University of Waterloo
Academic Calendar 1969-70
Enquiries and formal applications for admission 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 13 of the
Dana Porter Arts Library. Office hours are from 9 a.m. to
12 noon, 1 p.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
University of Waterloo
Academic Calendar 1969-70

1 The University of Waterloo
2 The Faculty of Arts
3 The Faculty of Engineering
4 The Faculty of Mathematics
5 The Faculty of Science
6 The School of Physical Education and Recreation
7 Environmental Studies - Architecture
8 Graduate Studies
9 Course Descriptions - Undergraduate, Graduate
10 Student Services
11 Fees
12 The University Libraries
13 The Department of Co-ordination and Placement
14 Scholarships, Bursaries, Prizes and Financial Aid
15 Governing Bodies and Staff
16 Faculty
17 Academic Calendar
Contents

1 The University of Waterloo
   History 8
   Use of the calendar 9

2 The Faculty of Arts
   Degrees 12
   Admission Requirements 13
   Examinations and Standings 16
   Academic Programmes 18
   The General Programme 20
   Honours Programmes 20
      Anthropology 20
      Applied Economics and Commerce 21
      Economics 21
      Economics and Political Science 22
      Economics and Mathematics 23
      English 23
      English (Drama) 24
      English and French 24
      English and German 25
      English and History 26
      English and Latin 26
      English and Philosophy 27
      English and Russian 27
      English and Spanish 28
      French 29
      French and German 29
      French and Latin 30
      French and Political Science 30
      French and Russian 31
      French and Spanish 31
      Geography 32
      Urban and Regional Planning 32
      Geography and Geology 34
      German and Russian 34
      German 35
      History 35
      History and Philosophy 36
      History and Political Science 36
      Latin 37
      Philosophy 37
      Philosophy and Literature 37
      Philosophy and Mathematics 39
      Philosophy and Political Science 39
      Philosophy and Psychology 40
      Political Science 41
      Political Science and Sociology 41
      Psychology 42
      Psychology and Sociology 43
      Psychology and Statistics 43
      Russian 44
      Sociology 45
      Sociology and Anthropology 45
      Spanish 46
      International Studies - Renison College 46
      Social Science (Applied) - Renison College 47

Graduate Studies
### 3 The Faculty of Engineering

#### Degrees
- Admission Requirements
- Examinations and Promotions
- Academic Programmes
  - Chemical Engineering
  - Civil Engineering
  - Electrical Engineering
  - Mechanical Engineering
  - Systems Design

### 4 The Faculty of Mathematics

#### Degrees
- Admission Requirements
- Examinations and Promotions
- Academic Programmes
- General Programme
- Honours Programmes
  - Regular
    - Actuarial Science
    - Applied Mathematics
    - Applied Analysis and Computer Science
    - Combinatorics and Optimization
    - Pure Mathematics
    - Statistics
    - Teaching
    - Mathematics and Economics
    - Mathematics and Philosophy
    - Statistics and Psychology
- Honours Programmes
  - Co-operative

### 5 The Faculty of Science

#### Degrees
- Admission Requirements
- Examinations and Promotions
- Academic Programmes
- Honours Programmes
  - Biology
  - Biology and Chemistry
  - Biology and Psychology
  - Chemistry
  - Chemistry (Mathematics Option)
  - Chemistry (Physics Option)
  - Co-operative Applied Chemistry
  - Chemistry and Physics
  - Earth Sciences
  - Physics
  - Theoretical Physics
  - Co-operative Applied Physics
  - Optometry Programme
  - General Programme

### 6. The School of Physical Education and Recreation

#### Degrees
- Admission Requirements
- Examinations and Promotions
- Academic Programmes
- Honours Kinesiology
- Honours Recreation
Contents

7. Environmental Studies
   Architecture
   Degrees
   Admission Requirements
   Examinations and Promotions
   Academic Programme

8. Graduate Studies
   Degree Requirements
   Admission Requirements
   Definitions
   Examinations

9. Course Descriptions
   Undergraduate, Graduate
   Anthropology
   Applied Analysis and Computer Science
   Applied Mathematics
   Architecture
   Art - see Fine Arts
   Arts
   Biology
   Chemical Engineering
   Chemistry
   Civil Engineering
   Classics
   Classics and Romance Languages
   Combinatorics and Optimization
   Earth Sciences
   Economics
   Electrical Engineering
   English
   Environmental Studies
   Film - see Fine Arts
   Fine Arts
   French
   General Engineering
   Geography and Planning
   German and Russian
   Greek
   History
   Italian
   Kinesiology
   Latin
   Management Sciences
   Mathematics
   Mechanical Engineering
   Music - see Fine Arts
   Optometry
   Philosophy
   Physics
   Planning
   Political Science
   Psychology
   Pure Mathematics
   Recreation
   Religious Studies
   Romance Languages
   Russian
   Science
   Sociology
   Social Work

Page 121
Page 121
Page 124
Page 124
Page 128
Page 132
Page 132
Page 133
Page 333
Page 254
Page 254
Page 206
Page 209
Page 136
Page 137
Page 142
Page 151
Page 161
Page 173
Page 172
Page 255
Page 180
Page 183
Page 188
Page 199
Page 207
Page 209
Page 209
Page 175
Page 213
Page 216
Page 228
Page 173
Page 236
Page 177
Page 245
Page 174
Page 249
Page 254
Page 273
Page 209
Page 285
Page 289
Page 298
Page 221
Page 309
Page 315
Page 256
Page 326
Page 328
Page 175
Page 231
Page 332
Page 333
Page 335
Contents

10 Student Services
Office of Student Affairs 346
University Counselling Service 346
Dean of Women 347
Medical Health Service 348
Health and Accident Insurance 348
Student Discipline 348
Foreign Student Office 349
Off-Campus Housing Office 349
Campus Centre 349
Federation of Students 349
Book Store 351
Career Planning and Placement 352
Regular Officers’ Training Plan (ROTP) 352
Residence Information 352
Conrad Grebel College 352
Renison College 353
St. Jerome’s College 353
Notre Dame College 353
St. Paul’s College 353
University of Waterloo Residences 354
Minota Hagey Residence 354
Department of University Extension 355
Centre for Continuing Studies in Marketing 355

11 Fees 358

2 The University Libraries 366

13 The Department of Co-ordination and Placement
Functions of the Department of Co-ordination and Placement 370
Staff
Co-operative Plan 371
The Industrial Advisory Council 374
Companies Employing Co-operative Honours 376
Mathematics Students 378
Organizations Employing Co-operative 379
Physical Education and Recreation Students 381
Organizations Employing Co-operative, Applied Psychology Graduate Students 381
Companies Employing Co-operative Engineering, Applied Physics and Applied Chemistry Students 381

14 Scholarships, Bursaries, Prizes and Financial Aid 394

15 Governing Bodies and Staff 410

16 Faculty 418

17 Academic Calendar 434
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, two 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 seven storey Dana Porter Arts Library Building which was opened in 1965. It provides immediate accommodation for 175,000 volumes as well as seating space for 400 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.

The University Health Service 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 Service 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.

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, 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 church-related liberal arts college incorporated in 1959, became affiliated with the University in July, 1960. The college, which is co-educational and residential, is located in new buildings on the University Campus. Renison College provides accommodation for 100 men and 80 women.

St. Paul's College

a United Church residential college and student centre, became affiliated with the University in 1961. St. Paul’s College provides accommodation for 100 men and 50 women.

Conrad Grebel College

a Mennonite residential college and student centre, became affiliated with the University in 1961. Conrad Grebel provides accommodation for 65 men and 40 women.

University Colours and Coat of Arms

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

Arms

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

Crest

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

Supporters

Two laurel branches joined in saltire below the shield, proper.

Motto

Concordia Cum Veritate-in harmony with truth.

The University Mace

The symbolic theme may be described as follows:

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

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

This four-fold diversity is significant because of the four faculties existing at the time this Mace was presented to the University and as well, of the four church-related colleges federated and affiliated with the University. These diverse elements together form a crown, and the points of the crown, while tending toward a union do not quite touch but remain as individuals suspended in tension and yet engaged in a deep harmony. This creative process is focussed not on the traditional spherical orb of static perfection but rather on an elliptical silver ovum—the egg-shaped symbol of creativity—the marvellous potential of a new--dual 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 8) explains the policies and programmes of each individual faculty or school. The second division (Chapter 9) 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 10 to 17) 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 1969-1970 academic session which commences in September, 1969. The Senate and the Board of Governors of the University of Waterloo reserve the right to make changes in the calendar without prior notice.
2 The Faculty of Arts
The Faculty of Arts

What have the Arts to offer to a student in the latter half of the Twentieth Century?

They can train a person for a profession, they can greatly increase his value and effectiveness as a citizen, and they can, above all, equip him to receive much more from life than would otherwise be possible. These have always been worthwhile ends, and they have always been difficult to achieve. In the remaining thirty years of this century they will become even more valuable, and even more difficult to achieve.

Many things go into their achieving: the willingness of a student to work hard, the inspiration which a professor may provide, the exchange of ideas among students, and the maturing responsibility of holding office in student affairs. All of these are of tremendous assistance—and so is the curriculum which a student may choose to follow. At the University of Waterloo the various curricula in the Arts (both General and Honours) have been designed with the last thirty years of the Twentieth Century very much in mind.

The graduate in Arts from the University of Waterloo will have become acquainted with the various principal ideas influencing his life and that of his fellow citizens. He will also have been trained to think clearly, critically, and creatively. Consequently he will be well equipped to enter the various businesses and professions; he will make a well-informed and perceptive citizen; and he will be exceptionally well-fitted to derive the greatest amount of benefit and enjoyment from his life.

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

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;
Admission Requirements

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, 1969. All other applicants must apply and have submitted all the necessary documents by August 1, 1969. 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.

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 translation of their academic documents.

Admission to Year I

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 Secretariat 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 - AN other subjects

Early Final Admission

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, 1969. 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 May 30, 1969 of their acceptance and will be asked to indicate their decision by June 15, 1969. 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 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)
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 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 competent authority, a student is not profiting from University studies.

Registration
September 10, 11, 12 1969

Fees
Refer to Section 11 page 358

Examinations and Standings
The following regulations govern the practice of the Faculty of Arts 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 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 sixteen, Year 3; and those with sixteen 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 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>Description</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>13</td>
</tr>
<tr>
<td>A-</td>
<td>12</td>
</tr>
<tr>
<td>B+</td>
<td>11</td>
</tr>
<tr>
<td>B</td>
<td>10</td>
</tr>
<tr>
<td>B-</td>
<td>9</td>
</tr>
<tr>
<td>C+</td>
<td>8</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
</tr>
<tr>
<td>C-</td>
<td>6</td>
</tr>
<tr>
<td>D+</td>
<td>5</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
</tr>
<tr>
<td>D-</td>
<td>3</td>
</tr>
<tr>
<td>F+</td>
<td>2</td>
</tr>
<tr>
<td>F</td>
<td>1</td>
</tr>
<tr>
<td>F-</td>
<td>0</td>
</tr>
</tbody>
</table>

c) Over-all standing is determined by the cumulative average of grades assigned for all courses taken at the University (at any time, whether passed for 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>

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 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 Dean of Arts or of one of the departments (depending upon the status of the student), and of the Examinations and Standings Committee. 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 course.

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 5.99 or his average in his field of specialization below 7 (C), he will be granted conditional status for one year, during which period he must make reasonable progress toward obtaining good standing or he will be asked to withdraw. A student whose cumulative over-all average falls below 3 (D—) may continue only with the permission of the Examinations and Standings Committee.

g) To be considered in good standing in the Honours 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 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 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, by petition to the Examining and Standing Committee, be considered 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.

c) make-up examinations are held in late July or early August. Application for these examinations must be filed by the end of June 1969, 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

I-Before graduation, all students in both General and Honours programmes must complete with a passing mark in each a minimum of four courses, not all in one subject, from Group A and a minimum of two courses in Group B. Of the four courses in Group A, a student must take:

- a minimum of two from Group A (i)
- a minimum of one from Group A (ii). (The Group A (ii) requirement may be met by an Arts Faculty student in his second or subsequent years by one of the following courses: German 271*/272*; Russian 271*/272*; Spanish 210; Classical Civilization 251*/252*).

Definitions of Group A and Group B:

Group A

(i) English, History, Philosophy
(ii) French, German, Greek, Italian, Latin, Russian, Spanish, Ukrainian

Group B

Anthropology, Economics, Geography, Planning, Political Science, Psychology, Sociology

2—Year One. (Common to both Honours Programmes and General Programmes). With the approval of his advisor, the student normally selects six courses, of which at least two will be from Group A and at least two from Group B.

Other courses available for student election upon approval of faculty advisor:

Courses in Religious Studies, Fine Arts, and courses in the other Faculties and Schools of the University.

In the Faculty of Arts a first-year student faces a more difficult decision in selecting courses than does a freshman in some of the other Faculties. Whereas scientific and technical programmes tend to restrict the syllabus for the first-year student, the Faculty of Arts offers first-year courses from which the student normally chooses six.

Although one student may begin his university career with the intention of entering a four-year Honours programme, another may wish to earn a General degree, which means that he chooses a “major subject.”
at the end of the first year and graduates in three years. Still another student may not have made up his mind which programme he wishes to enter nor has he determined the subject or discipline in which he will concentrate.

With these factors in mind the Faculty of Arts offers a first-year programme that will permit the student maximum flexibility in determining his programme. In most instances a student in Arts may defer these two significant decisions (the type of degree-Honours or General-and his field of concentration) until the end of his first year. At that time, if his marks are satisfactory, he is free "to major" in any of the six subjects he has studied during this year, or to go on in an Honours programme in one of these subjects.

This Calendar describes recommended Year 1 programmes for the various Honours Programmes, beginning on page 20. That student who definitely plans to work towards an Honours degree and who knows the field in which he wishes to major, will select the appropriate programme. The courses outlined for Honours students are also recommended for students who plan to major in that discipline.

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.

3-Each student's programme must be approved on or before registration day by a faculty advisor from the Faculty of Arts.

4-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 and until the last day of lectures, students may reduce their programmes from honours to general or drop only those courses previously designated as extra. (Under the course-system, courses designated as extra, once completed, are included in the cumulative average.) Changing of the course designated as extra is permitted under (a) and (b) above.

(An extra course is defined as one course beyond the minimum of five required in any one year for a General Programme or one beyond the minimum of six (in most cases) required for an Honours Programme).

Note 1 "Courses" refers to courses which extend for one full academic year; two half-year courses (half-year courses are marked with * in the course description section) are the equivalent of one full course.

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.
The General Programme

Year 1
For Year 1 programme refer io pages 18 to 20)

At the end of Year I, each student in the General Programme must choose one of the following subjects as his major field of study.

Anthropology Greek Psychology
Economics History Religious Studies
English Latin Russian
French Philosophy Sociology
Geography Political Science Spanish
German

Year 2 (General)
Each student in Year 2 must choose at least five courses in consultation with his department chairman:

a) two further courses in his major subject (see notes);
b) three other courses (see notes).

Year 3 (General)
Each student in Year 3 must choose at least five courses in consultation with his department chairman:

a) two further courses in his major subject:
b) three other courses.

Note 1 The programme of every student must in the General Programme 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 must have completed a minimum of sixteen courses with a passing mark in each.

Honours Programmes

In Year I 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 a minimum of twenty-four courses (unless otherwise 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 department concerned.

Honours Anthropology

Recommended Programme

Year 1
Anthropology 101*/102*
English 101
A language other than English
One additional course from Group B
One additional course from Group A(i)
One elective

Year 2
Anthropology 222 or 223
Anthropology 225 or 226
Biology 231 (or a course in physical anthropology)
Three electives

Hours

3
3
3
3
3
3
3
3
3
3
3
9
### Honours Programmes

#### Honours Economics

**Prerequisite**

- Year I: Anthropology 320 or 322
- Year I: Anthropology 350
- One other advanced (200 or above) anthropology course
- Three electives

**Year 4**

- Anthropology 450
- Anthropology 499
- Two other advanced (200 or above) anthropology courses
- Two electives

Honours Economics

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

#### Year 1

**Recommended Programme:**

- Economics 101*/102* 3
- One of Political Science 105*/106* or 115*/116* 3
- English 101 3
- History 100, or Philosophy 101 or equivalent 3
- A language other than English 3
- One Elective† 3

#### Year 2

- Economics 201*/202*† 3
- Economics 230†† 3
- Economics 256*/257* 3
- One of Economics 240, 261*/262*, and 320
- Two electives of which one must satisfy the Group A requirement, †††

#### Year 3

- Economics 300 3
- Economics 330 and 370 6
- Two Electives 6

#### Year 4

- Economics 400 3
- Economics 340 and 380 6
- Two other approved courses

† 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 Applied Economics

**Recommended Programme:**

- Economics 101*/102* 3
- Economics 256*/257* 3
- 3 Group A courses 9
- 1 Group B course other than Economics 3
Honours Programmes

**Year 2**
- Economics 201*/202* 3
- Economics 227*/228* 3
- Economics 258*/259* 3
- Economics 358*/359* 3
- Two electives 6

**Year 3**
- Economics 303*/304* 3
- Economics 336*/337* 3
- One of Economics 360*/361*, 370, 378*/379*, 454*/455*, 466*/467*, 468*/469*, 489*/490* 3
- Two electives 6

**Year 4**
- Economics 403*/404* 3
- Economics 460 3
- One of Economics 360*/361*, 370, 378*/379*, 454*/455*, 466*/467*, 468*/469*, 489*/490* 3
- Two electives 6

Honours Economics and Political Science

**Year 1 Recommended Programme:**
- Economics 101*/102* 3
- One of Political Science 105*/106* or 115*/116* 3
- History 100 3
- Philosophy 125*/140* 3
- Two electives, one of which should satisfy the foreign language requirement 6

**Year 2**
- Economics 201*/202* 3
- Economics 230 3
- Economics 240 3
- Political Science 260 3
- The equivalent of one other full course in Political Science selected in consultation with the Department. 3
- One elective 3

**Year 3**
- Economics 300 3
- One of Economics 320, 330, 340, 380 3
- One of Political Science 220 or 320 3
- Political Science 330 3
- The equivalent of one other full course in Political Science selected in consultation with the Department. One elective. 3

**Year 4**
- At least one further course in Economics selected in consultation with the Department. 3
- The equivalent of at least one further full course in Political Science (at the 400 or 500 level) selected in consultation with the Department. 3
- 3 other courses selected in consultation with the Departments 9
**Honours Programmes**

### Honours Economics and Mathematics

**Year 1 Recommended Programme.**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economics 101*/102*</td>
<td>3</td>
</tr>
<tr>
<td>English 101</td>
<td>3</td>
</tr>
<tr>
<td>One other Group A course</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 130, 131 and 132</td>
<td>9</td>
</tr>
</tbody>
</table>

**Year 2**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economics 201*/202* or 203*/204*</td>
<td>3</td>
</tr>
<tr>
<td>Economics 230 or 205*/206*</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 229, 233 and 237</td>
<td>9</td>
</tr>
<tr>
<td>Two electives</td>
<td>6</td>
</tr>
</tbody>
</table>

**Year 3**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economics 330 and 340</td>
<td>6</td>
</tr>
<tr>
<td>One other course in Economics selected in consultation with the Department</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 238 and 352</td>
<td>6</td>
</tr>
<tr>
<td>Two electives</td>
<td>6</td>
</tr>
</tbody>
</table>

**Year 4**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economics 400 and 460</td>
<td>6</td>
</tr>
<tr>
<td>One other course in Economics selected in consultation with the Department</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 338 and 452</td>
<td>6</td>
</tr>
<tr>
<td>Two electives</td>
<td>6</td>
</tr>
</tbody>
</table>

### Honours English

**Year 1 Recommended Programme**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 101</td>
<td>3</td>
</tr>
<tr>
<td>One of French 100, German 121*/122*, Latin 190, or equivalent language course</td>
<td>3</td>
</tr>
<tr>
<td>One approved course in Philosophy or History</td>
<td>3</td>
</tr>
<tr>
<td>Two courses from Group B or one course from Group B and a course in Religious Studies</td>
<td>6</td>
</tr>
<tr>
<td>One other course</td>
<td>3</td>
</tr>
</tbody>
</table>

**Year 2**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 251, 261, 360</td>
<td>9</td>
</tr>
<tr>
<td>Three other courses (See Note 1)</td>
<td>9</td>
</tr>
</tbody>
</table>

**Year 3**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 270, 370</td>
<td>6</td>
</tr>
<tr>
<td>Two other approved English courses</td>
<td>6</td>
</tr>
<tr>
<td>Two other courses</td>
<td>6</td>
</tr>
</tbody>
</table>

**Year 4**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 350, 380</td>
<td>6</td>
</tr>
<tr>
<td>Two other approved English courses (See Note 2)</td>
<td>6</td>
</tr>
<tr>
<td>Two other courses</td>
<td>6</td>
</tr>
<tr>
<td>Comprehensive Examination</td>
<td>6</td>
</tr>
</tbody>
</table>

**Note 1** Classical Civilization 265*/266* may be chosen as one of the supporting courses.

**Note 2** Senior Honours Essay may be chosen as one of these courses.
## Honours English (Drama)

**Year 1**

<table>
<thead>
<tr>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 101</td>
<td>3</td>
</tr>
<tr>
<td>One of French 100, German 101*/102*, Latin 190, or equivalent language course. One approved course in Philosophy or History. Two courses from Group B or one course from Group B and a course in Religious Studies</td>
<td>6</td>
</tr>
<tr>
<td>One other course</td>
<td>3</td>
</tr>
</tbody>
</table>

**Year 2**

<table>
<thead>
<tr>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 251: Literary Criticism: Its Origins and Practice</td>
<td>3</td>
</tr>
<tr>
<td>English 360: Drama to 1642</td>
<td>3</td>
</tr>
<tr>
<td>#English 216*/221*: The Development of Drama to 1660; Drama from 1660</td>
<td>3</td>
</tr>
<tr>
<td>#English 225: Principles of Dramatic Production I</td>
<td>3</td>
</tr>
<tr>
<td>Two other courses (See note 2)</td>
<td>6</td>
</tr>
</tbody>
</table>

**Year 3**

<table>
<thead>
<tr>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of English 270: Middle English or English 370: The Augustan Age</td>
<td>3</td>
</tr>
<tr>
<td>Two other approved courses in English</td>
<td>6</td>
</tr>
<tr>
<td>#English 329: History of the Theatre</td>
<td>3</td>
</tr>
<tr>
<td>#English 325: Principles of Dramatic Production 2</td>
<td>3</td>
</tr>
<tr>
<td>One other course (See note 2)</td>
<td>3</td>
</tr>
</tbody>
</table>

**Year 4**

<table>
<thead>
<tr>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seventeenth-Century Non-Dramatic Literature or English 380: The Romantic Movement</td>
<td>3</td>
</tr>
<tr>
<td>English 261 or another approved course in English</td>
<td>3</td>
</tr>
<tr>
<td>#English 425: Elizabethan Stage Production</td>
<td>3</td>
</tr>
<tr>
<td>#Two additional courses in Drama (See note 1)</td>
<td>6</td>
</tr>
<tr>
<td>One other course (See note 2)</td>
<td>3</td>
</tr>
</tbody>
</table>

#Courses marked thus are courses within the drama concentration.

**Note 1**

These courses may be in one or more of the following areas: stage design, lighting, and costume; dramatic criticism; acting; directing. These courses will be listed and described in the 1970-71 Calendar.

**Note 2**

Greek 366*/375*, Latin 475*, French 325*/326*, Spanish 276*/316* are especially recommended where appropriate.

---

## Honours English and French

**Year 1**

<table>
<thead>
<tr>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 101</td>
<td>3</td>
</tr>
<tr>
<td>French ’100</td>
<td>3</td>
</tr>
<tr>
<td>History 100 (or History I IO), or Philosophy 100 or equivalent</td>
<td>3</td>
</tr>
<tr>
<td>One of History 100, Philosophy 100 or equivalent, a course in German, Latin, or Spanish</td>
<td>3</td>
</tr>
<tr>
<td>Two courses from Group B or one course from Group B and a course in Religious Studies</td>
<td>6</td>
</tr>
</tbody>
</table>

**Year 2**

<table>
<thead>
<tr>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 251, 360</td>
<td>6</td>
</tr>
<tr>
<td>French-Two full courses or equivalent (See Note 2)</td>
<td>6</td>
</tr>
<tr>
<td>Two other courses</td>
<td>6</td>
</tr>
</tbody>
</table>
Year 3 One of English 270 or 370
One other approved English course
French-Two (or three) full courses or equivalent (See Note 2)
One or two other courses (See Note 3)

Year 4 One of English 350 or 380
English 261 or another approved English course
One other approved English course (Note 1)
French-Two (or three) full courses or equivalent (See Note 2 and Note 3)
One other course (if appropriate)

Note 1 Senior Honours Essay may be chosen as this course
Note 2 Students planning to enter the teaching profession must comply with the requirements as set down by the individual Colleges of Education in Ontario. In French they should complete a minimum of eight full courses or equivalent, including 250, 350, 455*-456*.

Note 3 A student in each of his third and fourth years must take a minimum of six full courses.

Honours English and German

Year 1 Recommended Programme

English 101
German—one full course or equivalent
History 100, or Philosophy 100 or equivalent
Three additional courses taken in accordance with general Arts Faculty regulations

Year 2 English 251, 360
German—minimum of two full courses or equivalent
Two other courses

Year 3 One of English 270 or 370
One other approved English course
German—minimum of two full courses or equivalent
Two other courses

Year 4 One of English 350 or 380
English 261 or another approved English course
One other approved English course (See Note 3) or one other German course
German—minimum of two full courses or equivalent
One other course

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

Note 2 Before graduation, students must complete the requirements for Honours courses as described on page 20 of the Calendar.

Note 3 Senior Honours Essay may be chosen as the English course.
### Honours English and History

#### Year 1

**Recommended Programme**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 101</td>
<td>3</td>
</tr>
<tr>
<td>History 100 or 110</td>
<td>3</td>
</tr>
<tr>
<td>One of French 100, German 121*/122*</td>
<td>3-4</td>
</tr>
<tr>
<td>Latin 190</td>
<td></td>
</tr>
<tr>
<td>Three additional courses taken in accordance with general Arts Faculty regulations</td>
<td></td>
</tr>
</tbody>
</table>

**Hours** | 9 |

#### Year 2

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 251, 360</td>
<td>6</td>
</tr>
<tr>
<td>Two History courses (See Note 1)</td>
<td></td>
</tr>
<tr>
<td>One of Philosophy 100 or equivalent, Psychology 110, an advanced literature course</td>
<td>3</td>
</tr>
<tr>
<td>One other course</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Year 3

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of English 270 or 370</td>
<td>3</td>
</tr>
<tr>
<td>One approved English course</td>
<td>3</td>
</tr>
<tr>
<td>Two History courses (See Note 1)</td>
<td>6</td>
</tr>
<tr>
<td>One other course</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Year 4

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of English 350 or 380</td>
<td>3</td>
</tr>
<tr>
<td>English 261 or another approved English course</td>
<td>3</td>
</tr>
<tr>
<td>One other English course (See Note 2)</td>
<td>3</td>
</tr>
<tr>
<td>Two of History 450-479</td>
<td>4</td>
</tr>
<tr>
<td>One other History course (See Note 1)</td>
<td>2-3</td>
</tr>
</tbody>
</table>

**Note 1** *The five undesignated courses in History beyond the first year will normally be selected from History 250, 255, 260, 265*/266*/295*/296*. 350, 361, 362, 363, 370.*

**Note 2** *Senior Honours Essay may be chosen as this course.*

### Honours English and Latin

#### Year 1

**Recommended Programme**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 101</td>
<td>3</td>
</tr>
<tr>
<td>Latin 190</td>
<td>3</td>
</tr>
<tr>
<td>History 100, or Philosophy 100 or equivalent</td>
<td>3</td>
</tr>
<tr>
<td>Two courses in social sciences</td>
<td>6</td>
</tr>
<tr>
<td>One other course</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Year 2

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 251, 360</td>
<td>6</td>
</tr>
<tr>
<td>Latin-minimum of two full courses or equivalent</td>
<td>6</td>
</tr>
<tr>
<td>Classical Civilization 251*/252*</td>
<td>3</td>
</tr>
<tr>
<td>One other course</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Year 3

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of English 270 or 370</td>
<td>3</td>
</tr>
<tr>
<td>One approved English course</td>
<td>3</td>
</tr>
<tr>
<td>Latin-minimum of two full courses or equivalent</td>
<td>6</td>
</tr>
<tr>
<td>Classical Civilization 265*/266*</td>
<td>3</td>
</tr>
<tr>
<td>One other course</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Year 4

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of English 350 or 380</td>
<td>3</td>
</tr>
<tr>
<td>English 261 or another approved English course</td>
<td>3</td>
</tr>
</tbody>
</table>
Honours Programmes

<table>
<thead>
<tr>
<th>Year</th>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year 1</strong></td>
<td><strong>Recommended Programme</strong></td>
<td><strong>Hours</strong></td>
</tr>
<tr>
<td></td>
<td>English 101</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>One of French 100, German 121*/122*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Latin 190, Greek 190</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>One of Philosophy 221*/222* or 280*/281*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Psychology 105*/106*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>One of History 100 (or History I IO), or a foreign language course</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>One other course</td>
<td>3</td>
</tr>
<tr>
<td><strong>Year 2</strong></td>
<td><strong>Recommended Programme</strong></td>
<td><strong>Hours</strong></td>
</tr>
<tr>
<td></td>
<td>English 251, 360</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>One of Philosophy 221*/222* or 280*/281*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Philosophy 282*/283* and one other Philosophy course</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>One other course</td>
<td>3</td>
</tr>
<tr>
<td><strong>Year 3</strong></td>
<td><strong>Recommended Programme</strong></td>
<td><strong>Hours</strong></td>
</tr>
<tr>
<td></td>
<td>One of English 270 or 370</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>One other approved English course</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Philosophy 399, 331. and one other Philosophy course</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>One other course</td>
<td>3</td>
</tr>
<tr>
<td><strong>Year 4</strong></td>
<td><strong>Recommended Programme</strong></td>
<td><strong>Hours</strong></td>
</tr>
<tr>
<td></td>
<td>One of English 350 or 380</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>English 261 or another approved English course</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>One other approved English course (See Note 2) or Philosophy 499</td>
<td>1-3</td>
</tr>
<tr>
<td></td>
<td>Two Philosophy courses</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>One other course</td>
<td>3</td>
</tr>
</tbody>
</table>

Note 1 Senior Honours Essay may be chosen as this course.

Note 2 Before graduation a student must complete a minimum of eight full courses in Latin.

Honours English and Russian

<table>
<thead>
<tr>
<th>Year</th>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year 1</strong></td>
<td><strong>Recommended Programme</strong></td>
<td><strong>Hours</strong></td>
</tr>
<tr>
<td></td>
<td>English 101</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Russian-one full course or equivalent</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>History 100 (or History I IO), or Philosophy 100 or equivalent</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Three other courses taken in accordance with general Arts Faculty regulations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>English 261 or another approved English course</td>
<td>3</td>
</tr>
</tbody>
</table>

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

Note 2 Senior Honours Essay may be chosen as the English course.
### Year 2
- **English 251, 360**  
  6
- Russian-minimum of two full courses or equivalent  
  6
- Two other courses  
  6

### Year 3
- One of English 270 or 370  
  3
- One other approved English course  
  3
- Russian-minimum of two full courses or equivalent  
  6
- Two other courses  
  6

### Year 4
- One of English 350 or 380  
  3
- English 261 or another approved English course  
  3
- One other approved English course (See Note 3) or one other Russian course  
  3
- Russian-minimum of two full courses or equivalent  
  6
- One other course  
  3

**Note 1** Before graduation, students must complete a minimum of seven full Russian courses.

**Note 2** Before graduation, students must complete the requirements for Honours courses as described on page 20 of the Calendar.

**Note 3** Senior Honours Essay may be chosen as the English course.

### Honours English and Spanish

**Year 1**

**Recommended Programme**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 101</td>
<td>3</td>
</tr>
<tr>
<td>French 100</td>
<td>3</td>
</tr>
<tr>
<td>Spanish 190</td>
<td>4</td>
</tr>
<tr>
<td>History 100 (or History 1 IO), or Philosophy 100 or equivalent</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 110 or Political Science</td>
<td>3</td>
</tr>
<tr>
<td>105*/106*</td>
<td>3</td>
</tr>
<tr>
<td>A course in Religious Studies or a second social science</td>
<td>3</td>
</tr>
</tbody>
</table>

**Year 2**
- **English 251, 360**  
  6
- Spanish-Two full courses or equivalent  
  6
- Two other courses  
  6

**Year 3**
- One of English 270 or 370  
  3
- One other approved English course  
  3
- Spanish-Minimum of two full courses or equivalent (See Note 2)  
  6-9
- One or two other courses  
  3-6

**Year 4**
- One of English 350 or 380  
  3
- English 261 or another approved English course  
  3
- One other approved English course (See Note 1)  
  3
- Spanish-Minimum of two full courses or equivalent (See Note 2)  
  6-9
- One other course (if appropriate)  
  3
Honours Programmes

Note 1 Senior Honours Essay may be chosen as this course.

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
Four more courses

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

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

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

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

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

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

Honours French and German

Year 1 Recommended Programme
French 100
German, one full course or equivalent
Four 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
Four more courses

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

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

Year 4 French, minimum of two full 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*.

Honours French and Political Science

Year 1 Recommended Programme
One of Political Science 105*/106* or 115*/116*
French 100
History 100
Economics 101*/102*
English 101 or Philosophy 100 or equivalent
Elective

Year 2 One of Political Science 220 or 320
Political Science 260
French 250
The equivalent of one other full course in French
History 265*/266*
†Elective

Year 3 Political Science 330
The equivalent of one other full course in Political Science selected in consultation with the Department
French 350
The equivalent of one other full course in French
†Two Electives
Honours Programmes

Year 4 The equivalent of two full courses in Political Science (at least one of which must be at the 400 or 500 level) selected in consultation with the Department 6
- French 455*/456* 3
- The equivalent of one other full course in French 3
† Elective 3

† Electives may be drawn from additional courses in Political Science or French as well as from other departments. Electives must be approved by the departments of French and Political Science.

Honours French and Russian

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

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

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

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

Note 1 The student may take the two required Social Sciences 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 20 of the Calendar.

Honours French and Spanish

Year 1 Recommended Programme
- French 100
- Spanish 190
- Four 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 I
Recommended Programme
Geography 100*/101*
Earth Science 130
Economics 101*/102*

Two courses from the Humanities chosen after consultation with the Department. One should be a language other than English; if desired, however, one of German 271*/272*, Russian 271*/272*, Spanish 210, Classical Civilization 251*/252* can replace the language course but only in Year 2.

One course chosen after consultation with the Department.

Year 2
Geography 210*/211*, 220, 260*/275*

Three courses chosen after consultation with the Department. Please note that four courses in the Humanities must be completed before graduation.

Year 3
Geography 300*/301*, 375, 381*, 451*

Three courses chosen after consultation with the Department.

