective techniques, including their rationale, administration and scoring, fundamentals of interpretation, and discussion of relevant research.

815* Tests in Education

An examination of the major testing materials available for assessment of achievement, interests, aptitudes, and learning disabilities of the child in a school setting. Special attention is given to diagnostic tests through practicum experience.

820* Assessment Practicum

Intensive assessment of individual persons, with emphasis on integrating results from a variety of tests. "May be graded on a pass-fail basis".

822* Social Problems

An overview of the literature on socially deviant behaviour, e.g., drug addiction, delinquency, and on problems of adjustment in industry and education.

830* Personality: Effectiveness and Disability

An examination of concepts of optimal, healthy or mature personality, and of factors that influence the formation and content of such concepts. Problems in the study of personality variation. Patterns and typologies in normal and deviant functioning. Dimensional and level differentiation. Conditions associated with improving and deteriorating functioning.
831* Theories of Psychopathology
A review of leading theoretical interpretations of deviant behaviour, e.g., psycholanalytical, Rogerian, and social-learning theories.

833* Interviewing
Applications and analyses of interviewing in the contexts of gathering and giving information, forming judgments and providing psychological assistance. An examination of influencing and communication processes in interviewing. Effects of interviewer and interviewee characteristics. Interview demonstrations, and introductory practice, reporting and self observation in interviewing.

834* Principles and Practices in Counselling
Counselling as a helping process, examined in the context of differing situations, practical orientations and theoretical interpretations. Communication and relationship features of the client-counsellor interaction. Explanations and research bearing on the process and effects of personal counselling and therapy. Comparison of individual and group counselling. The course will include a practicum of demonstrations and discussion of recorded and live interviews and, according to the opportunities available, experience as a participant counsellor in individual or group situations. 
Prerequisite: Psychology 833.

836* Practicum in Psychological Counselling
Supervised practice in individual and/or group counselling in settings selected with the student's individual interests and objectives in mind. Students will meet with their instructor or supervisor individually and in small groups for intensive examination and discussion of their own counselling sessions and related issues.
Prerequisite: Psychology 834* or consent of instructor.
"May be graded on a pass-fail basis".

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 on-going 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.
Prerequisite: Psychology 834 or consent of instructor.
"May be graded on a pass-fail basis".

840* Selected Topics in Applied Psychology

841* Professional Issues
Ethical concepts, practices and problems. Issues of responsibility, personal and professional values. Implications of a professional influencing function in relation to human conduct and personality. The counsellor in his contemporary and prospective institutional settings and inter-professional relations.
"May be graded on a pass-fail basis".

842* Applied Research
A seminar on methods and issues in applied research.
"May be graded on a pass-fail basis".
843* Research Essay
A formal paper which may either:
(a) report a research study carried out under supervision during work terms; or
(b) present an extensive review of the literature on some aspects of applied psychology; or
(c) present a series of related case studies within a theoretical framework.
"May be graded on a pass-fail basis".

844* Principles of Behaviour Modification and Programmed Learning
Theory and methodology of learning and behaviour change based on operant, reinforcement principles.

847* Organizational Psychology: Personnel
An examination of the psychological basis of the personnel function with special reference to personnel selection, performance review, training, and labour-management relations.

848* Organizational Psychology: Analysis of Organizational Behaviour
A consideration of current theories of organizational behaviour and the use of the system approach in its analysis. Special emphasis is placed on interpersonal interaction and organizational change.

849* Organizational Psychology: Motivation and Leadership
This course deals with the psychological basis of organizational effectiveness with special emphasis on leadership and motivation.

850* Exceptional Children
The classification and definition of the exceptional child within the school system. Characteristics of learning difficulties will be emphasized. Mental retardation, emotional problems, and receptive and expressive handicaps will be considered in detail.

851* Contemporary Issues in Education
A critical evaluation of current curriculum development, educational theory, and related issues in education.

852* Assessment and Treatment of Exceptionality
A study of diagnostic techniques including available tests used to identify the exceptional child. Treatment procedures will be considered, stressing available resources within the school system.

855* Child and Family Counselling
Theory, research and supervised practice in actualization counselling with children and families.

860*, 864* Internship
Four-month (one-term) full-time supervised internship, in a professional field setting affiliated or co-operating with the University for this purpose.
"May be graded on a pass-fail basis".
Department of Recreation

Associate Professor and Chairman of the Department
C.A. Griffith, B.A. (Sir George Williams), M.S. (Indiana), Re.D. (Indiana)

Assistant Professor
D. Ng, B.A. (Lingnan University), M.A. (Carver School, S.B.T.S.), R.E.I. (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 and Kinesiology (Kinesiology 103*)
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.

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.
3 lectures.

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* 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.
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.

240* Statistical Techniques Applied to Recreation
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 and Recreation.
2 hours lecture, 2 hours laboratory.

280* Principles of 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 students' administrative technique.
3 lectures.
285* Basic Recreation Skills

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*, 385*, 386*.
4 hours per week per term.

300* Philosophy of Recreation and Leisure

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.

310* Organization and Administration of Recreation Services

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.
3 lectures.
Prerequisite: Recreation 103.

315* Therapeutic Recreation

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 interrelationships of the various disciplines within the settings.
3 lectures.
Prerequisite: Consent of the instructor.

320* School Recreation

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.

325* Outdoor Recreation

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.

350* Research Design

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.

385* Basic Recreation Skills
(See Recreation 285*).

386* Basic Recreation Skills
(See Recreation 285*).

400* Comparative Programmes in Recreation

A study of recreation programmes in Canada, the United States and several European countries.
3 lectures.

410* 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.

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.

Water Polo Competition
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)

Associate Professor P
A.M. McCachlin, M.A. (Toronto), B.D. (Emmanuel), Th.D. (Emmanuel)

Assistant Professor R
M. Bird, B.A., M.A. (Iowa)

Assistant Professor P
E.B. Gamble (Miss), B.A. (Victoria), M.A. (Columbia), B.R.E. (Emmanuel)

Assistant Professor P
D.M. Lochhead, B.Sc., B.D., S.T.M., Ph.D. (McGill)

Assistant Professor G

Assistant Professor
D. Sahas, B.D. (Athens), S.T.M. (Christian Theological Seminary), Ph.D. (Hartford Seminary Foundation)

Lecturer
J. Dahms, B.A. (McMaster), B.D. (Evangelical Theological Seminary, Napierville), Th.M. (Emmanuel)

Lecturer P
W.H. Hall, B.A. (Loyola), B.Th., S.T.L. (Montreal)

Notes
Purposes of the Programme in Religious Studies
a) to expose the student to the issues 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 religions of the world;
c) to introduce him to the specifics of one or more religious traditions, and to the method of their systematic study.

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 Religious Studies 210*, 211*, One other course in RS
Year 3 Religious Studies 336P or 231J, One other course in RS

Each programme should also include at least one course which deals with the literary sources of religious traditions, (i.e., Scriptures).
The honours programme in Religious Studies may be found in Section 2 of this Calendar.

Undergraduate Courses

50J Grace and the Sacraments
Grace; concepts pertaining to all the sacraments; the meaning of sacramental life to the individual and to society.
3 lectures, (at Resurrection College only).

101J* Introduction to the Old Testament
Principles of Exegesis; date of composition, authorship, literary forms, historical and psychological backgrounds.
3 lectures, fall term.

102J* Introduction to the New Testament
This course will be conducted on the same lines as RS 101J*.
3 lectures, winter term.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>103G*</td>
<td>History and Literature of the Bible 1</td>
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<td></td>
<td>A study of the history of Israel with special emphasis on Israel's view of</td>
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<td>history and its consequences for ethics.</td>
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<tr>
<td>104G*</td>
<td>History and Literature of the Bible 2</td>
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<td></td>
<td>A study of the life and teaching of Jesus of Nazareth on the basis of the</td>
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<td></td>
<td>Synoptic Gospels.</td>
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<td>105P</td>
<td>Introductory Hebrew</td>
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<td>An introduction to Hebrew grammar. Translation and exegesis of selected</td>
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<td></td>
<td>passages from the Old Testament.</td>
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<tr>
<td>106P</td>
<td>New Testament Greek</td>
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<td>This course will consist of two parts: (a) An introduction to Greek grammar</td>
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<td>with appropriate grammatical exercises and development of vocabulary;</td>
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<td>(b) An exegetical study of the Greek text of the Synoptic Gospels,</td>
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<td>with Mark as the basis.</td>
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<td>107*-108*</td>
<td>Origins of the Judaeo-Christian Tradition</td>
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<td></td>
<td>A study of the history, literature and basic religious concepts of the</td>
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<td>Hebrew people up to and including the beginnings of the Christian Church.</td>
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<td>The Old and New Testaments will be used as basic sources. This course is</td>
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<td>offered jointly by Conrad Grebel, Renison, St. Jerome's and St. Paul's</td>
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<td>Colleges. It will be taught co-operatively by representatives of different</td>
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<td>religious traditions.</td>
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<tr>
<td>112G*</td>
<td>Ancient Near Eastern Religion</td>
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<td></td>
<td>An analysis of the myths, epics, legends, rituals, incantations, prayers,</td>
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<td>and festival texts of ancient near eastern peoples with special emphasis</td>
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<td>on the religions of Egypt, Babylonia and Phoenicia-Canaan.</td>
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<tr>
<td>130P*-131P*</td>
<td>Introduction to Theology</td>
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<tr>
<td></td>
<td>A survey of the basic elements of Christian Faith, the relationship</td>
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<td>between revelation and reason, the authority of Scripture, the doctrine of</td>
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<td>God, of man, of the Church, of God's activity in history.</td>
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<td>3 lectures, fall and winter terms.</td>
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<tr>
<td>135*</td>
<td>Philosophy Fundamentals of the Philosophy of Religion</td>
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<td>A philosophical consideration of problematic aspects of religious belief.</td>
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<td>Topics to be discussed will include: attempts to prove the existence of</td>
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<td>God, the problem of evil, faith and reason, religious experience, and</td>
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<td>religious language. Classical and contemporary readings will be used.</td>
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<td>3 lectures.</td>
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<td>205G</td>
<td>The Hebrew Prophets</td>
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<td>A study of the writings of Amos, Hosea, Isaiah, Micah, Jeremiah, and</td>
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<td>Ezekiel in the historical, social, and religious context of the ancient</td>
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<td>world, and of their influence upon the development of Old Testament</td>
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<td>literature.</td>
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<td>210*</td>
<td>Religions of Mankind 1</td>
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<td></td>
<td>An introduction to the religious traditions of the East: history, religious</td>
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<td>beliefs and practices of Hinduism, Buddhism, Shinto, Zen Buddhism, and</td>
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<td>Confucianism.</td>
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<td>3 lectures.</td>
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<tr>
<td>211*</td>
<td>Religions of Mankind 2</td>
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<td></td>
<td>Encounter with Judaism, Christianity and Islam: the history and interaction</td>
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<td>of the three major religious traditions which have shaped the image of the</td>
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<td>Western World.</td>
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<td>3 lectures.</td>
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</table>
212G* Ancient Near Eastern Religion
An analysis of the myths, epics, legends, rituals, incantations, prayers and festival text of ancient and near Eastern peoples with special emphasis on the religions of Egypt, Babylonia and Phoenicia-Canaan.

218*G Discipleship in Early Christianity
An exploration into the nature of early Christianity from the standpoint of one of its central concepts: Discipleship. Jesus as a teacher and the function of his teachings in the development of early Christianity will be investigated against the background of teacher-student (disciple) prototypes in Hellenistic and Jewish cultures.

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.
3 lectures.

224G* History of the Late Medieval and Reformation Church
(A.D. 1200-1560). Especially emphasized are parish life and belief and the causes of the reformation. The Anabaptist movement is studied as a significant part of the reformation in addition to the traditional concern with Lutheran, Reformed and Anglican Christianity.

231J Traditional Catholic Theology Facing the Modern World

232J Christology
New insights into the human side of Christ as presented in the Bible and reflected in Church History, especially the human consciousness of Christ and the satisfaction theory.

233P*-234P* Contemporary Atheism and Faith in God
An examination of the questions which contemporary atheists ask of the Christian faith. The atheistic universe and the absence of God, the question of God in philosophy, the nature of God as seen by faith, interpretations of the meaning of revelation, the act of faith, the relation of theology to other academic disciplines.
3 lectures.
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 selected from figures such as the Hebrew Prophets, Paul, the Apologists, Origin, Athanasius, Gregory of Nyssa, John of Damascus, Muhammad, the Mutazilites, al-Ashari, al-Ghazzali, Ibn Sina, Ibn Iahldun, Maimonides, Isaac Luria.
3 lectures.

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.
3 hours.

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.

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.

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 genetics, computer science, 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. 

301* Readings in World Religions
Readings from the Holy Scriptures and the Sacred Tradition of Judaism, Christianity and Islam, "The People of the Book" (Ahl-al-kitab): Torah and Talmud, Bible and Church Tradition, Qur'an and Hadith Literature.
Prerequisite: RS 211.

310* (Classical Civilization 371*)
Greek myth and religion.

311* (Classical Civilization 372*)
Early Christianity and the Roman Empire.

315*-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 instructor.
321* (History 321*) Medieval History 476-1100
A consideration of the main political, social, economic and religious themes of the Medieval period.
3 hours.

322* (History 322*) Medieval History 1100-1500
A consideration of the main political, social, economic and religious themes of the Medieval period.
3 hours.

323* (History 353*) Medieval Church History from 312 to 1122
3 hours, lectures and seminars.

324* (History 354*) Medieval Church History from 1122 to 1449
3 hours, lectures and seminars.

330J Contemporary Social Doctrine of the Church
The Church and society; the pronouncements of the Church on civil, domestic, professional and international societies.
3 lectures.

331J Theology of Secular Values
Historical survey of development in Catholic Theology during the last fifty years. The modern world facing the new Theology.

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 consideration will be announced in advance each year. Prerequisite: One full or two half Philosophy courses. 3 hours.

336P Contemporary Theology
The sources of contemporary theology in 19th century thought with particular reference to Schleiermacher, Kierkegaard and Nietzsche. The thought of selected contemporary theologians, including Barth, Tillich and Bonhoeffer. Special attention to certain problems such as secularization and the 'death of God'. 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.

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.

360* Eastern Christianity† The Orthodox Church of Greece, Middle East, Russia, and Eastern Europe, yesterday and today; its history, theology, culture, art and modern situation; accompanied by slides and music. Prerequisite: RS 223G*—224G* or History 260, or History 353*—354*.

398*-399* Directed Readings in Special Subjects.†

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.†

420 (History 476) Prerequisite: History 260 or Religious Studies 223G*-224G*.
Senior Tutorial in History of Renaissance and Reformation
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.†

434 The History of Christian Thought to 1800.†

435*-439* (Philosophy Studies in Philosophy of Religion) Prerequisite: Consent of instructor.
435*-439* A study of a particular philosopher or problem. The topic will be announced in advance each year.
3 hours.
† Students wishing to enrol in a course marked with a dagger (†) should consult the department.

Small Group Seminar
Science

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, fall term.

202* 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.