Year 4
One of: Geography 420-432
Geography 480, 490, 491*

Two courses chosen after consultation with the Department.

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., Geography 100*/101*.

Note 2 To enter Year II of the Honours Geography programme, a student must obtain a minimum overall grade point average of 9 in his Year I studies, and a minimum grade point average of 10 in Geography 100*/101*. In subsequent years, a student must obtain an overall grade point average of 9 as well as a grade point average of 10 in his Geography courses.

Note 3 Twelve Geography courses is the maximum number that can be taken.

Note 4 Any programme other than the one outlined above must be approved by the Department.

Note 5 Students intending to teach in Secondary School should select either Geography 420 or Geography 322.

Note 6 This programme prepares students for graduate study in Geography, for entry to secondary school teaching, or for research positions in industry and government.

Note 7 All Honours 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.

Honours Urban and Regional Planning

Year I
Recommended Programme
Planning 156*
Geography 100*/101*
Economics 101*/102*
Sociology 101*/102*
Philosophy 125*

Two courses from the Humanities chosen after consultation with the
Department. One should be a language other than English; one of German 271*/272*, Russian 271*/272*, Spanish 210, Classical Civilization 251/252* can replace the language course but only in Year II.

**Year 2 Planning** 255*, 256
Geography 21 1* 260*/275*
Geography 250 or 251*. If 251* is chosen, then the student must select Geography 220 or any 2 of Geography 210*, 321*, 322*; if 250 is chosen then the student must select another half-course elective in consultation with the Department.

One course from the Humanities chosen after consultation with the Department.

One half course chosen after consultation with the Department.

(Summer employment related to Planning)

**Year 3 Planning** 332*/333*, 355*/357*, 358*, 375
Economics 201*/202*
Philosophy 425*
One of: Political Science 260, Political Science 330 or Political Science 340 (consent of the Political Science instructor is required for 330 and 340)

(Summer employment related to Planning)

**Year 4 Planning** 456, 480, 490, 491*
Civil Engineering 461 *

Two courses chosen after consultation with the Department. Planning 404 and Economics 450 are recommended.

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 II of the Honours Planning Programme, a student must obtain a minimum overall grade point average of 9 in his Year I studies, and a grade point average of 10 in Planning 156* and Geography, 100*/101*. In subsequent years a student must obtain an overall grade point average of 9 as well as a grade point average of 10 in his Planning courses.

Note 3 The recommended programme outlined above meets the Arts Faculty requirement of four courses from the Humanities. Any alternative programme accepted by the Department must also meet this requirement.

Note 4 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 5 All Honours Planning students must spend two summers working with an agency involved in planning research, or other work related to planning. The Department, with the assistance of the Department of Coordination and Placement, will assist in securing a summer position.
Honours Geography and Geology Core courses in Physical Geography
100* Intro. to Physical Geography
300* Geomorphology
400 Advanced Geomorphology
Course electives in Earth Science
130 Introductory Geology
231* Minerology
232* Petrography
238* Historical Geology
334 Paleontology
335 Stratigraphy and Sedimentation
340 Structural Geology
437 Crustal Evolution

Note 1 Students selecting this program must obtain the approval of the department and arrange their courses in consultation with the departmental advisor for this programme.

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, 340, 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 (p. 321).

Honours German and Russian

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

Note 1 Each student will normally complete a minimum of at least one course from each of English, History and Philosophy.

Note 2 Before graduation students must complete a minimum of seven full German courses and eight full Russian courses.

Note 3 Before graduation students must complete the requirements for Honours Courses as described on page 20 of this Calendar.
Honours Programmes

Note 4 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 German with minor in English or any other discipline

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

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

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

Year 4 Minimum of three full German courses or equivalent
Minimum of one full English course or equivalent

Note 1 Before graduation students must complete the requirements for Honours Courses as described on page 20 of the 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 History

Year 1 Any first-year programme that fulfills the general faculty requirements (see page 20) is acceptable. History I 10 is especially recommended for those students intending to select Honours History.

Year 2 Three Honours History courses (see note 1).
Three other courses (see note 2).
Hours
9
9

Year 3 Three Honours History courses (see note 1).
Two other courses (see note 2).
9
6

Year 4 Two of History 450-79
History 499
Three History or approved alternative senior courses
6
2
9

Note 1 Before graduation an Honours History student must have completed at least nine Honours History courses which, to insure sufficient breadth, must include at least one from each of the following groupings:

<table>
<thead>
<tr>
<th>A</th>
<th></th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td></td>
<td>261-2</td>
<td>265-6</td>
<td>271-2</td>
</tr>
<tr>
<td>255</td>
<td></td>
<td>350</td>
<td>285</td>
<td>277</td>
</tr>
<tr>
<td>260</td>
<td>260</td>
<td>361</td>
<td>295-6</td>
<td>291-2</td>
</tr>
<tr>
<td>363</td>
<td></td>
<td>362</td>
<td>382</td>
<td>370</td>
</tr>
<tr>
<td>353-4</td>
<td>355-6</td>
<td>383-4</td>
<td>385-4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>385</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Note 2 These courses will be selected in consultation with a departmental advisor and tailored to the individual academic development of each student. By the end of Year 3 a sequence of at least two full courses should be completed both in the humanities and in the social sciences in addition to History.

Note 3 Graduation in this course with at least Second Class standing qualifies a student for admission to the Type A course in History at a College of Education in Ontario.

Honours History and Philosophy

**Year 1 Recommended Programme**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of Philosophy 221*/222* or 280*/281*</td>
<td>3</td>
</tr>
<tr>
<td>History 100 or 110</td>
<td>3</td>
</tr>
<tr>
<td>Four other courses to fulfil the general requirements (see page 20)</td>
<td></td>
</tr>
</tbody>
</table>

**Year 2**

<table>
<thead>
<tr>
<th>Course</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* and one other Philosophy course</td>
<td>6</td>
</tr>
<tr>
<td>Three Honours History courses (see note 2).</td>
<td>9</td>
</tr>
</tbody>
</table>

**Year 3**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philosophy 399, 325/326</td>
<td>4</td>
</tr>
<tr>
<td>Philosophy 346</td>
<td>3</td>
</tr>
<tr>
<td>Two Honours History courses (see note 2).</td>
<td>6</td>
</tr>
<tr>
<td>One additional course</td>
<td>3</td>
</tr>
</tbody>
</table>

**Year 4**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two of History 450 to 479</td>
<td>6</td>
</tr>
<tr>
<td>History 499</td>
<td>2</td>
</tr>
</tbody>
</table>

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 five undesignated courses in History in the Second and Third Years must be selected from History 250-99, 350-99 in consultation with a departmental advisor so as to be tailored to the student’s individual academic development.

Honours History and Political Science

**Year 1 Recommended Programme**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>History 100 or 110</td>
<td>3</td>
</tr>
<tr>
<td>One of Political Science 105*/106* or 115*/116*</td>
<td>3</td>
</tr>
<tr>
<td>One of Sociology 100 or Economics 101*/102*</td>
<td>3</td>
</tr>
<tr>
<td>Three electives, one of which should satisfy the foreign language requirement.</td>
<td>9</td>
</tr>
</tbody>
</table>

**Year 2**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two Honours History courses (see note 1).</td>
<td>6</td>
</tr>
<tr>
<td>Political Science 260 and the equivalent of Two other full Political Science courses selected in consultation with the Department.</td>
<td>9</td>
</tr>
<tr>
<td>One elective.</td>
<td>3</td>
</tr>
</tbody>
</table>

**Year 3**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two Honours History courses (see note 1).</td>
<td>6</td>
</tr>
<tr>
<td>One of Political Science 220 or 320 and the equivalent of One other full course in Political Science selected in consultation with the Department.</td>
<td>6</td>
</tr>
</tbody>
</table>
Honours Programmes

Year 4  Two of History 450-79. 6
History 499 or Political Science 499 2
The equivalent of two full courses in Political 6
Science (at least one of which must be at the
400 or 500 level) selected in consultation
with the Department
One elective. 3

Note 1  The four undesignated courses in History in the Second and Third years
must be selected from History 250-99, 350-99 in consultation with a
departamental advisor so as to be tailored to the student's individual
academic development.

Note 2  Those wishing to qualify for admission to the Type A course at a Col-
lege of Education in Ontario should use one of the electives for an addi-
tional course in Honours History.

Honours Latin

Year 1  Latin 190
Classical Civilization 251*/252*
Four 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
Three more courses

Note 1  Students intending to obtain a Type A certificate for teaching in On-
tario High Schools must take a Minor in addition to their Latin pro-
gramme. 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.

Honours Philosophy

Programme A. (For students selecting Philosophy in first year)

Year 1  Recommended Programme
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 399 or
one other Philosophy course 7-9
Three electives 6-9

Year 3  Three Philosophy courses (including 399 if not
taken in Year 2) 7-9
Two electives 4-6

Year 4  Four Philosophy courses including Philosophy 499 10
Programme B. (For entering at the beginning of Year II)

Year 1

<table>
<thead>
<tr>
<th>Philosophy 100 or two of Philosophy 125*; 135*, 140* or 150*</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>English or History</td>
<td>3</td>
</tr>
<tr>
<td>One of French, German, Latin or Greek</td>
<td>3</td>
</tr>
<tr>
<td>Three electives</td>
<td>9</td>
</tr>
</tbody>
</table>

Year 2

| Philosophy 221*/222*, 280*/281* and one other Philosophy course | 9 |
| One of Philosophy 240 or 282*/283*                            | 3 |
| Two electives                                                | 4-6 |

Year 3

| One of Philosophy 240 or 282*/283*                           | 3 |
| Two other Philosophy courses (including 399)                 | 4 |
| Two electives                                                | 4-6 |

Year 4

| Four Philosophy courses (including 499)                      | 10 |
| One elective                                                | 2-3 |

Honours Philosophy and Literature

Year 1 Recommended Programme:

| One of Philosophy 221*/222* or 280*/281*                      | 3 |
| French 100 (or German 121*/122*)                             | 3 |
| English 101†                                                | 3 |
| A Social Science                                            | 3 |
| Two of                                                     |   |
| A Natural Science                                          |   |
| Mathematics                                                |   |
| History                                                    |   |
| Another language††                                        |   |
| Another Social Science                                     |   |

Year 2

| One of Philosophy 221*/222* or 280*/281*                      | 3 |
| Philosophy 282*/283* and one other Philosophy course         | 6 |
| 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          | 7 |
| French: minimum of two full courses or equivalent (see note 1) |   |
| (or German 351*/352*; 361*/362*; 381*/382*)                 |   |
| One elective                                                | 3 |

Year 4

| Three Philosophy courses                                    | 9 |
| French: minimum of two full courses or equivalent (see note 1) |   |
| (or German 451*/452*; 461*/462*; 471*/472*)                 |   |
| Senior Essay                                               | 6, 1 |
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, 433*/456*.

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

### Honours Philosophy and Mathematics

**Year 1 Recommended Programme**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 101</td>
<td>3</td>
</tr>
<tr>
<td>One of Philosophy 221*/222* or 280*/281*</td>
<td>3</td>
</tr>
<tr>
<td>A foreign language</td>
<td>3</td>
</tr>
<tr>
<td>One course in the social sciences</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 130, 131</td>
<td>6</td>
</tr>
</tbody>
</table>

**Year 2 Mathematics 230, and (a) 231, 232 or (b) 237**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>and either 236 or 238</td>
<td>8</td>
</tr>
<tr>
<td>One of Philosophy 221*/222* or 280*/281*</td>
<td>3</td>
</tr>
<tr>
<td>One of Philosophy 240 or 340 or 282*/283*</td>
<td>3</td>
</tr>
<tr>
<td>Elective</td>
<td>3</td>
</tr>
</tbody>
</table>

**Year 3 Mathematics 330, 332, 233. 234**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>One of Philosophy 240 or 340 or 282*/283*</td>
<td>3</td>
</tr>
<tr>
<td>Philosophy 399 and one other Philosophy course</td>
<td>4</td>
</tr>
</tbody>
</table>

**Year 4 Mathematics 331, 337, 433, 446**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Three Philosophy courses</td>
<td>9</td>
</tr>
<tr>
<td>Elective (may be another Math.)</td>
<td>2-3</td>
</tr>
</tbody>
</table>

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 Dept. concerning rearrangement of their courses.

### Honours Philosophy and Political Science

**Year 1**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of Philosophy 221*/222* or 280*/281*</td>
<td>3</td>
</tr>
<tr>
<td>One of Political Science 105*/106* or 115*/116*</td>
<td>3</td>
</tr>
<tr>
<td>History 100</td>
<td>3</td>
</tr>
<tr>
<td>A Social Science other than Political Science</td>
<td>3</td>
</tr>
<tr>
<td>Two electives. one of which should satisfy the foreign language requirement</td>
<td>6</td>
</tr>
</tbody>
</table>

**Year 2**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philosophy 282*/283*</td>
<td>3</td>
</tr>
<tr>
<td>Philosophy 240 or alternatively 140 and another half course in Philosophy</td>
<td>3</td>
</tr>
<tr>
<td>Political Science 260</td>
<td>280</td>
</tr>
<tr>
<td>The equivalent of one full course selected from Political Science 251, 252*, 264*, 265*, 266*, or 268*</td>
<td>3</td>
</tr>
</tbody>
</table>
Honours Programmes

Year 3 Philosophy 399
Philosophy 327* and another half
course in Philosophy
The equivalent of three full courses
in Political Science selected in
consultation with the Department
One elective

Year 4 Philosophy 325*/326* or one other full
course or equivalent
Philosophy 499 or Political Science 499
The equivalent of two full courses in
Political Science (at least one of
which must be at the 400 or 500
level) selected in consultation
with the Department
Two electives

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 Recommended Programme Hours

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of Philosophy 221*/222* of 280*/281*</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 150</td>
<td>2</td>
</tr>
<tr>
<td>A language other than English</td>
<td>3</td>
</tr>
<tr>
<td>English 101</td>
<td>3</td>
</tr>
<tr>
<td>A Social Science other than Psychology</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics or a Natural Science</td>
<td>2-3</td>
</tr>
<tr>
<td></td>
<td>0-2</td>
</tr>
</tbody>
</table>

Year 2 One of Philosophy 221*/222* or 280*/281* | 3 |
One of Philosophy 240 or 340 or 282*/283* | 3 |
One other Philosophy Course | 3 |
Psychology 280 | 3 |
Psychology 290 | 2 |
One other Psychology Course | 3 |

Year 3 One of Philosophy 240 of 340 or 282*/283* | 3 |
Philosophy 399 | 1 |
Two other Philosophy Courses | 6 |
Psychology 360 | 2 |
One other Psychology Course | 3 |
An elective | 3 |

Year 4 Two Philosophy Courses | 6 |
Psychology 410 | 3 |
Psychology 430 | 2 |
Senior Honours Essay
(Philosophy-Psychology 499) | 6 |
Honours Programmes

Note 1 Biology 101 or I31 is recommended for students who lack Ontario Grade 13 Biology, Mathematics 85 for students who lack Ontario Grade 13 Mathematics. Students may benefit from including Mathematics 130, 243, or 449 and Biology 231 within their programmes.

Note 2 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 Recommended Programme

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Political Science 115*/116*</td>
<td>3</td>
</tr>
<tr>
<td>Two of Economics 101*/102*, Psychology 110, Sociology 101*/102*, Geography 101*/100*</td>
<td>6</td>
</tr>
<tr>
<td>One of History 100, Philosophy 100 or equivalent</td>
<td>3</td>
</tr>
<tr>
<td>Two electives, one of which should satisfy the foreign language requirement</td>
<td>6</td>
</tr>
</tbody>
</table>

Year 2 Political Science 260

The equivalent of two other full courses in Political Science at the 200 level selected in consultation with the Department | 6     |
An approved course in History, Philosophy or Economics | 3     |
Two other courses, at least one of which must be in a subject taken in Year 1 | 6     |

Year 3 The equivalent of three full courses in Political Science (which must include either 220 or 320) selected in consultation with the Department | 9     |
Two other approved courses | 6     |

Year 4 The equivalent of three full courses in Political Science (at least two of which must be at 400 or 500 level) selected in consultation with the Department | 9     |
Two other approved courses | 6     |

Honours Political Science and Sociology

Year 1 Recommended Programme

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Political Science 105*/106* or 115*/116*</td>
<td>3</td>
</tr>
<tr>
<td>Sociology 101*/102*</td>
<td>3</td>
</tr>
<tr>
<td>History 100</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 110</td>
<td>3</td>
</tr>
<tr>
<td>Two electives, one of which should satisfy the foreign language requirement</td>
<td>6</td>
</tr>
</tbody>
</table>

Year 2 Political Science 260

The equivalent of one other full course in Political Science selected in consultation with the Department | 3     |
The equivalent of three full courses in Sociology (which must include 202*) | 9     |
One other approved course | 3     |
## Honours Programmes

### Year 3

**One of** Political Science 220 or 320  
The equivalent of two other full courses in Political Science selected in consultation with the Department  
Sociology 320  
Sociology 325  
One elective

### Year 4

Either Political Science 499 or Sociology 499  
The equivalent of at least one further full course in Political Science (at the 400 or 500 level) selected in consultation with the Department  
The equivalent of at least one further full course in Sociology  
Two electives

## Honours Psychology

### Year 1 Recommended Programme

<table>
<thead>
<tr>
<th>Hours</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Psychology 150  
One of Philosophy, History or English  
A language other than English  
A Social Science other than Psychology  
Two other full year courses (or equivalent half courses)

### Year 2

Psychology 280  
Psychology 290  
One other full-year course (or equivalent half courses) in Psychology  
Three other full-year courses (one from group A) or the equivalent in half-courses

### Year 3

Psychology 360  
Two other full-year courses (or equivalent half courses) in Psychology  
Three other full-year courses (one from group A) or the equivalent in half-courses

### Year 4

Psychology 430  
Psychology 499  
One more full-year course (or equivalent half-courses) in Psychology  
Two other full-year courses or the equivalent in half-year courses
Honours Programmes

Note 1 Psychology 280, 290, 360, 430 and 499 are required of all students in Honours Psychology.

Note 2 It is strongly recommended that students intending to enter the honours programme in psychology offer three credits in Ontario Grade 13 Mathematics. Students who do not offer these papers should consult the department for advice on their programme.

Note 3 Students are permitted to enter 2nd year honours psychology from the first year of the general course.

Note 4 See also: Philosophy and Psychology, Psychology and Statistics. Psychology and Sociology, Statistics and Psychology (Faculty of Mathematics).

### Honours Psychology and Sociology

#### Year 1 Recommended Programme

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychology 150</td>
<td>2</td>
</tr>
<tr>
<td>Sociology 101*/102*</td>
<td>3</td>
</tr>
<tr>
<td>A Language other than English</td>
<td>3</td>
</tr>
<tr>
<td>One of Philosophy, English or History</td>
<td>3</td>
</tr>
<tr>
<td>Two other full year courses (or equivalent half courses)</td>
<td>6</td>
</tr>
</tbody>
</table>

#### Year 2

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychology 280</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 290</td>
<td>2</td>
</tr>
<tr>
<td>Psychology 253* or Sociology 210* and one half course in Social Psychology (Psychology 254* or 256*)</td>
<td>3</td>
</tr>
<tr>
<td>One other full-year course (or equivalent half courses) in Sociology</td>
<td>3</td>
</tr>
<tr>
<td>Two other full year courses (or equivalent half courses)</td>
<td>6</td>
</tr>
</tbody>
</table>

#### Year 3

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>One other full year (or equivalent half courses) in Psychology</td>
<td>2-3</td>
</tr>
<tr>
<td>Sociology 320</td>
<td>3</td>
</tr>
<tr>
<td>Sociology 325</td>
<td>3</td>
</tr>
<tr>
<td>One other full year (or equivalent half courses) in Sociology</td>
<td>3</td>
</tr>
<tr>
<td>One other full year course (or equivalent half courses)</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Year 4

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychology 430</td>
<td>2</td>
</tr>
<tr>
<td>Sociology 450</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 499 or Sociology 499</td>
<td>5</td>
</tr>
<tr>
<td>Two other full year courses (or equivalent half courses)</td>
<td>6</td>
</tr>
</tbody>
</table>

### Honours Psychology and Statistics

#### Year 1 Recommended Programme

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychology 150</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics 130, 131, 132</td>
<td>6</td>
</tr>
<tr>
<td>Philosophy 100 or two of Philosophy 125, 135, 140, 150</td>
<td>3</td>
</tr>
<tr>
<td>A language other than English</td>
<td>3</td>
</tr>
</tbody>
</table>
Honours Programmes

Year 2
Psychology 290  2  2
One other full year course in Psychology or the equivalent in half-year courses  2-3  0-2
Mathematics 229, 233, 237 6
A course in English, History, Philosophy, or a language other than English  3

Year 3
Psychology 360  2  2
One other full year course in Psychology or the equivalent in half-year courses  2-3  0-2
Mathematics 332, 338  4
A course in English, History, Philosophy, or a language other than English  3
Elective  2

Year 4
Psychology 430, 499  3  5
One other full year course in Psychology or the equivalent in half-year courses  2-3  0-2
Mathematics 438 or 440 2
Mathematics 439  2
Elective  2

Note 1 This is a recommended programme. Substitutions are permitted in courses other than Psychology and Mathematics with the consent of the departments. This programme leads to a B.A. degree; the same programme may be taken in the Faculty of Mathematics leading to a B. Math. degree (see Honours Statistics and Psychology).

Note 2 Recommended electives include Mathematics 130 and 499 and Biology 231.

Note 3 Honours Students are required to have Mathematics 130 and Mathematics 243.

Honours Russian with minor in English or any other discipline

Year 1 Recommended Programme
One full Russian course or equivalent
One full English course or equivalent
Four 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

Note Before graduation students must complete the requirements for Honours Courses as described on page 20 of the Calendar.
### Honours Sociology

#### Year 1
**Recommended Programme**
- Sociology 101*/102*
- History 100 or 110
- Philosophy 100 or equivalent
- English 101
- Psychology 110
- A language other than English

<table>
<thead>
<tr>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>

#### Year 2
Anthropology 102 and Sociology 212
and two other full courses in Sociology
Three electives

#### Year 3
Sociology 320, 325 and two other courses
in Sociology
Two electives

<table>
<thead>
<tr>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
</tr>
<tr>
<td>6</td>
</tr>
</tbody>
</table>

#### Year 4
Sociology 450, 465, 470 and 499
One elective

<table>
<thead>
<tr>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>

**Note** Students proposing to post-graduate work in Sociology should be aware of the necessary grounding they should have in Mathematics in selecting electives. Other special interests of the student can be satisfied through the proper elective choices.

### Honours Sociology and Anthropology

#### Year 1
**Recommended Programme**
- Sociology 101*/102*
- Anthropology 101*/102*
- French 100 or German 101*/102*
- Psychology 110
- Two of: History 100, Philosophy 100, English 101

<table>
<thead>
<tr>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>6</td>
</tr>
</tbody>
</table>

#### Year 2
Sociology 202*
Sociology 212*
Anthropology 225 or 226
Math 132
Sociology Elective
Anthropology Elective
One elective

<table>
<thead>
<tr>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>

#### Year 3
Sociology 320
Sociology 325
Anthropology 320 or 322
Anthropology 350
Anthropology 370*
One and one-half electives

<table>
<thead>
<tr>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>7%</td>
</tr>
</tbody>
</table>

#### Year 4
Sociology 450 or 470
Sociology 499 or Anthropology 499
Anthropology 450
Sociology elective at 300 level
Anthropology elective at 300 level
One elective

<table>
<thead>
<tr>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>6</td>
</tr>
</tbody>
</table>
Honours Spanish

**Year 1 Recommended Programme**

Spanish 190
One of English, Philosophy, History, or another language
Four 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
Two more courses.

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

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

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

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

Area Study Programmes

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

Renison College 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 128, 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 500 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, which ever 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, which ever is less. In exceptional cases, an extension of this time limit may be granted by petition of the department to the Faculty Graduate Affairs Group.

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

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

Thesis Deadlines

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

M.A. Spring 1969 convocation: April 25, 1969
      Fall 1969 convocation: September 19, 1969
      Spring 1970 convocation: April 24, 1970

M. Phil. Spring 1969 convocation: April 18, 1969
       Fall 1969 convocation: September 12, 1969
       Spring 1970 convocation: April 17, 1970

Ph.D.  Spring 1969 convocation: March 28, 1969
       Fall 1969 convocation: August 22, 1969
       Spring 1970 convocation: March 27, 1970

All degree candidates must submit five copies of the corrected thesis and pay for binding no later May 9, 1969 in the case of the Spring 1969 convocation, October 3, 1969 in the case of the Fall 1969 convocation,
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 any 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. 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 organized and supervised training in engineering practice. 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. 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) students elect one of the four principal divisions of engineering. The curriculum for each of the four 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 the engineering profession and exposes him to problems typical of those encountered in practice. Students are introduced to full-scale engineering projects and installations, far beyond the scope of any university laboratory. Arrangements for work assignments are made through the Co-ordination Department of the University, which provides a liaison between campus and industry. Through directed 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 well prepared for a career which requires high standards of professional skill and learning. The increasing dependence of our society on modern technology certainly requires engineers who along with their technical ability, are prepared for individual responsibility and 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
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 four main programmes. All courses entail five years of undergraduate study on the co-operative programme.

The Degrees 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 dept. 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>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fall</td>
<td>Winter</td>
<td>Spring</td>
<td>Fall</td>
<td>Winter</td>
<td>Spring</td>
</tr>
<tr>
<td>“A”</td>
<td>First</td>
<td>Second</td>
<td>Work</td>
<td>Third</td>
<td>Work</td>
<td>Fourth</td>
</tr>
<tr>
<td></td>
<td>Term</td>
<td>Term</td>
<td>Period</td>
<td>Term</td>
<td>Period</td>
<td>Term</td>
</tr>
<tr>
<td>“B”</td>
<td>First</td>
<td>Work</td>
<td>Second</td>
<td>Work</td>
<td>Third</td>
<td>Work</td>
</tr>
<tr>
<td></td>
<td>Term</td>
<td>Period</td>
<td>Term</td>
<td>Period</td>
<td>Term</td>
<td>Period</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stream</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Winter</td>
<td></td>
<td></td>
<td>1972</td>
<td></td>
<td>1974</td>
</tr>
<tr>
<td>“A”</td>
<td>1971</td>
<td>Fall</td>
<td>Winter</td>
<td>Spring</td>
<td>Fall</td>
<td>Winter</td>
</tr>
<tr>
<td></td>
<td>Fifth</td>
<td>Work</td>
<td>Sixth</td>
<td>Work</td>
<td>Seventh</td>
<td>Work</td>
</tr>
<tr>
<td></td>
<td>Term</td>
<td>Period</td>
<td>Term</td>
<td>Period</td>
<td>Term</td>
<td>Period</td>
</tr>
<tr>
<td>“B”</td>
<td>Work</td>
<td>Fifth</td>
<td>Work</td>
<td>Sixth</td>
<td>Work</td>
<td>Eighth</td>
</tr>
<tr>
<td></td>
<td>Period</td>
<td>Term</td>
<td>Period</td>
<td>Term</td>
<td>Period</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 various terms are shown in the academic calendar for the year. Students should read section 13 for details of operation of the co-operative programmes.

**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, 1969. All other applicants must apply and have submitted all the necessary documents by August 1, 1969. 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.

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 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 (I)
- Physics (I)
- 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.
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, 1969. 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 May 30, 1969 of their acceptance and will be asked to indicate their decision by June 15, 1969. 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 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
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: McGill Senior Matriculation or Quebec Senior High School Leaving Certificate
- 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.

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 Examination” or an equivalent examination.
Examinations and Promotions

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 taken and his standing in each. Because of the co-operative nature of the programme, no student will be admitted above the Year III 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 10, 1 I, 12. 1969

Fees Refer to section 11, page 358

Examinations and Promotions

The Faculty constitutes the examining body for all University examinations, and following procedures outlined below 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’s progress in his first term 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:

I) 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...
Examinations and Promotions

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:

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

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

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

The progress of all First Year students is examined at the end of their first term and students whose work is not considered satisfactory will not be allowed to proceed to the second term.

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 four 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.
Academic Programmes

An introductory course in social sciences and humanities.

Students who are intending to pursue a course of study in the Department of Chemical Engineering should register for: Chemical Engineering 10

All other students are required to register for General Engineering 1

<table>
<thead>
<tr>
<th>Course Arrangement</th>
<th>First Term lab.</th>
<th>Second Term lab.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lect.</td>
<td>prob.</td>
</tr>
<tr>
<td>Math 12 Calculus I</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 II Physics</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Chem. II General Chemistry</td>
<td>2</td>
<td>3*</td>
</tr>
<tr>
<td>GE22 Graphics II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GE23 Measurement GEI 1 Synthesis</td>
<td>3'</td>
<td>2</td>
</tr>
<tr>
<td>Ch. E. 10 Tutorial Introduction to Social Sciences</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Asterisks signifies a course given on alternate weeks. Detailed course descriptions commence on page 136.

At the completion of the first year, students are required to select one of the following major divisions of engineering.

Chemical Engineering
Civil Engineering
Electrical Engineering
Mechanical Engineering

It should be noted that students who wish to transfer into the Department of Chemical Engineering at the end of year I from the general Engineering Year I are free to do so. Similarly, students who have selected the Chemical Engineering option in Year I are free to transfer into the programmes of the Departments of Civil, Electrical, and Mechanical Engineering in Year II.

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.

A new four-year undergraduate programme in Systems Design Engineering has been initiated. For information on this programme contact the Registrar.

### 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 co-operative 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</th>
<th>Lect.</th>
<th>Lab. or Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math. 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math. 31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math. 32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chem. 22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chem 26</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### b. Engineering Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.E.</td>
<td>61 Philosophy of Science</td>
<td>3</td>
</tr>
<tr>
<td>E.E.</td>
<td>10 Introduction to Electrical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>10 Chem. Process Principles I</td>
<td>4</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>12 Chem. Process Principles II</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>16 Inorganic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>17 Applied Mathematics I</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>18 Engineering Statistics</td>
<td>2</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>21 Fluid-Mechanics (Transport Processes I)</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>22 Transport Processes II</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>23 Transport Processes III</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>31 Physical-Chemical Principles I</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>32 Thermodynamics I</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>33 Thermodynamics II</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>35 Electrochemistry</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>36 Physical-Chemical Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>41 Reaction Kinetics I</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>42 Reaction Kinetics II</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>51 Process Dynamics and Control I</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>61 Engineering Economics</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>62 Process System Design</td>
<td>2</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>71 Chemical Engineering Lab. I</td>
<td>4</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>72 Chemical Engineering Lab. II</td>
<td>6</td>
</tr>
<tr>
<td>Ch.E.</td>
<td>95 Seminar</td>
<td>1</td>
</tr>
</tbody>
</table>

#### 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 course 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 Extractive Metallurgy I
   - and at least two of the following three courses
   - Ch.E. 586 Extractive Metallurgy III; Chemical Metallurgy
   - Ch.E. 587 Extractive Metallurgy IV; Metallurgy of Iron and Steel Manufacture.
   - Ch.E. 588 Inorganic Chemistry 2
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 on 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)

Academic Programmes for Each Term (1969-70)

Chemical Engineering

Year 2A. Fall 1969 - Winter 1970
Math. 22
Math. 23
E.E. 10
Non-Technical Elective
Ch.E. 591

Year 2B. Fall 1969 and Spring 1970
Math. 31
Math. 32
Chem. 36
Non-technical elective
Ch.E. 32
Ch.E. 36

Year 3A. Winter 1970 and Spring 1970
Ch.E. 12
Ch.E. 17
Ch.E. 18
Non-technical elective
Ch.E. 41

Year 3B. Fall 1969 and Winter 1970
Ch.E. 22
Ch.E. 33
Ch.E. 35
Tech. Elect.
Non-technical elective
Ch.E. 42
Ch.E. 71

Year 4A. Fall 1969 and Spring 1970
Ch.E. 23
Ch.E. 51
Ch.E. 61
Ch.E. 72

Year 4B. Winter 1970
G.E. 61
Ch.E. 62
Elective
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) **Water Resources and Sanitary 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 operation of streets and highways and other modes of transportation.

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 water management.

g) **Experimental Mechanics**—for students with an interest in the rheology of materials used in experimental mechanics and the experimental methods for investigations of the static and dynamic behavior of structures.

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 Electricity and Magnetism
- G.E. 31 Thermodynamics
- G.E. 41 Mechanics of Deformable Solids
- G.E. 42 Kinematics and Dynamics
- G.E. 53 Structure and Properties of Materials
- G.E. 61 History and Philosophy of Science
Civil Engineering

b. Civil Engineering Core Courses
C.E. 200 Systems II (Special Problems)
C.E. 201 Mechanics of Deformable Solids II
C.E. 221 Calculus II
C.E. 222 Differential Equations
C.E. 223 Computer Programming
C.E. 232 Systems I (Economics and Social Sciences)
C.E. 241 Survey Camp
C.E. 303 Structural Analysis I
C.E. 304 Structural Analysis II
C.E. 305 Structure and Properties of Materials II
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. 400 Systems III (Project)
C.E. 401 Structural Steel
C.E. 402 Reinforced Concrete I
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. 500 Systems IV (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 II
C.E. 404 Design of Steel Structures
C.E. 505 Mechanical Behavior of Materials
C.E. 506 Advanced Mechanics of Materials
C.E. 507 Advanced Analysis of Structures
C.E. 508 Inelastic Behavior of Ductile Members and Structures
C.E. 509 Elementary Mechanics of Continua
C.E. 525 Failure in Metal Assemblies
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

Certain graduate courses are available as technical electives upon the consent of the Professor.