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 137) or equivalent.
2 lectures.
Department of Sociology and Anthropology

Sociology

Professor G.L. De Gré, B.S.S. (City College, N.Y.), M.A., Ph.D. (Columbia), Cated, Hon. (San Marcos, Lima)

Chairman of the Department

Professor H.I. Fallding, B.A., B.Sc., M.A. (Sydney), Ph.D. (Australian)

Visiting Professor O. Friedman, Jur. Dr. (Prague), M.Sc., (Econ.) (London)

Professor J.W. Fretz, A.B. (Bluffton), B.D. (Chicago Theol. Seminary), M.A., Ph.D. (Chicago)

Professor H.D. Kirk, B.S. (City College, New York), M.A., Ph.D. (Cornell)

Associate Professor F.A. Fasick, B.A. (Pennsylvania State), M.A., Ph.D. (Columbia)

Associate Professor D. Kubat, M.A. (Kansas), Ph.D. (L. Maximilian, Munich)

Associate Professor W.L. Sauer, B.A. (Wayne State), M.A., Ph.D. (Michigan State)

(On leave of absence)

Associate Professor E.W. Vaz, B.A., M.A. (McGill), Ph.D. (Indiana)

Assistant Professor J.M. Alleyne, B.A. (Sir George Williams), Ph.D. (Johannes Gutenberg)

Assistant Professor M.A. Beauchamp, B.A., M.A. (Buffalo)

Assistant Professor R.D. Lambert, B.A., M.A. (McMaster), Ph.D. (Michigan)

Assistant Professor A. Wipper (Miss), B.A., M.A. (McGill), Ph.D. (California)

Assistant Professor J.E. Gallagher, B.A. (Middlebury), M.A. (Indiana)

Lecturer (part-time) M.J. Orr (Mrs), B.A. (McMaster), M.A. (Waterloo)

Lecturer (part-time) E.S. Lucy, B.A. (Hobart)

Anthropology

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 M.H. Hill, B.A., M.A. (Washington State)

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)

Undergraduate Courses

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, Biology 231 (or a course in physical anthropology), Anthropology 320 or 322, Anthropology 350, Anthropology 450, and three additional advanced (200 or above) anthropology courses.

101* Origins of Man and Culture An introductory course in Physical Anthropology and Archaeology. Lectures on living and 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.

222 North American Archaeology
A survey of North American archaeology from the earliest known cultures to the time of European contact. Data on the Great Lakes will be emphasized.
Prerequisites: 101 or permission of the instructor.

223 Old World Archaeology
A survey of Old World archaeology from the beginning of culture up to the advent of history.
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.
Prerequisites: 102 or permission of the instructor.

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.

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 nativistic 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 102* or 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 socio-economic 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.

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.

320 Introduction to Structural Linguistics
A general introduction to structural linguistics. A survey of linguistic approaches to the analysis and description of languages.
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 (uses and functions of language). Illustrations will be from a variety of languages.

**Prerequisites:** 102 or permission of the instructor.

*347* 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.

*348* Peasant Society and Culture
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.

*350* Culture Theory
A survey of the historical development of the concepts of culture, cultural evolution, and acculturation.

**Prerequisites:** 101 and 102.

*353* Primitive Social Organization
A study of primitive social structure with primary emphasis on kinship systems.

**Prerequisites:** 102 or permission of the instructor.

*356* Comparative Economic Organization
A discussion of the alternative means of organizing economic activity, focused primarily on non-market societies.

**Prerequisites:** 102 or permission of the instructor.

*357* Hunting and Gathering Cultures of North America
Archaeological and ethnological data on various prehistoric and historic groups are presented. Emphasis is on hunting and gathering cultures as a distinct type.

**Prerequisites:** 101 and 102, or permission of the instructor.

*358* Archaeological Theory
A seminar on current Archaeological theory.

**Prerequisites:** 101, 222, or 223, or permission of the instructor.

*359* Political Anthropology
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.

**Prerequisites:** 102 or permission of the instructor.

*360* Variability in Human Populations
Study of physical variation and its causes in contemporary human populations.

**Prerequisites:** 260 or permission of the instructor.

*362* New World Civilizations
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.

**Prerequisites:** 222 or permission of the instructor.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Description</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>370*</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>
<td>102 or permission of the instructor.</td>
</tr>
<tr>
<td>371</td>
<td>Archaeological Field Methods</td>
<td>Data gathering techniques will be studied and applied in fieldwork on both constructed and natural archaeological sites.</td>
<td>101 or permission of the instructor.</td>
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<td>Offered summer 1971.</td>
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<tr>
<td>380*</td>
<td>Cross-Cultural Analysis</td>
<td>Examination of theory, method, and selected achievements of comparative studies. Classic and recent literature dealing with such topics as comparability of units and Galton's problem will be considered and a joint study undertaken as a class project.</td>
<td>102 or permission of the instructor.</td>
</tr>
<tr>
<td>388*</td>
<td>Applied Anthropology</td>
<td>The technical and ethical aspects of directed culture change will be examined.</td>
<td>370 or permission of the instructor.</td>
</tr>
<tr>
<td>390 or 391*</td>
<td>Reading in Anthropology</td>
<td>Guided reading in a selected portion of the anthropological literature.</td>
<td>Anthropology major and permission of the instructor.</td>
</tr>
<tr>
<td>401</td>
<td>Seminar in the Literature of Social and Cultural Anthropology</td>
<td>Intensive reading and discussion of the outstanding works of description and theory in Twentieth Century anthropology.</td>
<td>102 or permission of the instructor.</td>
</tr>
<tr>
<td>420*</td>
<td>Social and Cultural Change</td>
<td>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.</td>
<td>Anthropology 350 or permission of the instructor.</td>
</tr>
<tr>
<td>450</td>
<td>Honours Seminar</td>
<td>Seminar on selected contemporary issues in anthropology. Open only to Honours Anthropology students.</td>
<td></td>
</tr>
<tr>
<td>499</td>
<td>Honours Essay</td>
<td>Directed reading and research in a selected area of anthropological inquiry. Open only to Honours Anthropology students.</td>
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</tr>
</tbody>
</table>

**Sociology**

*Note 1* General students who major in Sociology must elect the following courses: Sociology 101*-102, 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:
Sociology 101*-102*, 202*, 321*-322*, 425*-426, three and one-half electives in Sociology, plus Sociology 499, if the student chooses. There are three joint Honours programmes, combining Sociology with each of the following disciplines: Anthropology, Political Science, and Psychology. Students interested in some other combination should consult with the Department.

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, and modern languages.

15* Sociology A general introduction to the subject covering the main concepts, theories and ideas and how they relate to study of groups in society.

101*-102* 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. Special small sections will be made available for students who are majoring in the Department, or who indicate their expectation to do so, including those engaged in joint programmes with Sociology: Anthropology, Psychology, Political Science, etc.

101* (Fall) General introduction to the subject covering main concepts and analytical approaches. Students should possess a sound knowledge of basic sociological concepts.

102* (Winter) On the basis of the theoretical and descriptive framework provided in Sociology 101*, continuing analysis of specific institutions, associations, social action, etc., will be undertaken. Prerequisite: Sociology 101*.

120*G and 121*G Focal Issues in Contemporary Society I and Focal Issues in Contemporary Society II 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.

202* Sociological Statistics A first course in sociological statistics; sampling, central tendency, probability, co-variance, as illustrated in specifically sociological data.

205*G 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.

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.
<table>
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<tr>
<th>Course Code</th>
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</tr>
</thead>
<tbody>
<tr>
<td>210*</td>
<td>Introductory Social Psychology</td>
<td>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.</td>
</tr>
<tr>
<td>212*</td>
<td>Interpersonal Relations</td>
<td>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.</td>
</tr>
<tr>
<td>230*G</td>
<td>Family and Kinship</td>
<td>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.</td>
</tr>
<tr>
<td>240*</td>
<td>Collective Behaviour</td>
<td>The sociological analysis of the behaviour of crowds, mobs, publics, and related phenomena and their relationships to social organization and social change.</td>
</tr>
<tr>
<td>241*</td>
<td>Social Movements</td>
<td>The sociological analysis of varieties of social movements and their relationships to social organization and social change.</td>
</tr>
<tr>
<td>250*</td>
<td>Crime and Society</td>
<td>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.</td>
</tr>
<tr>
<td>251*</td>
<td>Ethnic and Racial Relations</td>
<td>Relations between different racial and cultural groups; analysis of majority-minority group status.</td>
</tr>
<tr>
<td>252*</td>
<td>Juvenile Delinquency</td>
<td>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.</td>
</tr>
<tr>
<td>260*</td>
<td>Population</td>
<td>The study of population as an area of sociological investigation; population size, composition, and distribution; population trends and problems.</td>
</tr>
<tr>
<td>270*</td>
<td>Communication</td>
<td>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.</td>
</tr>
<tr>
<td>280*</td>
<td>Social Organization</td>
<td>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.</td>
</tr>
</tbody>
</table>
300* Human Communities (non-literate, folk and rural) A comparative analysis of different types of human communities from mainly sociological and anthropological points of view: primary emphasis on types of communities found in non-literate, folk, and pre-industrial rural societies; major theories concerning communities of these types. 
Prerequisites: Sociology 101* and 102* and Anthropology 102*.

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.

310* Seminar in 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 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.

312* Liberating Social Movements Dehumanizing institutions are not infrequently undermined by countervailing forces. Peasant and slave revolts, socialism and anarchism, consumer cooperation and utopian communities, some forms of nationalism, and a diffuse revolution of manners are among the social 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, 1 hour lab. Winter 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 lectures, 1 hour lab. Winter term.

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.

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.

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.

380* 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, readings, 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 relations to the environing system.

Prerequisite: Consent of instructor.

402* Marxist Social Theory and Historical Sociology

This course will focus on the contribution of Marxism to the development of sociological theory in its relation to other types of historical sociology. Readings will include selections from Marx, Engels, Lenin, Plekhanov, Lukacs, and contemporary sources.

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; 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: Practicum 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 basis of the reanalysis and reinterpretation of 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.

Graduate Programme in Sociology

The Department of Sociology of the University of Waterloo offers 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 once only.

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

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 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 honour 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 honour students.)

542* Seminar Organizational Analysis This seminar will study diverse theories, models and methods, and interdisciplinary approaches relevant to the analysis of complex or-
ganizations, 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 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

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.
Department of Sociology and Anthropology

(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 industrialization occurring in developing nations.

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.

660* The Bases of Community
Community is considered as an affinity bond rather than place (Durkheim's "mechanical solidarity"; Toennies' "Gemeinschaft"). The competitive strengths of the following in generating community are considered: kinship, territory, race, class and beliefs.

670* Social Psychology
A seminar dealing with theoretical issues and research findings in the area of social psychology.

699 Thesis
Department of Systems Design

Professor and Chairman
H.K. Kesevan, 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 Dean

Undergraduate Studies

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
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

Lecturer
D.G. McGeary, B.Sc. (Manitoba), M.A.Sc. (Waterloo)

Adjunct Professor
L.G. Innes, M.A. (Aberdeen)

Associated 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)

Undergraduate Courses

10 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. Parametric and polar equations. Mean value theorem. Introduction to partial derivatives. Introduction to differential equations with applications.

11 Finite Mathematics Review of symbolic logic and set theory; fundamentals of probability theory, equiprobable spaces, conditional probability; determinants, matrix algebra, matrix inverse.

12 Operations Research 1 Criterion functions, constraints; introduction to linear programming, primal and dual problems, the simplex method; applications involving the use of digital computers.

13 Operations Research 2 Introduction to dynamic programming; game theory; the Monte Carlo method, search techniques; steepest descent and gradient methods; applications to transportation; production and inventory, and other systems problems.

21 Numerical Analysis and Computation Application of digital computers to the solution of equations; determinants and matrices; eigenvalue problems, numerical solution of ordinary differential equations; difference equations, numerical integration methods; error analysis.
22 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.

23 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 in the design process; graphic input-output, time-sharing, conversational mode languages; design of problem-oriented computer languages.

31 Socio-Economic Systems 1
Econometric models, structural models and locational or regional models.

32 Socio-Economic Systems 2
Applications of the techniques and theories of operations research and economics to management systems.

33 Socio-Economic Systems 3
Mathematical programming in Economics by physical analogies. Large-scale socio-economic systems modelling.

34 Socio-Economic Systems 4
An extension of the materials of courses SD33 and SD53 to economic managerial systems.

41 Human Systems Engineering 1
The structure and function of man in relation to systems design; the relationship of biology and human physiology to engineering; biological concepts, biological variation; the cell as a microsystem; man as a complex of systems and subsystems.

42 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.

43 Human Systems Engineering 3
Problems of man within a man-machine environmental complex; the nature of human environmental stress; problems arising in association with environmental hazards.

44 Human Systems Engineering 4
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.

50 Physics
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.

51 Physical Systems 1
Component models, interconnection models, system equations and their rank properties and solutions. These concepts are developed with respect to electrical systems.
52 Physical Systems 2 The subject matter is similar to SD51 except that the development is based on other physical systems such as structural and hydraulic system.

53 Physical Systems 3 A study of multiparameter sensitivity analysis and probabilistic system analysis, with special reference to physical systems.

54 Optimization Theory Dynamic programming, simulation models for co-state equations, two-point boundary value problems, applications.

60 System Design 1 A course for first year students encompassing several major areas, namely: design of experiments, digital computation, graphics, engineering synthesis and, introduction to Socio-Economic Systems. (7 hours weekly for two terms.)

61 Systems Design Workshop 1 A selection of open-ended design problems and seminars to accompany courses SD21, SD41, SD31.

62 Systems Design Workshop 2 A selection of open-ended design problems and seminars to accompany courses SD51, SD42, SD12.

63 Systems Design Workshop 3 A selection of open-ended design problems and seminars to accompany courses SD52, SD13, SD32, SD22.

64 Systems Design Workshop 4 A selection of open-ended design problems and seminars to accompany courses SD33, SD81, SD23.

65 Systems Design Workshop 5 A selection of open-ended design problems and seminars designed for final year undergraduate students.

66 Systems Design Workshop 6 A selection of open-ended design problems and seminars designed for final year undergraduate students.

71 Communications 1 Study of human and machine communication processes, communication theories as applied to education. Design of communication systems including languages and messages.

72 Communications 2 A continuation of SD71 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.

81 Applied Electronics Component models of various electronic devices. oscillation, amplification, modulation, detection, application to instrumentation.

D501 Human Factors Man-machine systems; man-machine interface; presentation of information; design of displays and controls; workplace, layout, human factors in design.

D502 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 automative safety.

An undergraduate programme in Systems Design is currently under development and will be offered starting in the Fall semester of 1969.
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*
* Design Methodology and Morphology*
* Human Systems Engineering*
* Socio-Economic Systems*
* Systems Theory and 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 as 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 degrees 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 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 consists 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


611 Applications of Linear Graph Theory

Topological formulas for general linear systems, synthesis of communication nets, system diagnosis. Applications to switching theory, sociology, economics, etc.

622 Introduction to Computer-aided Design

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.

631 Games, Metagames and Rationality

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.

632 Applied Metagame Theory

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.
642 Human Function 1  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.)

643 Human Function 2  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.

651 System Theory 1  Review of linear graph theory. Rank properties of the matrices of graphs. Formulation of system equations based upon terminal representations of components. Branch, chord, and mixed methods in the Laplace domain. Solution of large systems through subsystems. Applications in a number of diverse fields.

652 System Theory 2  A continuation and generalization of SD651. Formulation of state models for discrete systems. Introduction to time domain sensitivity models.


668 Design Morphology and Organization  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.


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.