Academic Programmes for Each Term (1969-70)
Civil Engineering
Certain courses in the Civil Engineering curriculum have been designated as paired or year-long courses. These have been so indicated in the academic programme given below. Final marks for paired courses for both the A and B terms are processed at the end of the B term. All other courses are half-courses the marks for which are given at the end of the term in which they are taught.
Year 2A. Fall 1969 (Class of 1973, Stream A)
G.E. 41 (paired with C.E. 201 in II B)
G.E. 42
E.E. 10
C.E. 221 (paired with C.E. 222 in II B)
C.E. 232 (paired with C.E. 200 and C.E. 223 in II B)

Year 2A. Winter 1970 (Class of 1973, Stream B)
G.E. 41 (paired with C.E. 201 in II B)
G.E. 42
E.E. 10
C.E. 221 (paired with C.E. 222 in II B)
C.E. 232 (paired with C.E. 200 and C.E. 223 in II B)

Year 2B. Fall 1969 (Class of 1972, Stream B)
G.E. 31
G.E. 53
C.E. 201 (paired with G.E. 41 in II A)
C.E. 222 (paired with C.E. 221 in II A)
C.E. 223 (paired with C.E. 232 in II A)
C.E. 200 (paired with C.E. 232 in II A)

Year 2B. Summer 1970 (Class of 1973, Stream A)
G.E. 31
G.E. 53
C.E. 200 (paired with C.E. 232 in II A)
C.E. 201 (paired with C.E. 41 in II A)
C.E. 222 (paired with C.E. 221 in II A)
C.E. 223 (paired with C.E. 232 in II A)

Year 3A. Winter 1970 (Class of 1972, Stream A)
C.E. 305
C.E. 303 (paired with C.E. 304 in III B)
C.E. 321
C.E. 350 (paired with C.E. 351 in III B)
C.E. 361 (paired with C.E. 362 in III B)
C.E. 371 (paired with C.E. 372 in III B)

Year 3A. Summer 1970 (Class of 1972, Stream B)
C.E. 305
C.E. 303 (paired with C.E. 304 in III B)
C.E. 321
C.E. 350 (paired with C.E. 351 in III B)
C.E. 361 (paired with C.E. 362 in III B)
C.E. 371 (paired with C.E. 372 in III B)

Year 3B. Fall 1971 (Class of 1971, Stream A)
C.E. 305 (paired with G.E. 53 in III A)
C.E. 304 (paired with C.E. 303 in III A)
C.E. 322
C.E. 351 (paired with G.E. 32 in III A)
C.E. 362 (paired with C.E. 361 in III A)
C.E. 372 (paired with C.E. 371 in III A)
Year 3B. Winter 1970 (Class of 1971, Stream B)
C.E. 305 (paired with G.E. 53 in III A)
C.E. 304 (paired with C.E. 303 in III A)
C.E. 322
C.E. 351 (paired with G.E. 32 in III A)
C.E. 362 (paired with C.E. 361 in III A)
C.E. 372 (paired with C.E. 371 in III A)

Year 4A. Fall 1969 (Class of 1970, Stream B)
G.E. 61 C.E. 402
C.E. 400 C.E. 451
C.E. 401 C.E. 471

Year 4A. Summer 1970 (Class of 1971, Stream A)
G.E. 61 C.E. 402
C.E. 400 C.E. 451
C.E. 401 C.E. 471

Year 4B. Winter 1970 (Class of 1970, Streams A and B)
C.E. 452
C.E. 481
C.E. 500
three technical electives

Electrical Engineering
By his ingenuity and inventiveness, the engineer utilizes the resources
and forces of nature, to provide goods and services for mankind. Some
of the areas in which he works are research, development, design, produc-
tion, sales, service, management, etc. The specialities in electrical en-
gineering are very numerous. Some of these are Electronics, Electro-
mechanical Energy Conversion, Radio Communications, Sound and
Audio, Computers, Antennas and Microwaves, Circuit Theory, Instrumenta-
tion, Control Systems, Bio-Medical Engineering, Ultrasonics, etc.

Because the scope of electrical engineering is so broad, it is not feasible to specialize to any appreciable degree in the undergraduate pro-
gramme. Consequently emphasis is placed on fundamentals, especially
mathematics and physics. Some degree of specialization is provided in
the latter half of the fourth year by a choice of options.

A. Core Programme
a. Mathematics and Science courses
Math. 22 Calculus 2 3 -
Math. 31 Differential Equations 3 -
Math. 33 Differential Calculus 2 1
Math. 34 Integral Calculus 2 1
Math. 44 Complex Variables 2 1
Phys. 15 Modern Physics 3 -

b. Engineering Courses
G.E. 12 Introduction to Engineering Systems 2 3**
G.E. 31 Thermodynamics 3 -
G.E. 41 Mechanics of Deformable Solids I 2 2
G.E. 42 Dynamics 2 -
E.E. 12 Electrical Circuits 3 3 2
E.E. 13 Electricity and Magnetism 3 3** 1
E.E. 21 Probability and Reliability Theory 3 -
E.E. 22 Numerical Analysis and Computer Programming 2 3
E.E. 25 Application of Electronic Computers 3 3*
Electrical Engineering

E.E. 33 Physical Electronics  
E.E. 34 Physical Properties of Materials  
E.E. 42 Network Theory  
E.E. 543 Network Theory 2  
E.E. 51 Electronics  
E.E. 52 Electronics 2  
E.E. 61 Electromechanics  
E.E. 62 Electrodynamics  
E.E. 76 Electromagnetic Fields  
E.E. 77 Transmission Lines and Waveguides  
E.E. 81 Control Systems  
E.E. 99 Project  

**c. Non-Technical Courses**

G.E. 61 History and Philosophy of Science  
Arts elective  

**B. Option areas**

(one to be chosen)

1) E.E. 28 Communication Theory  
E.E. 35 Solid State Electronics  
E.E. 44 Pulse and Switching Circuits  
E.E. 578 Microwave Engineering  

2) E.E. 28 Communication Theory  
E.E. 529 Communication of Information  
E.E. 44 Pulse and Switching Circuits  
E.E. 582 Control Systems 2  

3) G.E. 13 Management Science 1  
E.E. 63 Topics in Power Engineering  
E.E. 565 Power Systems Analysis  
E.E. 582 Control Systems 2

---

**Academic Programmes for Year 2A. Fall 1969-Winter 1970**

**Each Term**  
(1969/70) Electrical Engineering  
G.E. 41  
G.E. 42  
arts elective

Year 2B. Fall 1969-Summer 1970

Math. 31  
Phys. 15  
G.E. 12  
E.E. 13

Year 3A. Winter 1970-Summer 1970

Math. 33  
Math. 34  
E.E. 33

Year 3B. Fall 1969-Winter 1970

Math. 44  
E.E. 25  
E.E. 34  
E.E. 52  
E.E. 62  
E.E. 76

Year 4A. Fall 1969-Summer 1970

E.E. 21  
E.E. 77
Electrical Engineering

Year 4 | B. Winter 1970
E.E. 543
E.E. 99

and one of these options
1) EE 28 2) EE 28 3) GE 13
EE 35 EE 529 EE 63
EE 44 EE 44 EE 565
EE 578 EE 582 EE 582

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) Thermo-Fluid Mechanics Option is to accommodate students chiefly interested in the inter-related fields of thermodynamics and fluid flow including aerodynamics and gas dynamics. Emphasis is placed on the mathematical and physical aspects of the subject in order to develop a sound engineering-scientific perspective and capability.

(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.

(d) **Engineering Materials Option**—is organized to provide an understanding of those phenomena which influence the mechanical and physical properties of engineering materials. The curriculum is designed to provide sufficient depth in the science of materials to permit further study and research in specialized fields such as physical metallurgy, ceramics, or nuclear materials, and at the same time to provide a fundamental understanding of the structure and behaviour of materials as processed, fabricated and used in industry.

(e) **Environmental Sciences Option**—is 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. Mathematics and Science Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 22</td>
<td>3</td>
</tr>
<tr>
<td>Math. 23</td>
<td>3</td>
</tr>
<tr>
<td>Math. 31</td>
<td>3</td>
</tr>
<tr>
<td>Math. 32</td>
<td>2</td>
</tr>
<tr>
<td>Math. 41</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus 2</td>
<td>3</td>
</tr>
<tr>
<td>Numerical Methods</td>
<td>2</td>
</tr>
<tr>
<td>Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>Numerical Analysis</td>
<td>4</td>
</tr>
<tr>
<td>Applied Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

#### b. Engineering Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.E. 31 Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>G.E. 32 Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>G.E. 41 Mechanics of Deformable Solids</td>
<td>2</td>
</tr>
<tr>
<td>G.E. 42 Dynamics</td>
<td>2</td>
</tr>
<tr>
<td>G.E. 53 Structure and Properties of Matter 1</td>
<td>3</td>
</tr>
<tr>
<td>G.E. 54 Structure and Properties of Matter 2</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 12 Electricity and Magnetism</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 14 Electromagnetics</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 32 Electronics</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 13 Kinematics</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 21 Mechanics of Machinery</td>
<td>2</td>
</tr>
<tr>
<td>M.E. 53 Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 60 System Dynamics and Controls</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 82 Mechanical Engineering Projects</td>
<td>9</td>
</tr>
<tr>
<td>M.E. 90 Engineering Physics</td>
<td></td>
</tr>
<tr>
<td>C.E. 301 Mechanics of Deformable Solids 2</td>
<td>2</td>
</tr>
<tr>
<td>G.E. 61 History and Philosophy of Science</td>
<td>3</td>
</tr>
</tbody>
</table>

**Non-Technical Courses**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>History and Philosophy of Science</td>
<td>3</td>
</tr>
<tr>
<td>Two Arts Electives</td>
<td></td>
</tr>
</tbody>
</table>

### B. Elective Courses

Eight elective courses are required in addition to the core courses listed above to fulfill the requirements of the Mechanical Engineering programme. Choices of electives generally should be restricted to those offered in a single option, however, other electives may be chosen, if the student feels they are relevant.
a. Thermodynamics-Fluid Mechanics Option
M.E. 54 Thermodynamics 2
M.E. 55 Thermodynamics 3
M.E. 56 Heat Transfer 2
M.E. 57 Combustion 1
M.E. 58 Internal Combustion Engines
M.E. 59 Energy Conversion
M.E. 61 Fluid Control Systems 1
M.E. 62 Fluid Mechanics 2
M.E. 63 Turbomachines
M.E. 64 Industrial Aerodynamics
M.E. 65 Gas Dynamics 1
M.E. 66 Turbulent Flow 1
M.E. 67 Aerodynamics of Flight
M.E. 68 Acoustics

b. Solid Body Mechanics and Mechanical Design Option
M.E. 22 Mechanical Design 1
M.E. 23 Mechanical Design 2
M.E. 24 Advanced Dynamics
M.E. 25 Mechanical Vibrations
M.E. 26 Mechanical Design 3-Human Factors
M.E. 27 Mechanics of Deformable Solids 3
M.E. 49 Metrology
M.E. 625 Experimental Mechanics
G.E. 13 Management Science 1
G.E. 14 Statistics in Engineering & Management
Math 55 Digital Computer Programming

c. Manufacturing Sciences Option
i. Metals
M.E. 41 Manufacturing Science 1
M.E. 42 Manufacturing Science 3
M.E. 43 Manufacturing Science 4
M.E. 44 Manufacturing Science 5
M.E. 49 Metrology
M.E. 31 Physical Metallurgy 1
M.E. 22 Mechanical Design 1

2 Plastics
Ch. E. 80 Introduction to Polymer Science
Ch. E. 81 Physical Chemistry of Polymers
M.E. 34 Properties of Polymers
M.E. 46 Manufacturing Science 7

3 Industrial Engineering
G.E. 13 Management Science 1
G.E. 14 Statistics in Engineering and Management

Des. 501 Human Factors
Des. 502 Ergonomics

d. Engineering Materials Option
Mechanical Engineering Electives
M.E. 31 Physical Metallurgy 1
M.E. 32 Physical Metallurgy 2
M.E. 33 Materials Science Laboratories
M.E. 34 Properties of Polymers
M.E. 37 Ceramics
M.E. 64 Mechanical Metallurgy
Suggested electives from other options and departments

M.E. 22 Mechanical Design I
M.E. 26 Human Factors Engineering
M.E. 27 Mechanics of Deformable Solids 3
M.E. 41 Manufacturing Science 1(Plasticity)
M.E. 44 Manufacturing Science 5(Welding)
M.E. 66 Heat Transfer 2
Chem. 25 Polymer Chemistry and Physics
C.E. 611 Elementary Mechanics of Continua

Environmental Sciences Option

M.E. 62 Fluid Mechanics 2
M.E. 66 Turbulent Flow 1
M.E. 69 Introduction to the Environmental Sciences
M.E. 70 Geophysical Fluid Dynamics 1
The above 4 courses are mandatory
Further electives
M.E. 68 Acoustics
M.E. 666 Wave phenomena in Fluid Flow
M.E. 668 Geophysical Fluid Dynamics 2
M.E. 669 Numerical Studies in Meteorology
M.E. 762 Turbulent Diffusion in the Natural Environment
M.E. 763 Micrometeorology
C.E. 686 Engineering Hydrology

General Mechanical Engineering Option

All of the following courses

M.E. 32 Physical Metallurgy
M.E. 41 Manufacturing Science I
M.E. 56 Heat Transfer 2
M.E. 62 Fluid Mechanics 2
M.E. 63 Turbomachines
M.E. 22 Mechanical Design I
M.E. 625 Experimental Mechanics
plus one further technical elective

Mechanical Engineering

Year 2 A. Fall 1969 and Winter 1970
Math. 22 G.E. 41
Math. 23 M.E. 13
E.E. 12 G.E. 42

Year 2 B. Fall 1969 and Summer 1970
Math. 32 G.E. 31
Math. 31 G.E. 53
E.E. 14

Year 3A. Winter 1970 and Summer 1970
G.E. 54 C.E. 301
G.E. 32 Math 41
M.E. 21

Year 3B. Fall 1969 and Winter 1970
M.E. 53
M.E. 60
M.E. 90
2 Technical electives
Arts 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. Now the department is extending its scope of interest and is offering an undergraduate programme in Systems Design Engineering.

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 tech-
nical 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.

Further detailed information on the Systems Design Undergraduate programme is available from:

The Chairman
Department of Systems Design
Faculty of Engineering
University of Waterloo
Waterloo Ontario Canada

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.) and a non-degree Diploma programme. 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 Department of Systems Design course work, electives from other university departments, and project work in the Department laboratories. In addition, the Industrial Research Institute provides the student with the opportunity for work and contact with a varied group of professional consultants who have backgrounds in the areas of Product Design, Chemical, Civil, Electrical and Mechanical Engineering, Films, Architecture, Geography, Planning, Graphic Design, Fine Arts, etc.

Research is being carried forward in the following areas:

Communication Systems Design
Computer-aided Building Layout
Computer-aided Design
Computer-aided Instruction
Computer Generated Animated Film
Computer Graphics
Development of Specialized Computer Languages
Educational Films and Teaching Aids
Exhibition Design
High Speed Photographic Techniques
Housing - User needs and industrialization
Human Systems Engineering
Resource allocation for underdeveloped regions
Specifications for mass residence accommodation
Systems Methodology for Urban Planning
System Theory

The Department of Systems Design is also active in the development of new pedagogical methods for undergraduate education, as manifested by a currently developing transdisciplinary programme in Systems Design, and innovative involvement in general engineering education.
Department of Systems Design

Systems Design Admissions Committee. While admission is generally on an individual basis, the Committee requires:

1) Evidence of the successful completion of undergraduate studies in one of the following or related areas:
   a) Architecture
   b) Commerce
   c) Communication
   d) Economics
   e) Engineering
   f) Geography
   g) Life Sciences
   h) Mathematics and Computer Science
   i) Sociology

Additionally, certain minimum standards must be obtained in subjects related to the sciences and engineering, and qualifying work is frequently required by new graduate students.

2.) Evidence of the candidate’s interest and/or ability in systems studies through previous course work or project experience.

The Master’s (M.A.Sc.) programme in Systems Design generally requires two years to complete and consists of course work and a Master’s thesis on an approved topic.

The Doctoral (Ph.D.) programme in Systems Design generally requires at least three years beyond the Master’s degree to complete and consists of course work, an oral comprehensive examination and a Ph.D. thesis which embodies the results of the candidate’s independent original research on an approved topic.

The Diploma programme

The diploma programme generally requires two years to complete and admission is on an individual basis through the Senate Admissions Committee for Diploma Programmes and the Department of Systems Design. It is intended that the diploma programme provide persons with industrial experience the opportunity to further their studies in specific areas.

Further information

Further details on the faculty members and graduate courses in the Department of Systems Design are provided in the Course Descriptions section of this calendar. Additional information is available by writing to:

Chairman: Department of Systems Design,
University of Waterloo,
Waterloo, Ontario, Canada.
4 The Faculty of Mathematics
The Faculty of Mathematics

The Faculty of Mathematics of the University of Waterloo has only been inaugurated as a separate faculty since 1966. However, general and honours programmes in Mathematics have been offered through the Faculties of Arts and Science for a number of years. The continued growth and development of these programmes has made it natural to unite them under one faculty. At the same time, this unification has led to greater flexibility in choice of electives.

Previously, entering students selected a General or Honours Mathematics programme with Arts electives, or a General or Honours Mathematics programme with Science electives (most frequently Physics electives), or the Co-operative Honours Mathematics programme for those with an interest in Actuarial Mathematics or Computer Science. Now, in the Faculty of Mathematics, all these possibilities, together with numerous others, are still open to mathematics students.

Each year entering students come in with additional secondary school background, and the enrolments in classical areas of pure and applied mathematics are rapidly increasing at almost the same rate as 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 79 to 85 show, specialize in Applied Analysis and Computer Science, Applied Mathematics, Combinatorics and Optimization, Pure Mathematics, or Statistics.

Admission Requirements

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 both Renison and St. Jerome’s Colleges offer 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 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, 1969. All other applicants must apply and have submitted all the necessary documents by August 1, 1969. 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.

**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**

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:

Three credits from Mathematics A (2) Mathematics B (1)

Four additional credits (4) 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 must 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 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** 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

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, 1969. 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 May 30, 1969 of their acceptance and will be asked to indicate their decision by June 15, 1969. 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 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
British Columbia
Manitoba
New Brunswick
Newfoundland
Nova Scotia
Prince Edward Island
Quebec
Scotland

Senior Matriculation (Grade 12)
Senior Matriculation (Grade 13)
Senior Matriculation-(Grade 12)
Senior Matriculation (Grade 13)
Year I Memorial University
Senior Matriculation (Grade 12)
Third Year Certificate from Prince of Wales College
McGill Senior Matriculation or Quebec Senior High School Leasing Certificate
Senior Matriculation (Grade 12)
The General Certificate of Education with passes in at least five subjects. [Two of which must be at Advanced Level.
The Scottish Certificate of Education.
United States of America

High School Graduation plus an additional year of formal study in subjects comparable to Ontario Grade 13.

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 either a student visa or a landed immigrant status. 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. If the applicant wishes to take courses 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 III 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.

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 I, apply to transfer to the second year of the Faculty of Science or the Faculty of Engineering. Similarly, students who complete successfully Year I Science or Year I Engineering may apply to transfer to Year II in the Faculty of Mathematics.

Students who have successfully completed Year I Arts and who have taken Mathematics may transfer to Year II of the Faculty of Mathematics. Similarly, students who successfully complete Year I Mathematics may transfer to Year II 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 10, 11, 12, 1969
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 examinations 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>
</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, 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 supplement 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, 1969 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.
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.

**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 130, Mathematics 131, Mathematics 132 and three other courses.

According to their fields of interest, students will enter Group A, Group B or Group C.

**Group A** Students interested in Science electives normally choose Physics 131, Chemistry 131, English 101.

**Group B** Students interested in Arts electives normally choose English 101, Philosophy 100, Psychology 110.

**Group C** Students interested in a variety of fields should discuss their elective courses with a Faculty advisor. For example, Physics 131, Philosophy 100, English 101, or a language course, would be a quite permissible selection. Another sample selection would be: Biology 131, History 100, Psychology 110.

The above choices are suggested, but are not compulsory.

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

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 electives from outside Mathematics.

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, 231.

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

Note 4
Students taking Actuarial Science will normally take Mathematics 235.

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 232, 234/6
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, 334, 336
One of Mathematics 333, 335, 338, 350, 352
Two electives from outside Mathematics.
Fourth Year  Five mathematics courses  
Mathematics 435, 437, 461  
Two of Mathematics 427, 438, 439, 440, 446, 452, 454, 457.  
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 or 341  
One of 332, 342, 343  
Mathematics 351  
One or both of 345, 352.  
Two electives from outside Mathematics.

Fourth Year  Five mathematics courses including  
Three or more of Mathematics 451, 452, 453, 454, 455, 457, 458, 459,460.  
Two elective from outside Mathematics.

Pore 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, 330, 332  
Two of Mathematics 334, 351, 352, 340, 234, 235, 238.  
Two electives from outside Mathematics.
Fourth Year

Five mathematics courses including

Mathematics 446
One of Mathematics 425, 344, 436
One of Mathematics 427, 451, 452, 453, 454, 455, 457.

Two electives from outside Mathematics.

Honours Mathematics

and Economics

Year 1

Economics 101/102 or 103/104.
Mathematics 130, 131, 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.

Honours Mathematics

and Philosophy

Year 1

Recommended Programme

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 101</td>
<td>3</td>
</tr>
<tr>
<td>One of Philosophy 221/222 or 280/281</td>
<td>3</td>
</tr>
<tr>
<td>A foreign language</td>
<td>3</td>
</tr>
<tr>
<td>One course in the social sciences</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 130, 131</td>
<td>6</td>
</tr>
</tbody>
</table>

Year 2

Mathematics 229, 231, 232
One of Philosophy 221/222 or 280/281
One of Philosophy 240 or 340 or 282/283
Elective

8
### Honours Applied Mathematics With Physics Minor

<table>
<thead>
<tr>
<th>Year</th>
<th>Mathematics</th>
<th>Physics</th>
<th>Chemistry</th>
<th>Elective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>130, 131, 132.</td>
<td>131.</td>
<td>131.</td>
<td>One elective.</td>
</tr>
<tr>
<td>3</td>
<td>332, 363, 360a*, 442*.</td>
<td>331, 334, 335.</td>
<td>One elective.</td>
<td></td>
</tr>
</tbody>
</table>

* indicates a one term course.

### Honours Statistics and Psychology

<table>
<thead>
<tr>
<th>Year</th>
<th>Psychology</th>
<th>Mathematics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>150.</td>
<td>130, 131, 132.</td>
</tr>
<tr>
<td>2</td>
<td>290.</td>
<td>229, 233 (substituted for Psychology 280).</td>
</tr>
<tr>
<td>3</td>
<td>360.</td>
<td>332, 338.</td>
</tr>
<tr>
<td>4</td>
<td>430.</td>
<td>499.</td>
</tr>
</tbody>
</table>
Psychology elective,
Mathematics 438 or 440.
Mathematics 439.
Mathematics elective.
See Honours Psychology and Statistics. Faculty of Arts.

The Co-operative Programme (Actuarial, Computer Science, Optimization, Statistics, and Teaching in Honours Mathematics Options)

Year 1 Students will take Mathematics 130, 131, 132, and three other courses. According to their fields of interest, students will enter Group A, Group B, or Group C.
Group A Students interested in Science minors normally choose English 16, 17, Chemistry 101, Physics 131.
Group B Students interested in Arts minors normally choose English 16, 17, Philosophy 125, Psychology 11.
Group C Students who wish to take their elective courses in a variety of fields should discuss their problems with a Faculty advisor; they may wish to take some Arts and some Science electives.

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

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

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.
Optimization: Five mathematics courses including two of Mathematics 451, 452, 454, 455.
Two electives.
Two 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 Students should read section 13 of the calendar for details of the operation of the co-operative programmes.

The Department of Combinatorics and Optimization

The following undergraduate courses are offered by the Department of Combinatorics and Optimization: 345, 351, 352, 451, 452, 453, 454, 455, 457, 458, 459, 460.

The following graduate courses are offered by the Department of Combinatorics and Optimization:

- Combinatorial Analysis (780)
- Special Topics in Combinatorial Analysis (799)
- Seminar in Combinatorial Analysis (798)
- Literature and Research Studies in Combinatorial Analysis or Graph Theory (690).

Combinatorial Graph Theory (782) Selected topics in graph theory and related areas of mathematics will be studied in some depth, emphasising where possible recent developments and promising areas for future research. The topics discussed will probably vary from year to year, but may include for example: existence of Hamiltonian arcs and circuits in graphs and similar problems; determination of the thickness, genus and crossing-number of particular graphs; the dimer problem; percolation processes; well-quasi-ordering problems related to graph theory; matchings in graphs; path problems; smallest regular graphs of given degree and girth.

Matroid Theory (789) Introductory lectures concerning the standard axiomatizations and classical examples of matroids (i.e. incidence geometry, or the theory of combinatorial dependence). Outlines of current research in the combinatorial, algebraic, geometric, latticial and integer-programming schools of matroid theory will be drawn.

Extrema in Graphs (786)

Linear Graphs (784) Definitions and basic theorems. Planar graphs and Kuratowski’s theorem. Selected topics from advanced graph theory.

Topics in Graph Theory (797) Seminar in Graph Theory (7%) Mathematical Operations Research (975) A selection of topics with emphasis on mathematical techniques having direct application to business, industrial, military and scientific problems.

Mathematical Optimization (970) A selection of theoretical mathematical techniques from classical optimization, sequential optimization or mathematical programming, Kuhn-Tucker theory.

Mathematical Programming (972) A selection of topics from non-linear programming, quadratic programming, integer linear programming, stochastic linear programming, dynamic programming and applications.

Directed Graphs and Applications (971) Directed linear graphs with application to operations research, economics, and other pertinent disciplines. Topics include: partial order, Dilworth’s theorem, other minimax relationships, duality, relations between matrices and graphs, and network flows.

Network Programming (973) General study of flows and flow algorithms with applications.

Literature and Research Studies in Optimization (690) Seminar in Mathematical Operations Research (976) Seminar in Optimization (978)
5 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 1968 over 1300 full-time students, of which more than 200 are graduate students, are taking programmes within the Faculty. In addition, courses are provided for students in arts, engineering, mathematics and physical education 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 except Earth Sciences offer post-graduate programmes and research facilities and these are listed in Section 9 of this Calendar-Course Descriptions. General regulations governing post-graduate studies are set forth in Section 8. 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 105.

All 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 13 for further information on the Cooperative programmes.

The Dean and Department Chairmen will be pleased to receive inquiries about the programmes in this Faculty. A student contemplating post-graduate study should direct his correspondence to the chairman of the department in which he proposes to specialize.

Degrees

The degree of Bachelor of Science (B.Sc.) is awarded by the University on the successful completion of any 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 8.

Admissions Requirements

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, 1969. All other applicants must
apply and have submitted all the necessary documents by **August 1, 1969.** 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.

**Applicatw 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, (I)
Physics, (I)
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, 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 XI theory will be considered one “additional credit” on the same terms as these except the marks received will not be computed in the average.

Students intending to take an Honours programme in Physics, or Cooperative Applied Physics should have a minimum of 66% in the credits presented in Mathematics and Science.

**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

**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”
The Faculty of Science

form submitted by April 1, 1969. 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 May 30, 1969 of their acceptance and will be asked to indicate their decision by June 15, 1969. 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 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

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 I Memorial University

Nova Scotia

Senior Matriculation (Grade 12)

Prince Edward Island

Third Year Certificate from Prince of Wales College

Quebec

McGill Senior Matriculation or Quebec Senior High School Leaving Certificate

Senior Matriculation (Grade 12)

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.

United States of America

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.
Admissions 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.

Admissions to Advanced Years

An applicant for admission to advanced standing must submit an official transcript from the University or educational institution which he has attended, showing in detail the courses which were taken and the standing in each course. Students applying to a co-operative programme may not be admitted above the Year 3, Term A level. Any student thus admitted would be required to register in the “A” stream and to complete a minimum of three work terms.

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 10, 11, 12, 1969.

Fees

Refer to Section I I page 358

Examinations and Promotions

The Faculty constitutes the examining body for all University examinations.

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. Supplemental examinations are held in July. The time normally allowed for each examination is three hours.

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 held at the end of each term. The time normally allowed for each examination is three hours.

The following regulations govern the practice of the Faculty Committee of Science 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 will be issued to individual students by the Registrar.

2) Standings in individual courses will be granted by letter grade as follows:
Examinations and Promotions

Range of Marks | Letter Grade
--- | ---
75-100 | A
66-74 | B
60-65 | C
50-59 | D
Below 50, supplemental allowed | S
Below 50, no supplemental allowed | F

If a supplemental examination is necessary in a course of D standing, it will be indicated in the Faculty decision.

3) Standing in an individual course is determined by combining the marks assigned for term work with those obtained on written examinations. The ratio in which these marks are combined is at the discretion of the individual departments. To pass in a course, a candidate must obtain a minimum of 50% in the combined term mark and examination mark. A student whose term work is deficient in a course may, at the discretion of the department concerned and the Dean, be barred from writing the final examination in that course.

4) Promotion to the next higher year or to graduation, will be based on passing the complete year’s work; credit will not be granted in individual courses where a candidate has not passed his year.

5) To pass his year clear, a student must pass in all courses with a minimum overall average of 50% in the General Science programme and 60% in an Honours programme. In addition, a minimum average of 60% in the course of the major field must be obtained in both the General and Honours programme. Standing and promotion in the Optometry programme is on the same basis as used in the regular Honours programmes of the Faculty.

Students in an Honours programme on a co-operative basis must obtain the 60% overall average and 60% major field average in each term beyond Year 1.

6) An overall standing in each year will be assigned based on the average of the results of the final examination in each course. This standing will be a class of honours in Honours programmes or a letter grade in the General Science programme. It will not be altered by marks obtained in supplemental examinations. Standings for the year will be granted as follows:

<table>
<thead>
<tr>
<th>Range of Average Mark</th>
<th>General Programme</th>
<th>Honours Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>75-100</td>
<td>A</td>
<td>First Class Honours</td>
</tr>
<tr>
<td>66-74</td>
<td>B</td>
<td>Second Class Honours</td>
</tr>
<tr>
<td>60-65</td>
<td>C</td>
<td>Third Class Honours</td>
</tr>
<tr>
<td>50-59</td>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>

7) 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 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 Office of the Registrar before the end of the examination period.
8) All examinations which receive a failing grade are automatically re-read.

9) In Year I, supplemental examinations will be allowed in failing courses only. In upper years, supplemental examinations may be allowed in courses where D or lower standing has been obtained. *Supplemental examinations will be allowed if all of the following conditions are met:*
   a) The student must have attended lecture and laboratory classes and completed all term work assignments to the satisfaction of the instructor of the course concerned.
   b) The student must not have defaulted the final examination except for a properly certified reason.
   c) The required overall average (described in 5) must be obtained *before* supplemental examinations will be allowed.
   d) In any given academic year of a regular programme no more than 2 supplementals in full year courses or 3 supplementals in a combination of full year and Semester (i.e. one-term) courses will be allowed. No more than 2 supplementals will be allowed in any term of a co-operative programme.

By such supplemental examinations a student may clear failing courses or achieve his major field average.

10) If more supplemental examinations than indicated in 9(d) would be necessary for a student to pass his year clear, the student will have automatically failed the year regardless of his overall average. He will not be eligible to try supplemental examinations. In cases where the Faculty Council considers that a student will not profit by further study, he will be notified with his examination results that he must withdraw from the Faculty of Science. Other failed students may repeat the year.

11) A student repeating any year of a programme must repeat all courses in class unless exemption has been granted by the Dean and the Faculty Council.

12) Supplemental examinations will be held in July for regular programmes. Applications for these supplemental examinations must be filed by the end of June on forms provided by the Office of the Registrar. In co-operative programmes, supplemental examinations will be written in the term immediately following that in which the respective final examinations are written. Fees for supplemental examinations must accompany the application. If the student subsequently decides not to write the examination, the fee is not refunded.

13) 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. If he has failed to achieve his major field average, he has failed his year. If he has failed a supplemental examination in a non-prerequisite course in other than his major field, he may be allowed a pass standing conditioned in this course; otherwise he must repeat the year. Where the conditioned course was not a mandatory part of his programme and where his major Department concurs, a student may be permitted to substitute another course for one in which he is conditioned.

14) If a student is conditioned in a course from a previous year and fails to pass it at the regular examinations, he may be allowed an additional chance at writing a supplemental if he has otherwise passed in the regular courses of his year as outlined in 9. No student may be pro-
Academic Programmes

In descriptions of programmes, the symbol * after a Course number indicates a one term course; * after the number of laboratory hours indicates a laboratory taken in alternate weeks.

First Year Regular Programmes
(For all students whether Honours or General except Co-operative Applied Physics (see page 103) and Co-operative Applied Chemistry (see page 99).

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arts Elective</td>
<td>(English 130 recommended) 3</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 131</td>
<td>General Chemistry 3</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 130</td>
<td>Calculus 3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 131</td>
<td>Mechanics, Wave Motion, and Heat 3</td>
<td>3</td>
</tr>
<tr>
<td>or Physics 100</td>
<td>General Physics 1 (see Note 5) 3</td>
<td>3*</td>
</tr>
</tbody>
</table>

**Two of:**
- Biology 132 Principles of Biology 2 3
- Earth Sciences 130 Introductory Geology 2 3
- Mathematics 131 Algebra and Solid Geometry 2 1
- Mathematics 132 Introduction to Computer Science 2 2

A total of six courses in the above listing must be selected at the time of registration. Chemistry, Physics, Calculus and an Arts elective are compulsory for all students as indicated. The choice of optional courses will be dictated by the field of further study which student intends to pursue. The following table lists the departmental requirements for each major honours programme in the Faculty; the requirements for the Optometry programme are also shown.

**Major Field of Study**
- Biology
- Biology & Chemistry
- Chemistry
- Chemistry (Math Option)
- Earth Sciences
- Optometry
- Physics

**Options Required in First Year**
- Biology 132
- Biology 132 (Mathematics 131 recommended)
- Mathematics 131
- (Biology 132 or Mathematics 132 recommended)
- Mathematics 131, Mathematics 132
- Earth Sciences 130 (Biology 132 recommended)
- Physics 100, Biology 132, Psychology I IO

**Note** The Ontario Department of Education has strongly recommended that all students who are preparing to teach science in high school should take at least one year of Biology.
Note 2 Earth Science 130 is a recommended course for students in the third year of the General Science programme with a major in Biology.

Note 3 Students wishing Psychology as an elective should normally select Psychology 110. Psychology 150 is available for students who plan to take the Honours programme in Biology enriched in Psychology and for a limited number of other students, but permission to take it must be secured from the Department of Psychology.

Note 4 Students planning to major in Earth Sciences may select Mathematics 131 in place of Biology if they have good standing in post-1965 Grade 13 Biology or on consultation with the Department.

Note 5 Physics 100 is the first part of a two-year sequence of Physics (Physics 100 + Physics 200) designed for students whose major department after Year I will be Biology. It is recommended for Year I Optometry students and also students desiring to major in Earth Sciences may elect either Physics 100 or 131. Students planning to enter any of the Year II programs involving Chemistry or Physics should select Physics 131 and not Physics 100.

Note 6 Students wishing to take the Biophysics option of Honours Physics are encouraged to take Biology 132 in the first year programme.

First Year Co-operative Programmes
(For students planning to choose either Co-operative Applied Chemistry or Co-operative Applied Physics.)
Students should read Section 13 for details of operation of the co-operative programmes.