711 Statistical Models in Systems Engineering
712 Analytic and Algebraic Methods in Systems Engineering
713 Topics in Graph Theory
722 Topics in Computer-Aided Design
723 Computer Simulation Methods
730 Topics in Socio-Economic System Theory
732 Seminar in Industrial Dynamics
741 Topics in Human System Engineering
751  Topics in System Theory
761  Topics in Probabilistic Systems
770  Topics in Design Morphology
752  Planning of Design Processes
760  Human Communications
735  Seminar in Differential Games
741  Topics in Human Systems Engineering
785  Optimal Control Theory 2
801  Oral Examination of the Research Thesis for the Ph.D.
803  Comprehensive Examination for the Ph.D.
804  Language Requirement for the Ph.D.
807  Engineering Project for the M.A.Sc.
808  Research Thesis for the M.A.Sc.
809  Research Thesis for the Ph.D.
School of Urban and Regional Planning

Professor L.O. Gertler, B.A. (Queen's), M.A. (Toronto), Planning (McGill)
Director of the School
Professor Helen Abell (Miss), B.H.Sc., M.Sc., Ph.D. (Cornell)
Visiting Professor E.A. Beecroft, B.A., M.A. (Toronto), Ph.D. (Yale)
Professor R.S. Dorney, B.Sc., M.Sc., Ph.D. (Wisconsin)
Professor (part-time) J.W. Wilson, B.Sc. (Glasgow), M.Sc. (M.I.T.), M.R.P. (N. Carolina)
(Geography and Planning)
Association Professor J.M. Crowley, B.A. (Ag.) (Idaho), M.S., Ph.D. (Minnesota)
Association Professor (Geography and Planning)
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. (Syracuse)
Associate Professor S. Herzog, B.Arch, (Toronto)
Assistant Professor K.S. Sayegh, B.Sc. (Cairo), M.C.P., Ph.D. (Harvard)
Lecturer C.M. Kitchen, B.A. (Queen's), M.A. (Waterloo)

Bachelor of Environmental Studies, Honours Urban and Regional Planning
The Honours Planning Programme as indicated on page 101, 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 84. For more specific information, you may obtain the Division's brochure on graduate programmes, from Mrs. Helen Ben-susan, 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

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 lectures and one-hour discussion session, (fall term).
157* Introduction to Urban and Regional Planning Techniques

Introduction to planning survey, analysis and synthesis in rural and urban areas; basic principles of environmental design; presentation techniques for planning; elementary exercises in survey and design.

Prerequisite: Planning 156* or consent of instructor.

1 - 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, (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 lectures, (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.

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)

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 its procurement and utilization in planning programme. 
No prerequisite. 
3 hours lecture (fall term)

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
A systems approach involving the cultural and natural environments as they relate to planning of recreational land uses and facilities. A study of the planning process as it relates to supplying recreational demands in urban-centered regions. Park planning at the local, provincial and national levels. 
Prerequisite: two of Geography 101*, 102* and Planning 156*, 157* 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 lectures. (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-centered, 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).

375 Quantitative Research Methods
The nature of scientific research; descriptive and inferential statistics as applied to problems in Planning. This course is the same as Geography 375.
Prerequisite: Honours Geography or Honours Planning students, or consent of instructor.
2 lectures, 1 hour seminar.

**391* 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).

**404* Advanced Quantitative Methods 1**
Multivariate statistics and their application in geography and planning. This course is the same as Geography 404*.
Prerequisite: Geography 375 or Planning 375 or consent of instructor.
Honours Geography and Honours Planning students only.
3 hours seminar and/or tutorial (fall term).

**405* Advanced Quantitative Methods 2**
Special techniques and their application in geography and planning, e.g. gravity models, trend surface analysis, Markov chains, linear programming, simulation. This course is the same as Geography 405*.
Prerequisite: Geography 404* or Planning 404* or consent of instructor.
Honours Geography and Honours Planning students only.
3 hours seminar and/or tutorial (winter term).

**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).

**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**
Historical development of the discipline of planning; current trends in the philosophy and methodology.
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-centered 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.

607 Seminar in Quantitative

Methods in Urban and Regional Planning

Advanced study of selected models of locational structure and methods used in location analysis. Emphasis on the analysis of urban and regional planning data using multivariate statistical techniques and the computer.

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 United States and developing countries.
fall 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*)

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.

653* Recreational Resource Planning (Geography 663*)

Forecasting recreational demands: methods of classifying recreational resources; methods of recreational resource inventory; principles of recreational land management and conservation.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
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<tbody>
<tr>
<td></td>
<td>(Geography 664*)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Geography 665*)</td>
<td><em>Prerequisite: Planning 654 or equivalent. Winter term.</em></td>
</tr>
<tr>
<td>656</td>
<td>The Process of Urban and Regional Planning</td>
<td>An advanced course in the techniques of Urban and Regional Planning. Techniques of population analysis and forecasting, economic base analysis, regional input-output, income and product accounts, capital budgeting principles, and social physics models will be considered within the framework of urban and regional case studies. Analysis will be considered in the framework of the planning process, from goal formulation to implementation of plan in the urban-centered region.</td>
</tr>
<tr>
<td>658</td>
<td>Regional Development Planning</td>
<td>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.</td>
</tr>
<tr>
<td>659</td>
<td>Special Problems and Projects</td>
<td>Special planning or resource management problems and projects chosen in consultation with a professor.</td>
</tr>
<tr>
<td>660</td>
<td>Politics and Administration of Planning</td>
<td>Focus on the understanding of the processes involved in policy-making and implementation in Canada and other western countries; study of the impact of technological and socio-economic change on Planning policies, and on the function, form and structure of decision-making institutions.</td>
</tr>
<tr>
<td>675*</td>
<td>Special Readings and Seminar on Selected Planning Topics</td>
<td></td>
</tr>
<tr>
<td>676</td>
<td>Special Readings and Seminar on Selected Planning Topics</td>
<td></td>
</tr>
<tr>
<td>680</td>
<td>Seminar on Philosophy and Methodology of Regional Planning and Resource Development</td>
<td>The conceptual framework of urban, regional, and resource planning; historical development of concepts and recent trends in methodology; relationship of the discipline of geography to the regional planning concept.</td>
</tr>
<tr>
<td>699</td>
<td>Thesis</td>
<td></td>
</tr>
</tbody>
</table>
11 Student Service
Counselling Services

**Director**
W.W. Dick, B.A., B.D. (Toronto), M.A., Ph.D. (Ottawa)

**Assistant Director**
J.J. Wine, B.A. (Bridgewater), M.S. (Iowa State), Ph.D. (Alberta)
A.L. Evans, B.A., B.D., (Toronto), S.T.M. (Boston)
V.R. Koop, B.A. (Tabor), M.A.Sc. (Waterloo)
S. Minas, (Mrs.) B.A. (Wayne State), M.A. (Ohio)
I.J.H. Smart, B.A. (R.C.M.), B.A. (Queen's), M.A.Sc. (cand. Waterloo)
D.J. Torney, B.A., M.A. (Western Ontario), Ph.D. (Waterloo)
J.A. VanEvra (Mrs.) B.A. (Valparaiso), M.A. (Bowling Green State), Ph.D. (Michigan State)
R.J. Walsh, B.A. (Queen's), M.A.Sc. (Waterloo)
J.L. Williams, B.A., M.A. (Alberta), Ph.D. (Missouri)

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 Service offers 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 his social context and his methods of relating to other people and helping him 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 him; for others, it means working on personal, family, or emotional problems which are hindering the student’s work progress or causing him to feel tense, anxious, depressed, alienated, confused, or in some cases, almost overwhelmed by his 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 344, in the Biology Link, Room 381, and in the Campus Centre Drop-In Centre, Room 106. Appointments can be made with the secretary for any time from 9:00-12:00 and 1:00-5:00, 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 the Counselling Service, Medical Health Service, Co-ordination and Placement, and 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 women 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 responsible for the moral and social behaviour of its students. The University rejects any such notion except insofar as such behaviour may affect the rights and welfare of other individuals in the University. This does not mean that members of the University com-
munity 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.

**Off Campus Housing Office**

The Off Campus Housing Office provides addresses of private homes to students wishing to live off-campus. These are not inspected or supervised by the University. Freshman students must bring with them proof of University admission when they apply for assistance. All inquiries must be made in person between the hours of 9:00 a.m. and 5:00 p.m. Monday to Friday. The Housing Office observes all legal holidays.
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 organizations. The campus centre is also the usual meeting place of 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 supersedes 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.
Federation of Students

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.

Organization
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
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
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
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 of 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 pro-
vides 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
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
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 Boards of Student Activities
The Board of Student Activities co-ordinates and supervises all campus-wide programmes, including, Freshman Orientation, Homecoming, Winter Weekend, Grad Ball and Summer Weekend. The Board also maintains a classical record collection for the use of all 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 four 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.

Career Counselling and Placement

The Career Counselling and Placement section of the Department of Co-ordination and Placement provides assistance to graduands from all Faculties who seek permanent employment and to all undergraduates (excluding students in co-operative programmes) who seek summer employment.

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 non co-operative students 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. Students from all faculties are urged to discuss career opportunities with the Placement personnel and to familiarize themselves with the Careers Information Library. Company brochures are also on display and distribution material is available. The Career Counselling and Placement Offices are located on the 6th floor of the Mathematics and Computer Building.

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

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
Residence Information

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.

**Fees**

<table>
<thead>
<tr>
<th></th>
<th>Per Academic Year</th>
<th>Per Academic Term</th>
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</thead>
<tbody>
<tr>
<td>Double</td>
<td>$900.00</td>
<td>$450.00</td>
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</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 International Studies and in Social Work, as well as general arts. Priority in admission is given to Arts students particularly with interests in International Studies and in Social Work. The College has residences for 100 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).

**Fees**

<table>
<thead>
<tr>
<th></th>
<th>Per Academic Year</th>
<th>Per Academic Term</th>
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<tr>
<td>Sept.-April</td>
<td>$975.00</td>
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<tr>
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<tr>
<td>Double</td>
<td>$900.00</td>
<td>$450.00</td>
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**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 is available.

(Single accommodation is not available to first year residents.)

**Fees**

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<tr>
<th></th>
<th>Per Academic Year</th>
<th>Per Academic Term</th>
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<tbody>
<tr>
<td>Single</td>
<td>$1,000.00</td>
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<tr>
<td>Double</td>
<td>$925.00</td>
<td>$462.50</td>
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</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 running water, built-in desks, book shelves, and wardrobes, will accommodate one hundred and twenty students.

The residence has 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**

<table>
<thead>
<tr>
<th></th>
<th>Per Academic Year</th>
<th>Per Academic Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>$1,000.00</td>
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</tr>
<tr>
<td>Double</td>
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<td>$462.50</td>
</tr>
</tbody>
</table>

**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. 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 towards degrees in Arts, Mathematics and Science.

<table>
<thead>
<tr>
<th>Fees</th>
<th>Per Academic Year</th>
<th>Per Academic Term</th>
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<tbody>
<tr>
<td>Semi-Private</td>
<td>$950.00</td>
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</tbody>
</table>

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: The residence portion 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 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 which 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 two hundred and forty women and seven hundred and twenty 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 to select compatible students to room together. It should be noted that room changes can only be made on an exchange basis and then only after a one month period has elapsed.

<table>
<thead>
<tr>
<th>Fees</th>
<th>Per Academic Year</th>
<th>Per Academic Term</th>
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<tbody>
<tr>
<td>Single</td>
<td>$1,100.00</td>
<td>$550.00</td>
</tr>
<tr>
<td>Double (Inter-connecting)</td>
<td>$1,000.00</td>
<td>$500.00</td>
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</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 will ultimately consist 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 West Tower, Northcourt and Westcourt will be ready for occupancy by September 1970. 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>$135.00</td>
<td>$155.00</td>
</tr>
<tr>
<td>8 Month lease</td>
<td>$130.00</td>
<td>$150.00</td>
</tr>
<tr>
<td>12 Month lease</td>
<td>$125.00</td>
<td>$145.00</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 nearby Food Services Building. A kitchen where light meals may be prepared with adjoining small dining room is located 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>One Term</th>
<th>Two Term</th>
<th>Three Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>$330.00</td>
<td>$660.00</td>
<td>$990.00</td>
</tr>
</tbody>
</table>

**Department of University Extension**

One of the responsibilities of a University is to provide opportuni-
ties for continuing education for adults. In an atmosphere of direct-
ed study, within the environment of academic discipline, these op-
portunities can be fulfilled. Within this frame of reference, the
needs of our community that can best be provided by a University,
are our first concern.

To help undertake this rapidly expanding task many community
leaders provide advice, counsel and guidance. In addition, many
dedicated citizens, fully supporting the concept of continuing edu-
cation for adults, give freely of their time to help in the develop-
ment of courses and programmes. The many and varied proposals
are carefully considered in the light of extending the resources of
the University.

Conferences, Seminars and Workshops are designed to make the
greatest use of the combined talents of scholars, business and
community leaders in residence on campus. Because of the sched-
uling of the undergraduate programmes, conferences and seminars
co-sponsored with off-campus organizations and associations are
normally arranged between 1st May and 1st September, when the
air-conditioned lecture spaces and the residence facilities are more
generally available for residential adult education.

In the special areas of business, the “updating” and “refresher”
approach recognizes and complements adult professional experience.
Present programmes designed with this in mind reflect this view
in the imaginative development of several new courses to meet the
needs of business, industry, labour and government.

Administrative services and programme design are available to
present special opportunities to secondary school teachers and
adult students, professional associations or other groups and the
general public through lectures, seminars, conferences, workshops,
intensive short courses and University orientation programmes.

The Department does not offer correspondence courses. Courses
not fully developed at the time of publication of the Calendar are
advertised in sufficient time to advise the public.

Details of courses, programmes and other offerings are set forth
in the University Extension Calendar. Further information is avail-
able from the Director, Department of University Extension,
University of Waterloo, Waterloo, Ontario.

**Centre for Continuing Studies in Marketing**

All courses and seminars in the Centre for Continuing Studies in
Marketing programme are strictly in the field of continuing edu-
cation. The “Centre” does not offer degree courses and no courses
involve degree credits. An “Acknowledgement” suitable for fram-
Centre for Continuing Studies in Marketing

...ing is granted to participants in extended courses involving a minimum of thirty lecture hours. No such "Acknowledgement" is granted for short-term seminars.

In the seven years in which marketing courses have been offered over five hundred national marketers from coast to coast have enrolled one or more of their upper or middle management people at all levels of line and staff responsibility. Over three thousand marketing people have participated in the various courses and seminars which have comprised the "Centre's" total programme.

The programme has grown from the original Advanced Course in Marketing and Sales Management in 1962 to over thirty offerings in 1969-70. The "Centre" will continue to explore new opportunities for service.

The staff of the "Centre" will be happy to assist management and individuals in selecting career development courses most appropriate to the individual's needs.

Courses and Seminars in Field Sales Management (3)
1969-70 Programme Sales Management
Courses Sales & Marketing Management for Industrial Marketers
Training the Sales Trainer (3)
Profession of Management (2)

Seminars Advertising Management
Management Development
Marketing Research
Sales Promotion
New Product Development
Marketing Planning
Physical Distribution
Product Management
Sales Office Management
Finance & Accounting for Marketing
Advanced Salesmanship (2)
New Dimensions in Sales Management
Innovations in Marketing Management
Leading and Motivating

Special Subject Workshops Human Relations
Communications
Motivation
Managing Management Time (3)
Leadership

For information re scheduled dates of above courses write or phone—
Centre for Continuing Studies in Marketing, University of Waterloo, Waterloo, Ontario, Area Code 519, 744-6111 (Ext. 2577)
12 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.

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:

- 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.

Incidental fees for Federation of Students (activities), Athletics and Health Services are refundable on a pro rata basis over 12 weeks for regular students and 6 weeks for co-operative student terms.
The fee schedule shown is the one approved for the 1970-71 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>$64.00</td>
<td>$574.00</td>
</tr>
<tr>
<td>Engineering</td>
<td>Co-operative per term</td>
<td>332.50</td>
<td>32.50</td>
<td>365.00</td>
</tr>
<tr>
<td>Division of Environmental Studies</td>
<td>Sessional</td>
<td>510.00</td>
<td>64.00</td>
<td>574.00</td>
</tr>
<tr>
<td>Architecture</td>
<td>Co-operative Year One</td>
<td>545.00</td>
<td>64.00</td>
<td>609.00</td>
</tr>
<tr>
<td>Integrated Studies</td>
<td>Sessional</td>
<td>510.00</td>
<td>64.00</td>
<td>574.00</td>
</tr>
<tr>
<td>Mathematics</td>
<td>Sessional</td>
<td>315.00</td>
<td>32.50</td>
<td>347.50</td>
</tr>
<tr>
<td>Co-operative</td>
<td>per term</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td>Sessional</td>
<td>315.00</td>
<td>32.50</td>
<td>347.50</td>
</tr>
<tr>
<td>Optometry</td>
<td>Sessional</td>
<td>510.00</td>
<td>64.00</td>
<td>574.00</td>
</tr>
<tr>
<td>Physical Education and Recreation</td>
<td>Co-operative per term</td>
<td>315.00</td>
<td>32.50</td>
<td>347.50</td>
</tr>
<tr>
<td>Part-time Students</td>
<td>Per Course</td>
<td>100.00</td>
<td>Nil</td>
<td>100.00</td>
</tr>
<tr>
<td>(limit, 2 course per session)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Incidental fees included in the above schedule are shown in detail below.

<table>
<thead>
<tr>
<th>Incidental Fees*</th>
<th>Co-operative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federation of Students (activities)</td>
<td>$22.00</td>
</tr>
<tr>
<td>Athletic</td>
<td>$11.00</td>
</tr>
<tr>
<td>Tenth Anniversary Fund — (see Note 1)</td>
<td>10.00</td>
</tr>
<tr>
<td>Tenth Anniversary Fund — (see Note 1)</td>
<td>10.00</td>
</tr>
<tr>
<td>Campus Health Services — (see Note 2)</td>
<td>10.00</td>
</tr>
<tr>
<td></td>
<td>5.50</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$64.00</td>
</tr>
<tr>
<td></td>
<td>$32.50</td>
</tr>
</tbody>
</table>

Society Fees (see Note 3)

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.
Fees

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 registration date.

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 co-operative students—the operating cost of campus health facilities for the term and the premium for supplementary medical 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 Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arts</td>
<td>$2.50</td>
</tr>
<tr>
<td>Engineering</td>
<td>—</td>
</tr>
<tr>
<td>Mathematics</td>
<td>$3.00</td>
</tr>
<tr>
<td>$1.50</td>
<td></td>
</tr>
<tr>
<td>Environmental Studies</td>
<td>$2.50</td>
</tr>
<tr>
<td>Science (including Optometry)</td>
<td>$4.00</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 registration date.

Miscellaneous Fees
Examination—Supplemental, each paper $10.00
—Presiding fee (at an outside centre each half day) 7.00
Late Registration—First day 10.00
—Each additional day 5.00
—Maximum 25.00
Transcript of record 1.00

Residence Fees
Information concerning Residence Fees can be found on page 449.
## Schedule of Fees - Graduate Studies

For specific details of programmes and definitions see the Graduate Studies Section, page 168

<table>
<thead>
<tr>
<th>Full-time Degree Students</th>
<th>Tuition</th>
<th>Incidental*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to the minimum fee for the programme (1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>per calendar year</td>
<td>$405.00</td>
<td>$69.00</td>
<td>$474.00</td>
</tr>
<tr>
<td>per term</td>
<td>135.00</td>
<td>34.00</td>
<td>169.00</td>
</tr>
<tr>
<td>Beyond the minimum fee for the programme</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>per calendar year</td>
<td>90.00</td>
<td>69.00</td>
<td>159.00</td>
</tr>
<tr>
<td>per term</td>
<td>30.00</td>
<td>34.00</td>
<td>64.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part-time Degree Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to the minimum fee for the programme</td>
</tr>
<tr>
<td>per academic year (two terms)</td>
</tr>
<tr>
<td>per term</td>
</tr>
<tr>
<td>Beyond the minimum fee for the programme</td>
</tr>
<tr>
<td>per calendar year</td>
</tr>
<tr>
<td>per term</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Full-time Qualifying Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>per academic year (two terms)</td>
</tr>
<tr>
<td>Faculty of Arts</td>
</tr>
<tr>
<td>Faculty of Engineering</td>
</tr>
<tr>
<td>Faculty of Mathematics</td>
</tr>
<tr>
<td>Faculty of Science</td>
</tr>
<tr>
<td>Division of Environmental Studies</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part-time Non-Degree Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>per full course (3)</td>
</tr>
<tr>
<td>per half course</td>
</tr>
</tbody>
</table>

**Note 1** Minimum tuition fees are as follows:
- a) 'One year' programme $405.00
- b) 'Two year' programme $810.00
- c) 'Three year' programme $1,215.00

**Note 2** Where permitted by the Faculty concerned

**Note 3** 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.

<table>
<thead>
<tr>
<th>Incidental* — Compulsory Assessment</th>
<th>Per Year</th>
<th>Per Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federation of Students (activities)</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>5.00</td>
</tr>
<tr>
<td>Campus Health Services — (see Note 2)</td>
<td>10.00</td>
<td>4.50</td>
</tr>
<tr>
<td>Society Fee</td>
<td>$5.00</td>
<td>$2.50</td>
</tr>
</tbody>
</table>

$69.00 $34.00
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 registration date.

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 supplementary medical coverage for a 12-month period from date of registration.  
b) for term students—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.  

Note  The Health Insurance plan does not include the premium or benefits of the Ontario Hospital Services Commission or Ontario Health Service Insurance Plan.  
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  
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 registration date.

Miscellaneous Fees  
Late Registration—1st two weeks after registration date $10.00  
—after first two weeks, additional $25.00  
Transcript of Record $1.00

Residence Fees  Information concerning Residence Fees can be found on page 449.
Training for a Swim Competition
13 The University Libraries
The University Libraries

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Degree Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>University Librarian</td>
<td>William J. Watson, B.J. (Carleton), M.A., B.L.S. (McGill)</td>
<td></td>
</tr>
<tr>
<td>Collections Development Librarian</td>
<td>Doris E. Lewis (Mrs.), B.A., B.L.S. (Toronto), L.L.D. (Trent)</td>
<td></td>
</tr>
<tr>
<td>Systems Librarian</td>
<td>Robert G. Bean, B.A. (Western), B.L.S. (Toronto)</td>
<td></td>
</tr>
<tr>
<td>Assistant to the Librarian</td>
<td>Paul Wiens, B.A., B.L.S. (U.B.C.)</td>
<td></td>
</tr>
<tr>
<td>Technical Services Head</td>
<td>Murray C. Shepherd, B.Ed. (Saskatchewan), M.A. (L.S.) (Denver)</td>
<td></td>
</tr>
<tr>
<td>Acquisitions Department Head</td>
<td>Enid Waterman (Mrs.), B.A. (McMaster), B.L.S. (Toronto)</td>
<td></td>
</tr>
<tr>
<td>Acquisitions Librarian</td>
<td>Paul Dyment, B.A. (Manitoba), B.L.S. (McGill)</td>
<td></td>
</tr>
<tr>
<td>Serials Section Head</td>
<td>Jeanette Schmidt (Miss), B.A. (Western), B.L.S. (Toronto)</td>
<td></td>
</tr>
<tr>
<td>Serials Librarian</td>
<td>Susan Gillespie (Miss), B.A., M.L.S. (Western)</td>
<td></td>
</tr>
<tr>
<td>Bibliographic Searching Department Head</td>
<td>Ramma Kamra (Mrs.), B.A. (Punjab), M.L.S. (Western)</td>
<td></td>
</tr>
<tr>
<td>Cataloguing Department Head</td>
<td>Joan Scanlon (Miss), B.A., M.A., B.L.S. (Toronto)</td>
<td></td>
</tr>
<tr>
<td>Cataloguers</td>
<td>Thomas Alburger, A.B. (Rutgers), M.S.L.S. (Western Reserve)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Samuel Alexander, B.A., M.A. (Delhi), M.L.S. (Western)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Catherine Barker, (Mrs.), B.Sc. (Guelph), B.L.S. (Toronto)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Amy Chan (Mrs.), B.A. (Hong Kong), M.L.S. (Western)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yulerette Gordon (Mrs.), B.A. (Manitoba), B.L.S. (Toronto)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Eva Huygen (Miss), B.Soc.Sc. (Hong Kong), M.S. (L.S.) (Wisconsin)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lesley Sangster (Miss), B.A. (Adelaide), Dip.Lib. (N.S.W.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wasyl Sirskyj, B.A. (Toronto), M.A. (Waterloo), B.L.S. (Toronto)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ritva Sjoman (Miss), B.A. (U.B.C.), B.L.S. (Toronto)</td>
<td></td>
</tr>
<tr>
<td>Public Services, Arts Library</td>
<td>Helen McKinnon (Miss), B.A. (Saskatchewan), B.L.S. (Toronto), M.L.S. (McGill)</td>
<td></td>
</tr>
<tr>
<td>Circulation Department Head</td>
<td>Eluine Reaman (Miss), B.A. (McMaster), B.L.S. (Toronto)</td>
<td></td>
</tr>
<tr>
<td>Reference Department</td>
<td>Brenda Bailey (Miss), B.A. (London), Dip.Ed. (Oxford), M.L.S. (Western)</td>
<td></td>
</tr>
<tr>
<td>Reference Librarians</td>
<td>Lois Black, (Miss), B.A. Waterloo College, B.L.S., M.L.S. (Toronto)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Judith Boettger (Miss), B.A. (Waterloo), B.L.S. (British Columbia)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rienzi W.G. Crusz, B.A. (Ceylon), B.L.S. (Toronto)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lynne Primrose (Miss), B.A., M.L.S. (McGill)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diane Wilkins (Miss), B.A. (Waterloo), M.L.S. (McGill)</td>
<td></td>
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<tr>
<td>Public Services, Engineering, Mathematics and Science Library Head</td>
<td>Ada Berti (Miss), B.A. (Windsor), B.L.S. (Toronto)</td>
<td></td>
</tr>
<tr>
<td>Circulation Department Supervisor</td>
<td>Frances Breithaupt (Mrs.), B.A. (Toronto)</td>
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</tbody>
</table>
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 between 1971 and 1974.

The second (main) floor of the Arts Library houses the public catalog, the reference department, the circulation department, the library administration and technical services. The third floor holds collections, provides seating for users, and houses the microforms room. 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 240,000 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 1970-71 another 48,000 volumes are expected to be added. The Library has 2,200 subscriptions to current periodicals.

The E.M.S. Library collections number 120,000 volumes of books and periodicals, plus many kinds of special materials. Additions in 1969-70 were 17,500 volumes, and in 1970-71 are expected to be 19,000 volumes. The Library has 1,800 subscriptions to current journals, plus a good collection of indexes and abstracts.

The library staff of 160 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 machine-readable record of its collections that will serve as the basis for a variety of projects. The first of these will be an automated circulation system, to be instituted in the Autumn of...
1970. 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.
14 The 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 successful operation of the work periods of the Co-operative Programmes. In addition, the department provides assistance to undergraduate and graduating students in all faculties in obtaining full-time or summer employment.

The staff of the department is comprised of professional personnel having extensive experience related to their fields of service. Each co-ordinator is responsible for a designated area and is the liaison officer between the University and the employers of students in his territory. Each acts as a counsellor and advisor to these students.

Director
A.S. Barber, B.I.E. (GMI), P.Eng.

Associate Directors
G.L. White, B.A.Sc. (Toronto), P.Eng.

Engineering
Assistant Director

Engineering Faculty Liaison
Assistant Director, Operations
R.J. Wieser, B.Eng. (Saskatchewan), P.Eng.

Executive Assistant
J.R. Culley, B.Comm. (McGill)

Co-ordinators
D.G.S. Anderson, B.A.Sc. (Toronto), P.Eng.
H.D. Ball, B.A. (Western), P.Eng.
R.E. Findlay, B.Sc. (McGill), 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.I. Lind, B.Sc. (Queen's), P.Eng.
R.D. Mumford, B.Sc. (Queen's), 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.
J.C. Wilson, B.Sc. (U.N.B.), P.Eng.

Applied Chemistry
R.A. Pullin, B.S.A. (Toronto)

Applied Physics
L.R. Bricker, B.Sc., M.Sc. (Waterloo)

Co-operative Mathematics
Options in Actuarial Science,
Computer Science,
Optimization, and Statistics
Assistant Director
B.A. McCallum, B.A. (Western)

Co-ordinators
A.R. Dunnet, B.B.A. (U.N.B.)
T.H. Fitzgerald, B.A. (St. Lawrence)
R.D. MacLean, B.Comm. (Dalhousie)
S.R. Stankus, B.Sc. (R.M.C.)

Option for Prospective High School Teachers
Co-ordinator
(To be appointed)
Co-operative Counselling and Human Relations

Co-ordinator R.J. Walsh, B.A. (Queen's), M.A.Sc. (Waterloo)

Co-operative Kinesiology and Recreation

Co-ordinators A.D.F. Burnett, B.A. (Ottawa), B.P.E. (Waterloo)
W.B. Fuller, B.A. (Western)
J.D. Paton, B.A. (U.N.B.), Rec. Cert. (Western)

Environmental Studies

—Architecture
Co-ordinator J.W. Hoag, B.Arch. (Toronto)

Career Counselling and Placement

Director E. Zapf, B.Ed. (Saskatchewan), B.S.W. (Toronto)
C.F. Burk, M.A.Sc. (Toronto), P.Eng.

The Co-operative Plan

What it is 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, the programme consists of eight four-month academic terms and six four-month work 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 experience gained, not in a random and uncertain manner, but within a structure of organized purpose and serious study.

Co-operative education is a synthesis of two educational themes—the academic theme and the theme of organized practical training in the area of career interest. These two themes, when carried on concurrently, give depth and meaning to the formative years of learning. The numerous industrial and business firms, as well as many other institutions and organizations that co-operate with the University in providing an opportunity for students at Waterloo, have entered a most serious undertaking to help prepare young men and women for fruitful careers. These companies and institutions exemplify an enlightened view of society's responsibility for preparing the coming generations of leaders. Students feel that industry and society are indeed interested in their development and this confidence can induce a reciprocal determination to strive and excel in their studies as well as in their introductory training.
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 management of the co-operative employment scheme is handled by a special department of the University—The Department of Co-ordination and Placement. The co-ordinators counsel their students, visit them on their work assignments, and assist students in adjustment to work situations and in professional development.

In the standard co-operative programmes 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 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 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. This selection is based upon students’ preferences for the work-study pattern if one stream or the other, financial considerations, etc. As far as possible students’ choices of A or B streams will be honoured, but in the case of imbalance of the streams, students may be placed arbitrarily in either 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 standard co-operative programmes are arranged as shown in the diagram.

<table>
<thead>
<tr>
<th>Stream “A”</th>
<th>1970 Fall</th>
<th>Winter</th>
<th>1971 Spring</th>
<th>Fall</th>
<th>Winter</th>
<th>1972 Spring</th>
<th>Fall</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Term 1A</td>
<td>Second Term 1B</td>
<td>Work Period 1</td>
<td>Third Term 2A</td>
<td>Work Period 2</td>
<td>Fourth Term 2B</td>
<td>Work Period 3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stream “B”</th>
<th>1973 Winter</th>
<th>1974 Fall</th>
<th>1975 Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Term 1A</td>
<td>Work Period 4</td>
<td>Sixth Term 3B</td>
<td>Work Period 5</td>
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</table>

Kinesiology and Recreation operates on “A” stream only, Systems Design (Engineering) is on B stream only and variations of the standard programme are used for Applied Physics, Environmental Studies—Architecture, the option in Co-operative Mathematics for
A basic requirement of the Co-operative Programmes at the University of Waterloo is satisfactory performance during co-operative work assignments.

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 the students must be approved by the Co-ordination Department in order to be considered as part of the required work assignments.