<table>
<thead>
<tr>
<th>Year</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I A</td>
<td>Chemistry 101 General Chemistry</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Physics 131 Mechanics, Wave Motion &amp; Heat</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Mathematics 130 Calculus</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Mathematics 131 Algebra and Solid Geometry</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Mathematics 132 Introduction to Computer Science</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Arts Elective (English 16 recommended)</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I B</td>
<td>Chemistry 101 General Chemistry</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Physics 131 Mechanics, Wave Motion &amp; Heat</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Mathematics 130 Calculus</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Mathematics 131 Algebra and Solid Geometry</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Mathematics 132 Introduction to Computer Science</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Arts Elective (English 17 recommended)</td>
<td>3</td>
</tr>
</tbody>
</table>

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; they are rather specialized in content, and the syllabus in each is rather rigidly prescribed. 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.
The following Honours programmes are available

### Honours Biology
*(For Year 1, see page 94)*

<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 of Microbiology</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 236</td>
<td>Organic Chemistry I</td>
<td>2</td>
</tr>
<tr>
<td>Physics 200</td>
<td>General Physics II</td>
<td>3</td>
</tr>
</tbody>
</table>

Elective as specified

<table>
<thead>
<tr>
<th>Year 3</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 333</td>
<td>Invertebrate Zoology</td>
<td>2</td>
</tr>
<tr>
<td>Biology 334</td>
<td>The Vascular Plants</td>
<td>2</td>
</tr>
<tr>
<td>Biology 335</td>
<td>Microbiology I</td>
<td>2</td>
</tr>
<tr>
<td>Biology 337</td>
<td>General Physiology</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 337</td>
<td>Biochemistry I</td>
<td>2</td>
</tr>
</tbody>
</table>

Elective as specified

<table>
<thead>
<tr>
<th>Year 4</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>General Microbiology</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 235</td>
<td>Invertebrate Zoology</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 336</td>
<td>Organic Chemistry II</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 337</td>
<td>Biochemistry I</td>
<td>2</td>
</tr>
<tr>
<td>Physics 242</td>
<td>Electricity and Magnetism</td>
<td>2</td>
</tr>
</tbody>
</table>

**Two of:**

<table>
<thead>
<tr>
<th>Year 3</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 333</td>
<td>Invertebrate Zoology</td>
<td>2</td>
</tr>
<tr>
<td>Biology 334</td>
<td>The Vascular Plants</td>
<td>2</td>
</tr>
<tr>
<td>Biology 335</td>
<td>Microbiology I</td>
<td>2</td>
</tr>
<tr>
<td>Biology 337</td>
<td>General Physiology</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 4</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 341</td>
<td>Inorganic and Nuclear Chemistry</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 437</td>
<td>Biochemistry II</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics 243</td>
<td>Statistics for the Sciences</td>
<td>2</td>
</tr>
</tbody>
</table>

**Three of:** Any **400-level** courses offered in Biology as specified
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 program 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 3 (1969-70 only)

<table>
<thead>
<tr>
<th>Subject</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 333</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 370</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Psychology 380</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics 243</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 337</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 301</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>or Biology 337</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Year 4 (1969-70 and 1970-71 only)

<table>
<thead>
<tr>
<th>Subject</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 434</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 430</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 431</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Biology 442</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 499</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>or Biology 499</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approved Elective</td>
<td>as required</td>
<td>as specified</td>
</tr>
</tbody>
</table>

Honours Chemistry (For Year 1, see page 94)

Year 2

<table>
<thead>
<tr>
<th>Subject</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 231</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 232</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry 235</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 236</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Physics 242</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 236</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Year 3

<table>
<thead>
<tr>
<th>Subject</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>6</td>
</tr>
<tr>
<td>Chemistry 336</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

One of:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 235</td>
<td>2</td>
<td>3*</td>
</tr>
<tr>
<td>Physics 332</td>
<td>2</td>
<td>3*</td>
</tr>
</tbody>
</table>

One or two of:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 337</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 229</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 243</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Mathematics 240</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Physics 332 (if not elected above)</td>
<td>2</td>
<td>3*</td>
</tr>
</tbody>
</table>
### Year 4

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 431</td>
<td>Inorganic Chemistry</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 435</td>
<td>Physical Chemistry III</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 436</td>
<td>Organic Chemistry III</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 439</td>
<td>Advanced Laboratory</td>
<td>0</td>
<td>9</td>
</tr>
</tbody>
</table>

**Two or three of:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 337</td>
<td>Biochemistry I</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 437</td>
<td>Biochemistry II</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 440</td>
<td>Polymer Chemistry</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 332</td>
<td>If not chosen above</td>
<td>2</td>
<td>3*</td>
</tr>
<tr>
<td>Mathematics 450</td>
<td>Applied Analysis</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

or Other suitable Mathematics

or Arts Elective. as specified

### Honours Chemistry

(For Year 1. see page 94)

(Mathematics Option)

#### Year 2

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 231</td>
<td>Chemical Bonding &amp; Structure</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 232</td>
<td>Analytical Chemistry</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry 235</td>
<td>Physical Chemistry I</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 236</td>
<td>Organic Chemistry I</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 236</td>
<td>Elementary Differential Equations</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 240</td>
<td>Applications in Computer Science</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**One of:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics 233</td>
<td>Probability and Statistics</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Mathematics 243</td>
<td>Statistics for the Sciences</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Mathematics 234</td>
<td>Introduction to Applied Mathematics</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 232 or 242</td>
<td>Electricity and Magnetism</td>
<td>2</td>
<td>3*</td>
</tr>
</tbody>
</table>

#### Year 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 331</td>
<td>Inorganic Chemistry I</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 335</td>
<td>Physical Chemistry 2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry 336</td>
<td>Organic Chemistry 2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 229</td>
<td>Linear Algebra</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 237</td>
<td>Differential &amp; Integral Calculus</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

**One of:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 337</td>
<td>Biochemistry I</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 235</td>
<td>Optics</td>
<td>2</td>
<td>3*</td>
</tr>
<tr>
<td>Physics 332</td>
<td>Electronics</td>
<td>2</td>
<td>3*</td>
</tr>
</tbody>
</table>

An additional Mathematics course approved by the Chemistry Department

#### Year 4

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 431</td>
<td>Inorganic Chemistry II</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 435</td>
<td>Physical Chemistry III</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 436</td>
<td>Organic Chemistry III</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 329</td>
<td>Abstract Algebra</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 343</td>
<td>Complex Variable Theory</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 434</td>
<td>Differential Equations of Mathematical Physics</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
Academic Programmes

One of:

Chemistry 437 Biochemistry II 2 3
Chemistry 440 Polymer Chemistry 2 0
Chemistry 439 Advanced Laboratory 0 6

Honours Chemistry (For Year 1, see page 94) (Physics Option)

<table>
<thead>
<tr>
<th>Year</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<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>6</td>
</tr>
<tr>
<td>Chemistry 235 Physical Chemistry I</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Chemistry 236 Organic Chemistry I</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>Physics 232 or 242 Electricity and Magnetism</td>
<td>2</td>
<td>3*</td>
</tr>
<tr>
<td>Physics 235 Optics</td>
<td>2</td>
<td>3*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry 331 Inorganic Chemistry I</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 335 Physical Chemistry I</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry 336 Organic Chemistry II</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 237 Differential and Integral Calculus</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 331 Classical Mechanics I</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 339 Atomic and Nuclear Physics</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry 431 Inorganic Chemistry II</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 435 Physical Chemistry III</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Chemistry 436 Organic Chemistry III</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 450 Applied Analysis</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 332 Electronics</td>
<td>2</td>
<td>3*</td>
</tr>
<tr>
<td>Physics 435* Solid State Physics</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

One of:

Chemistry 337 Biochemistry I 2 0
Chemistry 440 Polymer Chemistry 2 0
Chemistry 439 Advanced Laboratory 0 6

Co-operative Applied (For Year 1, see page 94) (Honours)

<table>
<thead>
<tr>
<th>Year</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry 202* Analytical Chemistry</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Chemistry 206* Introductory Organic Chemistry</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 209* Technical Literature</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 31* Differential Equations</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 236* Optics</td>
<td>3</td>
<td>3*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry 200* Radiochemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 201* Introductory Inorganic Chemistry</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Chemistry 205* Introductory Physical Chemistry</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 51* Probability &amp; Statistics</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Physics 243* Electricity and Magnetism</td>
<td>3</td>
<td>3*</td>
</tr>
</tbody>
</table>
### Academic Programmes

#### Year 3A
- Chemistry 301* Applied Inorganic Chemistry 3 3
- Chemistry 306* Applied Organic Chemistry 3 3
- Chemistry 308* Instrumental Measurements I 1 3
- Physics 341* Electronics 3 3
- Arts Elective* 3 0

#### Year 3B
- Chemistry 303* Introductory Polymer Chemistry 3 3
- Chemistry 305* Applied Physical Chemistry 3 3
- Chemistry 307* Introductory Biochemistry 3 3
- Chemistry 318* Instrumental Measurements. II 1 3
- Arts Elective* 3 0

#### Year 4A
- Chemistry 400* Electrochemistry and Corrosion 3 3
- Chemistry 402* Modern Organic Analysis 2 3
- Mathematics 55* Digital Computer Programming 3 0
- Arts Elective* 3 0

One of:
- Chemistry 403* Physical Chemistry of Polymers 3 3
- Chemistry 405* Surface Chemistry 3 0
- Chemistry 407* Applied Biochemistry 3 3
- Chemistry 408* Instrumentation I 1 3
- Mech. Eng. 31* Physical Metallurgy 1

#### Year 4B
- Chemistry 412* Analysis of Materials 2 3
- Chemical Eng. 61* Industrial Economics 3 0
- Civil Eng. 452* Water Resources Engineering 2 3
- Elective* (Arts, Science or Engineering) 3 0
- Chemistry 410* Applied Chemistry Seminar 0 1

One of:
- Chemistry 413* Properties of Polymers 3 3
- Chemistry 415* Catalysis 3 0
- Chemistry 418* Instrumentation II 1 3
- Mech. Eng. 37* Ceramics 3 3
- Biology 235A* Microbiology 2 3

#### 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 program 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 3 (1969-70 only)

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 236</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 335</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Mathematics 233</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>or Mathematics 243</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Physics 331</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 334</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 336</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>
## Academic Programmes

### Year 4 (1969-70 and 1970-71 only)

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 341</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Inorganic and Nuclear Chemistry</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 336</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Organic Chemistry II</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 332</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Electronics</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Physics 333</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Intermediate Laboratory</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>Physics 434</strong></td>
<td><strong>2</strong></td>
<td><strong>0</strong></td>
</tr>
<tr>
<td>Atomic and Nuclear Physics II</td>
<td><strong>6</strong></td>
<td><strong>0</strong></td>
</tr>
</tbody>
</table>

**Option A (Chemistry)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 435</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physical Chemistry III</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>One of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry 337</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Biochemistry I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 440</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Polymer Chemistry</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>one Arts Elective</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Option B (Physics)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 435*</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Solid State Physics</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>one Arts or Science Elective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>as specified</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Honours Earth Sciences (Geology Option)

*(For Year 1 see page 94 and notes 4 and 5)*

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Sciences 230</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Mineralogy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 232*</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Petrography (half course)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 237*</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Field Geology (half course)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 238*</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Historical Geology (half course)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 240*</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Geomorphology (half course)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry 241</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Principles and Applications of Chemical Bonding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arts Elective. English 240 is strongly recommended.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**One of:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics 132</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Introduction to Computer Science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics 243</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Statistics for the Sciences</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>Earth Sciences 330</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Igneous and Metamorphic Petrology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 334</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Paleontology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 335</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Stratigraphy and Sedimentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 340</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Structural Geology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arts Elective.</td>
<td>as <strong>required</strong></td>
<td></td>
</tr>
</tbody>
</table>

**One of:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 333</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Invertebrate Zoology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics 200</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>General Physics II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics 237</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Astronomy I</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>Earth Sciences 430</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Economic Geology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 435*</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Seminar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 436</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Thesis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 437</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Crustal Evolution</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 440*</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Quaternary Geology (half course)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arts Elective.</td>
<td>as <strong>required</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Two courses from:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Sciences 338</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Geophysics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 431</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Geochemistry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 432*</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Precambrian Geology (half course)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 434*</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Bisostatigraphy (half course)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 438*</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Engineering Geology (half course)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 439*</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Groundwater Geology (half course)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Honours Physics

(For Year 1, see page 94)

Basic Programme

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

<table>
<thead>
<tr>
<th>Year 2</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core: Physics 233</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Physics 232</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 236*</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 234*</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 237</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>or Mathematics 236</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>or Mathematics 31*</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Electives: Courses totalling 6 lecture hours.

<table>
<thead>
<tr>
<th>Year 3</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core: Physics 333</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Physics 331</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 334</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 335</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Electives: Courses totalling 8 lecture hours.

<table>
<thead>
<tr>
<th>Year 4</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core: Physics 434</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 435*</td>
<td>3*</td>
<td>0</td>
</tr>
<tr>
<td>Physics 441</td>
<td>2</td>
<td>0*†</td>
</tr>
</tbody>
</table>

Electives: Courses totalling 10 lecture hours.

† 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 245*, 247*, 253, Mathematics 240.
Year 3 Physics 332, 336, 353, Arts Elective.

Ex. 2. Honours Physics  (especially suitable as preparation for high school teaching)

Core plus: Year 2 Chemistry 23 I, Mathematics 229, 240 or Physics 247* & 257*
Year 3 Physics 332, 338, 353, Chemistry 325.
Academic Programmes

Ex. 3. Honours Physics (with Biophysics)

Core plus: Year 2 Mathematics 51*, Chemistry 205*, 206*, Physics 245*

Year 3 Physics 316*, 317*, 332, 336.


Ex. 4. Honours Physics (with Computing)

Core plus: Year 2 Physics 245*, Mathematics 240, Arts Elective.

Year 3 Physics 336, Mathematics 51*, 334, 340.

Year 4 Physics 332, 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 332, 336, Chemistry 236.

Year 4 Physics 432*, Chemistry 335, 341 Elective.

Theoretical Physics Programme

Students with an interest in theoretical physics may wish to emphasize the more mathematical aspects of the subject. A suitable programme consists of 'core' and 'electives' of Honours Physics according to the following scheme:

Core plus: Year 2 Physics 245*, Mathematics 229, 240.

Year 3 Physics 336, | or 3 of Mathematics 233, 332, 333, 334, 335, 352|.


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.

The demand for applied physicists in Canada is virtually assured by the increased emphasis that government and industry are placing on applied research to develop secondary industry in Canada.

Information about the Co-op work terms and the Co-ordination Department can be found starting on page 370
(For Year 1, see page 94)

### Year 2A
- **Core:**
  - Physics 233 Laboratory: 0 lectures, 3 labs.
  - Physics 232 Electricity & Magnetism: 2 lectures, 0 labs.
  - Physics 236* Optics: 3 lectures, 0 labs.
  - Mathematics 237 Differential & Integral Calculus: 3 lectures, 0 labs.
  - Mathematics 3 1* Differential Equations: 3 lectures, 0 labs.
- **Electives:** Courses totalling 5 lecture hours.

### Year 2B
- **Core:**
  - Physics 233 Laboratory: 0 lectures, 3 labs.
  - Physics 232 Electricity & Magnetism: 2 lectures, 0 labs.
  - Physics 234* Quantum Physics: 3 lectures, 0 labs.
  - Mathematics 237 Differential & Integral Calculus: 3 lectures, 0 labs.
- **Electives:** Courses totalling 8 lecture hours.

### Year 3A
- **Core:**
  - Physics 333 Intermediate Laboratory: 0 lectures, 3 labs.
  - Physics 331 Classical Mechanics I: 3 lectures, 0 labs.
  - Physics 334 Atomic 8 Nuclear Physics I: 2 lectures, 0 labs.
  - Physics 335 Thermodynamics, and Statistical Physics: 3 lectures, 0 labs.
- **Electives:** Courses totalling 8 lecture hours.

### Year 3B
- **Core:**
  - Physics 333 Intermediate Lab.: 0 lectures, 3 labs.
  - Physics 331 Classical Mechanics I: 3 lectures, 0 labs.
  - Physics 334 Atomic 8 Nuclear Physics I: 2 lectures, 0 labs.
  - Physics 335 Thermodynamics, and Statistical Physics: 3 lectures, 0 labs.
- **Electives:** Courses totalling 8 lecture hours.

### Year 4A
- **Core:**
  - Physics 434 Atomic & Nuclear Physics II: 2 lectures, 0 labs.
  - Physics 435* Solid State Physics: 3 lectures, 0 labs.
  - Physics 441 Electromagnetic Theory: 2 lectures, 0 labs.
- **Electives:** Courses totalling 9 lecture hours.

### Year 4B
- **Core:**
  - Physics 434 Atomic & Nuclear Physics II: 2 lectures, 0 labs.
  - Physics 441 Electromagnetic Theory: 2 lectures, 0 labs.
- **Electives:** Courses totalling 12 lecture hours.

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

### Options
Some suggested programmes are given below.

**Ex. 1 Co-op Appl. Physics (Solid State)**
- Core plus: Year 2A Physics 253, Mathematics 240, Arts Elective.
- Year 3A Physics 332, 336, E.E. 42* or Chemistry 201.*
Year 4A  Physics 433, 436, Mathematics 334, E.E. 44*.
Year 4B  Physics 432*, 433, 436, Mathematics 334, E.E. 81*.

**Ex. 2 Co-op Appl. Physics (Biophysics)**

**Core** plus: Year 2A  Chemistry 206*, Elective.
Year 2B  Physics 245*, 316*, Mathematics 51*.
Year 3A  Physics 332, 336, Chemistry 205*.
Year 3B  Physics 332, 336, Chemistry 307*.
Year 4A  Physics 417*, 433, Elective.
Year 4B  Physics 317*, 416*, 433, 444*.

**Ex. 3 Co-op Appl. Physics (and Chemistry)**

**Core plus:** Year 2A  Chemistry 206*, Arts Elective.
Year 2B  Chemistry 200*, 205*, Physics 245*.
Year 3A  Physics 332, 336, 353, Chemistry 301* or 306*.
Year 3B  Physics 332, 336, 353, Chemistry 305*.
Year 4A  Physics 433, 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 245*.
Year 3A: Mathematics 340, Physics 332,336,353.
Year 3B: Mathematics 340, Physics 332,336,353.
Year 4A: Mathematics 243,334,352, Physics 436.
Year 4B: Mathematics 243,334,352, Physics 436, Elective.

**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 at the end of Year 3, on petition to the Dean, may be permitted to transfer to a B. Sc. program requiring one additional year of study. The degree awarded in this case will be the 3-year General B.Sc. and will normally require a major in the Dept. of Biology.

Upon completion of their training in optometry graduates will be eligible to apply for registration as optometrists in the province of their choicer 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 Promotions may be found on page 91. All other inquiries relating to the course should be sent to the Secretary of the School of Optometry at the University.

†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...
Academic Programme

(For Year 1, see page 94. This Pre-Optometrical year is the normal Year 1 programme of the Faculty of Science with Physics 100, Biology 132 and Psychology 110 as options.)

### Year 2

<table>
<thead>
<tr>
<th>Subject</th>
<th>Lectures</th>
<th>Labs</th>
<th>Clinic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 201</td>
<td>4</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Anatomy, Histology and Embryology (fall term)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology 233</td>
<td>2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Vertebrate Zoology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry 2 16*</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Introduction to Organic and Biochemistry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics 236*</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Optics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychology 201*</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>General Experimental Psychology: Learning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychology 202*</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>General Experimental Psychology: Perception</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 200*</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>History and Orientation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 201*</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physiological Optics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 202*</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Introduction to Clinical Optometry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 204</td>
<td>5</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Anatomy of the Eye and Associated Structures (winter term)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Year 3

<table>
<thead>
<tr>
<th>Subject</th>
<th>Lectures</th>
<th>Labs</th>
<th>Clinic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 301</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Vertebrate Physiology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychology 281*</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Elementary Statistics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychology 282*</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tests and Measurements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 300*</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Binocular Relations of the Non Strabismic Patient</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 301</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physiological Optics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 302</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Optometrical Optics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 305</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>General Pathology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 306*</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Advanced Geometrical Optics</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Year 4

<table>
<thead>
<tr>
<th>Subject</th>
<th>Lectures</th>
<th>Labs</th>
<th>Clinic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychology 211*</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Developmental Psychology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychology 212*</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Socialization Processes in the Child</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 400</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Clinical Optometry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 401</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physiological Optics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 402</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Optometrical Optics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 404</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physiology of Visual Systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 405</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Ocular Pathology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 407*</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Optometrical Specialities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 408</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Optometry Clinic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 409</td>
<td>60 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer Clinic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 432*</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Light and Illumination</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Year 5

<table>
<thead>
<tr>
<th>Subject</th>
<th>Lectures</th>
<th>Labs</th>
<th>Clinic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optometry 500</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Advanced Clinical Optometry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 501</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physiological Optics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 502</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Optometrical Optics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 504*</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Genetics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 506</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Optometrical Jurisprudence and Praxis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 507</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Public Health Optometry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 508</td>
<td>0</td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>Optometry Clinic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optometry 509*</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pharmacology</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Indicates a one term course.
The General Science Programme

The General Science Programme is available as a three-or four-year option in all departments. Graduates of the four-year programme who have taken appropriate courses will be eligible for certain categories of industrial and government employment for which the three-year programme will not fit them; likewise they can meet the subject requirements for application to Type-A courses at a College of Education in Ontario with specialization in a single subject. Depending on the option chosen, a student may graduate with the General B.Sc. after either three or four years; the graduation diploma will indicate whether the three or four-year programme has been completed. A student who has graduated from the three-year programme may apply to register for the four-year programme; upon successful completion of the latter, a new graduation diploma will be issued in exchange for the original, but the student will not graduate a second time.

Graduates of the three-year programme who have taken the required courses are qualified to apply for admission to medical schools 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.

In the second and higher years the student will select a major field of study from one of the following departments: Biology, Chemistry, Earth Sciences, or Physics. He must have attained C Standing in this field in his first year before he may choose it for major study. He must attain C Standing in this field in subsequent years for promotion, and in the final year for graduation.

The curriculum after Year I is arranged as follows:

<table>
<thead>
<tr>
<th>Three-Year Programme</th>
<th>Minor Fields†</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year</strong></td>
<td><strong>Major Field</strong></td>
<td><strong>Minor Fields†</strong></td>
</tr>
<tr>
<td>2</td>
<td>2 courses</td>
<td>3 courses</td>
</tr>
<tr>
<td>3</td>
<td>2 courses</td>
<td>3 courses</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Four-Year Programme</th>
<th>Minor Fields†</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year</strong></td>
<td><strong>Major Field</strong></td>
<td><strong>Minor Fields†</strong></td>
</tr>
<tr>
<td>2</td>
<td>2 courses</td>
<td>3 courses</td>
</tr>
<tr>
<td>3</td>
<td>2 or 3 courses</td>
<td>2 or 3 courses</td>
</tr>
<tr>
<td>4</td>
<td>2 or 3 courses</td>
<td>2 or 3 courses</td>
</tr>
</tbody>
</table>

†Minor fields must be courses for which the student is qualified and must be chosen from other than the student's major field of study. No more than one course from each of the following minor fields should normally, be selected in a given year: Biology, Chemistry, Earth Sciences, Physics, Mathematics. an Arts Elective. At least one non-science course must be chosen. In some instances where a student’s major Department approves, two Arts or two Mathematics courses may be chosen as electives providing the other three choices are Science courses. (The term “course” denotes a full-year course; two half-year or term courses are the equivalent of one full-year course).
Extra Courses The following regulations apply to both General and Honours programmes. An extra course may be taken, but it must be in addition to the programme specified by the calendar or by the departmental chairman. It must be designated as an extra on the Registration Form (e.g. Chem. 337x). If dropped during the first term it will not appear on the student’s record; if dropped in the second term, but before the final examinations, it will appear on the transcript as “Incomplete.” The mark in the extra course will not be averaged with those from the required programme for overall standing.

There will be no supplemental privileges with extra courses.

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. Other combinations of courses may be taken provided they fit the student’s timetable and are approved by his departmental chairman.

Biology Major

**Year 1** Including Biology 132

**Year 2** Two of: Biology 233, 234, 235
Chemistry 236
Physics 200
Arts or Mathematics Elective

**Three-year programme**

**Year 3** Two of Biology 333, 334, 335, 337
Chemistry 337
Earth Sciences 130 or a non-Biology Science Elective
Arts or Mathematics Elective

**Four-year programme**

**Year 3** Two or three of: Biology 333, 334, 335, 337
Chemistry 337
Earth Sciences 130 or a non-Biology Science Elective if only two Biology courses chosen.
Arts or Mathematics Elective.

† Students wishing to apply for the Ontario Department of Education Type-A certificate must choose three courses in Biology or take a third Biology course as an extra course.

**Year 4** Three Biology courses acceptable to the Biology Department
Chemistry 437
Arts or Mathematics Elective.
Chemistry Major

Year 1 Including Mathematics 131

Year 2 Chemistry 236, 242
One of Mathematics 236 (required for four-year programme),
Physics 237
One of: Physics 242, Biology 233, 234, 235*, Earth Sciences 130 or 230
Arts Elective**

Three-year programme

Year 3 Chemistry 325
One of: Chemistry 241, 337
One of: Physics 235, Biology 231
One of: Mathematics 243, Earth Sciences 330 or 340
Arts Elective**

Four-year programme

Year 3 Chemistry 241, 325
Physics 235, or 242 (if not taken previously)
One of: Biology 231, Mathematics 243. Chemistry 336† or 337.
Earth Sciences 330 or 340
Arts Elective**

Year 4 Chemistry 341
Two of: Chemistry 335† (3 hours lab.), 336†, 337, or 440
One other course in Biology, Earth Sciences,
Mathematics or Physics acceptable to
the Department of Chemistry
Arts Elective**

† Biology 235 preferred. Biology 233, 234 may be taken if timetable permits.
** Mathematics elective may be chosen if no other Mathematics course selected in the same year.
†† One of the courses Chemistry 335, 336 must be taken to qualify for graduation from the four-year programme with a Chemistry major.

Earth Sciences Major

Year 1 Including Earth Science 130 and Biology 132†
† Another course from the option list may be selected by students who have achieved a good standing in post-1965 Grade 13 Biology or equivalent, or by special arrangement.

Two of: Chemistry 241, Physics 200, Biology 231, Mathematics 243.
Arts Elective: English 240 is strongly recommended.

Three-year programme

Year 3 Two of: Earth Sciences 330, 334, 335, 340.
Two of: Chemistry 242, Biology 234, Physics 237, Mathematics 132.
Arts Elective.
General Science Programme

**Four-year programme**

**Year 3**  
**Two or three of:** Earth Sciences 330, 334, 335, 340.  
Arts Elective.

**Year 4**  
**Two or three of:** Earth Sciences 338, 430, 431, 432*, 434*, 437, 438*, 439*, 440*.  
One or two Science Courses.  
Arts Elective.  
*Half courses: 2 of these make the equivalent of one course selection.

**Physics Major**

**Year 1**  
Including Mathematics 131

Year 2  
One of: Mathematics 132, 236, 237  
One of: Chemistry 23 I, 236, Biology 231. Earth Sciences 130 or 230  
Elective

**Three-year programme**

**Year 3**  
Physics 339  
One of: Physics 237, 332, 338  
One of: Mathematics 229, 243  
One of: Chemistry 23 I, 325  
Elective

**Four-year programme**

**Year 3**  
Physics 339  
One or two of: Physics 237, 332, 335, 338, 316* and 317*  
One or two of: Mathematics 229 or 243; Chemistry 231 or 325  
Arts or Mathematics Elective

**Year 4**  
**Two or three of:** Physics 237, 33 I, 332, 335, 336, 338, 416* and 417*, or 441  
Two or One science courses other than Physics Electives.  
Arts or Mathematics Elective
6 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’ interim Type “A” Certificate from the Youth and Recreation Branch of the Department of Education of Ontario.

The co-operative course gives the student an opportunity, unique in Canada, to gain experience in several of the career fields open to Kinesiology and Recreation graduates. Work opportunities are planned in educational institutions, community recreation departments and private agencies such as the 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:

<table>
<thead>
<tr>
<th>1969</th>
<th>1970</th>
<th>1971</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fail Winter</td>
<td>Fall Winter</td>
<td>Fall Winter</td>
</tr>
<tr>
<td>First</td>
<td>Second</td>
<td>Third Work Period</td>
</tr>
<tr>
<td></td>
<td></td>
<td>work Period</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fourth Work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Period</td>
</tr>
</tbody>
</table>

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.
School of Physical Education and Recreation

Admission Requirements

General

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

Admission cannot be granted until all the requirements have been met and all the required documents submitted. Applicants currently enrolled in Ontario Grade 13 and who wish to be considered for Early Final Admission must apply before April 1, 1969. All other applicants must apply and have submitted all the necessary documents by August 1, 1969. 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, Ont.

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 1969-1970 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 (I)
   Physics (I)
   Mathematics A (I)
   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.

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

**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, 1969. 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 May 30, 1969 of their acceptance and will be asked to indicate their decision by June 15, 1969. 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.

**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 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 I Memorial University
- Nova Scotia: Senior Matriculation (Grade 12)
- Prince Edward Island: Third Year Certificate from Prince of Wales College
Examinations and Promotions

Quebec
McGill Senior Matriculation or
Quebec Senior High School Leaving Certificate

Saskatchewan
Senior Matriculation (Grade 12)

England and Wales,
The General Certificate of Education
West Indies, East and West Africa
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.

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 expense 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 experience working, applicant’s 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 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 10, 11, 12, 1969

Fees
Refer to Section I page 358

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 00. The first two terms, or semesters, comprise the “First year” and courses that extend over the
Examinations and Promotions

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></td>
<td>F</td>
</tr>
</tbody>
</table>

b) Standing in a year's programme is to be interpreted as follows:

<table>
<thead>
<tr>
<th>Range of Marks</th>
<th>Letter Grade</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 their 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 final over-all 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 the first term in year one. A student may not write supplemental examinations to raise the standing in subjects already passed.

6) No student will be permitted to continue in course if he fails a supplemental examination in a course which is required as a prerequisite for further study, except with the approval of the Examinations and Promotions Committee and the appropriate department of the school. Where a necessary prerequisite subject has not been cleared, a student may either repeat the year or term, or remain out of course until the deficiency is cleared at a subsequent examination.

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

- **Year 1** (Fall, Winter)
  - Kinesiology 100*/101*, 185*/186*
  - Psychology 110
  - Biology (Zoology)*
  - Physics (Mechanics in Human Movement)*
  - English 16*/17*
  - Two Electives

- **Year 2, Term 2A** (Fall)
  - Kinesiology 200*, 221*, (220* for 1969), 285*
  - Chemistry 16*
  - Three Electives

- **Year 2, Term 2B** (Spring)
  - Kinesiology (221* for 1970)
  - 230*, 240*, 280*, 286*
  - Psychology 211*
  - Chemistry 37*

- **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 131 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 100*/101*
- Kinesiology 185*/186*
- Psychology 110
- Biology 131
- English 16*/17*
- Geography 100*/101*
- Sociology 100

Year 2, Term 2A (Fall)
- Recreation 380*
- Economics 101*
- Psychology 211* and one other
- Sociology 205*, 210*
- One Elective

Year 2, Term 2B (Spring)
- Recreation 200*, 205*, 210*, 220*, 230, 380*
- One Elective

Year 3, Term 3A (Winter)
- Recreation 380*
- Economics 102*
- Psychology 212* and one other
- Sociology 212*
- Two Electives

Year 3, Term 3B (Fall)
- Recreation 380*
- Psychology 290
- Sociology 331* and one other
- Political Science 103*
- Two Electives

Year 4, Term 4A (Spring)
- Recreation 230, 350*, 380*, 420*, 440*, 470*
- One Elective

Year 4, Term 4B (Winter)
- Recreation 380*
- Political Science 104*
- Psychology 290
- Four Electives (at least one Sociology)
7 Environmental Studies - Architecture
Programme in Environmental Studies and Architecture

**Philosophy**

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. We must strive to once again make the term “Architect” synonymous with the concept of integrity and leadership in all aspects and phases of building, planning and construction. Pursuit of Architecture is based or 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 programme must explore a wide variety of disciplines to equip the students with a correlated understanding of the disciplines to Architecture.

The Architectural programme must strive to be a centre for research in order to generate new knowledge and understanding of Architecture. It 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 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 knowhow 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 school 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 Canada’s and U.S.’s professional and business community to help determine the operational
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.).

Cooperative Programme

The programme provides six terms of study and five terms of employment during the Bachelor of Environmental Studies programme and four terms of study and one term of employment during the subsequent Bachelor of Architecture programme. These are arranged as shown in the diagram below.

Students should refer to Section 13 of the calendar for details of operation of the co-operative programmes.

Bachelor Environmental Studies

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Term</td>
<td>Work Period</td>
<td>2nd Term</td>
<td>Work Period</td>
<td>3rd Term</td>
<td>Work Period</td>
<td>4th Term</td>
<td>Work Period</td>
</tr>
</tbody>
</table>

Bachelor of Architecture

<table>
<thead>
<tr>
<th>1973 Fall</th>
<th>1974 Spring</th>
<th>1975 Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Term</td>
<td>Work Period</td>
<td>3rd Term</td>
</tr>
</tbody>
</table>

Terms available in 1969-70

1969-70 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.

Admission Requirements

Application for admission to the programme of Environmental Studies-Architecture 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, 1969. All other applicants must apply and have submitted all the necessary documents by August 1, 1969. 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, Ont.

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 1968-69 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.
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:

Three credits from
- Mathematics A (2)
- Physics (1)

Two credits from
- Biology (1)
- Chemistry (1)
- Geography (1)
- History (1)
- Mathematics B (1)

Two additional credits.

Additional credits can be selected from any of the optional subject offered at the Grade 13 level with the qualification that no more than one of the following may be counted as an “additional” credit: Accounting 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 VIIIpractica and Grade II theory will be considered as “one additional credit” or 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

**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, 1969. 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 May 30, 1969 of their acceptance and will be asked to indicate their decision by June 15, 1969. 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 and the Canadian Achievement Tests.
matics and Physics if the corresponding Grade 13 credits are offered for admission to the University.

Other Canadian Provinces 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** McGill Senior Matriculation or Quebec Senior High School Leaving Certificate
- **Saskatchewan** Senior Matriculation (Grade 12)
- **England and Wales** The General Certificate of Education with passes in at least five subjects.
- **West Indies, East and West Africa** 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.

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 Architecture where a student alternates four months of study with four months of practical experience, applicants from other countries are strongly recommended to obtain landed immigrant status in Canada before applying for admission to the University.

**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 were taken and the standing; in each course.
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 10, 11, 12, 1969

Fees  Refer to Section II page 358

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 nor 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 Examinations  Arrangements will be made in accordance with University policy.

Academic Programme  The programme being offered attempts to expose the student not only to the traditional approaches to design but also to the rigor of modern analytic and quantitative methods. In entering the course the student should be prepared to develop a basic understanding of five subject areas. The arrangement of these five subject areas is outlined in the accompanying chart. (See page 125)
<table>
<thead>
<tr>
<th>Course Work</th>
<th>Term I Fall Hrs/Week</th>
<th>Term II Summer Hrs/Week</th>
<th>Team III Winter Hrs/Week</th>
<th>Term IV Fall Hrs/Week</th>
<th>Term V Summer Hrs/Week</th>
<th>Term VI Winter Hrs/Week</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Computer Science 1 hr.</td>
<td>Computer Science 1 hr.</td>
<td>Computer Science 1 hr.</td>
<td>Computer Science 1 hr.</td>
<td>Computer Science 1 hr.</td>
<td>Computer Science 1 hr.</td>
</tr>
<tr>
<td>Studio B</td>
<td>Workshop 8 hrs.</td>
<td>Workshop 8 hrs.</td>
<td>Workshop 8 hrs.</td>
<td>Workshop 8 hrs.</td>
<td>Workshop 8 hrs.</td>
<td>Workshop 6 hrs.</td>
</tr>
</tbody>
</table>
8 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, Sociology and Anthropology.