By registering in a co-operative course, students give permission for the release of their marks to employers. Academic marks and work term evaluations are included in the student records which are sent to prospective employers in the course of the interview process. Copies of examination reports received by students while on work assignments are provided for the information of cooperating employers.

Students and employers’ representatives choose each other through the Department’s placement process. Job notices are posted on the bulletin boards and students are asked to examine the notices and indicate their interest by applying for interview appointments. An interview schedule is prepared and the employers’ representatives interview the students on campus. In signing for an interview in most programmes a student undertakes to accept the employment offered if he should be chosen. Under certain conditions and with the permission of the Co-ordination Department a student may be allowed to withdraw from a specific job situation. The experience obtained in these interviews is a fundamental part of the student’s education.

It is inevitable that some students will not be successful in being selected for employment on an assignment of their choice, and likewise that some employers will not obtain the students they have selected. Consequently, the Department will make every effort to place these students and satisfy the employers where the best interests of each can be served. On the other hand, the Department is not responsible for assisting in the placement of students required to repeat an academic term, until evidence of the successful completion of such term has been received.

Although the Co-ordination Department does not guarantee placement of students, every effort is made to ensure that appropriate employment is made available.

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 periods to make him completely self-supporting.

Students in co-operative courses are required to return for a second work term when acceptable to employers. A part of first work terms, varying with the nature of the job, must be devoted to training before students become productive members of employers’ staffs. Second work terms provide students with a better understanding of the jobs, and offer employers some hope of a
reasonable return on their training efforts. 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 on some phase of his current employment during his work assignments. He is provided with details of the requirements for his particular co-operative programme.

These reports serve a dual purpose. Experience is gained in the preparation of written reports similar to those which an employer expects from a responsible employee. In addition, the necessity of gathering material for such a report will develop in the student a thorough appreciation of job analysis. In effect, 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.

**Conduct and Responsibilities**

During his early years in the course, the work assignments teach the student the importance of being co-operative, industrious and punctual in his daily work. Although his initial assignments may not necessarily be related to the work done by professional personnel, he is provided with an increasing opportunity to gain experience in his field as he progresses through the course.

It is emphasized that during the student's work periods he carries a responsibility to build and maintain his own good reputation as well as that of the University. Poor performance, unexcused absence from work, consistent lack of punctuality, inability to work with supervisors or fellow workers, lack of interest in the job, will be interpreted as an indication that he is not acceptable for professional training. 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 University for breach of discipline.

The satisfactory completion of co-operative work assignments is a requisite of graduation. No student may continue in a co-operative course at University of Waterloo if he is not capable of acceptable progress in his work assignments. Unsatisfactory performance by a student in two work terms will result in a thorough investigation of his suitability for professional training. Unless there are extenuating circumstances he may be suspended or required to withdraw from the course. The Co-ordination Department maintains a close liaison with faculties, employers and students so that a valid assessment of a student's progress can be made by members of the department.

**Industrial Advisory-Council for Co-Operative Engineering and Applied Sciences**

The Industrial Advisory Council is composed of delegates from organizations interested in education in engineering and the applied sciences. The Council acts in an advisory capacity to the University on the programming of the co-operative courses in engineering, applied chemistry and applied physics as it affects the relations of the University and its students with employers. A list of members follows:
Department of Co-ordination and Placement

Mr. H.L. Hinchcliffe Shell Canada Limited
   \textit{Chairman}

Mr. A.E. Ades Air Canada
   \textit{Vice Chairman}

Mr. L.J. Eskritt Ball Brothers Limited
   \textit{Secretary}

Mr. H.W. Adcock Ontario Department of Highways
Mr. A.G. Asplin Horton Steel Works Limited
Mr. W.R. Coulter Coulter Copper & Brass Co. Ltd.
Mr. D.L. Dickson Pioneer Saws Limited
Mr. A.W. Downe Joseph E. Seagram & Sons Limited
Dr. F.S. Eadie Northern Electric Co. Limited
Mr. A.J. Fisher Fiberglas Canada Limited
Mr. R. Fortier Bell Canada
Mr. J.A. Frost Crowe Foundry Limited
Mr. P.C. Gunyon Aluminum Co. of Canada Limited
Dr. D.H. Laughland Public Service Commission
Mr. C.P. Layard The Steel Company of Canada Limited
Dr. H.R.L. Streight DuPont of Canada Limited
Mr. A. Staig Proctor and Redfern
Mr. W.L.W. Taylor Falconbridge Nickel Mines Limited

\textbf{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 Mathematics, Waterloo County
          Board of Education
Mr. J.W. Fencott R.H. King Collegiate Institute, Scarborough
Mr. J.C. Gardner Superintendent of Programme Development,
          Carleton Board of Education, Ottawa
Mr. N.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. Palmer Mathematics Co-ordinator, London
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

\textit{University Members}

Dr. B.C. Matthews President
Prof. C.F.A. Beaumont Associate Dean of Mathematics
Mr. R.G. Dunkley Assistant to the Dean of Mathematics
Mr. R.D. Eaton Associate Director, Co-ordination Department
Dr. K.D. Fryer Associate Dean of Mathematics
Prof. R.A. Honsberger Assistant Professor of Mathematics
Mr. B.A. McCallum Assistant Director, Co-ordination Department
Advisory Council—Kinesiology and Recreation

Mr. R. Capling
Chairman
Conestoga College of Applied Arts and Technology

Mr. W.J. Hare
Vice Chairman
Mississauga Parks and Recreation Department

Mr. L.G. Branch
Burlington Recreation Department

Miss N. Cannon
National Young Women’s Christian Association

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

Two Elected Students
School of Physical Education and Recreation, University of Waterloo

Organizations Employing Co-operative Architectural Students

Abram & Ingleson, Architects
H.G. Acres & Company Limited
Gordon S. Adamson & Associates
Affleck, Dimakopoulos, Lebensold Architects
John Andrews, Architect
Balharrie Helmer Gibson, Architects
Barnett & Rieder Associates
G. F. Remi & Associates
Betts, Beaudoin, Cash & Nobbs
BINDHARDT, Cheney, VanPortland & Walner
Boigon and Heinonen Architects
Bolton Elwood & Aimers, Architects
Cadillac Construction Company
R. Calvin Clendaniel
The Cannon Partnership
Carl Carter A.I.A., Architect
Central Mortgage and Housing Corporation
Clifford & Lawrie, Architects
Cluff & Cluff Architects
Cox, Moffet & Duncan, Architects
Craig & Boake, Architects
Craig, Zeidler & Strong Architects
Crichley & Delean, Architects
Department of Transport, Architectural Department
Louis N. Fabbro, Architect
John J. Farrugia, Architect & Town Planner
Henry Fleiss & Associates, Architects
Robert P. Flemming, Architect
Gerencser & Russell
Giffels Associates
Gilleland & Janiss
Gilvesy Construction
Govan Kaminker Langley Keenleyside
Hancock Little Calvert Associates
William J. Hilliker, Architect
Internorth Construction
William E. Keenan, Architect
J.G. Kelton, Architect
Janis Kravis, Architect
Mrs. Gail E. Lamb
John E. Lingwood
Lithwick Lambert Sim & Johnston, Architects
Ludlow & Fleury, Architects
Henry York Mann, Architect
Marani, Routhwaite & Dick, Architects
Mathers & Haldenby, Architects
J. Manfred May
Melick Devonshire Wilson, Architects
C. Blakeway Millar, Architect
Moffat, Moffat & Kinoshita
Raymond Mariyama, Architect
Ronald E. Murphy, Architect
James A. Murray, Architect
Murray & Murray
National Capital Commission
Page & Steele
John B. Parkin & Associates
Philip Patersfield, Landscape Architect
Robbie Vaughan & Williams, Architects
Kevin Roche, John Dinkeloo & Associates
Saxby & Pokorny
Shore, Moffat & Partners
Warren M. Smale
R. Stewart Smith, Architect
Joseph P. Storey, Architect
Texaco Canada Limited
Townend, Stefura, Baleshta & Pfister, Architects
Turley, Stievater, Walker & Mauri
University of Waterloo—Department of Design
Warner, Burns, Toan & Lunde
Webb, Zeaifa, Menkes, Architects

Organizations Employing Co-Operative Mathematics Students

AGT Management Systems Consultants
Air Canada
Aluminum Company of Canada Limited
American Can Company
A.E. Ames & Company Limited
Atlas Steels Company
Atomic Energy of Canada Limited
Automatic Electric Canada Limited
Bank of Montreal
Bata International Centre
Becker Milk Company Limited
Becton-Dickinson Company of Canada Limited
Bell Canada
Border Brokers Limited
Budd Automotive Company of Canada Limited
Burroughs Business Machines Limited
Canada Cement Company Limited
The Canada Life Assurance Company
Canada Permanent Trust Company
Canada Starch Company Limited
Canada Trust—Huron & Erie
Canadian Canneries Limited
Canadian General Electric Company Limited
Canadian General-Tower Limited
Canadian Imperial Bank of Commerce
Canadian Industries Limited
Canadian Ingersoll Rand Company
Canadian International Paper Company
Canadian Kodak Company Limited
Canadian Pacific Railway
Canadian Westinghouse Company Limited
Canadair Limited
Clark Institute of Psychiatry
Commercial Union Insurance Company
Computel Systems Limited
Computing Devices of Canada Limited
Confederation Life Association
Consolidated Graphics Limited
Consumers Gas Company
Control Data Canada Limited
Co-operators Insurance Association
The Crown Life Insurance Company
D.C.F. Systems Limited
De Havilland Aircraft of Canada Limited
DeLoitte, Plender, Haskins & Sells, C.A.
Digital Methods Limited
Doherty Roadhouse & McCuaig Brothers
Dominion Foundries & Steel Limited
The Dominion Life Assurance Company
Dominion Stores Limited
Dominion Textile Company Limited
Domtar Fine Papers Limited
Domtar Limited
Domtar Packaging Limited
Douglas Aircraft Company of Canada Limited
Drug Trading Company Limited
Eldorado Nuclear Limited
Electric Reduction Company of Canada Limited
Emco Limited
The Empire Life Insurance Company
The Excelsior Life Insurance Company
Falconbridge Nickel Mines Limited
Firestone Tire & Rubber Company of Canada Limited
Fleet Manufacturing Limited
Ford Motor Company of Canada Limited
Garret Manufacturing Limited
General Foods Limited
General Motors of Canada Limited
General Spring Products Limited
Global Life Insurance Company
B.F. Goodrich Canada Limited
Goodyear Tire Rubber Company of Canada Limited
Grace Computer Services
Great-West Life Assurance Company
Gulf Oil Canada Limited
Government of Canada
Department of Energy Mines & Resources
Department of Supply & Services
Department of Forestry
Department of Indian Affairs & Northern Development
Department of National Health & Welfare
Department of National Revenue
Post Office Department
Department of Transport
National Energy Board
Public Service Commission of Canada
Hamilton Board of Education
Honeywell Controls Limited
Imperial Life Assurance Company of Canada
Imperial Oil Limited
Imperial Tobacco Company of Canada Limited
Industrial Acceptance Corporation Limited
International Business Machines Company Limited
International Harvester Company of Canada Limited
International Nickel Company of Canada
Kellogg Company of Canada Limited
Charles A. Kench & Associates Limited
Kimberly-Clark of Canada Limited
Kingsway Transports Limited
R. Laidlaw Lumber Company Limited
Laurier Life Insurance Company
Lever Brothers Limited
Liquor Control Board of Ontario
London Life Insurance Company
James F. MacLaren Limited
Manitoba Hydro
The Manufacturers Life Insurance Company
The Mercantile & General Reinsurance Company Limited
Metropolitan Life Insurance Company
Microspec 69 Limited
Mobil Oil Canada Limited
Molson Breweries of Canada Limited
Montreal Life Insurance Company
Montreal Trust Company
The Mutual Life Assurance Company of Canada
Mutual of Omaha
The National Life Assurance Company of Canada
National Trust Company
North American Life Assurance Company
Northern Electric Company Limited
Province of Nova Scotia—
Department of Provincial Secretary
Ontario Hydro
Ontario Institute for Studies in Education
Province of Ontario
Computer Service Centre
Department of Agriculture & Food
Department of Education
Department of Highways
Department of Revenue
Treasury Board
Treasury Department
Oshawa Wholesale Limited
Outboard Marine Corporation of Canada Limited
Philips Electronics Industries Limited
Phoenix of London Group Company
R.L. Polk Company Canada Limited
Polymer Corporation Limited
Procter & Gamble Company of Canada Limited
The Prudential Assurance Company Limited
Quebec Hydro
RCA Limited
Richardson, Bond & Wright Limited
Riddell, Stead & Company, C.A.
Robin Hood Flour Mills Limited
Rothmans of Pall Mall Canada Limited
The Royal Bank of Canada
Royal Trust Company
Samsonite of Canada Limited
Savage Shoes Limited
J.M. Schneider Limited
Score Scientific-Commercial Research Services
S.D.I. Associates
I.P. Sharp Associates Limited
Shell Canada Limited
Simens-Sears Limited
The Sovereign Life Assurance Company of Canada
The Standard Life Assurance Company
The Steel Company of Canada Limited
Sun Life Assurance Company of Canada
Sun Oil Company Limited
Sunshine Uniform Supply Company Limited
Systems Dimensions Limited
Texaco Canada Limited
City of Toronto—Finance Department
The Toronto-Dominion Bank
Toronto General Hospital
Municipality of Metropolitan Toronto
Toronto Transit Commission
The Toronto Stock Exchange
Union Gas Company of Canada Limited
United Aircraft of Canada Limited
United Co-operatives of Ontario
United Investment Services Limited
United Shoe Machinery Company of Canada Limited
Univac—Division of Sperry Rand Canada Limited
University of Guelph
University of Ottawa
Queen's University
University of Toronto
University of Waterloo
University of Western Ontario
York University
Wabush Mines
Workmen's Compensation Board
Organizations Employing Co-Operative Mathematics Students - Option for Prospective High School Teachers

Brant County Board of Education
Carleton County Board of Education
Etobicoke Board of Education
Huron County Board of Education
Lincoln County Board of Education
London Board of Education
North Bay Board of Education
North York Board of Education
Ottawa Collegiate Institute Board
Oxford County Board of Education
Sault Ste. Marie Board of Education
Scarborough Board of Education
Stormont Dundas & Glengarry County Board of Education
Sudbury Board of Education
Timmins Board of Education
Waterloo County Board of Education
Wentworth County Board of Education
York Borough Board of Education
York County Board of Education

Organizations Employing Co-operative Kinesiology and Recreation Students

Addiction Research Foundation, Education Department
Advanced Pool Services Limited
Angelstone Limited
Arnprior District High School
Aurora Community Centre
Aurora Recreation Committee
Balmerton Recreation Committee
Bay View Resort
Beaver Lumber Co. (Cottage Div.)
Bobby Orr-Mike Walton Sports Camp
Borough of Scarborough, Recreation Department
Brampton, Town of—Recreation Department
Bristol Mountain Developments—New York
Brown’s Sports, Guelph
Burlington, Town of—Recreation & Parks Department
Burlington Y.M.C.A
Camp Kawabi
Camp Lochalsh
Camp Nagiwa
Camp Pathfinder
Camp Tawingo
Camp Towhee
Camp Wanakita
Camp White Pine
Cedar Villa Lodge
Central (Toronto) Branch Y.M.C.A.
Chicopee Skiing Association
Cochrane, Town of—Recreation Committee
Community Services Board, Sault Ste. Marie
Conestoga College of Applied Arts & Technology
Conestoga Country Club
Cottagers' Association, Honey Harbour
Credit Valley Golf & Country Club
Department of Parks, Belleville
Department of Tourism & Recreation, Winnipeg
Dryden, Town of—Recreation Department
East Northumberland Secondary School
East Park Golf Gardens
Eastview (Toronto) Branch Y.M.C.A.
Ecole Secondaire Theriault
Edmonton, City of—Recreation Department
Elliot Lake Recreation Committee
Elmira District Secondary School
Etobicoke, Borough of—Board of Education
Fern Resort
Fort Frances, Town of—Recreation & Parks Development
Fort Frances High School
The Frontier College
Grand River Conservation Authority
Hearst Recreation Department
C.M. Hinks Treatment Centre
Holiday Inns of Ontario
Humber College of Applied Arts & Technology
Improvement District of Bicroft
Kapuskasing High School
Kirkland Lake Recreation Department
Kitchener, City of—Parks & Recreation Department
Kitchener & Waterloo High School Board
Kitchener-Waterloo Y.M.C.A.
Lambton College of Applied Arts & Technology
Learn & Play Nursery School
London, City of—Board of Education
London, City of—Recreation Department
Major Holdings & Development Limited
Metropolitan Toronto Association for Retarded Children
Middlesex County Separate School Board
Milton Recreation Commission
Mississauga, Town of—Parks & Recreation Committee
Mitchell Recreation Department
Montreal Association for the Blind
Moose Jaw Y.M.-Y.W.C.A.
Moosonee, Town of—Recreation Committee
Nepean, Township of—Recreation Department
Niagara College of Applied Arts & Technology
North Toronto Branch Y.M.C.A.
Oakville, Town of—Recreation Committee
Ontario Hospital School, Orillia
Ontario, Province of
Department of Education
Special Schools and Services Branch
Youth and Recreation Branch
Department of Health
Adult Occupation Centre, Barrie
Brockville Psychiatric Hospital
Cedar Springs Hospital School
Goderich Psychiatric Hospital
Gravenhurst Hospital School
Hamilton Psychiatric Hospital
Midwestern Regional Children’s Centre
Orillia Hospital School
Penetang Psychiatric Hospital
Rideau Regional Hospital School
Whitby Psychiatric Hospital

Department of Lands and Forest
Ontario Society for Crippled Children
Oshawa, City of—Hillsdale Manor
Ottawa, City of—Recreation & Parks Department
Ottawa Collegiate Institute Board
Ottawa Public School Board
Orillia Y.M.C.A.
Outboard Marine Corporation of Canada Ltd.
Owen Sound, City of—Recreation Department
Paignton House (Resort)
Peel County Board of Education
Peterborough Recreation Commission
Picnic Island Resort
Port Colborne High School
Port Elgin, Town of—Recreation Committee
Preston High School
Rockway Golf Course
Rostrevor Lodge
Sarnia Recreation Department
Sault Ste. Marie, City of—Board of Education
Seneca College of Applied Arts and Technology
Sheridan College of Applied Arts & Technology
Silver Lake Camp
Skylon Tower
South Porcupine High School
St. Jerome’s High School
St. John’s School
St. Mary’s, Town of—Recreation Committee
Stratford, City of—Recreation Department
Stratford Golf & Country Club
Sudbury General Hospital
Sudbury High School Board
Sunset Haven Senior Citizens’ Home
Table Rock House
Tecumseh Recreation Department
Thunder Bay, City of—Civic Recreation Committee
Thunder Bay Y.M.-Y.W.C.A.
Toronto, City of—Parks & Recreation Department
Trent University, Peter Robinson College
University Settlement, Toronto
University of Waterloo

Department of Athletics
Department of Kinesiology
Department of Mechanical Engineering
Department of Psychology
Department of Recreation

Waterloo, City of—Community Services Branch
Waterloo County Board of Education
Waterloo Fitness Centre
Waterloo-Oxford District Secondary School
Wellington County Board of Education
Department of Co-ordination and Placement

West Haldimand District High School Board
West Scarborough Boys' Club
Windsor Parks & Recreation Department
Woodgreen Community Centre
Workmen's Compensation Board
York, Borough of—Board of Education
York, Borough of—Parks & Recreation Department

Organizations Employing Co-Operative Counselling and Human Relations (M.A.Sc.) Students

Centre for Vocational Services, Hamilton
Clarke Institute of Psychiatry, Toronto
Conestoga College of Applied Arts & Technology, Kitchener
The Donwood Foundation Hospital, Toronto
The Halton County Board of Education, Oakville
International Business Machines Co. Limited, Toronto
Jewish Vocational Services of Metropolitan Toronto
McMaster University, Dept. of Psychiatry, Hamilton
Mental Health Clinic for Children & Adolescents, Hamilton
Ontario Department of Health
   Lakeshore Psychiatric Hospital, Toronto
   London Psychiatric Hospital
Ontario Hydro, Toronto
Ryerson Polytechnical Institute, Toronto
The Board of Education for the City of Toronto
University of Waterloo, Counselling Centre
Waterloo County Separate School Board, Kitchener
The Workmen's Compensation Board, Hospital & Rehabilitation Centre, Toronto
Y.M.C.A. Counselling Services, Toronto

Organizations Employing Co-operative Engineering, Applied Physics and Applied Chemistry Students

ABC Structural Concrete Limited
Abex Industries of Canada Limited
H.G. Acres & Company Limited
Advanced Farming Systems Limited
Ainley & Associates Limited
Ajax Engineers Limited
Aldershot Industrial Installations Ltd.
The Algoma Steel Corporation, Limited
Allan Crawford Associates Ltd.
Allen-Bradley Canada Limited
Allied Chemical (Canada) Limited, Brunner Mond Division
Aluminum Company of Canada, Limited
Aluminum Laboratories Limited
Amalgamated Electric Corp. Ltd.
Anaconda American Brass Limited
Angelstone Limited
Anglo Paper Products, Limited
H.H. Angus & Associates Ltd.
AOCO Limited
Anthea Eastern Limited
A P Parts Canada Ltd.
C.G. Russell Armstrong
Armco Canada Limited
Armstrong Brothers Construction Company
Armstrong-Lang Laboratories Ltd.
Atkins Hatch & Associates Limited
Atlas Steels Company
Atomic Energy of Canada Limited
Aunor Gold Mines Limited
Automatic Electric (Canada) Limited
Automotive Hardware Limited
Babcock-Wilcox Canada Limited
Bailey Meter Company Limited
Bannerman Contracting Ltd.
Barringer Research Limited
Barton Tubes Limited
Bata Limited
Baton Broadcasting Limited
Bauer Brothers Company (Canada) Limited
Baxter Laboratories of Canada Ltd.
Beach Foundry Ltd.
Beatty Bros., Division of General Steel Wares Ltd.
Beaver Air Conditioning Limited
The Beaver Wood Fibre Company, Limited
Bechtel and Company
Bell-Camp Corporation Limited
Bell Canada
Beller Steel Company
Bendix-Eclipse of Canada Limited
Bennett & Wright Contractors Limited
Bick's of Canada Limited
Black-Clawson-Kennedy Ltd.
Black & McDonald Limited
Blacktop Construction Limited
The Borden Chemical Company (Canada) Ltd.
Borg Fabrics Ltd.
Borg-Warner (Canada) Limited
Bot Construction Company Limited
J.P. Bowman Limited
Bradstock, Reicher & Partners Limited
Brampton, Town of
Brant, County of
Brantford, The Corporation of the City of
Brantford, Public Utilities Commission
Brantford Tool Limited
B.P. Refinery Canada Limited
British Leyland Motors Canada Limited
Brunswick of Canada Ltd.
The Budd Automotive Co. of Canada Ltd.
Building Products of Canada Limited
Bundy Canada Limited
Burlington, Corporation of the Town of
Burnaby Canada Limited
Burroughs Corporation
Burton Electronic Services Ltd.
Bushnell T.V. Company Limited
Butler Manufacturing Company (Canada) Limited
Calvert Distillers Limited
Canbar Wood Tank Company-Division of Canada Barrels & Kegs Ltd.
Canada Construction Limited
Canada and Dominion Sugar Company Limited
Canada Foils Limited
Canada Forgings Limited
Canada Machinery Corporation, Limited
Canada Packers Limited
Canada Sand Papers Limited
Canada Starch Company Limited
Canadair Limited
Canada Wire & Cable Co. Ltd.
Canadian Admiral Corporation Ltd.
Canadian Bechtel Limited
The Canadian Blower & Forge Company Limited
Canadian Bluebird Coach Limited
Canadian Brass Limited
Canadian Broadcasting Corporation
Canadian Canners Limited
Canadian Carborundum Company Limited
Canadian Coleman Company, Limited
Canadian Controllers Limited
Canadian Copper Refiners Limited
Canadian Filters (Harwich) Limited
Canadian General Electric Company Limited
Canadian Hanson & Van Winkle Company Ltd.
Canadian Industries Limited
Canadian Johns-Manville Co., Limited
Canadian Marconi Company
Canadian Mitchell Associates Ltd.
Canadian Motorola Electronics Company
Canadian National Railways
Canadian Pacific
Canadian Pacific Telecommunications
Canadian Pittsburgh Industries Ltd.
Canadian Refractories Limited
Canadian Steelcase Company Limited
Canadian Timken, Division of the Timken Roller Bearing Co.
Canadian Trailmobile Limited
Canadian Vegetable Oil Processing Ltd.
Canadian Westinghouse Company Limited
Canron Limited
The Carling Breweries Limited
Wm. H. Carr, O.L.S.
Catalytic Construction of Canada Limited
Ceilcote Canada Limited
Cello Products (Preston) Div.
The Center of Forensic Sciences
Chatham, City of
William T. Chatham
Chemcell Limited
Chicago Rawhide Products Canada Limited
Chipman Chemicals Limited
Jack Chisvin & Associates Ltd.
CLM Industries, Division of McGraw-Edison (Canada) Limited
Clare Brothers Limited
Coin Acceptors Canada Ltd.
Columbian Carbon (Canada) Ltd.
Cominco Ltd.
Computing Devices of Canada Limited
P.R. Connolly Construction Limited
Conestoga College of Applied Arts & Technology
Consolidated-Bathurst Limited
Consolidated Computer Services Limited
Consolidated Sand & Gravel Company
Construction Testing Services Ltd.
The Consumers' Gas Company
Consumers Glass Co. Ltd.
Continental Can Company of Canada Limited
Cooper-Bessemer of Canada Ltd.
Coulter Copper & Brass Co. Limited
Coulter Manufacturing Limited
Crane Canada Limited
Crane Packing Company, Limited
Croven Limited
Crowe Foundry Limited
CSA Testing Laboratories
F.G. Cunningham, O.L.S.
Cunningham-Limp Limited
Curtis Products Ltd.
Cutler-Hammer Canada Limited
Cyanamid of Canada Limited
Dahmer Steel Limited
Damas & Smith Limited
Dawn Industries Limited
Daymond Co. Ltd.
Dearborn Chemical Company Ltd.
Decca Radar (Canada) Limited
John Deere Welland Works
The DeHavilland Aircraft of Canada, Limited
De Laval Company Limited
Delmar Chemicals Limited
Deloro Stellite, Division of Deloro Smelting & Refining Co. Ltd.
Democon Limited
Diesel Equipment Ltd.
Digital Equipment of Canada Ltd.
Digital Systems Associates Limited
M.M. Dillon & Company Limited
P.D. Dirksen Limited
Dodge Construction Company Limited
Doerner Products Limited
Dome Mines Limited
Dominion Bridge Company Limited
Dominion Engineering Works Limited
Dominion Foundries and Steel, Limited
Dominion Magnesium Limited
Dominion Road Machinery Co. Limited
Dominion Sash Limited
Dominion Welding Engineering Co. Limited
Domtar Chemicals Limited
Domtar Construction Materials Ltd.
Domtar Fine Papers Ltd.
Domtar Limited
Domtar Newsprint Limited
Department of Co-ordination and Placement

Domtar Packaging Limited
Dorr Oliver-Long Ltd.
Dow Chemical of Canada, Limited
Drope Paving & Construction Ltd.
Dryden Chemicals Limited
Dryden Paper Company Limited
Dunker Construction Limited
Dunlop Research Centre
Du Pont of Canada Limited
Eastern Steel Products Company - Div. of Turnbull Elevator Ltd.
T. Eaton Company Limited
Eaton Springs Canada Ltd.
Ecstall Mining Company Ltd.
The. E.B. Eddy Company
Edo (Canada) Limited
Elder Engineering Limited
Eldorado Nuclear Limited
Electric Reduction Company Canada Limited
Electrical Bureau of Canada
Electrohome Limited
Electronic Controls Limited
Electronic Craftsmen Limited
Ellis-Don Limited
El-Met Parts Limited
Erie Technological Products of Canada, Ltd.
Etobicoke, Borough of
The Exolon Co.
Extrusion Machine Co. Ltd.
FAG Bearings Limited
Falconbridge Nickel Mines Limited
The Falk Corporation of Canada Limited
Farkas Barron Jablonsky
Ferranti-Packard Limited
Ferrco Engineering Limited
Fiberglas Canada Limited
Firestone Tire and Rubber Company of Canada Limited
Fisher Scientific Co. Limited
Ford Motor Company of Canada, Limited
Foster Wheeler Limited
The Foundation Company of Canada, Limited
Foxboro Company Limited
Frankel Structural Steel Limited
The Frontier College
FWD Corporation (Canada) Ltd.
John Gaffney Construction Company Limited
W.J. Gage Limited
Galt, City of
Galt Metal Industries Limited
Gamma Engineering Ltd.
Garrett Manufacturing Limited
Gaspe Copper Mines Limited
Gates Rubber of Canada Ltd.
General Concrete Ltd.
General Foods Limited
General Motors of Canada, Limited
General Sound and Theatre Equipment Ltd.
General Springs Products Limited
Department of Co-ordination and Placement

Giffels Associates Limited
Gilvesy Construction Limited
H.Q. Golder & Associates Ltd.
Goodkey Weedmark and Associates Limited
B. F. Goodrich Canada Limited
The Goodyear Tire and Rubber Company of Canada, Limited
Gore and Storrie Limited
Government of Canada:
Analytical Chemistry Research Service
Department of Communications
Department of Energy, Mines and Resources
Department of Fisheries
Department of Industry, Trade & Commerce
Department of National Health and Welfare
Department of Public Works
Department of Transport
Post Office Department
Grand River Conservation Authority
G. Granek and Associates
Graphico Precision Works Limited
The Great Lakes Paper Company, Limited
A.P. Green Refractories (Canada) Ltd.
Grey, County of
The Griffith Laboratories Ltd.
Griffith Mine
Guelph, City of
Guelph Sand & Gravel Limited
Guelph, University of
Physical Resources Dept. Engineering Section
Gulf Oil Canada Limited
Hamilton, The Corporation of the City of
Hawker Industries Limited
Hawker Siddeley Canada Limited
Hayes-Dana Limited
H.J. Heinz Company of Canada Limited
Holderbank Technical Services Limited
Holstead and Orendorff
Honeywell Controls Limited
The Hoover Company Limited
Horton Steel Works Limited
Hussmann Refrigerator Company Limited
Hydro-Electric Commission of Welland
Hydro Mississauga
Hydro Quebec
Imperial Oil Enterprises Ltd.
Imperial Oil Limited
Indusmin Limited
Industrial Development Bank
Ingersoll Machine & Tool Co. Ltd.
International Business Machines Company Limited
International Cellulose Research Limited
International Harvester Company of Canada Limited
International Nickel Company of Canada, Limited
International Systcoms Limited
Interprovincial Corrosion Control Co. Ltd.
Iron Ore Company of Canada
Libra, Government of