Courses leading to the degree of Master of Applied Science (M.A.Sc.) are offered in Applied Psychology, Chemical Engineering, Civil Engineering, Design, Electrical Engineering, Management Science, and Mechanical Engineering.

Courses leading to the degree 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 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, 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:

i) 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

ii) 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’s degree or equivalent, except in certain clearly identified two-year Masters’ programmes. 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 three years are considered sufficient time to complete all requirements. In special circumstances an extension may be granted by the Faculty. In any case, the candidate must remain continuously registered at the University to the end of the term in which he completes the degree requirements.

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:

i) successfully completed six two-term courses (or twelve term courses),
ii) 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 fulfilment 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, three years are considered sufficient time to complete all requirements.
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 studying will arrange for a public defence of his thesis to be held in the presence of an adequate number of members of the University and its guests.
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 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 report in light of the report to him from the chairman of the thesis committee.
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 regular graduate students.

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

Regular Full-Time Graduate Students

Students possessing an Honours Bachelor’s Degree or equivalent with such standing that they have been accepted by a Faculty Graduate Committee to study for a higher degree.

A full-time graduate student is taken to mean a graduate student enrolled for more than the equivalent of a one-term course in any given term.

Qualifying (Full Time) Students

Students possessing a university degree, who, in the opinion of the Faculty Graduate Committee concerned, may not yet be prepared to un-
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 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.

- A: 75 - 100%
- B: 66 - 74%
- C: 60 - 65%
- F: Less than 60% (failure)

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 11 Page 358

**Registration (Fall Term)** September 22 Monday Graduate Studies.

All students are required to register at the commencement of each session.
9 Course Descriptions
Undergraduate, Graduate
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 resources and applying a critical judgment of material secured. (Group B elective).

The following course is administered by Conrad Grebel College.

Arts 300C Full Course 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.

Campus Centre
Department of Biology

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

Professor C.H. Fernando, B.Sc. (Ceylon), D.Phil (Oxford), F.R.E.S.
Professor A.D. Harrison, M.Sc., Ph.D. (Cape Town)
Professor J.K. Morton, B.Sc., Ph.D. (Durham)
Professor A. de Vos, M.Sc., Ph.D. (Wisconsin)

(Geography and Biology)
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 J.C.H. Carter, B.A. (Toronto), M.Sc., Ph.D. (McGill)
Assistant Professor A.M. Charles, M.Sc., Ph.D. (Manitoba)
Assistant Professor N.N. Kapoor, M.Sc. (Punjab) 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)

Research Associate J.W. Moule, B.S. (Michigan), M.Sc. (McMaster), M.D.C.M. (McGill)

Undergraduate Course Descriptions

By special arrangement, courses labelled (†) may be taken in 2 sequential halves by students in co-operative programs.

Students registered for one or more of the courses 431, 433, 437, 438 and 441 (all marked with †) are expected to participate in a field expedition held either in April or September preceding their final year.

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
201 Anatomy, Histology 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. (Fall course).
(Not available to students whose major field is Biology).

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 on extracourse)

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 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.
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
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 but available to others whose major or minor field is not Biology.)

302 Vertebrate Physiology A study of 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).

333† Invertebrate Zoology A survey of the major invertebrate phyla with emphasis on the anatomy, taxonomy, and ecology of selected representatives.
Prerequisite: Biology 131 or 132
2 lectures, 3 hours laboratory.

334† The Vascular Plants A study of aspects of their structure, ecology, cytogenetics and morphogenesis.
Prerequisite: Biology 234.
2 lectures, 3 hours laboratory.
335† Microbiology 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.
Prerequisite: Chemistry 236.
2 lectures, 3 hours laboratory.

431† Ecology An analysis of the freshwater, marine and terrestrial environments and the communities of organisms they support. The distribution and numbers of plants and animals. Animal movements and migrations.
Prerequisites: Biology 233, 234 and 333.
2 lectures, 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.
Prerequisite: Biology 333.
2 lectures, 3 hours laboratory.

434 Genetics A survey of genetics with emphasis on bacterial and bacteriophage genetics and the molecular basis of gene action.
Prerequisite: Biology 337 or 335.
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 interrelationships; biosynthetic processes, cellular regulatory mechanisms, quantitative experimental methodology.
Prerequisites: Biology 235, Chemistry 337.
2 lectures, 3 hours laboratory.

437† Evolution and Biosystematics A study of living organisms in relation to evolutionary processes and classification.
Prerequisite: Biology 234.
2 lectures, 3 hours laboratory.

438 Phycology and Mycology A study of selected topics in the biology of the algae and the fungi.
Prerequisites: Biology 234.
2 lectures, 3 hours laboratory.

Prerequisite: Biology 337, Chemistry 337.
2 lectures, 3 hours laboratory.

441† Plant Physiology A detailed study of water relations, mineral nutrition, metabolism and growth and development in plants.
Prerequisites: Biology 337, Chemistry 337.
2 lectures, 3 hours laboratory.
**442 Animal Physiology**  
A 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 II**  
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 mechanisms 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 Rotation.
- 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** Methods of quantitative plant ecology, plant distribution and plant so- and Plant Geography ciology.

605 **Limnology I** 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.

610 **Evolution and Biosystematics** An advanced study of living organisms in relation to evolutionary processes and classification.

611 **Advanced Animal Physiology I** Critical discussion of selected topics in animal physiology.

612 **Advanced Plant Physiology I** Critical discussion of selected topics in plant physiology.

613 **Mycology** Critical discussions of selected mycological topics-taxonomy, ecology, plant pathology.

615 **Limnology for Engineers** A lecture, seminar and practical course providing a study of the aquatic environment with special reference to the effects of modern man. I term.

618 **Advanced Microbial Physiology** Discussion of selected topics in microbial physiology.

620 **Advanced Cytology** Selected approaches to the biochemical and structural organization of cells.

621 **Advanced Animal Physiology II** Critical discussion of selected topics in animal physiology.

622 **Advanced Plant Physiology II** Critical discussion of selected topics in plant physiology.

625 **Limnology II** An advanced discussion of selected topics in limnology. *Prerequisite: Biology 605 or equivalent.*

667 **Molecular Biology** 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.

699 **Thesis.**
Undergraduate Course Descriptions

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. II
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.

21 Transport Processes 1 Physical properties of fluids and fundamental concepts of fluid flow, (Fluid Mechanics) 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 phases (gases, liquids and crystals), phase equilibria 3 lectures

32 Physical Chemistry 2 Solutions. Equilibria in multicomponent homogeneous and heterogeneous systems. Elements of kinetic theory of gases. 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

36 Physical-Chemical Laboratory A laboratory to demonstrate physical chemical principles and techniques of physical measurement. Concurrently with ChE31. 3 hours laboratory, 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. Prerequisites: ChE 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: ChE 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 computer control.
Prerequisite: Math. 31, Ch. E. 22
3 lectures, one term.

61 Engineering Economics
Mathematics of annuities, mortgages, bonds, and small loans. Cost accounting, including direct costing, depreciation, taxes and financial statements. Estimation of sales and capital and operating costs of a new process or product. Study of criteria for the appraisal of capital expenditures. Introduction to the Critical Path Method. Introduction to Linear Programming.
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: ChE 12. ChE 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: ChE 13. ChE 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.
3 lectures, one term.

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.
3 lectures, one term.

82 Polymer Processing
3 lectures, one term.

85 Extractive Metallurgy 1
Introduction to Mineral Dressing and Extractive Metallurgy. Fundamentals of important metallurgical extraction processes are studied.
cesses of particular application in Canadian industries are analyzed. Offered in Fall and Winter terms 13 lectures/.

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 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 reactions; design and scale 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.

586 Extractive Metallurgy 3, Chemical Metallurgy Principles of hydrometallurgy, pyrometallurgy and electro-metallurgy; application of physico-chemical principles to extraction of metals from ores, and to metallurgical products from a unit process point of view.
Technology of base metal production.
Prerequisite: Chemical Engineering 85
2 lectures during term I field trip and 4 laboratory periods.
Offered on demand in Spring or Fall terms.

587 Extractive Metallurgy 4, Metallurgy of Iron and Steel An analysis of the production processes including blast furnace operation, open hearth, Bessemer and basic oxygen furnace steel making. Physical — Chemical metal-slag relationships and process analysis problems. Physical nature of solution& slag theory.
Prerequisite: Chemical engineering 85
2 lectures. During term one field trip and 4 laboratory periods. Offered on demand in Winter term.

588 Inorganic Chemistry 2 Co-ordination chemistry, homogeneous and heterogeneous catalysis.
Prerequisite: Chemical Engineering 16 or equivalent.
3 lectures.
590 Fermentation and Food  Introduction to the application of chemical engineering principles to the processing of materials of biological character or origin. Methods of solving problems imposed by biological and related factors on process design in the manufacturing industries. Foods. Beverages. Pharmaceuticals. Waste treatment. 3 lectures. one term.

591 Industrial Microbiology  Introductory study of microorganisms of industrial significance. Growth, metabolism and stability relevant to engineering design. Quality control in the food and fermentation industries. 3 lectures. one term.

592 Applied Eiachemistry  Physico-chemical properties of biological materials. Metabolism of carbohydrates, lipids, amino acids, proteins. 3 lectures. one term.

Graduate Course Descriptions

The Department of Chemical Engineering offers courses of study leading to the degrees 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 or 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.E. 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 Ch.E. 600, 642, 650 and 672, selected on the basis of his major
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
   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 vapor 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.

The following four courses are intended to serve as advanced core courses giving fairly broad coverage in a field. It is expected that all graduate students will normally take one or more of these four before proceeding to more specialized graduate course work.

600 Theory and Application of Transport Phenomenon

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.

642 Chemical Thermodynamics

Review of laws of thermodynamics, Gibbs equation, thermodynamic behavior of gases, and applications.
**650 Process of Optimization**


3 lectures, one term.

**672 Advanced Mathematics in Chemical Engineering**

Review of fundamental concepts and methods of mathematical analysis with applications in Chemical Engineering. Topics covered will be selected from Advanced Calculus, Vector Analysis, Tensor Analysis, Matrix Algebra and Calculus, Ordinary and Partial Differential equations, numerical techniques. 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.

The courses below are intended mainly for students pursuing a research project, but are open to those in the professional course with the consent of the instructor and of the students’ advisors. The courses described below are of a broader scope than those listed as Special Topics in Groups A, B or C.

**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.

**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 in two-phase tube flow, packed column behaviour, mass and heat transfer during mixing, boiling and condensation phenomena.

3 lectures, one term.

**634 Statistical Theory of Matter**

Introduction to statistical methods, statistical description of systems of particles, statistical thermodynamics, techniques and results of statistical mechanics with application, kinetic theory of transport, irreversible processes.

3 lectures, one term.

**640 Chemical Reactor Analysis**

Effects of mixing on chemical reactor performance, analysis of homogeneous and heterogeneous reactor stability and control, polymerization reactor analysis, optimal control of some chemical reactors.

3 lectures, one term.

**673 Advanced Mathematics in Engineering Research**

Generalizes and extends the techniques of Ch.E. 672.

Prerequisite: Ch.E. 672.

3 lectures, one term.

**680 Principles of Polymer Science**

Introduction to the physical chemistry of high polymers, principles of polymer synthesis, mechanisms and kinetics of polymerization reactions, copolymerization theory, polymerization in homogeneous and heterogeneous systems, chemical reactions of polymers. Theory and experiments.
tal methods for the molecular characterization of polymers.

3 lectures, one term.


Prerequisite: Ch. E. 680.
3 lectures. one term.


Prerequisite: Ch. E. 680.
3 lectures. one term.

684 Advanced Polymer Science Selected advanced topics in the thermodynamics of polymer solutions, kinetics of polymerization, kinetics and thermodynamics of crystallization and melting, polymer degradation, transport phenomena in polymers.

Prerequisite: Ch. E. 682 and 683.

686 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.

687 Theoretical Chemical Metallurgy The application of physicochemical principles to chemical metallurgy; thermodynamic equilibria of heterogeneous processes. Electrolytic and electrode reactions, theory of rate processes and their application to process metallurgy.

3 lectures. one term.


Special Topics (Given only when justified by demand)

Group A - (Topics in Transport Theory)

705. Particle-Fluid Dynamics
707. Non-Newtonian Flow
715. Radiant Heat Transfer
716. Heat Transfer in Two Phase Systems
724. Use of Transient and Frequency Response to measure Physical Quantities
726. Dissolution and **Crystallization**
727. Ion Exchange

**Group B**—(*Topics in Thermodynamics and Chemical Kinetics*)
735. Advanced Thermodynamics
736. Surface Chemistry
741. Advanced Reactor Analysis
744. Advanced Chemical Kinetics
745. Physical Processes in Heterogeneous Catalysis
746. Kinetics of Consecutive and Chain Reactions
747. Kinetics of Biological Systems
748. Residence Time Distributions, Reactor Flow Models
    and Reactor Stability

**Group C**—(*Topics in Control Theory and Applied Mathematics*)
754. Mathematical modeling 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.
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.
809. Research Thesis for Ph.D. Degree
Department of Chemistry

Professor and Chairman of H.G. McLeod, M.A.. Ph.D. (Toronto)
Department (until July 1, 1969)
Professor and Chairman of L.W. Reeves, B.Sc., Ph.D. (Bristol)
Department (after July 1, 1969)
Professor (Statistics and W.F. Forbes, D.I.C., Ph.D., D.Sc. (London)
Chemistry)
Professor and Dean W.A.E. McBryde, M.A. (Toronto), Ph.D. (Virginia)
of the Faculty of Science
(under July 1, 1969)
Professor (Chemistry and Physics) W.B. Pearson, M.A., D.Phil., D.Sc. (Oxon)
and Dean of the Faculty of
Science (after July 1, 1969)
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 R.G. Woolford, M.Sc. (Western), Ph.D. (Illinois)
the Faculty of Science
Senior Lecturer R.H.F. Manske, M.Sc. (Queen’s), Ph.D., D.Sc. (Manchester), D.Sc. (McMaster), F.R.S.C.
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.Sc., Ph.D. (Toronto)
Associate Professor J.R. Mills, M.A. (Toronto), Ph.D. (Illinois)
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)
Associate Professor G.E. Toogood, B.Sc., Ph.D. (Nottingham)
Assistant Professor A. Balasubramanian, M.Sc. (Madras), Ph.D.
(Indian Institute of Science)
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 V.A. Snieckus, B.Sc. (Alberta), M.S. (California), Ph.D. (Oregon)
Instructor W.J. Byars, H.N.C. (Dundee Technical College)
Instructor W.A. Cameron, H.N.C. (Hendon Technical College)
Instructor B.B. Carson (Mrs.), B.A. (New Hampshire), M.S. (Oregon State)
Instructor M.C. Michael (Miss), B.Sc. (Waterloo)
Instructor G. Tomlinson, G.R.I.C. (North Staffordshire College of Technology)

Undergraduate Course Descriptions

Details of the undergraduate programmes offered by the Faculty of Science are to be found on page 94

11 General Chemistry An elementary study of the states of matter, changes of state, solution
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 I
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 II
An introduction to the important classes of heterocyclic compounds and natural products. A laboratory course on preparative organic chemistry and organic techniques accompanies the lectures.
Prerequisite: Chemistry 26.
3 lectures. 3 hours laboratory, alternate weeks, one term.

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; oxidation-reduction, chemical equilibria; descriptive chemistry of the common elements.
2 lectures. 1 tutorial, 3 hours laboratory for two terms.

131 General Chemistry
Elementary study of the states of matter, changes of state, solution laws; atomic structure and bonding; stoichiometry of equations, oxidation-reduction, chemical equilibria; descriptive chemistry of the commoner elements in terms of the periodic table.
2 lectures. 1 tutorial, 3 hours laboratory.

200* Radiochemistry
Stability rules for atomic nuclei; modes of decay of radioisotopes; radiations and their detection methods; nuclear reactions applied to activation analysis; radiation induced chemical reactions; use of radioisotopes in science and industry as tracers and radiation sources.
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.

3 lectures. 3 hours laboratory, one term.

Theory and practice of analytical chemistry stressing wet methods in common use today. Treatment of analytical data to obtain meaningful information.

3 lectures, 9 hours laboratory, one term.


3 lectures, 3 hours laboratory, one term.

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

3 lectures, 3 hours laboratory, one term.

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.

A general survey of the important principles and applications of organic and biochemistry for Optometry students only.

3 lectures, Winter Term.

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.

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

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 make them possible and to the general principles which they exemplify. A knowledge of ionic equilibria will be assumed and extended.

2 lectures, 6 hours laboratory.

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

2 lectures, 1 hour problems.

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.

2 lectures, 3 hours laboratory.

Classical and wave theories of the electronic structure of atoms developed and applied to the rationalisation of the periodic table and the
Department of Chemistry

problems of chemical bonding. Application to the systematic chemistry of the non-transition elements.
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.
2 lectures, 6 hours laboratory.

301* Applied Inorganic Chemistry The physical principles bonding and structure developed and applied to such industrial processes and materials as extractive metallurgy, synthesis of industrial chemicals; ceramics and alloys.
3 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.
3 lectures. 3 hours laboratory, one term.

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.
3 lectures. 3 hours laboratory, one term.

307* Introductory Biochemistry Carbohydrates; proteins; nucleic acids; lipids; metabolism of these compounds.
3 lectures, 3 hours laboratory, one term.

308* Instrumental Measurements I Introduction to the use of instruments to obtain accurate measurements of physical and chemical properties of materials.
1 lecture. 3 hours laboratory, one term.

318* Instrumental Measurements II Extension of Chemistry 308 to dynamic measurements following the course of a chemical reaction or monitoring a continuous process.
1 lecture, 3 hours laboratory, one term.

325 Physical Chemistry An introduction to the study of matter from the macroscopic and molecular point of view. Classical kinetic theory of gases, thermodynamics, electrochemistry, kinetics, molecular structure, surface phenomena, phase equilibria and macromolecules. A knowledge of calculus is assumed.
2 lectures, 3 hours laboratory.

331 Inorganic Chemistry I Systematic inorganic chemistry of the non-transition elements based on the principles established in Chemistry 231; introduction to nuclear-and radio-chemistry. The laboratory illustrates methods of synthesis and characterization of typical inorganic compounds.
2 lectures, 3 hours laboratory.

335 Physical Chemistry II The thermodynamics of systems of variable composition including real gases and binary solutions of non-electrolytes. Electro-chemistry and the thermodynamics of electrolytic solutions.
336 Organic Chemistry II Correlation between electronic structure and chemical properties and reactivity; stereochemistry; synthetic methods, especially enolate and related condensations, and cycle-addition reactions; carbohydrate and peptide chemistry.
2 lectures, 3 hours laboratory.

337 Biochemistry I 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.
2 lectures, 3 hours laboratory (except for Honours Chemistry and Physics students).

400* Electrochemistry and Corrosion Electrolytic conductance and transport; thermodynamics of electrolytic solutions; electrode potentials; the measurement of pH; metallic corrosion.
3 lectures, 3 hours laboratory alternate weeks, one term.

402* Modern Organic Analysis Application of wet chemical and instrumental methods in current use to the identification, determination and characterization of organic materials.
2 lectures, 3 hours laboratory, one term.

403* Physical Chemistry of Polymers Polymerization reactions; effects of monomer structure, stereoregularity; polymer solutions; degradation and stabilization of polymers; network polymers and polymerization reactions; polymer elasticity.
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.
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.
3 lectures, 3 hours laboratory, one term.

1 lecture, 3 hours laboratory, one term.

410* Applied Chemistry Seminar I 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.
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.
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.
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.
1 lecture, 3 hours laboratory. one term.

431 Inorganic Chemistry II Systematic inorganic chemistry of the transition elements; introduction to selected topics including ligand field theory; magnetochemistry; interpretation of electronic spectra. Organometallic chemistry; chemistry of metal carbenes, cyclopentadienyls, and related compounds.
2 lectures.

435 Physical Chemistry III Introduction to quantum chemistry and statistical thermodynamics. Applications to kinetics, surface chemistry, and spectroscopy.
2 lectures. 1 hour problems.

436 Organic Chemistry III The use of spectroscopic techniques in organic chemistry; analysis of reaction mechanisms; free radical chemistry; a brief introduction to natural product chemistry.
2 lectures.

437 Biochemistry II Selected topics and techniques in modern biochemistry; energy transfer, transport across membranes, comparative aspects of metabolism, mechanism and kinetics of enzyme activity, structural macromolecules.
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.

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.
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 follow-
chemistry. Course work will be appropriate to the area selected and a research director should be chosen from members of the department who are presently engaged in various fields of endeavour as listed.

**Major Areas of Research**

**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; the aging process; the role of free radicals in tobacco smoke carcinogenesis; 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.

*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/or admission. New areas of research are usually added each year.*

**Graduate Course Descriptions**

*Courses marked with an asterisk (*) are topics taught in the fall semester; those marked with a double asterisk (**) are taught in the spring semester.*
610 Advanced Nuclear Systematics of atomic nuclei; nuclear models; radioactive decay processes; nuclear reactions; interaction of radiation with matter; radiation detection methods and radiochemical assay; tracers in chemical applications; radiochemical techniques and radiation chemistry.

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.

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 Advanced Biochemistry Selected topics in the field.


641* Chemical Bonding in Inorganic Chemistry Construction of hybrid orbitals. Molecular orbital theory. The Huckel method. Ligand field theory. Application to complex inorganic and organometallic molecules. Prerequisite: Chemistry 640 or its equivalent.

642 Chemical Instrumentation Instrument components and optimum application; rudiments of design; electrical, spectral, migrational and other methods.

645 Molecular Quantum Mechanics A course on the quantum theoretical elucidation of chemical and physical properties of molecules. Quantum mechanical principles. Quantum mechanical techniques, perturbation and variation methods. Molecular orbital method. Nature of chemical binding.

646* Theoretical Organic Chemistry The stereochemistry and chemical reactivity of saturated and unsaturated 3-, 4-, 5-, 6- and 7-membered carbocyclic systems, including the decalins and perhydrophenanthrenes. Elimination reactions. Aromaticity, including a study of valence bond isomers and the annulenes, and aromatic chemistry in general, including living point-to-point effects.

647 Selected Topics in Physical Biochemistry Discussion of several related fields covering the application of spectroscopic methods to biochemistry; ultracentrifugation; light scattering; and tracer chemistry.

651* Physical Methods in Inorganic Chemistry Optical, nuclear magnetic resonance, mossbauer, nuclear quadrupole and mass spectroscopy and their uses in inorganic chemistry.

655 Chemical Kinetics Statistical methods applied to the kinetic molecular theory and to the treatment of interacting systems. The kinetics of homogeneous reactions in gases with emphasis on unimolecular reactions, and of reactions in condensed phases.

656* Synthetic Methods of Organic Chemistry A discussion of classical and newer concepts in the synthesis of organic compounds with emphasis placed on the fundamental behaviour patterns. An integration of experimental facts and modern theories is presented.

661* Synthetic Methods in Inorganic Chemistry An introduction to the synthetic techniques of inorganic and organometallic chemistry. Chromatography, inert atmospheres, techniques with non-aqueous solvents, high vacuum techniques etc. The application of these methods to the synthesis of selected groups of inorganic compounds will be discussed.

662* Colloquia on Current Topics in Analytical Chemistry Graduate students will each present for discussion short colloquia based on their reading of assigned topics. Participation in the discussions, as well as the actual presentation of papers, will be an integral part of the course. Admission to this course will be at the discretion of the Analytical faculty.


Prerequisite: Chemistry 640 or its equivalent.

666* Organic Spectroscopy Introduction to ultraviolet, infrared, and resonance spectroscopy, with emphasis on applications to studies of organic molecules.


675 Selected Topics in Physical Chemistry Discussion of specialized topics in thermodynamics, electrochemistry, surface phenomena and quantum chemistry at an advanced level.

676* Selected Topics in Organic Chemistry Discussion of specialized topics related to the research interests of members of the Department.

681* Inorganic Reaction Mechanisms Substitution, oxidation-reduction, isomerisation and racemisation reactions of coordination compounds in aqueous solutions. Experimental techniques and treatment of data.

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.

Department of Civil Engineering

Professor W.A. McLaughlin, B.Eng. (Saskatchewan), MS., Ph.D. (Purdue)

Chairman of the Department

Professor ST. Ariaratnam, B.Sc.(Eng.) (Ceylon), M.Sc. (London), Ph.D. (Cambridge)

Professor M.Z. Cohn, Candidate of Tech. Sc. (Bucharest), M.Sc. (Queens), M.A.Sc., Ph.D. (Waterloo)

Professor V.K. Handa, (Calcutta), B.Sc. (Eng.) (London)


Professor T. Prasad, B.Sc., M.Sc., Ph.D., (Cambridge)

Professor A.N. Sherbourne, B.Sc. (Toronto), M.A.Sc. (Wisconsin), M.Sc., Ph.D. (Waterloo)

Professor D.T. Wright, B.A.Sc. (Toronto), M.A.Sc., Ph.D. (Cambridge)

On leave of absence

Associate Professor R. Green, B.Sc., M.Sc., Ph.D. (Waterloo)

Associate Professor R.C.G. Haas, B.Sc., M.Sc., Ph.D. (Waterloo)

Associate Professor H. M. Hill, B.A.Sc., M.Sc., Ph.D. (Waterloo)

Associate Professor B. LeLievre, B.Eng., M.A.Sc., Ph.D. (Waterloo)

Associate Professor W.C. Lennox, B.A.Sc., M.Sc., Ph.D. (Waterloo)

Associate Professor E.L. Matyas, B.A.Sc., D.I.C., M.Sc., Ph.D. (Waterloo)

Associate Professor J. Roorda, B.A.Sc., M.Sc., Ph.D. (Waterloo)

Associate Professor J. Schroeder, B.Eng., M.Eng., Ph.D. (Waterloo)

Associate Professor I. Shortreed, B.Eng., M.Sc., Ph.D. (Waterloo)

Associate Professor T.E. Unny, B.E. (Madras), M.A.Sc., M.E. (Kharagpur), D. Ing. (Dresden)

Assistant Professor E.F. P. Burnett, B.Sc., M.A.Sc., Ph.D. (Waterloo)

Assistant Professor G.M. Cornwall, B.A.Sc., M.A.Sc., Ph.D. (Waterloo)

Assistant Professor I. Holubec, B.A.Sc., M.A.Sc., Ph.D. (Waterloo)

Assistant Professor G.M. McNeice, B.A.Sc., M.A.Sc., Ph.D. (Waterloo)

Assistant Professor J. J. Farquhar, B.A.Sc., M.A.Sc., Ph.D. (Wisconsin)

Assistant Professor D.E. Grierson, B.A.Sc., M.A.Sc., Ph.D. (Wisconsin)

Assistant Professor T. Prasad, B.A.Sc., M.A.Sc., Ph.D. (Waterloo)

Assistant Professor G.M. McNeice, B.A.Sc., M.A.Sc., Ph.D. (Waterloo)

Assistant Professor J. E. Leisch, B.E. (John Hopkins)

Adjoint Professor C. Marsh, M.A., Ph.D. (Cambridge)

Assistant Professor P.M. Pearson, B.A.Sc., M.A.Sc., Ph.D. (California)

Lecturer R.M. Wetzel, B.S., M.S. (Illinois)

Undergraduate Course Descriptions

200 Systems II A series of problems designed to complement lecture material. The (Special Problems) problems are related to the various divisions of Civil Engineering.

201 Mechanics of A general treatment of the behaviour of structural components from the
theorems, theories of failure, elastic and inelastic analysis of unsymmetrical bending, shear center, torsion of cellular members, columns and stability, and virtual work.


232 Systems I (Economics and 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, etc.

241 Measurement Surveying Field Camp The use of surveying instruments.


321 Statistics Modern statistics and engineering; treatment of data, frequency distributions; theory of probability; Binomial, Poisson and Normal distributions; Central Limit Theorem; Normal Law of Errors; sampling distributions; statistical inference; regression theory.

322 Engineering Analysis Formulation and solution of various eigenvalue equilibrium and propagation problems in discrete and continuous systems. Topics include equations of mathematical physics, separation of variables, eigenvalues and eigen function, numerical methods, calculus of variations, Raleigh-Ritz, Galerkin and other approximate methods.

350 Fluid Mechanics Physical properties of fluids and fundamental concepts of fluid flow. Dimensional analysis and similitude and their use in solving problems of fluid mechanics. Laws for conservation of mass, energy, momentum and entropy and their application to a variety of engineering problems such

361 Urban Planning  A systematic approach to urban planning. Goals, objectives and criteria, plan alternatives, optimization and plan implementation. Theories of urban growth and development. A group planning project.


371 Geology for Engineers  An introductory course in geology with emphasis on topics related to civil engineering; mineralogy and petrology, structural geology, geomorphology (especially glacial geology). Aggregates: properties and occurrence. Field trips.


400 Systems III (Project)  Design of civil engineering projects, building structures, bridges, highway and municipal engineering works. Emphasis is given to the interrelationship between practical design and the various sciences and disciplines covered in the undergraduate course of studies.

401 Structural Steel  The design of structural elements in steel. Beams, tension and compression members, connections and plates.

402 Reinforced Concrete I  Properties of concrete and reinforcing steel. Section design: ultimate strength design and working stress design. Design principles.


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.


481 Engineering Law  General introduction to law and the Common Law legal systems; formation of contracts, effect of mistakes on contracts, interpretation of contracts, breach of contracts, legal remedies; scope and content of technical specifications; sale of goods; introduction to the Law of Agency; the Tort of Negligence, professional negligence; some aspects of restrictive trade practices; introduction to Patent Law.

500 Systems IV (Project)  An independent piece of engineering work, usually not entailing experimentation, under the direction of a faculty member.

505 Mechanical Behaviour of Materials  A review of crystalline and non-crystalline structures; elastic and inelastic properties, imperfection and plasticity in crystals; plastic deformation and creep; brittle, ductile and fatigue fracture. Plasticity in ceramics and polymers. Cyclic deformation.


531 Introduction to Experimental Stength Analysis  A study of the factors that influence the service life of structures with particular attention paid to the role of stress analysis. Range of validity of common engineering solutions based on analytical idealizations. Elementary methods of deformation and stress analysis: elementary photoelasticity; mechanical, optical and electrical strain gauges: moiré, brittle coatings; mechanical and mathematical models (Analog methods). Tensometric and photoelastic models. Typical transducers. Principles of
540 Highway Engineering
(Planning and Design)
Highway planning; methods. results. Classification needs, sufficiency ratings. Economics of location. Highway finance and administration. Geometric design; principles, methods.

541 Pavement Materials

542 Pavement Structural Design

Note Courses numbered within the 500 series are considered to be undergraduate courses but are intended to form a transition from the undergraduate to the graduate programme in certain areas of Civil Engineering. They serve two major functions:
1) to provide technical electives for the undergraduate so that he may specialize in a particular area,
2) to provide background information for the graduate student when such is lacking. Courses of this series may be credited toward a graduate degree.

Graduate and Research Programmes
Both co-operative and conventional graduate study leading to the degree of Master of Applied Science (M.A.Sc.) or Doctor of Philosophy (Ph.D.) can be undertaken in Civil Engineering. At present, there are five major areas of study in which specialization may be undertaken: Structural Engineering and Applied Mechanics, Soil Mechanics and Geotechnical Engineering, Water Resources and Sanitary Engineering, Transportation Planning and Engineering, and Hydraulics and Water Resources Systems Planning.

Structural Engineering and Applied Mechanics
Major subdivisions of study are applied mechanics, structural mechanics, concrete structures, properties of materials, experimental mechanics, and stochastic systems. Graduate courses in this area are CE 605 to 635 inclusive; other courses may be offered in the 700 series.
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 pretressed 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, longwave photoelasticity, photoelastic 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. The graduate courses offered within the group are CE 640 to 649 inclusive. Additional courses are available in urban and regional planning, economics, sociology and operations research.
Current research activities include investigations in transportation systems analysis, urban transportation analysis methods, urban land use models, economic analysis of transportation systems, intercity air trans-
Department of Civil Engineering

Soil Mechanics and Geotechnical Engineering

Major subdivisions of study in this area are soil mechanics, foundation engineering and engineering geology. Graduate courses CE 650, 658 and 664 are offered regularly. Additional special graduate courses may be offered if there is sufficient demand.

Current activities include studies on the yielding of soils, settlement of structures, model testing, seepage and engineering geology.

Water Resources and Sanitary Engineering

Graduate course offerings in this area are CE 671 to 677 inclusive and CE 791 and CE 792. Supporting courses are available in biology, hydraulics, hydrology, chemistry, and other related fields.

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

The available courses are CE 686, 687, 688, 689, 791, and 792. Courses in associated areas of fluid mechanics, soil mechanics, planning and economics are also available.

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

605 Mechanical Behaviour of Materials

A review of crystalline and non-crystalline structures; elastic and inelastic properties, imperfection and plasticity in crystals; plastic deformation and creep; brittle, ductile and fatigue fracture. Plasticity in ceramics and polymers. Cyclic deformation.

606 Fatigue Behaviour of Metals

An introduction to cyclic and fatigue behaviour of materials. Metallographic features, crack nucleation, propagation and fracture, discussion of fundamental mechanisms. Effect of material properties, stress, geometry, surface and environment on fatigue behaviour.

607 Advanced Mechanics of Materials


608 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.

609 Stability and Dynamics of Structures

finite number of degrees of freedom. Wind oscillations and earthquake response.

610 Inelastic Behaviour of Ductile Members and Structures

611 Elementary Mechanics of Continua

612 Experimental Mechanics

613 Mathematical Methods in Applied Mechanics
An introduction to the formulation of engineering problems in mathematical form as preparation for further study and research. Equilibrium problems, eigenvalue problems, and propagation problems as studied in lumped-parameter systems and continuous systems. Introduction to matrix and tensor analysis. Elements of linear graph theory with applications to the analysis of lumped-parameter systems. Introduction to extremum problem formulations.

614 Mechanics of Continua

616 Plasticity

617 Elasticity

619 Theory of Plates and Shells

620 Theories of Design
621 Energy Methods and Structural Stability
An introduction to the variational principles of mechanics and their applications in engineering. Virtual work, principles of minimum potential energy and complementary energy.

622 Reinforced Concrete III

623 Limit Design of Concrete Structures

624 Prestressed Concrete

625 Failure in Metal Assemblies

626 Advanced Analytical Mechanics
Fundamental dynamical theorems and their application to advanced problems; generalized co-ordinates; Lagrange’s equation; fixed and moving constraints; non-holonomic systems; principle of least action; introduction to qualitative and quantitative methods of nonlinear analysis; stability; parametric excitation.

627 Linear Stochastic Systems

628 Non Linear Systems with Random Inputs.
See EE 633.
Prerequisite CE 627

632 Physical Basis of Mechanical Model Studies
Physical basis of similarity of strain and stress fields. Linear elastic bodies, linear visco-elastic bodies, real model materials. Relations between basic quantities: stress, strain, birefringence. Mechanical and optical creep and creep recovery. Linear limit stress for strain and birefringence. Dispersion of birefringence. Relation between dispersion of birefringence and linear and nonlinear mode of behaviour. Influence or rheological behaviour of model materials on the accuracy of model tests and on laboratory technique.

Lectures and Laboratory).
633 Advanced Photoelasticity I
(Lectures and Laboratory).

634 Advanced Photoelasticity II
(Lectures and Laboratory).

635 Special Problems of Experimental Mechanics
Recent advances in the field of experimental methods for evaluation of strength of structures, of strain and stress fields, for investigation of dynamic behaviour of structures, for investigation of propagation and interference of stress waves in solids and pressure waves in fluids.
(Lectures and Laboratory).

636 Experimental Stress Analysis
Relations between stress state, strain state and mode of failure of a structure. Static and dynamic problems. Direct methods, model methods, similarity criteria. Theory and technique of the main methods of stress analysis: displacement and strain measurements by means of mechanical, electric; and optical transducers, (mechanical, optical, electric, photoelastic and moire gages); brittle coatings; measurements of changes of mechanical, electromagnetic and thermodynamic properties (photoelasticity, x-ray techniques, ultrasonic techniques, temperature measurements). Principles of designing and choice of measuring systems. Recording techniques. Evaluation and analysis of results.
(Lectures and Laboratory).

640 Introduction to Transportation

641 Civil Engineering Systems I

642 Civil Engineering Systems II
643 Urban Transportation Planning I

644 Urban Transportation Planning II

645 Highway Planning

646 Geometric Design
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.

647 Traffic Engineering I
Basic characteristics of drivers, traffic vehicles, volumes, speed, delays etc. Capacity determination. Accidents. Traffic laws and ordinances, regulations and administration.

648 Traffic Engineering II
Theory of traffic flow: statistical models, flow analysis, following concept, queuing theory, simulation, network analysis.

649 Airport Engineering and Planning
Civil aviation, air traffic control, financing of airports. The role of the airport in the transportation system. Planning considerations. Demand predictions current problems in air transportation planning and engineering.

650 Advanced Soil Mechanics
Steady state seepage of fluids through porous media. Stress distribution due to static boundary loads of a soil mass. General theory of consolidation.

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.

664 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.

671 Water Resources Engineering I

672 Water Resources Engineering II

673 Water Resources Engineering III


700 to 790 Special Advanced Courses and Directed Studies.
720 Advanced Theory and Design of Structures.
721 Approximate Analysis of Structures.
722 Structural Synthesis and Case Histories.
781 Hydroelastic Vibrations.
782 Hydraulic Transients.
801 Oral examination of the Thesis for the Ph.D.
803 Comprehensive examination (As determined by the Department).
804 Language requirement for the Ph.D. (As determined by the Department).
807 Engineering Project.
808 Research thesis for the M.A. Sc. degree.
809 Research thesis for the Ph.D. degree.
**Department of Classics and Romance Languages**

**Professor**, R.L. Myers, B.A. (Western), M.A.. Ph.D. (Johns Hopkins)

**Chairman of the Department**

**Professor**, A. Ages, B.A. (Carleton), M.A.. Ph.D. (Ohio State)

**Deputy Chairman**

**Professor J** J.R. Finn, C.R., B.A. (Western), M.A. (Toronto).

**Professor J** B.J. Graf, C.R.. M.A. (Western)

**Professor J** M.I. Kieffer, B.A. (St. Louis), M.A. (McGill), M.M. L. (Middlebury), Ph.D. (Gregorian)

**Visiting Professor**, Louis Landré, Docteur ès Lettres. (Sorbonne)

**Professor**, D.C. MacKenzie, A. B., M.A., Ph.D. (Princeton)

**Professor**, J.C. McKeogney, 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, L.en Phil. rom., Agrégé (Brussels)

**Associate Professor**, E. Grey, B.A. (Texas Western), M.A. (Colorado), Ph.D. (Harvard)

**Executive Secretary**

**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** J.B. Bullbrook, C.R., B.A. (Western), M.A. (Laval)

**Assistant Professor** J.R. Dugan, B.A., M.A. (Toronto), Ph.D. (Yale)

**Assistant Professor**, J. Dumont, Licence-ès-Lettres (Neuchâtel)

**Assistant Professor**, C.M. Fernandez (Mrs.), Lie. en Arq. (Madrid), M.A. (Tulane)

**Assistant Professor**, J.-F. Gounard, Licence-ès-Lettres (Bordeaux)

**Assistant Professor**, J. Lafrance (Miss), B.Paed., M.A. (Laval)


**Lecturer**, H.S. Fournier (Mrs.), B.A. (Toronto), M.A. (Western)

**Lecturer**, R.J. Fournier, B.A.. M.A. (Western)

**Lecturer**, S. Haag (Mrs.), B.A.. M.A. (Queen's), M.Phil. (Toronto)

**Lecturer**, O. Romanyschyn, B.A. (Waterloo)

**Lecturer (part-time) R** C.C. Abbott (Mrs.), B.A., M.A. (Ohio State)

**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) Course numbers ending in 5, indicate a fall-term course, those ending in 6, indicate a winter-term course. Course numbers ending in 0 indicate a full (two-term) course.
Undergraduate Courses

Classics

Classical and Mediaeval Civilization (Courses in Translation)

251* Near Eastern and Greek History
A survey of the civilizations of the Near East and of Greece emphasizing their political, military, social and economic aspects.
Three lectures.

252* Roman History
A military, political, social, economic survey of Rome from earliest times to the Empire’s fall.
Three lectures.

255* Mediaeval Civilization
Study of mediaeval literature, art, architecture, music and other expressive forms. The periods from late antiquity to the High Middle Ages will be studied.
Three lectures.

256* Mediaeval Civilization
Study of mediaeval literature, art, architecture, music and other expressive forms. The periods from the High Middle Ages to the Renaissance and Reformation will be studied.
Three lectures.

265* Classical Literature in Translation 1
Greek and Roman Epic and Drama.

266* Classical Literature in Translation 2
Classical Satire, Historiography and Verse

350 Classical Art and Archaeology A survey of art and architecture from the Aegean age through the Roman Empire.
Three lectures.

365* Problems in Greek A detailed study of a selection of problems in Greek History.
History 1 Prerequisite. Class. Civ. 2.51.

370 Myth, Religion and Art Deities, myths, and sagas correlated with literature, religion, philosophy and art from the 6th century B.C. to the 4th century A.D.
Three lectures.

375* Problems in Roman A detailed study of a selection of problems in Roman History.
History 1 Prerequisite, Class. Civ. 252.

376* Problems in Roman A detailed study of a selection of problems in Roman History.
History 2 Prerequisite, Class. Civ. 252.

495 Mediaeval Civilization Senior Essay.

Greek

100 Introductory Greek
Four lectures.

190 Epic and Philosophy (to Plato). Homer Iliad, I, VI, IX: Plato, Apology and Crito; prose composition and sight translation.
Department of Classics and Romance Languages

Prerequisite: Grade 13 Greek, Greek 100 or permission.
Four lectures.

250 Language Study Composition, translation, basic grammar with intensive analysis of selected prose works.
Three lectures.

265* History and Historiography Selections from Herodotus

266* Lyric and Elegiac Poetry Selections from Lyric and Elegiac Poets.

350 Language Study Composition, translation, advanced grammar, with intensive analysis of selected literary works, including verse.
Three lectures.

365* History and Historiography Selections from Thucydides.

366* Tragedy Euripides, Medea and other selections.

375* Drama Selections from Aeschylus, Sophocles and Aristophanes.

376* Literary Criticism Selections from Plato’s Gorgias and Phaedrus and Aristotle’s Poetics

Latin

100 Introductory Latin
Three lectures.

190 Literature of the Republic Catullus (selections): Cicero, Pro Archia: Vergil, Eclogues (selections), and Aeneid I.
Prerequisite: Grade 13 Latin, or Latin 100 or permission.
Three lectures.

250 Language Study Composition, translation, basic grammar with intensive analysis of selected works.
Three lectures.

265* Letters Selections from the letters of Cicero and Pliny.

266* Epic Vergil, Aeneid 2, 4, 6.

350 Language Study Composition, translation, advanced grammar, with intensive analysis of selected literary works, including verse.
Three lectures.


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.

396* Medieval Latin Literature from the twelfth century to the Renaissance. Selected readings in various genres such as the chroniclers and the Goliardic Songs.

450 Advanced Language Study Changing styles of Latin authors, historical view of syntax, with composition and translation adapted to individual needs.

465* Philosophy Lucretius, De Rerum Natura I, 3, & 5 (selections); Cicero, De Officiis (selections).

466* Satire Horace, Satires (selections); Juvenal, Satires (selections).

475* Comedy Plautus, Rudens; Terence, Phormio.

476* Historiography and Literary Criticism Tacitus, Annals I - 16 (selections); Quintilian IO.

485* Historical Monograph 1 Sallust, Catiline; Seneca, Apocolocyntosis.

486* Historical Monograph 2 Tacitus, Agricola; Suetonius, Caligula.

4% Senior Seminar on selected topics such as epigraphy, textual criticism, remains of old Latin. Topics selected will be related as far as possible to individual student interest.

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. The literature and civilization portion of the course will consist of weekly lectures on the texts being studied, followed by a discussion period. 

Prerequisite: Grade 13 French or permission.

250 Structural grammar Intensive language training, and writing practice.

Prerequisite: French 100.

Three lectures.

245* Classical literature A study of some of the major writers of 17th century France Not offered in 1969-70.


260 Literature of the Offered in summer school and/or post-degree programme only. 17th Century To be offered in the Fall/ Winter Term in 1969-70.

265* Nineteenth century literature The literary scene in 19th century France.
325 French theatre before 1850 A study of French theatre of the baroque, rococo and romantic periods. Special attention will be given to Corneille, Racine, Marivaux, Hugo, and Musset.

326 Modern French theatre A study of the major developments in French drama since 1850. Special attention will be given to le théâtre libre, Maeterlinck, Claudel, Cocteau, Sartre, Ionesco, Beckett, etc.

345 French poetry of the 19th century An intensive study of the romantic, parnassian, and symbolist schools of French poetry.

346 French poetry of the 20th century An intensive study of the main schools of poetry in 20th century France.


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.

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.

370 French Literature From Balzac to 1900 To be offered in summer school and/or post-degree programme only.

426 The Novel in French Canada Special emphasis on contemporary novels.

425 Medieval French An introduction to the problems of mediaeval French language and readings from the major literary texts of the period.

435 French prose of the Renaissance Particular attention will be paid to the aesthetics of prose in the period. Readings in the conteurs, Rabelais, and Montaigne, etc.

436 French poetry of the Renaissance Particular attention will be given to the aesthetics of poetry in the period. Readings in Marot, the Pléiade, the baroque poets, etc.

446 The genius of French prose cluding Pascal, Diderot, Voltaire, Stendhal, and Flaubert.


456 Compared stylistics and advanced composition, translation and oral practice. An introduction to the problems of stylistics. Lectures, debates, panels. This course is not a repetition of French 455. Prerequisite: French 350. Three lectures.
480 The French Novel of the Twentieth Century
A systematic study of the major French novelists of the 20th century.

485* Principles of French Criticism
A study of various critical methods and points of view in French literary criticism.

486* Senior Seminar on approved topics.

The following courses are administered by St. Jerome's College.

50J Preliminary Year French
Authors and Composition. The Ontario Grade 13 curriculum will be followed.
4 lectures (at Resurrection College only).

275*J Survey of French Literature from 1550-1660 or offered in 1969
Plutide, Malherbe, Baroque period, Corneille, Moliere. Pascal.

276*J Survey of French Literature from 1660 to the Revolution.
La Fontaine, Racine, Boileau, minor genres of classicism, novels and comedies to the Revolution. Not offered in 1970.

315*J French literature from 1900 to 1930
A survey of the main developments in the French novel, theatre, and poetry of the early twentieth century. Special attention is given to Gide, Claudel, Proust, Mauriac, and the Surrealists.

316*J French literature from 1930 to present
A survey of the main developments in French literature from 1930 to present with special emphasis on Malraux, Giraudoux, Sartre, Anouilh, Camus and Sarraute.

375*J French Literature of the Romantic Period
A study of the major French authors of the romantic period.

376*J French Literature of The Realist and Naturalist Periods
A study of the major French authors of the realist and naturalist periods.

Italian

The following courses are administered by St. Jerome's College.

110J Introduction to Italian
Intensive the fundamentals of grammar and conversation. The language laboratory will be used regularly.
Five lectures.

190J Intermediate Italian
Advanced study of grammar and conversation. Readings in Italian literature. For students with some knowledge of spoken and written Italian.
Three lectures.

Spanish

110 Introduction to Spanish
Intensive drill in the fundamentals of grammar and composition. The language laboratory will be used regularly.
Five lectures.
190 Intermediate Spanish  For students with some knowledge of Spanish. The language laboratory
will be used regularly.
Prerequisite: Spanish I 10 or Grade 13 Spanish.
Four lectures. Conducted largely in Spanish.

210 Spanish Civilization  A study in English of the main historical and cultural currents in Spain
and Spanish America.
Three lectures.

250 Composition and
Conversation  Selections from representative works of major Spanish authors. Oral
practice and composition.
Prerequisite: Spanish1 90.

275* The Enlightenment in Spanish Literature
A study of the works of Luzán, Feijoo, Jovellanos, and Cadalso.

276* Drama of the Nineteenth Century
A study in the development of the drama from the Duque de Rivas to
Echegaray.

295* The Novel of the Nineteenth Century
A study of the literary currents of the past century such as the costum-
braista movement, realism and naturalism.

296* Galdós  Intensive study of the novels and the theatrical works of Galdós.

315* Spanish Lyrics from
Garcilaso to Góngora
Conceptism and Culteranism.

316* The Theatre of the Golden Age
Dramatic theory and practice. The innovations of Lope.

325* The Prose of the Golden Age
A study of the Quijote and other major works of Cervantes.

326* The Picaresque Novel
Intensive study of the major picaresque novels from Lazarillo de
Tormes to La Picara Justina.

350 Advanced Composition and
Conversation  Writing of essays based on critical examination of selected plays and
novels; discussion, in Spanish, of these works.
Prerequisite: Spanish 250.

385* Survey of Spanish American Poetry
A study of the major poets from Lo Araucana to the beginning of the
Modernista movement.

386* Modern Spanish American Poetry
A study of Spanish American poetry from the Modernista movement to
the present.

395* Spanish American Prose
A critical study of Spanish American prose works from the Cortés let-
ters to the works of Sarmiento.

396* Spanish American Prose
A critical study of masterpieces in prose from Sarmiento to the present.
415* The Prose of the Generation of '98
A study of philosophical essays from Ganivet to Zubiri.

416* Drama and Poetry of A general view of Spanish poetry and drama from Antonio Machado to the Generation of '98 Juan Ramón Jiménez.

425* Twentieth Century Movements in Spanish Poetry
A study of poetical works from García Lorca to Rafael Alberti

426* Contemporary Spanish Novel
The development of Spanish fiction from Cela to Sender.

450 Senior Spanish Composition and Conversation
This course will provide intensive practice in spoken Spanish on the advanced level.

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.

495* The Novel in Mexico
Principal stress will be placed on novels dealing with the Mexican Revolution.

Graduate Courses

All graduate courses with the exception of the Thesis are one-term courses.

600 Literary Criticism in French (Problems and Methods)
601 History of the French Language
602 Mediaeval French Literature
603 Literature of the Renaissance in France
604 Reading Course in approved topics
606 Classical Tragedy in Seventeenth Century France
607 Comedy at the time of Molière
608 The Theatre in Eighteenth Century France
610 Romanticism in Nineteenth Century French Literature
611 Realism and Naturalism in the Nineteenth Century French Novel
612 Voltaire and the Age of Enlightenment
616 Pierre Bayle
617 Rousseau and Romanticism
618 Diderot
619 Classical and neoclassical French poetry
620 Twentieth Century French Literature
625 The Literature of French Canada
626 Gongorismo and its antecedents in Spanish Literature
627 The indianista novel in Spanish America
650 Supervised Reading in Selected areas of French Literature.
   (Not to be counted toward completion of M.A. course requirements.)
699 Thesis.
Undergraduate Course Descriptions

Details of the undergraduate programmes offered by the Faculty of Science are to be found on page 94.

Earth Sciences 130 is prerequisite for all later courses in Earth Sciences with the exception of Earth Sciences 230 and 231. 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.

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.

230 Mineralogy
2 lectures and 2 hours laboratory.

231* Mineralogy (Half course--primarily for Geography students.) Content comprises the first half of Earth Sciences 230.

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 Precambrian, Paleozoic, Mesozoic, and Cenozoic stratigraphy and orogenesis.
2 lectures, 2 hours laboratory, winter term.

240* Geomorphology
2 lectures, 3 hours laboratory, fall term.
matic series and igneous provinces. Controls of metamorphic crystallization; metamorphic facies concepts and series. Laboratory study of rocks and rock suites.

Prerequisite: Earth Sciences 230.
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 trips and laboratory study of fossils and fossil assemblages.

2 lectures, 2 hours laboratory.

335 Stratigraphy and Sedimentation


2 lectures, 3 hours laboratory.

338 Geophysics


2 lectures.

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.

430 Economic Geology

Principles and processes governing the formation of ore and industrial mineral deposits. An introduction to mineral economics. The study of important examples, primarily from Canada. Laboratory study will include instruction and practice in ore microscopy.

Prerequisite: Earth Sciences 230.
2 lectures, 2 hours laboratory.

431 Geochemistry

The geological application and interpretation of geochemical data. Chemical characteristics of sedimentary, igneous, and metamorphic rocks. Theory of distribution patterns and co-efficients of major and minor constituents. The recognition and elucidation of metasomatic rocks. Isotope studies and radiometric dating.

2 lectures, 2 hours laboratory-seminar.

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 palaeontological data in solving stratigraphic problems. Methods of differentiation and correlation of rock units on the basis of their fossil assemblages. Types of palaeontological zones. Field trips.

2 lectures, 2 hours laboratory, fall term.

435 Seminar

Oral and written presentation of special topics in the general field of geology.
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 A chronological study of the origin and development of continents and oceans. Geotectonics; orogenesis and epeirogenesis; cratonic and geosynclinal evolution. Shields, island arcs. Study of selected orogenic belts. 2 lectures, 2 hours laboratory.

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 hour laboratory. Fall term.

Museum Visitors
Department of Economics

Professor J.S. Minas, B.A. (Wayne) Ph.D. (Illinois)

Acting Chairman of the Department. Dean of Faculty of Arts

Professor A. Qayum, B.A., M.A., Ph.D. (Aligarh), D.Sc. (Netherlands Sch. Econ.)

Professor S.S. Sengupta, M.A., D.Phil. (Calcutta)

Professorial Associate K.D. MacKenzie, A.B., Ph.D. (University of California at Berkeley)

Associate Professor J.N.E. Lavigne, C.R., B.A. (Western), M.Comm. (Ottawa), M.B.A. (Detroit)

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 L.P. Fletcher, B.Comm. (Mount Allison), A.M., Ph.D. (Brown)

Assistant Professor S.W. Kardasz, B.A. (Loyola)

Assistant Professor R.R. Kerton, B.Comm. (Toronto), M.A. (Carleton), Ph.D. (Duke)

Assistant Professor, Deputy Chairman W.R. Needham, B.Comm. (Carleton), M.A., Ph.D. (Queen’s)

Lecturer F.J. Carmone, Jr., B.S., M.B.A. (Pennsylvania)

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 descriptions 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 230.

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.

110* Mathematical Foundations of Economics 1

Abstract structures: their analysis and representation. Elementary structures based on sentences; operations and the algebras induced by them; structure of partially ordered sets and their algebra. Essentials of Boolean algebras and applications of Boolean polynomials.

3 lectures.

111* Mathematical Foundations of Economics 1

Compositions, Decomposition and Counting; partitions of a given set; generating functions; problems of assigning objects to places; partitions and compositions.

Prerequisite: Economics 1 10*
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 202*.

206* General Equilibrium Theory 2 Theories of business fluctuations; models of growth and technological change.

Prerequisite: Economics 205.

227* Probability Theory Frequency and Measure notions of probability; Constructive theory of measures; probability as an integral; The calculus of probabilities; probabilities of compound events; Limit Theorems; Various models of probability; Conditional probability; Elementary notions and calculus of Markov Chains.

228* Probability Theory Subjective probability; the axioms and calculus of subjective probability; utilities and expectations; the applications in business decisions under uncertainty and in Statistical decisions.

230 Money and Banking and Macro Economic Theory A study of the Canadian Banking system; major emphasis is placed upon the social accounts and the theory of money, income, employment and public policy.

Prerequisite: Economics 101*/102*.

240 Economic History of Canada The economic development of Canada in its North American setting. Particular emphasis is given to Canadian development within the framework of the staple export hypothesis and the developing international economy.

Prerequisite: Economics 101*/102*.

2 lectures. 1 hour discussion.

256* Introduction to Financial Accounting 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 Managerial Accounting Systems of Cost Accounting, analysis of cost variances, budgeting, break-even analysis, the problem of changing price levels.

Prerequisite: Economics 256.
258*/259* Production and Inventory Management Description of Technology: Engineering processes; Production functions; Description and analyses of technological change; Formulation of optimal production and decisions; quantity and/or price decisions; Scheduling of production over time and over facilities; Optimal inventory system; Price output-inventory interactions at the micro and macro-economic levels; Statistical techniques of inventory management.

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. I hour discussion.

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. I hour discussion.

300 Statistical Methods Frequency distributions; measures of central tendency, dispersion, skewness and kurtosis; probability theory; tests of hypotheses; sampling techniques; time series analysis; aggregation and index numbers; the estimation and testing of economic relationships using regression and correlation techniques. Prerequisite: Economics 102. 3 lectures.


330 Public Finance The place of public expenditures and revenue in the national economy, taxation, debt management, and the role of fiscal policy in economic stabilization. Prerequisite: Economics 201, 202. 3 lectures.


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 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 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.


Prerequisite: Economics 257.

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; wage 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.

378*/379* Economics of Marketing Management Descriptive study of marketing organization for principal products and industries-Price-output structures-Marketing variables and types of competition-Models of advertising and selling efforts—Models of pricing-Interactions between pricing and product differentiation-Planning changes in the product: strategies of product introduction and improvement—Techniques of controlled experimentation.

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 230.

400 Advanced Economic Theory An advanced treatment of selected topics in economics.

Prerequisite: Economics 201, 202, 230.

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.
440 History of Economic Thought A survey of the historical development of economic theory.
Prerequisite: Economics 201, 202, 230.

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, 230, 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, 230, 300 or equivalent. 3 lectures.

465* Security Analysis and Investment Policy This course is designed to relate corporate financing priorities and an individuals 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.

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, 230. 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, 230 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.
### Department of Electrical Engineering

**Professor Chairman**
P.R. Bryant, **M.Sc.** (London), M.A., Ph.D. (Cambridge)

**Professor**
R.G. Anthes, **B.A.Sc., M.A.Sc.** (Toronto)

**Professor**
E.L. Heasell, **B.Sc., Ph.D.** (Imperial College, London)

**Professor**
S.N. Kalra, **B.Sc. (Punjab), M.S., Ph.D. (Illinois)**

**Professor**
A.R.M. Noton, **B.Sc. (Sheffield), B.Sc. (London), Ph.D. (Cambridge)**

**Professor**
H.C. Ratz, **B.A.Sc. (Toronto), SM. (Massachusetts Institute of Technology), Ph.D. (Saskatchewan)**

**Professor Associate Chairman**
L.A.K. Watt, **B.Sc. (Manitoba), M.S. (Chicago), Ph.D. (Minnesota)**

**Professor**
L.Y. Wei, **B.S. (National Northwestern College, China), M.S., Ph.D. (Illinois)**

**Associate Professor**
J.H. Anderson, **B.Sc. (Leeds), M.Sc., Ph.D. (Manchester)**

**Associate Professor**
N. Bergman, **B.Eng. (McGill) M.S., Ph.D. (State University of New York, Buffalo)**

**Associate Professor**
Y.L. Chow, **B.Eng. (McGill), M.A.Sc., Ph.D. (Toronto)**

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

**Associate Professor**
J.A.A. Field, **B.E. (Saskatchewan), M.A.Sc., Ph.D. (Toronto)**

**Associate Professor**
J.S. Keefer, **B.A.Sc., M.A.Sc. (Belfast)**

**Associate Professor**
R.H. MacPhie, **B.A.Sc. (Toronto), M.S., Ph.D. (Illinois)**

**Associate Professor**
R.S. Ramshaw, **B.Sc., Ph.D. (Nottingham)**

**Associate Professor**
J. Reeve, **B.Sc., M.Sc., Ph.D. (Manchester)**

**Associate Professor**
D.J. Roulston, **B.Sc. (Belfast), D.I.C. Ph.D. (Imperial College, London)**

**Assistant Professor**
S.G. Chamberlain, **M.Sc., Ph.D. (Southampton)**

**Assistant Professor**
G.J. Dufault, **B.A. (Ottawa), B.Sc. (Carleton)**

**Assistant Professor**
J. Hanson, **B.A.Sc. (Toronto), D.I.C. M.Sc., Ph.D. (Imperial College, London)**

**Assistant Professor**
T. Kameda, **B.S., M.S. (Tokyo), Ph.D. (Princeton)**

**Assistant Professor**
W.N. Meikle, **B.A.Sc., M.A.Sc. (Toronto)**

**Assistant Professor**
R.G. Van Heeswijk, **Dipl. Ing. (Delft, Holland)**

**Assistant Professor**
W.J. Vetter, **B.A.Sc. (Toronto), M.A.Sc., Ph.D. (Waterloo)**

**Assistant Professor**
P.A. Vuorinen, **B.A.Sc. (Toronto), Ph.D. (London)**

---

**10 Introduction to Electrical Engineering**


**Prerequisite:** Physics I I

3 lectures, 3 hours alternate tutorial and laboratory, one term.

---

**12 Electrical Circuits**


**Prerequisites:** Math 12, Math 21

*Electrical Engineering: 2 lectures, 3 hours laboratory, 2 hours tutorial, one term.*

*Mechanical Engineering: 2 hours lectures, 3 hours laboratory every alternate week, 2 hours tutorial, one term.*

Prerequisite: EE 12
3 lectures, 3 hours laboratory every third week, 1 hour tutorial, one term.


Prerequisite: EE 12. 3 lectures, 2 hours tutorials. 3 hours laboratory every alternate week, one term.

21 Probability and Reliability Theory  Probability and frequency distribution, Bayes’ theorem. Continuous random variable and density functions. Characteristic function, moments, centreal limit theorem, regression, Rayleigh distribution, random process and correlation functions, reliability of components, standby and parallel redundancy, repair and preventive maintainance, standby systems.

Prerequisites: Math 22 or equivalent
3 lectures per week, one term.


2 hours lectures, 3 hours problems. one term.


Prerequisite: Math 31, EE 22
3 lectures, 3 hours laboratory alternate weeks, one term.

26 Design of Computing Machines  The design principles of digital, analogue and hybrid computers. Boolean algebra and switching circuits. Discrete and continuous arithmetic units, memory types, input/output and control units. Number systems, floating point arithmetic.

Prerequisite: EE 25
3 lectures, 3 hours laboratory every third week, one term.

28 Communication Theory  Relations between information content of messages and system capacity; transmission through electric networks; modulation systems; periodic sampling, noise, comparative analysis of information transmission systems. The role of system bandwidth and noise in limiting the transmission of information is stressed.

Prerequisite: EE 52
3
32 Electronics
Introduction to the principles and characteristics of diodes, vacuum tubes, transistors, and other electron devices, and to the design and analysis of rectifiers, amplifiers, and other electronic circuits.

Prerequisite: EE 12.
3 lectures. 3 hours laboratory. one term.

33 Physical Electronics
Introduction to statistical mechanics, elementary band theory of solids, intrinsic and extrinsic semiconductors, minority carrier charge dynamics, physical principles of the operation of the p-n junction and the junction transistor.
2 lectures. 3 hours laboratory alternate weeks, one term.

34 Physical Properties of Materials
Crystal structure and the common lattices, x-ray and electron diffraction analysis, chemical bonding. Dielectrics: the origin of electrical polarization, dipole relaxation and dielectric losses, ferro-electrics. Magnetics: the atomic origin of diamagnetism and paramagnetism, paramagnetic resonance, ferro-magnetism, magnetic anisotropies, domains, magnetization curves of bulk material, antiferromagnetism, ferrimagnetism and ferrites.
3 lectures. one term.

35 Solid State Electronics
A study of the basic physical principles underlying the operation of some of the important solid state devices, including an introduction to quantum electronics and a discussion of the maser and the laser. An introduction to the phenomenon of superconductivity and a discussion of superconductive devices. Band theory of semiconductors and a discussion of some of the modern semiconductor devices.
3 lectures. one term.

42 Network Theory

Prerequisite: EE 12
2 lecturers. 1 hour tutorial. 3 hours laboratory alternate weeks, one term.

44 Pulse and Switching Circuits

Prerequisites: EE 42, EE 52
3 lectures. 3 hours laboratory every third week, one term.

51 Electronic Device Characteristics
Abrupt p-n junction. Switching conditions in abrupt pn junctions. Introduction to transistors. Transistor Characteristics. The vacuum tube.
2 lectures, 1 hour tutorial, 3 hours laboratory alternate weeks, one term.

52. Electronic Circuits

Prerequisite: EE 51
2 lectures, 1 hour tutorial, 3 hours laboratory alternate weeks, one term.
61 Electromechanics  
Introduction to energy conversion with special emphasis on electromechanical energy converters, linear and rotary. Physical magnetic and electrostatic circuits. Statically and dynamically coupled magnetic circuits.  
Prerequisites: EE 12, 13  
2 lectures. 1 hour tutorial. 3 hours laboratory alternate weeks, one term.

62 Electrodynamics  
Development of dynamic and steady state equations for the generalized rotary energy conversion device. Study of dc and ac machines as particular types of the generalized device with particular emphasis on their steady state and transient external characteristics.  
Prerequisite: EE 61  
2 lectures. 1 hour tutorial. 3 hours laboratory alternate weeks, one term.

63 Topics in Power Engineering  
3 lectures, 3 hours laboratory every third week, common with EE 565, one term.

76 Electromagnetic Fields  
A vectorial treatment of electromagnetism. Maxwell’s equations, plane wave propagation, plasmas.  
Prerequisite: EE 13, Math 33, Math 34  
3 lectures, 1 hour tutorial, one term.

77 Transmission Lines and Waveguides  
Representation of transmission line by the four line parameters. Derivation of the differential equations. Sinusoidal analysis; characteristic impedance, propagation constant, phase velocity. Terminated lines; reflection coefficient, standing wave ratio, impedance matching. Use of the Smith Chart. Telephone and power lines. Introduction to waveguides, TM and TE modes in rectangular guides, guide wavelength and cutoff frequency, attenuation. The transmission line wave guide analogy.  
3 lectures, 3 hours laboratory alternate weeks, one term.

81 Control Systems  
Time domain and transfer function models for components and systems. Analysis and compensation of linear single input-single output control systems through transient analysis, s-plane methods, and frequency domain methods; performance specifications, error characteristics and stability. State equations for multivariable systems. Introduction to state-space analysis and algebraic methods of control system synthesis.  
3 lectures, 3 hour laboratory every third week, one term.

99 Project  
An engineering assignment requiring the student to demonstrate initiative and assume responsibility. The student will select a project at the end of the IIIB term from an approved list prepared by the Department. A short progress report at the end of the IVA term and a full report at the end of the IVB term are required. The project mark will be equivalent to two normal one term courses.  
2 hours first term, 6 hours second term, 2 terms.

529 Communication of Information  
communication capacity of systems. Representation of computer programs, sampled data.

Prerequisite: EE 21, EE 26.
3 lectures, one term.

543 Network Theory II Review of linear graph properties, state equation formulation, solution and stability by analog and digital methods, network design by computer techniques.
Prerequisite: EE 42
3 lectures, one term.

3 lectures. laboratory common with EE 63. one term.

578 Microwave Engineering Antenna theory; electromagnetic potentials, retarded potentials, dipole radiation, antenna arrays, pattern synthesis, microwave antennas, sky waves, ground waves. Microwave scattering theory; scattering matrix, resonators, microwave transmission devices and components. Microwave electronics; klystrons, travelling wave amplifiers, backward wave oscillator, magnetrons.
Prerequisite: EE 76
3 lectures, one term.

582 Control Systems II 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, sample data feedback system. Optimization gradient methods. Nonlinear control, stability analysis via Lyapunov and describing function methods.
Prerequisite EE 21, 81
3 lectures. 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. degree, below.
Equivalent credit may be given to students transferring from other recognized universities for appropriate graduate courses previously taken, up to a maximum of two units. Certain senior undergraduate courses may be taken for graduate credit (500 series) 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 part-time employment at the University or otherwise, must take a reduced academic load, as detailed in the separate section on financial assistance below.

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 specificallyap-
Master’s Degree Programmes

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 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. Suitable courses offered by other departments may be taken, as appropriate.

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 him.

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 one academic year from an honours Bachelor’s degree or equivalent, except in certain clearly identified two-year Master’s programmes. The actual time taken to complete the requirements depends on the candidate and may be considerably longer than the minimum.

Normally three years are considered sufficient time to complete all requirements. In special circumstances an extension may be granted by the Faculty. In any case, the candidate must remain continuously registered at the University to the end of the term in which he completes the degree requirements.

The 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 of C, (60-66%) or less, in more than one course in Electrical Engineering, or in more than a total of two course units, including minor fields.

English language requirement: A student whose mastery of spoken English is inadequate may be required to take a non-credit course in English and to pay an additional fee of approximately $25.

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.
Students must satisfy the requirements of the comprehensive examination as set out in paragraph five. 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 academic years from the same level. Part-time programmes are not encouraged, and students may normally satisfy only the subsidiary requirements of the programme on a non-resident basis. A minimum of three terms of full-time resident study are required in those cases where all other requirements have previously been met on a part-time basis.

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, aside from a usual maximum of eight units, 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.

The Comprehensive Examination This examination is conducted orally by a committee usually consisting of the student’s supervisor and two or more faculty members with interests in the same or related areas of study. It will normally be held 8-12 months after the initial registration for the Ph. D. degree. The purpose of the examination is to assess the candidates academic preparation and his knowledge of his chosen field of study. The committee will examine the work he has so far done to prepare himself for full-time work on his research topic, i.e. literature survey, method of attack, suitability of the topic etc.

The foreign language requirement is satisfied by demonstrating proficiency in reading and translating into English, technical literature in either German, Russian or French.

Graduate Course Descriptions


networks, topological network synthesis, approximation of network functions; time domain synthesis, synthesis of networks with unusual elements.