S.C. Johnson and Son Limited
Jones and Laughlin Mining Company, Ltd.
Joy Manufacturing Company (Canada) Limited
Kam-Kotia Mines Limited, Cobalt Refinery Division
Kam-Kotia Porcupine Mines Limited
Kaufman Footwear Limited
Keates Organ Company Limited
Keenan Industries Limited
Keith A. Ivey & Associates Ltd.
Peter Kiewit Sons Co. of Canada Ltd.
Kilborn Engineering Limited
Kimberly-Clark of Canada Limited
Kimberly-Clark Pulp and Paper Company Limited
Kitchener, City of
Kitchener Materials Testing Ltd.
Kitchener Water Commission
Kitchener-Waterloo Hospital
J. Klassen & Associates Limited
G.V. Kleinfeldt & Associates Ltd.
Konvey Construction Company Limited
Kuntz Electroplating Ltd.
Labatt Breweries of Canada Limited
R. Laidlaw Lumber Co. Ltd.
Lake Ontario Steel Company
Lakefield Research of Canada Ltd.
Lakeshore Mines Limited
Lambert-Hoppen Limited
Lau Products Limited
J.D. Lee Engineering Limited
Leigh Instruments Limited
Lennox Industries (Canada) Limited
Lever Bros. Limited
Lincoln, County of
Listowel Silos Limited
Litton Systems (Canada) Limited
LOF Glass of Canada Limited
Lofthouse Brass Manufacturing Ltd.
London, City of
W.P. London and Partners
London, Public Utilities Commission of
Long Manufacturing Company Limited
Looby Construction Limited
The Lummus Company Canada Ltd.
Lundy Steel Products
Robert McAlpine Limited
T.C. McAvour & Associates
McCormick and Rankin Limited
W.A. McDougall Ltd.
McGrath Engineering Limited
McGregor Associates Limited
McIntyre Porcupine Mines, Limited
McKinnon Industries Limited
McLean-Peister Limited
James F. MacLaren Limited
MacLeod Cockshutt Gold Mines Limited
McMaster University
McNamara Corporation Limited
McNamara Marine Limited
Mallory Battery Company of Canada Limited
Mansfield-Denman General Limited
Markham, Township of
Marshall Macklin Monaghan Limited
Marsland Engineering Limited
Ian Martin Associates Limited
V.K. Mason Construction Co. Ltd.
Mathews Conveyor Company Limited
Matthews Group Limited
Mattagami Lake Mines Limited
John Metz, Surveyor
Millhaven Fibres Limited
Mimik Limited
Minnesota Mining and Manufacturing of Canada Limited
Mississauga, Town of
Mississauga Water Commission
Mitchell Signs Limited
Moffats Limited
Molson's Brewery (Ontario) Limited
Monsanto Canada Limited
A.R. Monteith Limited
Monteith Ingram Engineering Ltd.
Montgomery Elevator Company, Limited
Montreal Engineering Company Limited
M & T Products of Canada Limited
National Sewer Pipe Limited
National Standard Company
National Steel Car Corporation Ltd.
Niagara Falls, City of
R.H. Nichols Co. Limited
Nisbet, Letham Ltd.
Norak Steel Construction Ltd.
Noranda Mines Limited
Noranda Research Centre
North York Hydro Office
Northern Electric Company Limited
Novatronics of Canada Ltd.
O & W Electronics Limited
Oakville, Town of
Oliver, Lloyd and Associates Limited
W.H. Olsen Manufacturing Company Limited
Omark Industries of Canada Ltd.
Ontario, County of
Ontario Hydro
Ontario Hydro, Research Laboratories
The Ontario-Minnesota Pulp and Paper Co. Ltd.
The Ontario Paper Company Limited
Ontario, Province of
Department of Health
Department of Highways
Department of Labour
Department of Mines
Department of Public Works
Ontario Water Resources Commission
Orrhan Mine Limited
Orenda Limited
Ortho Pharmaceutical (Canada) Ltd.
Otis Elevator Co. Ltd.
Parke, Davis and Company, Limited
C.C. Parker and Associates Limited
County of Peel, Assessment Dept.
Peel Village Developments Co. Ltd.
Peninsula Research & Development Corp., Ltd.
Peterborough, City of
E.M. Peto and Associates Limited
E.W. Petzold
Philips Electronics Industries Ltd.
Pigott Construction Company Limited
Pioneer Electric Ontario Limited
Pioneer Saws Limited
Polymer Corporation Limited
H.K. Porter Company (Canada) Limited
Potter and Brumfield - Division of AMF Canada Limited
Powell Agri-Systems Ltd.
Pre-Con Murray Limited
Preston, Town of
Preston Sand and Gravel Co. Ltd.
The Price Company, Limited
Prince George Pulp & Paper Co. Ltd.
Procor Limited
The Procter and Gamble Company of Canada, Limited
The Proctor and Redfern Group
Provincial Paper Limited
Purolator Products (Canada) Limited
Quan, Carruthers, King and Quan Limited
Quebec North Shore Paper Company
Quemont Mining Corporation, Limited
Racey, MacCallum & Bluteau, Ltd.
Radar Exploration Company
Ralston-Purina of Canada Ltd.
Ramsey REC Limited
Raponi Eastwood Paving and Construction Limited
Raytheon Canada Limited
RCA Victor Company Ltd.
Redirack Industries Limited
Reichhold Chemicals (Canada) Limited
Reid Crowther and Partners Limited
Reliance-Reeves-Master Limited
Reuter-Stokes Canada Limited
Rio Algom Mines Limited
Wm. Roberts Electric Limited
P.L. Robertson Manufacturing Co. Limited
Robertson-Yates Corporation Limited
Rohm and Haas Company of Canada Limited
Rolls-Royce Canada Limited
B.M. Ross and Associates Ltd.
Royal Military College of Canada
Rybka, Smith and Ginsler Ltd.
Ryerson Polytechnical Institute
St. Lawrence Cement Company
St. Lawrence Fertilizers Ltd.
The St. Lawrence Seaway Authority
St. Mary's Cement Co. Ltd.
St. Thomas, City of
Sandwell and Company Limited
Sarnia Canada Limited
Sarnia Inspection Company Ltd.
Sault Ste. Marie, City of
Scarborough, City of
Scarborough Hydro and Water Commission
F. Schaeffer and Associates Limited
J.M. Schneider Limited
Schutte & Koerting Co. (Canada) Ltd.
Scintrex Limited
Joseph E. Seagram and Sons Limited
Sehl Engineering Limited
Selco Exploration Company Ltd.
Semple-Goodes & Company Limited
Seneca Manufacturing Limited
The Shawinigan Engineering Co. Ltd.
Sheldons Engineering Limited
Shell Canada Limited
Sheridan College of Applied Arts & Technology
Sherman Mine
The Sherwin-Williams Co. of Canada
M.V. Shore and Associates
Shore and Moffat and Partners
Sick Children's Hospital
A.C. Simmonds and Sons Ltd.
Simpson-Sears Limited
Sinclair Radio Laboratories Ltd.
Site Investigation Services Limited
N. Smith Belting Works Ltd.
C.R. Snelgrove Co. Ltd.
Southam Murray Printing and Gravure Limited
Spino Construction Co. Ltd.
Spruce Falls Power and Paper Co. Limited
Square D Company Canada, Limited
Standard Tube and T.I. Limited
The Stanley Works of Canada, Limited
Starr and Tarasick
Steed & Evans Limited
The Steel Company of Canada, Limited
Steep Rock Iron Mines Limited
Stephens-Adamson Mfg. Co. of Canada, Limited
Sterling Drug Ltd.
Stewart-Warner Corp. of Canada Ltd.
Sudbury, City of
Sunar Industries Ltd.
Sun Oil Company Limited
J.L. Sylvester, O.L.S.
Syntron (Canada) Limited
T-Scan Limited
Tele-Radio Systems Limited
Texaco Canada Limited
Texas Instruments Inc.
Peter Thomson & Sons Ltd.
Edward Thornley & Associates Ltd.
TMC (Canada) Limited
Toronto, City of
Board of Education
Department of Public Works
Toronto Coppersmithing Co. Ltd.
Toronto, The Corporation of the Township of
Toronto Foundry Limited
Toronto General Hospital
Toronto Harbour Commissioners
Toronto Hydro-Electric System
Toronto, Municipality of Metropolitan
Department of Works
Traffic Engineering Department
Toronto Transit Commission
Toronto, University of—Physics Department
Totten, Sims, Hubicki and Associates Ltd.
Trans-Canada Pipe Lines Limited
Travelaire Trailer Mfg. Ltd.
W.A. Trow and Associates Limited
Underwater Gas Developers Limited
Union Carbide Canada Limited
Union Drawn Steel Company, Limited
Union Gas Company of Canada, Limited
Uniroyal Chemical
United Aircraft of Canada Limited
United Gas Limited
Uni-Tel Limited
Univac
Vanbots Construction Company
Varian Associates of Canada Limited
V.N.G. Auto Parts Limited
Wabush Mines
Wallaceburg Brass Limited
Walter, Eull and Elliott Ltd.
Walter, Fedy and Associates Ltd.
The Warner and Swasey Company
Warnock Hersey International Limited
Waterloo, City of
Waterloo Public Utilities Commission
Waterloo Spring Co. Ltd.
Watts and Henderson Ltd.
University of Waterloo
Audio Visual Centre
Dept. of Chemical Engineering
Dept. of Civil Engineering
Dept. of Co-ordination and Placement
Dept. of Systems Design
Dept. of Electrical Engineering
Dept. of Mechanical Engineering
Dept. of Physics
Dept. of Psychology
Engineering Computing Centre
General Studies
Physical Plant and Planning
Water Resources Institute
Jervis B. Webb Company of Canada, Ltd.
Welland, County of
Welland Forge Limited
Wentworth, County of
George Wimpey and Company Limited
The W.C. Wood Company Limited
Worthington (Canada) 1955 Limited
Yorkville Sound Ltd.
Yost Mews & Associates
15 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 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, 1970.

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.

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 accepted by the University of Waterloo for entrance into a course 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**
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.

**E.L. Ruddy Scholarship**
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.

**G. Ealmore Raeman Scholarship (History)**
A scholarship in the value of $300 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.

**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.

**The Institute of Chartered Accountants' of Ontario Scholarship at the University of Waterloo**
The Institute of Chartered Accountants of Ontario offers a scholarship to a third year student in the Faculty of Arts who expresses a definite interest in the field of Accountancy as a future career. Application should be made to the Office of the Registrar, University of Waterloo, not later than September 30.

**Isaac Newton Scholarships**
The Department of Physics awards Isaac Newton Scholarships annually to the top three students entering each year in Physics. Each scholarship is valued at $150.
Undergraduate Scholarships

Isaac 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 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 examinations and maintain this standing throughout the course. The scholarship will be paid at the rate of $250 a term for up to six terms. 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 $2,000 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 Office 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, 1970.

Rotary Scholarship for Study Abroad
The Rotary Clubs of Kitchener & Waterloo offer a scholarship to an undergraduate or graduate student from the University of Waterloo to study abroad for one year. The value of this scholarship may be up to $1,500. Applicants should have a high scholastic ability, and be able to read, write and speak the language of the country in which he/she is to study. Application should be made before April 30 to the Awards Officer, Office of the Registrar, University of Waterloo.
The Saskatchewan Optometric Association Scholarship

The Saskatchewan Optometric Association presents an annual scholarship of $500. to a Saskatchewan student enrolling in the School of Optometry.

Application for this Scholarship should be submitted to the Scholarship Committee before July 31st, 1970.

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 Christmas customer gift-giving to bursaries for deserving 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 bona-fide 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.
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.

IBM—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 International Business Machines 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 Sciences. 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. Application for a bursary should be made through the Awards Office.

J.P. Bickell Foundation Bursaries
The Foundation is making available a sum of money to be used in providing bursary assistance to Chemical Engineering 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.

K-W University Women's Club Bursary Fund
The University Women's Club of Kitchener-Waterloo 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 and are in need of financial assistance. Preference will be given to girls not holding tuition scholarships. Application should be made on the forms provided by the Awards Office.
Undergraduate Bursaries

Lambton County Bursary
Lambton County Council offers a bursary valued at $100. to a student from that 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.

Oxford County Bursaries
Oxford County Council has granted the University of Waterloo an amount of $800. 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 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 may be awarded to any full-time undergraduate student at the University, who has a good academic record and is in need of financial assistance for continued studies.

Awards will be made by the Scholarships Committee. Application for a bursary should be made to the Awards Office.
Undergraduate Prizes

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

Association of Professional Engineers Gold Medal for Academic Achievement Award

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

Canadian Optical Supply Co.

Centennial Optical Limited

Dominion Contact Lens Laboratory, New Toronto, Ontario
Undergraduate Prizes

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.

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 Hermant 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.

K & W 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 final examinations of any non-graduating year of each Faculty. This is provided that the student attains a minimum of 80% in the final 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.
Undergraduate Prizes

**French Department Prize**
The French Department Prize, of the value of $50, will be awarded annually to the student who in first year attains the highest mark in the prerequisite course for honours French. To qualify for the prize the student must enroll in the second year of an honours programme offered by the French Department.

**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 academic year 1966-67, 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 major subject and one registered with Chemistry as major subject. Qualifications are (a) a clear pass standing and (b) highest standing in Biology with a minimum of B standing, or highest standing in Chemistry 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 George Crabbe Prize for Creative Writing**
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 superior creative writing in any of the following 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 are 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 evidence, 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 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 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 for it 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 remain primarily responsible for the costs of post-secondary education, your 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.

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.

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.
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.

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. In 1969 these fellowships carried a stipend up to a maximum of $2,600 per year. 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 instructional duties in addition to research.

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: 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 Dean of Engineering.
Graduate Scholarships and Fellowships

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, 1970.

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 II 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 1969 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 school in the United States or Canada. The Foundation primarily supports candidates in the humanities and social sciences who wish to 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, 1969.

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 Sciences and Humanities (two fellowships). Nomination of students...
Graduate Scholarships and Fellowships

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 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 own 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.

Full information and application forms may be obtained from the Association of Universities and Colleges of Canada, 151 Slater Street, 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 for annual competition at Canadian universities. Each award has a possible tenure of three years, and is valued at $4,500. annually of which $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 con-
cerned 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 Fellowships
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.
16 Governing Bodies and Staff
The Board of Governors

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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

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<th>Elective Members</th>
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<tr>
<td>Donald S. Anderson</td>
<td>R. Bruce Marr</td>
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<td>John E. Motz</td>
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<td>C.A. Pollock</td>
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<td>W.M. Rankin</td>
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<td>A.R. Kaufman</td>
<td>Vacancies—5</td>
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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.

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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)

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D.S. Scott, B.Sc., M.Sc., Ph.D. (Dean of Engineering)
W.F. Forbes, D.I.C., Ph.D., D.Sc. (Dean of Mathematics)
W.B. Pearson, M.A., D.Sc., D.F.C., F.R.S.C. (Dean of Science)
L.A.K. Watt, B.Sc., M.Sc., Ph.D. (Dean of Graduate Studies)

The Academic Dean of each Federated College

Z.T. Ralston, C.R., M.A., Ph.D. (St. Jerome’s College)

The Librarian

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C.A. Pollock, B.A.Sc., B.S.

The Registrar

C.T. Boyes, B.A.

The Director of Extension

A.A. Beveridge, B.A.