611 Advanced Electronics A study in depth of selected circuits used in electronics, using both vacuum tubes and transistors. This is an analysis course in which various techniques are used, but Thevenin and Norton equivalent circuits and the pole zero approach are stressed. Analysis of such amplifier circuits as cascode, differential, operational, feedback, Darlington, etc., are included and are applied in the analysis of more complex circuits. Shortcut methods are introduced, based on these concepts.

612 Advanced Electronics A continuation of EE 61 I to include clamping and clipping circuits, flip-flops, twin-T configurations, Butterworth filters, break point analysis of complex diode circuits, etc.

Prerequisite: EE 61 I;

615 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.

619 Electroacoustics Physical and physiological fundamentals of audio vibrations; properties and applications of electroacoustic transducers; analysis and measurement of sound; recording and reproduction of sound, synthesis of sound.

620 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.

626 Semiconductor Device Characteristics Resume 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 the 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.

627 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 Schröedinger’s equation for some simple systems. The Hydrogen Atom, angular momentum.

628 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-


637 Variational Methods in Control Engineering  Performance criteria, classical calculus of variations, dynamic programming, digital control systems, continuous forms of dynamic programming, multivariable control systems. Pontryagin’s Principle with examples, the two point boundary problem, computer control of processes.


643 Antenna Theory and Techniques  Topics selected from representative types and techniques of antennas: linear and travelling wave antennas, horns and lenses, reflector types of antennas, interferometers and antenna arrays, antenna measurements. data processing for radio astronomy antennas.

644 Electromagnetic Engineering  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. Green’s functions, the dipole. Antennas; linear antennas, arrays, impedance, gain, super-gain, pattern synthesis.

645 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.
function expansions, multipoles, dyadic Green’s functions. Coherence theory: mutual coherence function quasi-monochromatic analysis, coherent and incoherent limits, interferometer and linear array applications.

**650 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 reactance, fault conditions, sustained small oscillations; excitation and transient performance of synchronous machines.

**651 High-Voltage Engineering**

Determination of the electric field for different electrode configurations. Surge voltages, their origin and effects. Laboratory generation of high voltages. Measurements. Insulation coordination.

**652 Power System Analysis**


**660 Electronic Computing Machines**


**661 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.

**662 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.

**663 Sequential Machines and Automata**


**670 Statistical Theory of Communication**

Statistical basis For the description of signals; distributions, moments, and characteristics functions; cumulative distribution functions. Sets, Lebesque measure, and the Lebesque-Stieltjes integral. Random variables, Functions of random variables, ensembles, and ergodicity. Generalized harmonic analysis; correlation functions and spectral densities, statistical properties of message ensembles and the estimation of spectra, higher order statistics and the classification of random processes. Correlation detection of very low level signals. Linear filtering; physical realizability, random signals and input-output cross-correlations; Hilbert transforms. Derivation of the Wiener-Hopf equation, spectral Factoring and the solution For optimum linear systems.

**671 Information Transmission**

Sequential Sources, signal selection, channel models, channel capacity; implementation of coded systems, encoding and decoding, sequential decoding; error rates in different system and dut.
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.

703 Advanced Topics in System Theory
723 Topics in Quantum Electronics
724 Experimental Techniques for Solids
725 Topics in the Theory of Solids
726 Topics in the Theory of Electron Phonon Interactions
731 Advanced Topics in Control Theory
732 Stochastic estimation and Control
741 Radio Propagation Studies
742 Microwave Engineering 2
743 Approximate Methods in Electromagnetic Theory
750 High Voltage D. C. Transmission
751 Advanced Topics in Gaseous Discharges
752 Topics in High Vacuum Technique
753 Power Electronics and Control Devices
754 Advanced Topics in High Voltage Engineering
755 Power System Protection and Control
770 Topics in Communication Theory
771 Topics in Information Theory
772 Topics in Communications Systems
801 Oral Examination for Ph.D.
803 Comprehensive Examination for Ph.D.
go4 Language Requirement for Ph.D.
807 Engineering Project for Master’s Degree
go8 Research Thesis for Master’s Degree
go9 Research Thesis for Ph.D.
Department of English

Professor, Chairman of the Department  W. U. Ober, B.A. (Washington and Lee), Ph.D. (Indiana)
Professor (part-time)  E.M. Boyd (Miss), A.B. (Grinnell), M.A. (Chicago).
Ph.D. (Columbia) (Roberts Fellow)

Professor J L.A. Cummings, A. B. (Washington), M.A. (Missouri), Ph.D. (Washington)
Professor J.C. Gray, B.A. (Washington State), M.A. (Connecticut), Ph.D. (Syracuse)
Professor K. Ledbetter, A.B. (Central College, Mo.), M.A., Ph.D. (Illinois)

Professor C.F. MacRae, B.A. (Western), M.A. (McMaster), Ph.D. (Toronto)
Professor W.R. Martin, M.A., D. Litt. et Phil. (South Africa)
Professor W.K. Thomas, M.A., Ph.D. (Toronto)

Professorial Associate  E. Perry, B.A. (Hons.) (King’s College, London), B.A. (Queen’s), M.A. (Toronto) Professor Emeritus (Brandon University)
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)
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 J P.M. Hinchcliffe, B.A. (British Columbia), M.A., Ph.D. (Toronto)

Assistant Professor J A.M. MacQuarrie, B.A. (Acadia), M.A. (Toronto)
Assistant Professor  J.S. North, B.A., M.A. (British Columbia)
Assistant Professor  E.F. Shields (Miss), B.A. (Chestnut Hill), M.A. (Villanova), Ph.D. (Illinois)

Assistant Professor J Sister M. Leon, S.S.N.D., B.A. (Toronto), M.A. (Detroit)
Assistant Professor  G.E. Slethaug, B.A. (Pacific Lutheran), M.A., Ph.D. (Nebraska)
Assistant Professor R H. Tuyn, M.A. (Utrecht and Oxon.)

Lecturer  P.D. Beam, B.A. (Waterloo), M.A. (McMaster)
Lecturer  M.J. Estok, B.A., M.A. (Saskatchewan)
Lecturer  D.L. Hedges, B.A. (Northeastern, Okla.), M.A. (Arkansas)
Lecturer J D. Keppel-Jones, B.A. (Natal), M.A. (Queen’s)
Lecturer J D. Letson, B.A. (Waterloo), M.A. (McMaster)
Lecturer R. Lister (Mrs.), B.A., M.A. (Toronto)
Lecturer W.R. Macnaughton, B.A. (Toronto), M.A. (Wisconsin)
Lecturer M.G. Thysell (Mrs.), M.A. (Montana)
Lecturer J E.M. Uram, C.R., B.A. (Western), M.A. (St. Louis)

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 23 to 28.
Department of English

**English Major In General Arts**

**Recommended Programme**

**Year 1**

English 101
One approved course in Philosophy or History
One of French 100, German 121*/122*, Latin 190, or equivalent
Three other courses in accord with the general regulations of the Arts Faculty (see p. 20).

**Year 2**

English 251, 360
Three other courses

**Year 3**

Three approved English courses, of which at least one shall be chosen from English 270, 350, 370, 380, 452*/453*
Two other courses

**Undergraduate Courses**

*Restrictions:* With the exception of 16*, 17*, 50J, and 130 all the following courses are Honours courses, but are also open to students enrolled in General programmes. English 190, however, is not open to English majors; English 225, 240, 325, 329, and 335 may not be included in fulfilling minimum course requirements for an English programme. English 225, 325, and 329 are, however, required in the programme in Honours English (Drama).

**Note 1**
In *English programme descriptions, the word “course” means one full course or two half 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 1969-70.

**16* English Literature 1**
Designed for students in Applied Physics, Applied Chemistry, and Co-operative Mathematics, this course seeks to further the understanding and appreciation of the various types of English literature and of the humanistic values to be found in it. Since such understanding cannot be separated from the clear and effective communication of the ideas concerned, students are required to write a number of essays. Poetry and drama will be emphasized.†

**17* English Literature 2**
Similar to 16 above, with the emphasis on fiction.†

**101 The Art and Themes of Literature**
A study, through representative works, of the major genres, modes, and methods of literature, and its principal recurring themes. For all first-year Arts students electing English.†

**130 The Types of English Literature**
An examination of the nature and forms of English literature, to be combined with practice in writing. (Primarily for Science students).†

**190* Shakespeare A**
A study of selected plays. Designed for students in programmes other than English.†

**211* The Novel 1**
A study of the principal techniques, movements, and themes in the English novel.†
216* The Development of A study of the origins and development of English drama, with special concentration on sixteenth-century and early seventeenth-century non-Shakespearean drama.

221* 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.

225 Principles of An introduction to directing, acting, and staging, with practical experience in the University's theatres.

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.

237* Literature of Ideas 2 Similar to 236 above, with concentration on philosophic and scientific 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 Literary Criticism: Its Origins and Practice One part of the course is devoted to a study of the major classical critics and of the transmission of their writings through Mediaeval and Renaissance critics. The other part provides a training in the application of critical principles to the works of literature.

261 Old English and the History of the Language An introduction to the Anglo-Saxon language and literature in their historical context, and a study of the development of the English language to modern times.

270 Middle English A study of Middle English literature with special emphasis on the works of Chaucer.


282* Later Sixteenth-Century A study of the non-dramatic literature of the last two decades of the sixteenth century, with special emphasis on Sidney and on Spenser's Faerie Queene.

290* American Literature A survey of major American authors from Edward Taylor to Stephen Crane.

311* Literature of Canada A survey of Canadian poetry and prose.

312* Literature of the Commonwealth A survey of Australasian poetry and prose, with some consideration of the literatures, in English, from South Africa and the West Indies.
320* Fictional Prose, Not Including the Novel
The mutations of prose style and form as seen in the “romance” writers such as Malory, Sidney, Bunyan, Swift; in the Novella and picaresque writers such as Nashe and Defoe; in the short story and novelette writers such as Poe, Conrad, and Faulkner.

321* Personal and Utilitarian Prose
The mutations of prose style and form as seen in writers of biography and autobiography such as Boswell, Franklin, Strachey; letter writers such as Chesterfield, Keats, Dickinson; essayists such as Bacon, Burton, Ruskin, Orwell; and writers of scientific, historical, and philosophical prose such as Browne, Darwin, Macaulay, Trevelyan.

325 Principles of Dramatic Production 2
This course extends the work of English 225 and gives attention to technical aspects of voice, movement, lighting, etc., as well as an historical perspective.†
Prerequisite: English 225.

329 History of the Theatre
The theatre of Greece and Rome; Medieval and Renaissance theatre to 1642; Restoration and 18th-Century theatre; 19th- and 20th-Century theatre.†

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 MS 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 later 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 I, 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.†

360 Drama to 1642
The life and works of Shakespeare, with the rise of the drama and dramatic form, the work and influence of Shakespeare’s predecessors, and the post-Shakespearean drama to the closing of the theatres.†

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, in seminars, of the drama, poetry, novels, and other writings of the age from Dryden to Burns.†

375 Linguistics and An interpretation of linguistics and its application in the English class-
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.

388 The Romantic Movement An historical and critical study, in seminars, of the principles and practice of the English Romantic authors from Blake to Keats, with primary emphasis on poetry.

385 Contemporary Literature Same description as English 385R.

390 Beowulf A literary and linguistic study of the Old English epic Beowulf (and the Finnsburg Fragment), with an investigation of its origins in history and mythology.

Prerequisite: English 261.

425 Elizabethan Stage Production The development of the early theatres (c. 1500–c. 1642), with attention to the structure of the Academic, Court, and Public theatres; to the organization and personnel of the dramatic companies; to different methods of staging in the various types of theatres; and to representative plays of the period. Includes practical work in the theatre.

452* Literature of the Victorian Age I An historical and critical study of the writers in the period between the Romantic era and the rise of characteristically twentieth-century literature; with special emphasis on the major poets (Tennyson, Browning, and Arnold) and on writers of critical prose works of lasting significance (e.g. Newman, Ruskin).

453* Literature of the Victorian Age II Similar in scope to 452 above, but with emphasis on the more important novelists (e.g. Dickens, Thackeray, Eliot) and on writers of general prose (e.g. Mill, Huxley).

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, Shaw, Synge, and O’Casey.

461* Twentieth-Century British Novel and Drama A critical study of the works of such authors as Conrad, Joyce, Woolf, Lawrence, Shaw, Synge, and O’Casey.

462* Twentieth-Century British Poetry and Criticism A critical study of the poetry of such authors as Hopkins, Yeats, Eliot, Auden, and Thomas, with a consideration of the major literary criticism of the period.

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.
The following course is administered by St. Jerome’s College.

50J Preliminary Year English General literature and composition, analogous to the Ontario Grade 13 curriculum.

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.

Graduate Courses

The Department of English offers courses leading to the degree Master of Arts and to the degree Master of Philosophy. (The departmental graduate brochure provides details of the requirements for these degrees and information concerning which courses are likely to be offered in 1969-70.)

600* Introduction to Methods A study of the methods of book manufacture, the problems of establishing a true text, the finding of recondite sources, problems in documentation, and the making of critically annotated bibliographies.

601* Studies in Bibliographic Method Work on individual bibliographic problems, with a study of book manufacture, manuscripts and their relation to the printed text, editorial problems, and literary forgeries.

603* Practical Criticism Instruction and supervised practice in the art of reading closely, interpreting, and evaluating.

605* Beowulf A study of Beowulf as a work of literature. A knowledge of Old English is a prerequisite for admission to this course.

606* Piers Plowman After a glance at late Fourteenth-Century literature, especially the alliterative revival, the study of the complete poem in its three texts.

607 Chaucer A study of the works of Chaucer, with emphasis on The Canterbury Tales and Troilus and Criseyde.

608* Mediaeval Drama After a cursory consideration of the ancient theatre and its cessation, a study of the rise of the drama in the tenth century until the sixteenth century, using principally English examples. The church music-play, the mystery, the miracle, the morality, and the interlude will be examined from the approaches of the textual critic, the musicologist, the literary historian, and the literary critic.

610* Spenser A study of the works of Spenser, with emphasis on The Faerie Queene.

615 Shakespeare 1 A study of the comedies, problem plays, and poems.

616 Shakespeare 2 A study of the histories and tragedies.
622* Metaphysical and Cavalier Poets A study of their theory and practice.

625 Milton A study of the poetry of Milton. Some attention will be given to selected prose works.

627* Drama of the Restoration The chief comedies and tragedies of the period 1660-1707.

630 Satire A study of the early development of satire, an intensive examination of its flowering in the Restoration and Augustan periods, and a survey of the contributions made to it by such later writers as Burns, Byron, Peacock, Huxley, Orwell, and Auden. Attention will be paid to varying purposes, to the genesis of major works, and especially to methods and devices.

632* The Periodical Essay in the Eighteenth Century A study of the origins of the literary periodical essay, an intensive examination of The Spectator, and a survey of the contributions to the genre made by such later writers as Johnson and Goldsmith.

635* Fielding A study of a few of Fielding’s plays for the dramatic techniques he carried over to the novel, and a close examination of his various works of fiction: their genesis, their art forms, and their methods.

636* Johnson and his Circle A study of the literary theories, writings, and relations of Johnson, Boswell, and their circle.

640 Wordsworth and Coleridge A study of the poetry and prose of Wordsworth and Coleridge, with emphasis on the period of close association of the two poets.

642* Shelley A study of the poetry and prose of Shelley.

643* Keats A study of the poetry and letters of Keats,

645* Byron A study of the poetry of Byron, with emphasis on Don Juan.

647* Jane Austen: Novelist Her place in the development of the novel; her work in relation to the Romantic Revival; an analysis of Jane Austen criticism.

650 Studies in Victorian Poetry A complete survey of the poetry of Tennyson, Browning, and Arnold, in relation to the thought of the Victorian Age.

652 Expository Prose of the Victorian Age Reading, study, and discussion of the major prose works of Carlyle, Newman, Ruskin, Arnold, Mill, and Huxley, with selected readings from Macaulay, Pater, and Stevenson.

654 Late Victorian Poets A study of the poetry of Swinburne, D. G. Rossetti. Meredith, Morris, Clough, and the poets of the 1890’s.

656 The Victorian Novel A study of the principal works of such novelists as Dickens, Thackeray, Eliot, Meredith, and Hardy.

660 Antebellum American Literature After some attention to the colonial beginnings, the course will centre on such authors as Irving, Poe, Hawthorne, Emerson, Thoreau, Melville, and Whitman.

665 The Rise of Realism in American Literature A study of the works of such authors as Dickinson, Howells, Crane, Twain, and James.
670 The Twentieth-Century A study of the works of such novelists as James, Conrad, Lawrence, Joyce, Forster, and Woolf.

671* D. H. Lawrence A study of the work of D. H. Lawrence, with emphasis on the major novels.

672 Twentieth-Century A study of the works of such poets as Hopkins, Yeats, Eliot, Lawrence, Owen, and Auden.

673* Yeats A study of Yeats’ work, with emphasis on the later poetry.

677 Twentieth-Century Drama A study of the major drama of the twentieth century.

680 Twentieth-Century American Fiction A study of the works of such authors as Hemingway, Faulkner, Dos Passos, and Steinbeck.

682* Twentieth-Century American Poetry A study of the works of such poets as Frost, Sandburg, Jeffers, Eliot, and Stevens.

685 Studies in Canadian History and Letters A study of the major works and movements in Canadian literature, seen in the context of social and political developments. (Given in conjunction with the Department of History).

687* Studies in Australian Poetry A study of the works of the major Australian poets, seen in the context of Australian literary history as a whole and compared with Canadian literary development.

694* Current Schools of Literary Criticism A critical evaluation of the contributions and limitations of the current schools of literary criticism.

695* Special Studies Studies in a specific author, genre, or period.

696 Special Studies Studies in a specific author, genre, or period.

697 M.A. Thesis

698 M.Phil. Thesis
ES10 Design Problems Level 1

Problems which require the observation of simple events which can be modeled by simple graphical, mathematical, simulative or verbal techniques. Manipulation of the models for the purpose of determining the changes necessary to modify subsequent events toward the fulfilling of some defined objectives. Problems involving the spatial arrangement of components as related to qualitative and quantitative aspects of form, symmetry, structure, etc. Problems related to the functional interaction of components also approached qualitatively and quantitatively.

1st and 2nd term open time assignment with at least 8 hours per week in which advice and discussion is available from the faculty.

ES100

Introduction to mechanics, wave motion and heat, including vectors, rectilinear motion, plane motion, work, energy, linear and rotational motion, sound waves, heat and elementary thermo-dynamics, introductory topics in optics and sound.

Introduction to Mechanics of Solids, statics and resistance of materials, equilibrium, rigid and deformable bodies, introduction to stress and strain.

1st and second term 4 hours per week.

ES110

Introduction to Calculus, functions and limits, the derivative differentiation formulae, tangents, rates, extremes, definite integrals, fundamental theorem of integral calculus, Applications to area, volume, moments of inertia, etc. Formal integration and applications to physical problems.


Introduction to Measurement, measurement units, concept of accuracy, precision, systematic and random errors. Introduction to probability, normal distribution functions, elementary sampling.

1st and second term. 4 hrs. per week.

ES120


Introduction to psychological characteristics of man learning, motivation, emotion, sensation, perception, on individual differences. Discussion of techniques of psychological observation and measurement.

1st and 2nd terms 3 hrs per week.
ES130  The History of the Physical Environment. The development of artifacts, structures and mechanisms as they form the physical environment of particular cultures. The development of the arts, sciences and technologies as they relate to the creation of the physical environment. Visual fundamentals such as colour, texture, space symmetry, as they relate to cultural periods and development.

1st and 2nd term, 3 hrs per week.

ES140  The nature of the design process, principles of problem identification, analysis and concept creation. Introduction to planning of the design process, feasibility and concept development. Use of simulation and modeling.

1st and 2nd terms, 2 hrs per week.

ES150  Skill and practice work related to drawing, sketching, drafting and communication. Introduction to calculating devices such as desk calculators and simple computer programmes.

1st & 2nd term, 4 hrs. 1st term, 3 hrs. 2nd term per week.
Fine Arts

Assistant Professor
N.L. Patterson, (Mrs.)  B.A. (Washington)

Acting Chairman
H. Martens, (Miss)  B.A., M.A. (Minnesota)  Phd. (Columbia)

Assistant Professor G
L. Spree, Dipl. (Hochschule Fur Gestaltung VIns, Germany,
J. Uhde, M.A. (J.E. Purkyne Univ., Brno. Czechoslovakia)

Notes
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.
Fine Arts is a programme of service courses in Art, Film, and Music.

Undergraduate Courses

110* Introduction to World Art I
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.

111* Introduction to World Art II
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*.

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.
2 2-hour studio sessions weekly

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*.
2 2-hour studio sessions weekly

130* Introduction to Film Making I: 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.
2 hours weekly, plus 4 hours project work.

131* Introduction to Film Making II: 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.
Prerequisite: Fine Arts 130*.
2 hours weekly, plus 4 hours project work.

140* History of Film I
The history and art of the silent film from 1894 to 1929.

141* History of Film II
The history and art of the talking film from 1929 to the present.
Prerequisite: Fine Arts 140*. 
**172 Art Criticism**  Students will endeavour to develop an understanding of and an 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 to 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.

**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.

**210* Modem Art I**  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 twentieth century art. *Will not be offered 1969/70*

**211* Modem Art II**  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*. *Will not be offered 1969/70*

**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. *Will not be offered 1969/70*

**220* Fundamentals of Painting I**  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.

**221* Fundamentals of Painting II**  A continuation of Fine Arts 220* with an emphasis on independent problems.  
*Prerequisite: Fine Arts 220*. *Will not be offered 1969/70.*

**222* Fundamentals of Sculpture I**  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.  
*Will not be offered 1969/70*

**223* Fundamentals of Sculpture 2**  A continuation of Fine Arts 222* with an emphasis on independent problems.  
*Prerequisite: Fine Arts 222*. *Will not be offered 1969/70*
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)
4 hours studio work weekly.

231* Advanced Film Making II: 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*
Studio work.
Limited number. Will not be offered 1969/70

270* Film Theory This course in film theory will give students basic knowledge of the principles of film language so that they may make an aesthetic judgement of a cinematic work.

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 I 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 I From its earliest beginnings to 1750. Will not be offered 1969-70.

251*G The History of Music II From 1750 to the present. Will not be offered 1969-70.

300*G Stratford Festival Seminar An interdisciplinary course intended for students interested in English, Music, Drama and Speech. The focus of the seminar is centred 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.

301*G Continuation of Fine Arts 300*G Offered Summer Only
Prerequisite: An introductory course in Music, Drama, or Speech, or consent of instructor.

350*G Bach to Beethoven The development of cantata, oratorio, mass and opera, concerto and symphony in the compositions of Bach, Haydn, Mozart, and Beethoven.

351*G 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.
352\textsuperscript{G} The 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 150\textsuperscript{G} and 151\textsuperscript{G}, or consent of the instructor.

The following course is administered by St. Jerome's College.

240J Studies in 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.
General Engineering

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

12 Introduction to Engineering Systems

Introduction to basic methods of analysis through mathematical models for components and processes. Systematic formulation of terminal representations and of system equations or linear systems, utilizing terminal and system graph concepts in conjunction with matrix notation. Solutions through Laplace transforms and by computer methods. Examples are drawn from the various engineering disciplines.

3 hrs lectures, 1 hr problems

13 Management Science 1

Applications of economic performance indices in choosing between engineering alternatives and choosing optimum operating levels. Topics: the planning process; generation and classification of cash flows; accounting concepts; methods for tangible evaluation of alternatives; capital resources and allocation principles; determination of minimum costs and maximum profit; elements of economic measurement, analysis, and forecasting; competition.

3 hours per week.

14 Management Science 2

Application of the systems approach in operational activities. Development of an input - output model for production activities. Application of statistical methods to engineering and management problems. Probability distributions, sampling methods, queuing, decision theory. Discussion of models for decision making, planning, behavioural evaluations and systems control. Correlation of marketing, finance and production relationships in management.

2 hours, one term.

21 Graphics

A course in the fundamentals of graphical projections of all type-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 co-planar and non-co-planar. 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 measurement techniques for specific problems illustrating other Year 1 courses:

3 hours laboratory, alternate weeks.

24 Tutorial

Students will meet in very small groups with a faculty member designated as their tutor. Performance in problem assignments and conceptual difficulties with other courses will be discussed, along with interrelation of present coursework, later work and engineering practice. The student will be responsible to his tutor for undertaking of certain assignments.
1 hour per week, both terms. (Consultation periods with teaching assistants regarding specific course problems as and when required at the initiative of the student or his tutor, will be available).

31 Thermodynamics

3 hours lectures.

32 Fluid Mechanics

Physical properties of fluids and fundamental concepts of fluid flow. Dimensional analysis and similitude, a survey of the principal problems of fluid mechanics on the basis of dimensional analysis. Conservation laws for mass, momentum, energy and entropy, applications to a variety of engineering problems such as flow in pipes, turbomachines, etc.
3 hours lectures, 3 hours laboratory.

41 Mechanics of Deformable Solids 1

2 lectures, 2 hours tutorials.

42 Dynamics

2 lectures, 1 hour tutorial.

53 Structure and Properties of Matter 1

Gases; condensed states of matter; origin of interatomic forces; structure of crystals and non-crystalline solids; free electron theory of metals; semiconductors; physical electronics; optical processes; magnetic properties; nuclear processes.
2 hours lectures. 3 hours laboratory. Alternate weeks.

54 Structure and Properties of Matter 2

Properties associated with primary forces, waves and vibrations, theory of systematic reactions; properties associated with defect structures, plasticity, viscosity, hardness, creep, brittle fracture, ductile fracture fatigue; stability under service environment.
2 hrs lectures 3 hrs laboratory alternate weeks

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 Islam. From the Renaissance to Newton.

3 lectures, 1 hr tutorial
Department of Geography and Planning

Professor R.R. Krueger, B.A. (Western), M.A. (Western), Ph.D. (Indiana)
Chairman of the Department
Professor, L.O. Gertler, B.A. (Queen's), M.A. (Toronto). Planning (McGill)
Deputy Chairman
Professor Helen Abell, (Miss) B.H.Sc. (Cornell). M.Sc. (Cornell), Ph.D. (Cornell)
Professor A. de Vos, M.Sc. (Wisconsin). Ph.D. (Wisconsin)
Professor D.K. Erb, B.Sc. (Western), M.A. (Toronto), Ph.D. (McGill)
Associate Professor R.S. Dorney, B.Sc. (Wisconsin), M.Sc. (Wisconsin). Ph.D. (Wisconsin)
Associate Professor J. Goldstaub, B.A. (Brooklyn), M.S. (Yeshiva). Ph.D. (Yeshiva)
Associate Professor J.T. Horton, B.A. (Wheaton), M.A. (Northwestern)
Associate Professor R.M. Irving, B.A. (Toronto), M.A. (Toronto). Ph.D. (Minnesota)
Associate Professor L.H. Russwurm, B.A. (Western), M.A. (Western), Ph.D. (Illinois)
Associate Professor H.D. Steiner, M.Sc. (Zurich), Ph.D. (Zurich)
Assistant Professor J.H. Bater, B.A. (U.B.C.), M.A. (U.B.C.)
Assistant Professor R.A. Bullock, B.A. (Queen's, Belfast) M.A. (Queen's, Belfast)
Assistant Professor L. Martin, B.A. (Queen's, Kingston), M.A., M.R.P. (Syracuse)
Assistant Professor A.G. McLellan, B.Sc. (Glasgow). Ph.D. (Glasgow)
Assistant Professor W.B. Mitchell, B.A. (U.B.C.), M.A. (U.B.C.)
Assistant Professor E.R. Officer, B.A. (British Columbia), M.A. (Wisconsin)
Assistant Professor D.F. Walker, B.Sc. (Econ.) (London)

Note 1 General Geography Programme. Students majoring in Geography are required to take Geography 100*/101* and in consultation with the Department select additional courses from Geography 210*/211*, 220, 231*, 321*/322*, 331*/332*, 341 and 345* to complete their programmes. Only in exceptional cases will a student be considered for a fourth year make-up programme beyond the General Degree.

Note 2 Honours Geography Programme. The Honours Geography programme as indicated on page is the standard prescription. Students desiring a planning course as one of their options outside Geography may select from Planning 342*/343*, 344*. The programme for each student must be arranged in consultation with the Department.

Note 3 Honours Urban and Regional Planning Programme. The Honours Planning programme as indicated on page is the standard prescription. The programme for each student must be arranged in consultation with the Department.

Note 4 Students in other disciplines may select from Geography 100*/101*, 251*, 321*/322*, 331*/332*, 341. 345* and Planning 342*/343*. Entrance to other Geography or Planning courses requires consent of instructor.

Note 5 Not all the courses listed below are offered each year. Students should consult the Department prior to registration.

Note 6 Course numbers followed by an asterisk (e.g. 101*) 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 342*/343*.

Note 7 The number of hours of lectures shown after the course description is an attempt to indicate the “normal”. Each instructor determines how
Undergraduate Courses Geography

15* Surrey of Geography

This one term course presents a general review of the field of geography, its scope, approach, and basic concepts. The primary aim is to provide the student with background material, readings, resources and ideas against which major political developments, international economic relationships, and current problems of the Commonwealth and underdeveloped areas may be viewed. Course topics include: the development and character of modern geography; fundamentals of physiography; population patterns and problems; resources, economic growth and industrialization; the geographic bases of political patterns and events; urban growth and land use planning.

3 lectures (one term).
(Not offered in 1969-70.)

100' 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 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 materials and the resultant effects on the subsystems of the natural environment.

No Prerequisite.
2 lectures, 2 hours lab for Honours Geography and Honours Planning students and Geography Majors; other students will replace lab with a one-hour discussion session. (Given in winter term and normally follows Geography 101*.)

101* Introduction to Human Geography

An introduction to the discipline of geography with an emphasis on its conceptual framework, its relationship to other disciplines; and its application to problems relating to man’s use of the earth. Introduction to selected subfields of human geography: population, urban, economic, political, land use, and applied geography.

No prerequisite.
2 lectures, 2 hours lab for Geography and Planning Honours students and Geography Majors; other students will replace lab with one-hour discussion session. (Given in fall term and normally precedes Geography 100*.)

Note Unless otherwise noted Geography 100*/101* is a prerequisite for further courses in Geography. Permission of the instructor is necessary where this requirement cannot be met.

210* Economic Geography World Resources

Nature and occurrence of world resources and problems of resource development; production, distribution and consumption patterns; analysis of agricultural industry on a world scale; rural settlement and agricultural problems.

2 lectures. 2 hours lab. (Given in winter term - normally this course will follow Geography 211*.)

211* Economic Geography World Industries

World patterns of population and industry; analysis of major industrial regions; location factors underlying selected primary and secondary industries; structure of world trade.

2 lectures, 2 hours lab. (Given in fall term.)

220 World Regional Geography

This course studies in depth selected areas of the world’s climatic regions, emphasizing characteristic problems of these regions as well as their physical, cultural and economic inter-relationships. Among the
sources, 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.

2 lectures, 2 hours lab.

250 Urban Geography

The city: a study of urban phenomena and urbanization processes; problems of urban growth, concepts and techniques of urban analysis will be emphasized. 
Prerequisite: Honours Geography or Honours Planning students or consent of the instructor.
3 lectures.

251* Introduction to Urban Geography

Processes and problems of urban development in North America. Basic analytical techniques of urban geography.
No prerequisite.
3 lectures.

260* Cartography

Cartographic principles, techniques, and basic mapping procedures scales, map projections and design analysis for cartographic presentation, drafting.
Prerequisite: Honours Geography or Honours Planning students only.
3 hours seminar and/or lab. (Given in fall and winter terms.)

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: Honours Geography or Honours Planning students only.
3 hours lab, seminar and field work. (Given in fall and winter terms.)

300* Geomorphology

A study of landforms and their origins. Basic geomorphologic processes, the influence of climate, vegetation, soils and geology, and the general significance of landforms to man.
Prerequisite: Honours Geography or Honours Planning students, or consent of instructor.
2 lectures, 2 hours lab. (Given in fall term.)

301* Climatology and Meteorology

Prerequisite: Honours Geography or Honours Planning students or consent of instructor.
2 lectures, 2 hours lab. (Given in winter term - normally this course will follow Geography 300*.)

321* Regional Geography of Anglo America I

The United States. 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.

Note Geography 321* is designed particularly for students majoring in Geography (General Course) and for students in other disciplines. No prerequisite.
3 lectures. (Given in fall term.)
322* Regional Geography of Anglo-America 2: Canada

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.

Note Geography 322* is designed particularly for students majoring in Geography (General Course) and for students in other disciplines. No prerequisite.
3 lectures. (Given in winter term - normally this course will follow Geography 321*.)

331* Cultural Geography 1

Analysis of man's use of the earth's surface as revealed by a geographic study of selected examples of cultures, culture areas, cultural landscape and human geography.

Note Geography 331* is designed particularly for students majoring in Geography (General Course) and for students in other disciplines. No prerequisite.
3 lectures. (Given in fall term).

332* Cultural Geography 2

Population geography and its relationship to demography and human ecology. Analysis of the growth, diffusion, and distribution of human populations throughout the world, and an explanation of how and why people have adapted to their physical and cultural environments in different world regions.

Note Geography 332* is designed particularly for students majoring in Geography (General Course) and for students in other disciplines. No prerequisite.
3 lectures. (Given in winter term - normally this course will follow Geography 331*.)

341 Historical Geography of Canada and the United States

The changing geographies of settlement and resource use from the Discoveries to the present. Emphasis upon Canada and Canadian-American interrelationships.
3 lectures.

345* Political Geography

A study of differences from place to place in political phenomena. Subjects covered include the interrelationships of states and nations, centripetal and centrifugal "forces" within states, electoral geography, boundary and frontier problems, the location of capital cities, internal organizations of states, external relations, and geo-politics.
3 lectures. Winter term.

355* Principles of Biogeography and Ecology

Principles of plant and animal geography, biogeography, and ecology. This course is the same as Planning 355*.
Prerequisite: Honours Geography or Honours Planning, or consent of instructor.
2 lectures, 2 hours lab. (Given in fall 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 Planning 357*.
Prerequisite. Honours Geography and Honours Planning students, or consent of instructor.
3 lectures. (Given in winter term - normally this course will follow Geography 355*.)
Department of Geography and Planning

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 and Planning 490 is required from students intending to enrol in Geography 490 and Planning 490. This course is the same as Planning 375.

Prerequisite: Honours Geography and Honours Planning students or consent of the instructor.
2 lectures, 1 hour seminar.

381* Seminar on Subfields of Geography
Seminar discussion on the major subfields of geography not covered in the mandatory core of courses, inventory, and prospects of geographical research. Guest lectures will be arranged. Review of Senior Honours Essay and selection of topics.

Prerequisite: Honours Geography students only.
3 hours seminar. (Given in winter term.)

400 Advanced Geomorphology
Advanced study of geomorphologic processes, morphometric analysis, and applied geomorphology. Students will select specific problem areas which will be subjected to field, laboratory, and literary examination.

Prerequisites: Geography 275*, 300* and Earth Sc. 130, or consent of instructor.
3 hours seminar and/or lab.