Faculty Representatives

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To 1970
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E. Brundrett, B.S.A., B.A.Sc., M.A.Sc., Ph.D. (Engineering)
P.M. Reilly, B.A.Sc., D.I.C., Ph.D., F.S.S. (Engineering)
P.C. Eastman, B.Sc., M.Sc., Ph.D. (Science)
L.A. Cummings, A.B., M.A., Ph.D. (St. Jerome’s)
J.B. Ellis, B.A.Sc., D.I.C., M.Sc., Ph.D. (Division of Environmental Studies)

To 1971
I.C. Gray, B.A., M.A., Ph.D. (Arts)
L.A.K. Watt, B.Sc., M.Sc., Ph.D. (Engineering)
A. Kerr-Lawson, B.A., S.M., Ph.D. (Mathematics)
W.S. Long, B.A., O.D. (Science)
P.E. Morrison, M.Sc., Ph.D. (Science)
W.A. Delahey, B.A., B.P.H.R.E. (Physical Education & Recreation)
A.M. MacQuarrie, B.A., M.A. (St. Jerome’s)
T.E. Bjornstad, B.Arch., A.I.A. (Division of Environmental Studies)
To 1972
P.G. Cornell, E.D., M.A., Ph.D. (Arts)
B.G. Hutchison, B.E., M.Sc., Ph.D. (Engineering)
J. Aczel, Ph.D., Habil. D.Sc. (Mathematics)
H.D. Sharma, M.Sc., Ph.D., (Science)
C.A. Griffith, B.A., M.S., Ph.D. (Physical Education & Recreation)
P.S. Smith, B.A., M.A., Ph.D. (St. Jerome's)

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R.C. VanVeldhuisen, B.A.Sc.
P.A. Boucher, C.R., B.A.

To 1972
M. Kuxdorf, B.A., M.A., Ph.D.
B.C. Hayes, C.R., B.A. (St. Jerome's)

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To 1970
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**Assistant Dean of Women**  
I. Mackay (Mrs.), B.Sc.

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**Vice-President, Academic**  
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**Assistant to the Vice-President, Academic**  
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**Assistant to the Dean**  
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(Graduate Studies) Assistant to the Dean W.K. Brooke, B.A.
Foreign Student Advisor E. Beausoleil (Mrs.)

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Assistant Director W.A. O'Leary, B.A.

Centre for Continuing Studies in Marketing

Director D.V. Deverall, B.A.

Computing Centre

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Associate Director J.C. Wilson, B.A.Sc., Ph.D.
Administrative Assistant G. Hill
Faculty Liaison D.J. McNaughton, B.Sc., M.Sc., Ph.D.

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Director of Academic Services D.P. Robertson, B.Comm.

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Associate Director G.L. White, B.A.Sc., P.Eng.
Assistant Director B.A. McCallum, B.A.
Assistant Director R.J. Wieser, B.Eng., P.Eng.

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.

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Collections Development Librarian Doris E. Lewis (Mrs.), B.A., B.L.S., L.L.D.
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Head, Public Services, Arts Library Helen McKinnon (Miss), B.A., B.L.S., M.L.S.
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Head, Public Services, Engineering, Mathematics and Science Divisional Library
Ada Berti (Miss), B.A., B.L.S.

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B.A. Lumsden, B.A.
Associate Registrar, Records and Scheduling
A.R. Grenier, B.Sc.
Assistant Registrar—Arts
J.F. Willms
Assistant Registrar—Engineering
G.I. Smiley, B.A.
Assistant Registrar—Mathematics
R.J. Bullen, B.Math.
Assistant Registrar—Science, Physical Education and Recreation
G.V. Ambrose
Assistant Registrar—Environmental Studies
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A.R. Dejeet
Systems Analyst
W.G. Ullman

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Vice-President, Operations
A.K. Adlington, B.A.

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J.W. Brown, B.A.
Bookstore Manager
E. Fisher (Mrs.)
Food Services Manager
R. Mudie
Graphic Services Manager
J.W. Hammond
Office Services Manager
G.N. Selinger
Supervisor, Bookings and Office Services
U. Mundhenk

Development
Director
J.O. Hemphill

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Director
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R.L. Knight, B.A.
Assistant Director, Salary Administration
R.J. Elliott, B.A.
Assistant Director, Recruiting
L.W. Brown

Physical Plant and Planning
Director
Assistant Director, Recruiting
Assistant Director (Planning)
A.E. Lappin, P.Eng.
Residences and Housing Administration

Warden (Village 1, Village 2, Minota Hagey Residences)
H.R.N. Eydt, M.Sc., Ph.D.
Director of Housing and Residence Operations
H.C. Vinnicombe, B.Sc. (Eng.)

Safety
Director N. Ozaruk

Security
Director A.E. Romenco, B.A.

Treasurer
Treasurer A.B. Gellatly, B.A., C.G.A.
Research Grants V.E. Leavoy (Miss)

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Comptroller A.H. Headlam, C.A.
Accountant To be appointed
Budgets Officer S.S. Farrell, M.B.A.
Office Manager W.K. Randell, R.I.A.

Purchasing
Purchasing Agent W.G. Deeks
Assistant Purchasing Agent W. Buzza
Manager-Central Stores C.A. Lawrence

Internal Audit
Internal Auditor B.R. Foord, C.A.
17 Faculty
Faculty

Abbott, C.C. (Mrs.)  Classics and Romance Languages
Abbott, W.R.  Philosophy
Abell, H. (Miss)  School of Urban and Regional Planning
Abler, T.S.  Sociology and Anthropology
Aczel, J.  Applied Analysis and Computer Science
Adamczewski, Z.  Philosophy
Adams, K.G.  Mechanical Engineering
Ages, A.  Classics and Romance Languages
Albright, S.  Optometry
Allen, H.A.J.  Statistics
Alleyne, J.M.  Sociology and Anthropology
Alpay, S.A.  Mechanical Engineering
Amoroso, D.M.  Psychology
Anderson, A.  Physics
Anderson, J.E.  Political Science
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
Applevich, I.D.  Electrical Engineering
Appleyard, A.C.  Earth Sciences
Ariaratnam, S.T.  Civil Engineering
Armour, L.  Philosophy
Ashton, N.J.  Kinesiology
Ashworth, E.J.  Philosophy
Atkinson, G.F.  Chemistry
Aziz, R.A.  Physics
Baker, I.  Optometry
Bakos, G.A.  Physics
Balasubramanian, A.  Chemistry
Baldock, A.J.  Optometry
Banks, R.K.  Psychology
Baker, J.A.  Applied Analysis and Computer Science
Barnes, C.R.  Earth Sciences
Barrett-Lennard, G.T.  Psychology
Barron, F.H.  Management Sciences
Barron, F.L.  History
Bater, J.H.  Geography
Batke, T.L.  Chemical Engineering
Baycroft, G.H.  Kinesiology
Beachey, R.W.  History
Beam, P.D.  English
Beauchamp, M.A.  Sociology and Anthropology
Beaumont, C.F.A.  Applied Mathematics
Beecroft, E.A.  School of Urban and Regional Planning
Beingessner, C.G.  Mechanical Engineering
Belovsov, V.D.  Mathematical Research
Bennett, G.W.  Statistics
Bennett, K.M.H.  Economics
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Slawson, P.R.  
Slethaug, G.E.  
Smale, W.M.  
Smith, H.J.T.  
Smith, J.G.  
Smith, P.S.  
Snieckus, V.A.  
Snyder, M.E. (Mrs.)  
Snyder, R.A.  
Sobkowski, L.  
Somfray, J.C.  
Sommerville, E.  
Soulis, G.N.  
Sparks, B.B.  
Spink, D.R.  
Spree, L.  
Springer, C.C.  
Sprott, D.A.  
Srinivasan, V.S.  
Srivastava, K.D.  
Staal, R.A.  
Steffy, R.A.  
Steiner, H.D.  
Steslicka, M.  
Stone, J.S.  
Strong, A.B.  
Suits, B.H.  
Sullivan, H.F.
Sumner, D.B.  
Taht, V.  
Tang, F.C.Y.  
Taplin, D.M.R.  
Taylor, M.A.  

Thalman, B. (Mrs.)  
Thomas, W.K.  
Thompson, F.  
Thompson, H.  
Thompson, H.C.  
Thompson, J.C.  
Thompson, J.E.  
Thysell, M.G. (Mrs.)  
Thysell, R.V.  
Toida, S.  
Tomlison, G.  
Toogood, G.E.  
Topper, T.H.  
Torrie, B.H.  
Totzke, C.A.W.  
Trim, D.W.  
Tucker, J.W.  
Turner, G.A.  
Tutte, W.T.  
Tuyn, H.  
Uhde, J.  
Unny, T.E.  
van der Hoff, B.M.E.  
Van Evra, J.A. (Mrs.)  
Van Evra, J.W.  
van Heeswijk, R.G.  
Vatcher, M.  
Vaz, E.W.  
Vellinga, J.H.  

Vetter, W.J.  
Viswanatha, T.  
Vlach, J.  
Vogel-Sprott, M.D.  
de Vos, A.  
Vranch, J.K.  
Vuorinen, P.A.  
Wahl, J.M.  
Wahlsten, D.L.  
Wainwright, J.  
Walker, D.F.  
Waller, T.G.  
Walter, D. (Mrs.)  
Wang, S.F.  
Watson, R.B.  
Watt, L.A.K.  
Weaver, D.S.  
Weaver, S.M. (Mrs.)  
Wei, L.Y.  
Weintraub, S.  
Wentzell, R.A.  

Pure Mathematics  
Statistics  
Pure Mathematics  
Mechanical Engineering  
Applied Analysis and  
Computer Science  
Classics and Romance Languages  
English  
School of Architecture  
Optometry  
Optometry  
Civil Engineering  
Biology  
English  
Statistics  
Systems Design  
Chemistry  
Chemistry  
Civil Engineering  
Physics  
Kinesiology  
Applied Mathematics  
Pure Mathematics  
Chemical Engineering  
Combinatorics and Optimization  
English  
Fine Arts  
Civil Engineering  
Chemical Engineering  
Psychology  
Philosophy  
Electrical Engineering  
Chemistry  
Sociology and Anthropology  
Applied Analysis and  
Computer Science  
Electrical Engineering  
Chemistry  
Electrical Engineering  
Psychology  
Combinatorics and Optimization  
Biology  
Electrical Engineering  
History  
Man-Environment Studies  
Applied Mathematics  
Geography  
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Physics  
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Sociology and Anthropology  
Electrical Engineering  
Economics  
Applied Mathematics
Wertheim, D.G.  Applied Mathematics
White, O.L.  Earth Sciences
Whitney, J.B.  Statistics
Whiton, J.  Germanic and Slavic Languages and Literatures
Widmeyer, W.N.  Kinesiology
Wigley, T.M.L.  Mechanical Engineering
Willis, B.L.  Systems Design
Wilson, J.C.  Applied Analysis and Computer Science
Wilson, J.M.  Political Science
Wilson, J.W.  School of Urban and Regional Planning
Wilson, T.C.  Applied Analysis and Computer Science
Wilton, R.C.  Pure Mathematics
Wipper, A. (Miss)  Sociology and Anthropology
de Witte, P.  Pure Mathematics
Woodruff, M.E.  Optometry
Woolford, R.G.  Chemistry
Woolner, K.A.  Physics
Wright, D.E.  History
Wright, D.T.  Civil Engineering
Wubnig, J. (Miss)  Philosophy
Wylie, K.J.R.  English
Wynnyckyj, J.R.  Chemical Engineering
Wynne, R.E.  History
Wyszecki, G.W.  Optometry
Young, J.C.  Statistics
Young, L.  Physics
Young, M.  Physics
Young, M.M.  Chemical Engineering
Younger, D.H.  Combinatorics and Optimization
Yovanovich, M.M.  Mechanical Engineering
Zachariah, K.  Biology
Zarnke, C.R.  Applied Analysis and Computer Science
Zima, P.  Combinatorics and Optimization
Zimmer, J.A.  Combinatorics and Optimization
Zweers, A.  Germanic and Slavic Languages and Literatures
18 Academic Calendar
The University of Waterloo reserves the right to change its academic calendar at any time.

July 6, 1970 Monday Lectures Begin—Post Degree Programme

July 20 Monday Supplemental Examinations Begin
August 7 Friday Lectures End—Spring Term
August 8 Saturday Examinations Begin—Spring Term
August 13 Thursday Lectures End—Post Degree Programme

August 14 Friday Examinations Begin—Post Degree Programme

August 15 Saturday Examinations—Post Degree Programme

August 15 Saturday Examinations End—Post Degree Programme
August 28 Friday Summer Work Term Ends—Co-operative Programmes
August 31 Monday Fall Work Term Begins—Co-operative Programmes
September 7 Monday Labour Day—University Closed
September 8 Tuesday Registration Begins—Undergraduate

September 11 Friday Registration Ends—Undergraduate

September 11 Friday Registration—Graduate Studies
September 12 Saturday Registration—Undergraduate Students—Part-time
September 14 Monday Lectures Begin

October 2 Friday End of Course Change Period—Fall Session
October 8 Thursday Meeting—Senate Executive Committee
October 12 Monday Thanksgiving Day—University Closed
October 20 Tuesday Meeting—Board of Governors
October 22 Thursday Meeting—University Senate

December 3 Thursday Meeting—Senate Executive Committee

December 11 Friday Lectures End

December 12 Saturday Examinations Begin—Fall Term
December 17 Thursday Meeting—University Senate
December 23 Wednesday Examinations End—Fall Term Ends
December 25 Friday Christmas Day—University Closed

December 26 Saturday Fall Work Term Ends—Co-operative Programmes
December 28 Monday Winter Work Term Begins—Co-operative Programmes

December 28 Monday Supplemental Examinations—Post Degree
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<tr>
<th>Date</th>
<th>Day</th>
<th>Event</th>
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<tr>
<td>Jan. 1, 1971</td>
<td>Friday</td>
<td>New Year's Day—University Closed</td>
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<tr>
<td>January 4</td>
<td>Monday</td>
<td>Registration—Undergraduate Co-operative Programmes</td>
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<tr>
<td>January 5</td>
<td>Tuesday</td>
<td>Registration—Undergraduate Co-operative Programmes</td>
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<tr>
<td>January 5</td>
<td>Tuesday</td>
<td>Registration—Winter Term—Graduate Studies</td>
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<tr>
<td>January 6</td>
<td>Wednesday</td>
<td>Lectures Begin—All Undergraduate Students</td>
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<tr>
<td>January 19</td>
<td>Tuesday</td>
<td>Meeting—Board of Governors</td>
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<tr>
<td>January 19</td>
<td>Tuesday</td>
<td>End of Course Change Period—Winter Session</td>
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<td>January 22</td>
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<td>End of Course Change Period—Winter Session</td>
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<tr>
<td>February 4</td>
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<td>Meeting—Senate Executive Committee</td>
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<td>February 18</td>
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<td>Meeting—University Senate</td>
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<td>March 15</td>
<td>Monday</td>
<td>Supplemental Examinations Begin—Co-operative Programmes</td>
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<td>March 15</td>
<td>Monday</td>
<td>Pre-registration Begins—Regular and Fall Co-operative Students</td>
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<td>March 19</td>
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<td>Pre-registration Ends—Regular and Fall Co-operative Students</td>
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<td>April 8</td>
<td>Thursday</td>
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<td>April 9</td>
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<td>Good Friday—University Closed</td>
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<td>April 10</td>
<td>Saturday</td>
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<td>April 30</td>
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<td>April 30</td>
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<td>May 3</td>
<td>Monday</td>
<td>Spring Work Term Begins—Co-operative Programmes</td>
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<tr>
<td>May 4</td>
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<td>Registration—Undergraduate Co-operative Programmes</td>
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<tr>
<td>May 4</td>
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<td>Registration—Graduate Studies Spring Term</td>
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<td>May 5</td>
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<td>May 24</td>
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<td>May 28</td>
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<td>May 29</td>
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<td>June 22</td>
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<td>August 6</td>
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<tr>
<td>August 7</td>
<td>Saturday</td>
<td>Examinations Begin</td>
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<tr>
<td>August 14</td>
<td>Saturday</td>
<td>Examinations End—Spring Term Ends</td>
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