401 Advanced Air Photo Interpretation
Basic photogrammetric principles including mensuration, radial line plotting, the use of stereo plotters, mosaic and map construction. Detailed air photo interpretation, micro feature analysis and problem studies in geographic and geomorphologic fields, will be emphasized.

Prerequisites: Geography 275*, 300* and Earth Sc. 130, or consent of instructor.
3 hours seminar and/or lab.

403 Advanced Cartography
Advanced theory and methodology in cartography. Experimentation in new methods of cartographic representation.

Prerequisite: Geography 260*.
2 hours seminar and/or tutorial.
(Not offered in 1969-70.)

404 Seminar on Quantitative Methods in Geography
Advanced study of selected models of locational structure and methods used in locational analysis. Emphasis on the analysis of geographical data using multivariate statistical techniques and the computer. This course is the same as Planning 404.

Prerequisite: Geography 375, or equivalent, and consent of instructor.
3 hours seminar and/or tutorial.

420432 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.
431. Polar Lands.
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 the spring.

**Prerequisite:** Fourth year Honours Geography students, or consent of instructor.

2 hours seminar.

*(Not offered in 1969-70.)*

451* Soils Geography

An analysis of the factors affecting soil development and classification. Techniques of soil survey and land classification.

**Prerequisite:** Honours Geography and Honours Planning students, or consent of instructor.

3 lectures. *(Given in fall term.)*

452* Problems of Rural Land Use

The application of soil survey information and land classification techniques to rural land use problems.

**Prerequisite:** Honours Geography and Honours Planning students, or consent of instructor.

3 lectures. *(Given in winter term--normally this course will follow Geography 451*.)*

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 Geographic Thought and Methodology

Historical development of the discipline of geography; contributions of German, French, British and American geographers; current trends in the philosophy and methodology of geography.

**Prerequisite:** Honours Geography 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.

3 hours seminar.

491* Field Research: Methods and Projects

One-week field camp session, preparatory assignments and follow-up seminars with presentation of research papers. This course is the same as Planning 491*.

**Prerequisite:** Fourth Year Honours Geography students only and consent of the instructor.

2 hours seminar. *(Given in fall term.)*

Planning

156* Introductory Urban and Regional Planning

Planning concepts and principles; the nature, purpose, and scope of land-use planning; elements of economic and social planning theory; introduction to planning survey, analysis and synthesis in rural and urban area; basic principles of design and aesthetics as applied to planning; elementary exercises in planning and design.

2 lectures, 2 hours studio for Honours Planning and Honours Geography students; other students will replace 2 hour studio with one hour discussion session. *(Given in winter term - normally this course will follow Geography 101*.)*
Department of Geography and Planning

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 data sources and methods of data collection.
Prerequisite: Honours Planning students, or consent of instructor.
2 lectures. 2 hours studio. (Given in fall term.)

256 Principles of Environmental Design
Goals, objectives, standards of design; principles of aesthetics as applied to urban and regional planning; architectural composition, civic and landscape design, the functional requirements of space and buildings in relation to their distribution, size, arrangement, form and relative cost; articulation of design in a master plan; social, economic and political problems in implementing good design; construction and layout; models sketching perspective, proportions, presentation technique.
Prerequisite: Honours Planning students or consent of instructor.
2 lectures, 2 hours studio.

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.
3 lectures. (Given in fall term.)
Prerequisite: Honours Planning students (Yr 3 only), or consent of instructor.

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.
3 lectures. (Given in winter term - normally this course will follow Planning 332*.)
Prerequisite: Planning 332*. Honours Planning students (Yr 3 only), or consent of instructor.

342* Urban, Regional and Resource Planning 1.
This course provides an overview of the field of urban and regional planning. Classic controversies in the field of planning, in its definition and delimitation; the role of public investment criteria and welfare economic criteria in urban and regional planning; the place of planning in a democratic society; the role of interest group and grass-roots politics in planning will be considered. An overview of the techniques of information collection and analysis, and of the tools of implementation available to urban and regional planners will also be provided.
Note Planning 342* is designed particularly for students in disciplines other than Planning.
No prerequisite.
3 lectures. (Given in fall term.)

343* Urban, Regional and Resource Planning: Survey of the Field
The identification and analysis of urban and regional planning problems.
Note: Planning 343' is designed particularly for students in disciplines other than Planning. No prerequisite. 3 lectures. (Given in winter term-normally this course will follow Planning 342'.)

**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*.100* and Planning 156*, or consent of instructor.
3 lectures.

**355* Principles of Biogeography and Ecology**
Principles of plant and animal geography, biogeography, and ecology. This course is the same as Geography 355*.

**Prerequisite:** Honours Geography or Honours Planning, or consent of instructor.
2 lectures, 2 hours lab. (Given in fall 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:** Honours Planning and Honours Geography students, or consent of instructor.
3 lectures. (Given in winter term-normally this course will follow Planning 355*.)

**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:** Honours Planning students, or consent of instructor.
2 lectures, 2 hours studio.

**375 Quantitative Research**
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 and Planning 490 is required from students intending to enrol in Geography 490 and Planning 490. This course is the same as Geography 375.

**Prerequisite:** Honours Geography and Honours Planning students or consent of the instructor.
2 lectures, 1 hour seminar.

**404 Seminar on Quantitative Methods in Urban and Regional Planning**
Advanced study of selected models of locational structure and methods used in locational analysis. Emphasis on the analysis of urban and regional planning data using multivariate statistical techniques and the computer. This course is the same as Geography 404.

**Prerequisite:** Planning 375 or equivalent, and consent of instructor.
3 hours seminar and/or tutorial.

**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 statutory planning systems in the
Dep8rtm8nt of Geography and Planning

provinces; the jurisdiction of provincial bodies and agencies.
Prerequisite: Honours Planning students, or consent of instructor.
3 lectures.

475* Projects, Problems and Readings in Planning
Special planning projects and problems chosen in consultation with instructor.
Prerequisite: Honours Planning students, or 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: Honours Planning students, or consent of instructor.
3 hours seminar and/or tutorial.

480 The Philosophy and Methodology of Urban and Regional Planning
Historical developments 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.
3 hours seminar.

491* Field Research: Methods and Projects
A one-week field camp session; preparatory assignments, and follow-up seminars with presentation of research papers. This course is the same as Geography 491*.
Prerequisite: Honours Planning students and consent of instructor.
2 hours seminar. (Given in fall term.)

Graduate Courses
The Department offers training leading to the M.A. and Ph.D. degrees in both Geography and Regional Planning and Resource Development. Detailed information about these programs can be obtained by writing to the Administrative Assistant, Department of Geography and Planning.

Geography

600 Geomorphology
A specialized advanced geomorphology course concentrating particularly on the detailed processes and effects concerned with glaciation, rivers and sediments. Special emphasis will be placed on applied geomorphology, laboratory and field analytical techniques. Students will be expected to undertake considerable practical work in various subfields of geomorphology.

601 Climatology
Advanced study of selected subfields of climatology. Emphasis on applied and microclimatology.

602 Air Photo Interpretation
Advanced studies involving air photo interpretation, use of stereo-plotting instruments, mosaic construction, map production, and applied research.

607 Seminar in Quantitative Methods in Geography
Advanced study of selected models of locational structure and methods used in locational analysis. Emphasis on the analysis of geographical data.
Department of Geography and Planning 225

610 Economic Geography Advanced study of selected subfields of Economic Geography, with emphasis on industrial development.

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.
631 Eastern Europe.
632 Soviet Union.

633 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 the Winter. 
2 hours seminar.

645 Political Geography A review of contrasting approaches to the field; recent theories and their integration; Geopolitics; quantitative research in Political Geography.

650 Urban Geography An analysis of concepts and theory in urban geography, including regional interaction of cities and city regions, economic base study, central place theory and city classification; urban functions and land use: methods of urban research with emphasis on the use of statistical measurement and computers.

655 Geographical Analysis of Metropolitan Regions Geographic approach to the problems of settlement, land use, and urbanization, and functional interaction in metropolitan areas.

657 Agricultural Land-Use Physical and human problems associated with agricultural land use in Problems 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* (Planning 652*) 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* (Planning 653*) Recreational Resource Planning Forecasting recreational demands; methods of classifying recreational resources; methods of recreational resource inventory; principles of recreational land management and conservation.

665* (Planning 655*)

Resource Conservation and
Development

Appraisal of renewable natural resources with reference to demands and changing technology. Problems related to management and development of resources. Resource oriented regional case studies and projects. *(Offered in the winter term.)*

675* Special Readings and
Seminar on Selected Topics in Geography

676 Special Readings and
Seminar on Selected Topics in Geography

680 Geographic Thought and
Methodology

An analysis of the changing methods and philosophy of geographic research. Special attention is focused on problem formulation, the design and evaluation of geographic research, and scholarly writing.

699 Thesis Seminar.

**Planning**

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.

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.

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.

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.

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*

652* (Geography 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.

653* (Geography 663*)

Recreational Resource Planning

Forecasting recreational demands; methods of classifying recreational resources; methods of recreational resource inventory; principles of recreational land management and conservation.

654* (Geography 664*)

Ecological Principles of biogeography and environmental biology. Ecological principles of vegetation and related topics.
Deparatment of Geography and Planning

655* (Geography 665*) Resource Conservation and Development
Appraisal of renewable natural resources with reference to demands and changing technology. Problems related to management and development of resources. Resource-oriented regional case studies and projects. (Offered in the winter term.)

656 The Process of Urban and Regional Planning
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.

658 Regional Development
The theories of regional development. Regional economic development within a national planning framework. Canadian and international case studies will be used to illustrate classic controversies in the field of regional economic development via efficiency vs income redistribution as goals; concept of growth poles; sociological aspects of regional development; consideration of the relationship between regional economic and environmental planning.

659 Special Problems and Projects
Special planning or resource management problems and projects chosen in consultation with a professor.

675* Special Readings and Seminar on Selected Planning Topics.

676 Special Readings and Seminar on Selected Planning Topics.

680 Seminar on the Philosophy and Methodology of Regional Planning and Resource Development concept.
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.

699 Thesis
Department of German and Russian

Visiting Professor H. Boeschenstein, Ph.D. (Rostock)
Visiting Professor B.L.D. Coghlan, Ph.D. (Birmingham)
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)
Deputy Chairman
Professor S. Hoefert, B.A., M.A., Ph.D. (Toronto)
Professor I. Levitsky, A.B. (Rochester), M.A. (Buffalo), Ph.D. (Duke)

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)
Assistant Professor M. Richter, Staatsexamen (Berlin and Bonn), M.A. (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 (part-time) R.S. Ages (Mrs.), B.A. (Ohio State), M.A. (Waterloo)
Lecturer (part-time) M.A. Davies (Mrs.), B.A. (Washington), A.M. (Radcliffe)
Lecturer A. Donskov, B.A., M.A. (British Columbia)
Lecturer H. Marsden (Mrs.), B.A. (Randolph-Macon), M.A. (Waterloo)
Lecturer H.W. Panthel, B.A. (Waterloo), M.A. (Cincinnati)

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’ fields 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.
121* Introduction to German  Reading and interpretation of selected works by major German authors.  
Literary Movements  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  Course description as in German 121.  
Literary Movements

201* Scientific German  A review of the fundamentals of grammar is followed by a more advanced study of language structure and idioms. Readings and translation from contemporary scientific writing in the Physical Sciences with the aim of helping the student 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 German  Course descriptions as in 201.  
Scientific German  One term, 3 lectures.  
Prerequisite: German 201 or equivalent. Permission of instructor.

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, Holderlin, etc.).  
One term, 3 lectures.  
Prerequisite: German 102 or 122; permission of department chairman.

262* German Romanticism  Reading, interpretation, and critical analysis of representative works (Novalis, Brentano, Tieck, Eichendorff, etc.).  
One term, 3 lectures.  
Prerequisite: German 102 or 122; permission of department chairman.

271* German Thought and Culture  A study of the major thought movements and masterpieces of philosophy, literature, music, art, etc. to the time of Enlightenment. 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. 18 for course requirements in the Faculty of Arts).

272* German Thought and Culture  A study of the major thought movements and masterpieces of philosophy, literature, music, art, etc. from Goethe to the present. This course is taught in English.
351 Intermediate Conversation and Composition
Written reports on prescribed themes and topics. Oral drill.

Prerequisite: German 252 or equivalent.

352 Intermediate Conversation and Composition
As 351.

Prerequisite: German 351

361 Young Germany and Riedermeier
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, 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 (Klopstock, Herder, Gerstenberg, Lenz, Klinger, etc.).

One term. 3 lectures.

Prerequisite: German 102 or 122.

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, As 451.

Grammar and Composition
Prerequisite: German 451

461 Introduction to the History of the German Language
Readings in Middle High German

Prerequisite: German 102 or 122.

462 Middle High German
Reading and interpretation of prescribed works of the first “Bluetezeit” Literature 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 beginning 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, Bidermann, Luther, Sachs, 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, Gunther, etc.).
One term. 3 lectures.
Prerequisite: German 102 or 122.

495*-498* Reading Course  One term each, 3 lectures.
 in Approved Topics  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.
102* First Year **Russian Course** description as in Russian 101.

201* **Scientific** Russian 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:** Russian 102 or equivalent. Permission of instructor.

202* **Intermediate** Course description as in 201.
Scientific Russian **Prerequisite:** Russian 201 or equivalent. Permission of instructor.
One term. 3 lectures.

251* **Conversation, Composition, Grammar and Phonetics** This course is conducted 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. 18 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
Prerequisite: Russian 351.
One term. 3 lectures.

361* Russian Realism
(Aksakov, Gogol, Goncharov, Turgenev, Tolstoy, Ostrovsky) Reading, interpretation, and critical analysis of selected fiction and drama.
Prerequisite: Russian 101 and 102.
One term. 3 lectures.

362* Russian Realism
(Chernyshevsky, Leskov, Dostoevsky, Saltykov-Shchedrin, 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 Caucausus 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, 102.
One term. 3 lectures.
Department 01 German and Russian

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 As 471. and the Russians in Western Thought and Writings

481* Russian Poetry A study of themes and forms of representative authors of Classicism, Romanticism and Realism (Lomonosov, Derzhavin, Pushkin, Lermontov, Nekrasov, Fet, Tiutchev, 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, Mayakovsky, 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

201* Introduction to Ukrainian Literature The place of Ukrainian in the Slavic family of languages; review of grammar; reading of texts chosen from the works of Ukrainian authors. (Skovoroda, Kotliarev’s’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 Kotliarev’s’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. (Shevchenko, Kostomariv, Kulish, and others). Prerequisite: Ukrainian 202 or admission by consent of the instructor. One term. 3 lectures.

302* Ukrainian Romanticism The literary revival in Western Ukraine. A critical study of the literary movement with special emphasis on the major authors (Shashkevych, Wahylevych, Holovats’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.
620 Old Church Slavonic.
621 History of the Russian Language.
630' Tolstoy.
631* Dostoevsky.
640* The Russian Drama.
650* Contemporary Russian Literature.
651* Early East Slavic Literature (the epics, the byliny, the chronicles.)

695*-698* Reading Course in Approved Topics.

All courses are one term courses with the exception of 620, 621, and 699.
Department of History

Associate Professor D.A. Davies, B.A., Ph.D. (Washington)
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 H. MacKinnon, B.A. (Montreal), Ph.L., S.T.L. (Gregorian) M.A. (Toronto), D.Phil. (Oxford)
Professor R. A.W. Rees, M.A. (Wales)
Associate Professor G. M.T. Cherniavsky, M.A. (Oxford)
Associate Professor W. Klaassen, B.A. (McMaster), D. Phil. (Oxford)
Associate Professor J.F. F. H. Newson, M.A. (Melbourne), Ph.D. (Toronto)
Associate Professor E. P. Patterson, B.A. (Baylor), M.A. (Kansas), Ph.D. (Washington)
Assistant Professor T. Barcsay, M.A. (Toronto),
Assistant Professor M. J. Craton, B.A., P.G.C.E. (London), M.A., Ph.D. (McMaster)
Assistant Professor K. R. Davis, B.A. (Toronto), M.A. (Wheaton), Ph.D. (Michigan)
Assistant Professor J.P.E. Dembski, M.A. (Toronto)
Assistant Professor K. D. Eagles, M.A. (Cantab), M.A., Ph.D. (Washington)
Assistant Professor D.F. Horton, M.A. (Cantab), M.A., Ph.D. (Washington)
Assistant Professor L. A. Johnson, B.A. (Waterloo), M.A., M.Phil. (Toronto)
Assistant Professor R. C. MacGillivray, B.A. (Queen’s), A.M., Ph.D. (Harvard)
Assistant Professor J.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)

Note 1 The number of hours assigned to each course in the course descriptions indicates its relative weight and not necessarily the number of weekly meetings. Half courses (meeting for one term only) are designated by an asterisk (*) after the course number.

Note 2 Not all courses listed below are offered each year.

Bachelor of Arts

(a) Students majoring in History should consult the General Course requirements listed on page 18. They will normally choose courses listed in the General Course section of the calendar. In addition, one course must be chosen from the Honours Survey section as a prerequisite to graduation. The exact programme for each student will be worked out in consultation with the departmental undergraduate advisor.

(b) History Honours students will normally follow the Honours History programme described on page 35. 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: (a) History 600 (b) a minor field and (c) a major field (a thesis and a comprehensive examination in the period). The candidate 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 600 (b) in consultation with the department either two minor fields and a cognate essay or three minor fields involving research work.
lected 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 129 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**

This degree is not offered in 1969-70. The department expects to offer the Ph.D. programme in the near future.

**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 periods of history will be studied in some depth.

**General Courses**

**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-independence movements which culminate in the end of empire in the mid-twentieth century.

**211* British History To 1603**

A survey of the major developments in British history from Julius Caesar to the death of Queen Elizabeth I.

3 hours. No Prerequisite.

**212* British History Since 1603**

A survey of the major developments in British history from the accession of the House of Stuart to the present.

3 hours. No Prerequisite.

**213 British Empire and Commonwealth History**

Similar to 274, but geared to the needs and interests of the General student.

3 hours, lectures and discussions. No Prerequisite.

**215* Central Europe 1648-1848**

The course will cover in some depth selected topics of political, social and economic history from the Peace of Westphalia to the revolutions
216* The Habsburg Monarchy: Special attention will be given to the emergence of nationalism in Central European as well as other selected topics of political, social, and economic history. 3 hours. No Prerequisite.

217* South Asia: Economic, social and political repercussions of contact with Europe since 1600. Emphasis will be on events in the Indian subcontinent. 3 hours. No Prerequisite.

218* East Asia: The response of China and Japan to the impact of the West during the nineteenth and twentieth centuries. 3 hours. No Prerequisite.

219* Ancient and Pre-Colonial Africa: A study of the political, social and economic history of the major states of sub-Saharan Africa from the earliest times to the advent of Europeans. The course includes an examination of the Cushite, Sudanic, Forest, Swahili and Central African states. 3 hours. No Prerequisite.

220* 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. No Prerequisite.

301* Canadian History To 1867: An analysis of selected issues: New France, Atlantic outlook, Loyalism and the crisis of Empire, rebellion and reconstruction, regional royalties and the strategy of Confederation. 3 hours. No Prerequisite.

302* 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.

303* American History To 1865: An analysis of selected issues in American history: the Revolution and the rise of the American nation; the era of Jefferson and Jackson; sectionalism, slavery and secession; the Civil War — impact and interpretations. 3 hours. No Prerequisite.

304* 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.

305* 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.

306* The History of Selected Racial and Regional Minorities: An examination of the emergence of minority assertiveness and the changing perception of majority — minority relationship. 3 hours. No Prerequisite.
Department of History

311* Twentieth Century History  The European Phase  An examination of major European countries independently and collectively from the Treaty of Versailles to World War II.  
3 hours. No Prerequisite.

312* Twentieth Century History  The Extra European Phase  An examination of the recent historical development of three or four of the following key areas in the modern world: Japan (with Korea), China (with Vietnam), Indonesia, India, Africa, the Middle East, Latin America.  
3 hours. No Prerequisite.

315* Russian History 1611-1914  The course will focus on selected themes in the development of the Russian state and society during three hundred years of Romanov rule with special emphasis on the problems besetting Russia after 1861.  
3 hours. No Prerequisite.

316* Russian History Since 1914  The course will focus on selected themes with particular emphasis on the Russian Revolution and the internal development of the USSR.  
3 hours. No Prerequisite.

321* Medieval History 476-1100  A consideration of the main political, social, economic and religious themes of the Medieval period.  
3 hours. No Prerequisite.

322* Medieval History 1100-1500  A consideration of the main political, social, economic and religious themes of the Medieval period.  
3 hours. No Prerequisite.

Honours Survey Courses

250 History of Medieval Europe  The political, cultural, economic and ecclesiastical development of Europe from 300 to 1300.  
3 hours, lectures and seminars. (Not offered 1969-70)  
Prerequisite, History 100, History 110 or permission of the instructor.

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 lectures.  
Prerequisite, History 100, History 110 or permission of the instructor.

260 Renaissance and Reformation  History of Europe in transition from 1300-1600.  
3 hours, lectures and seminars.  
Prerequisite. History 100, History 110 or permission of the instructor.

261* Central Europe 1648-1848  The course will cover in some depth selected topics of political, social and economic history from the Peace of Westphalia to the revolutions of 1848.  
3 hours.  
Prerequisite History 100, History 110 or permission of the instructor.

262* The Hapsburg Monarchy And The Germanic Lands 1848-1900  Special attention will be given to the emergence of nationalism in Central Europe as well as other selected topics of political, social and economic history.  
3 hours.  
Prerequisite, History 100, History 110 or permission of the instructor.
265* Canadian History 1  Selected topics in the period to 1867.
   3 hours, lectures and seminars.
   Prerequisite, History 100, History 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, History 110 or permission of the instructor.

271* South Asia  Economic, social and political repercussions of contact with Europe
   since 1660. Emphasis will be on events in the Indian subcontinent.
   3 hours.
   Prerequisite, History 100, History 110 or permission of the instructor.

272* East Asia  The response of China and Japan to the impact of the West during the
   nineteenth and twentieth centuries.
   3 hours.
   Prerequisite, History 100, History 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 biographies 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, History 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, History 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, History 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, History 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, History 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.
**Department of History**

3 hours. lectures and seminars.  
Prerequisite. History 100, History 110 or permission of the instructor.

**350 Later Modern European History**  
An exposure to important issues of European history since the French Revolution with an emphasis on intellectual and diplomatic themes as well as the more usual political, economic and social aspects.  
3 hours.  
Prerequisite, History 100, History 110 or permission of the instructor.

**353* Medieval Church History 3**  
From 312 - 1122  
Prerequisite, History 100, History 110 or permission of the instructor.

**354* Medieval Church History 3**  
From 1122-1449  
Prerequisite, History 100, History 110 or permission of the instructor.

**355* Russian History 16111914**  
The course will focus on selected themes in the development of the Russian state and society during three hundred years of Romanov rule with special emphasis on the problems besetting Russia after 1861.  
3 hours.  
Prerequisite, History 100, History 110 or permission of the instructor.

**356* Russian History Since 1914**  
The course will focus on selected themes with particular emphasis on the Russian Revolution and the internal development of the USSR.  
3 hours.  
Prerequisite, History 100, History 110 or permission of the instructor.

**361 English History 14851660**  
A study of achievements and crises in the Tudor and early Stuart periods.  
3 hours, lectures and seminars.  
Prerequisite, History I 100, History I 110 or permission of the instructor.

**362 Modern England Since 1660**  
A study of the development of the world’s first industrialized state.  
3 hours, lectures and seminars.  
Prerequisite, History 100, History 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, History 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.  
Prerequisite, History 100, History 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 in the United States.  
3 hours, lectures and seminars. (not offered 1969-70)  
Prerequisite, History 100, History 110 or permission of the instructor.

**383* History of French Canada 3**  
Prerequisite, History 100, History 110 or permission of the instructor.

**384* History of French Canada 3**  
Prerequisite, History 100, History 110 or permission of the instructor.
Department of History

385 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.

391 Directed Studies in Special Topics

Study in a limited field under tutorial guidance. A high standard of written work will be expected.

Seminars

450 Senior Tutorial in American History

2 hours.
History 295/296 normally a prerequisite.

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.

460 History of the Far East in the Nineteenth and Twentieth Centuries

3 hours, lectures and seminars.

463 Modern International History, Mainly Since 1900

3 hours, lectures and seminars.

465 The History and Theory of Historical Writing

3 hours, lectures and seminars.

470 Senior Tutorial in English History

2 hours.

471 Senior Tutorial in Canadian History

2 hours.
History 255/256 normally a prerequisite.

472 Senior Tutorial in Medieval History

2 hours.
History 250 normally a prerequisite.

473 Senior Tutorial in Imperial and Colonial History

2 hours.
History 274 or 370 normally a prerequisite.

474 Senior Tutorial in German History

2 hours.
History 261/262 normally a prerequisite

475 Senior Tutorial in Asian History.

476 Senior Tutorial in History of Renaissance and Reformation

2 hours.
History 260 normally a prerequisite.
477 Senior Tutorial in the History of Native Response to Colonial Rule
2 hours.

478 Senior Tutorial in Russian History
2 hours.
History 355/356 normally a prerequisite.

479 Senior Tutorial in French History

491 Directed Studies in Special Topics

495 Special Senior Tutorial

499 Senior Honours Essay (Required of all History honours students in their fourth year). Defended by an oral examination.

The following courses are administered by Renison College.

231R* Europe From 1789-1848
The impact of French revolutionary ideology, Bonapartist militarism, and the new technology on the traditional political, social and economic institutions of Europe. Metternich’s Conservatism re-examined. The containment of political radicalism nationalism, and socialism by conservative forces.
3 hours. Fall Term. (Not offered 1969-70)

232R* Europe From 1848-1901
The emergence of the nation state in Germany and Italy; the spread of industrialism: The population explosion: the expansion of Russia: the second industrial revolution; the “new” imperialism; the European conquest of Africa; the awakening of Japan and China; the revolution in Russia; towards World War.
3 hours. Winter Term. (Not offered 1969-70)

313R War and Revolution in Twentieth Century World History
Contemporary history from 1914 to the present day: the first world war; the Russian revolution; Fascism; Nazism; world communism; the Second world war; the Chinese revolution; collapse of western imperialism; war in the nuclear age.

The following courses are administered by St. Jerome’s College.

246J* 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.

247J* 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.

Graduate Fields in History.

600. The History and Theory of Historical Writing.
610. Canadian History: The Conservative Tradition.
611. Canadian History: The French-Canadian Tradition.
612. Canadian History: Selected Regions.
615. Colonial and Imperial History.
619. Modern English History 1.
620. Modern English History 2.
621. German History.
622. Medieval History. (not offered 1969-70)
632. French History.
624. Russian History.
625. Central European History.
626. United States History.
627. Early Modern Europe: The Reformation Era.
695. Cognate Essay.
Department of Kinesiology

Chairman of the Department
N.J. Ashton, B.Sc. (P.E.) (McGill), M.S. (Michigan)

Associate Professor
D. Hayes, B.Sc., B.P.E., M.Sc. (Springfield)

Associate Professor of the Department
D.J. Pugliese, B.A., B.P.E. (McMaster), Ed.M. (Buffalo)

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
C.A.W. Totzke, B.A. (Western)

Director of Athletics
W.N. Widmeyer, B.A. (Western), B.P.E. (McMaster), M.A. (California)

Lecturer
R.E. Priddle (Mrs.), B.P.H.E. (Toronto)

Lecturer
P. Davis (Miss), B.P.H.E. (Toronto), M.Ed. (North Carolina)

Lecturer
E.J. De Armon, B.Sc. (Northeastern S.C.), M.A. (George Peabody)

Lecturer
R.D. Graham, B.A., B.P.E. (Western)

Lecturer
P. Hopkins, B.A. (Carleton), B.P.E. (Waterloo)

Lecturer
S. Kemp (Miss), B.A. (Sir George Williams)

Lecturer
R.W. Norman, B.A., B.P.E. (McMaster), M.Sc. (Alberta)

Course Descriptions

100* Introduction to Physical Education and Recreation
A study of the history of physical education and recreation and the role that biological, sociological and psychological factors play in these areas. Reference will also be made to different schools of philosophy and the effect they have on physical education and recreation. 3 lectures.

101* Institutional Physical Education and Recreation
The roles of institutions and agencies in meeting the leisure and physical activity needs of people are discussed. The implications of changing social conditions for such agencies are examined. 3 lectures.

160* (Fine Arts 180)* History of Dance to 1900
Consideration is given to folk forms of dance and their eventual development to ethnic forms, theatre dance and neoclassic dance. Particular attention is paid to the simultaneous development of social folk and social ballroom dance with emphasis on the latter’s development to the classic dance of the 19th century. 3 lectures.

161* (Fine Arts 181)* History of Dance Since 1900
The emergence of modern dance in North America is examined in detail. The conditions leading to this new dance form, as well as past and future developments, are analyzed. 3 lectures.

185* Basic Skills
(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.
Department of Kinesiology

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.

Skills Week

Students will be given complete courses in canoeing, sailing, orienteering, and camping. Lectures in camp and waterfront administration will also be included.

200* Human Anatomy

A study of the human anatomical systems and their integration. Particular emphasis is placed on the skeletal, articular and muscular systems.

3 lectures, 2 hours lab.

220* Introduction to Mechanics and Quantitative Techniques in Kinesiology

A background course designed to provide the Kinesiology student with a knowledge of such topics as projectile motion, momentum, torque, angular momentum, standard scores and variability, to enable him to advance to subsequent courses in the analysis and evaluation of human motor performance.

3 hours lectures. 2 hours lab.

221* Introduction to the Analysis of Human Movement

Anatomical, neural and mechanical considerations of human physical activity are examined.

3 lectures, 2 hours lab.

230* Evaluation of Human 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 (Part 1)

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 students administrative technique.

3 lectures.

285* Basic Skills See Kinesiology 185.

286* Basic Skills See Kinesiology 185.

300* Growth, Development and Aging

The changing capacities and interests of man as he grows and develops are studied. The contribution of physical activity to 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
“Normal” and “abnormal” movement patterns will be studied for insight into central nervous system mechanisms involved in skilled movement.

3 hours 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 hour lab.

330* Research Design An introduction to the basic principles of scientific inquiry in Kinesiology and Recreation. A systematic treatment of the logic and practice of methods and techniques employed in research related to physical activity with an examination of the problem 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 personnel 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 hour 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 recreational 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.
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 today'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.
Department of Management Sciences

Professor D. J. Clough, B.A.Sc. (Toronto), M.B.A. (Toronto).

Chairman of Department


Professor P.M. Reilly, B.A.Sc. (Toronto), D.I.C., Ph.D. (London), F.S.S. (Chemical Engineering)

Professor S.D. Saleh, B.A. (Cairo), M.A. (Western Reserve), Ph.D. (Western Res.)

Associate Professor F.E. Burke, B.A. (London)

Associate Professor E.A. Silver, B.Eng. (McGill), Sc.D. (M.I.T.)

Adjunct Assistant Professor J.J. Munk, B.Eng. (McGill), L. L. B. (Osgoode Hall).

Lecturer J.P.H. Castle, B.Comm. (McGill), C.A.

Lecturer J.B. Moore, B.A.Sc. (Toronto), M.A. (Waterloo).

Special Lecturer B.A. Brown, B.A. (Toronto), M.A. (Toronto).

Special Lecturer J.R. Joseph, B.Tech. (Indian I.T.), M.S. (Brooklyn Poly.)

Special Lecturer W.P. McReynolds, B.A.Sc. (Toronto), M.Sc. (U.B.C.) (Ontario Institute/or Studies in Education)

Associated Faculty

Professor J.S. Minas, B.A. (Wayne). Ph.D. (Illinois) (Department of Philosophy)

Professor S. Sengupta, M.A.. D.Phil (Calcutta) (Department of Economics)

Activities and Scope

The Department of Management Sciences, Faculty of Engineering, was established in 1969 as a consolidation of the Management and Systems Engineering Programme. 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 1969 - 70 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 categories described below, and the aim of the new Department is to strengthen and develop these major fields of study.

Operations Analysis and Codified methods and techniques of mathematical analysis, experimental design, data and information processing and statistical inference as applied to the solution of management problems. The extension, development and validation of new methods and techniques for modelling, analyzing and studying management systems, and their extension into new fields of application. Current research involves mathematical and experimental studies in inventory and production control, optimization of linear and non-linear structures, some aspects of operations research and decision theory, and research in the field of combinatorial optimization.

Operations Research

The study of psychological and sociological aspects of human behaviour within the organizational system such as motivation leadership, control, interpersonal relations and group interactions, conflict, communication, organizational change, decision making and perception. Current research involves mathematical models of organizational behaviour and structure.

The application of theories, models, methods and techniques of management sciences to the development and operational management of large resource systems in both the public and private sectors of the economy, involving problems of both public policy and private decision criteria. Emphasis is placed on the determination and measurement of value, and the use and evaluation of various utility theories and methods of benefit-cost analysis. Current research applications include mathematical models for water resource planning, manpower planning, petroleum and natural gas distribution, park and recreation systems planning, and education systems planning.

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.

The Master’s Degree (M.A.Sc.) in Management Sciences is awarded upon demonstration of individual accomplishment of a high professional and academic standard. The candidate, with 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 application problem.

A research thesis may be submitted for graduate credit. The topic of the thesis and the choice of the remaining 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 M.S.
must be performed under the direction of the Faculty Advisor, and is finally approved and accepted by him.

A Project Report may be submitted for graduate credit, under MS 807. The topic of the report and the remaining 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 MS 807 and MS 808.

Candidates will normally be required to study in depth in one of the four fields of activities delineated above, and to demonstrate acquaintance with the other three.

The time limitations for a Master’s degree are four consecutive academic years for all course work and project or thesis requirements to be completed. The normal programme involves three terms of full-time study which must be extended if three or fewer units per term are taken.

Academic performance must be sufficient that the student receives an average grade 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 (60-66%) 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 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. Students must satisfy the requirements of the comprehensive examination as set out below. 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 academic 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, aside from a usual maximum of eight units, 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.

The Comprehensive Examination

The form of this examination varies with the applicant’s background and will be determined by the Department. The following are regarded as minimum examples: (I) Candidates holding master’s degrees from this university may have an oral examination. (2) Candidates having master’s degrees awarded mainly by thesis, and able to present themselves for examination, may elect to be examined orally on their thesis
If accepted they will then be required to follow three graduate courses in their first term and to obtain at least a 70% average. Successful candidates may then be registered retroactively for the Ph.D. (4) Candidates may submit substantially documented Ph.D. research proposals in writing and may elect to be examined orally on their proposals. Unsuccessful candidates will not be allowed to proceed.

Course Descriptions

Note All 600 level courses carry one unit of graduate credit and are completed in one term.

501 Introduction to Operations Survey course in O.R. techniques and applied systems concepts for students minoring in Management Sciences. Open to senior undergraduate and as a pre-requisite subject for Management Sciences. Pre-requisites: algebra, calculus, statistics. Winter Term only.

602 Mathematical Foundations of (a) Vector Algebra to Linear Programming; Variational Methods to Management Science Dynamic Programming. (b) Statistical Decision Theory; Stochastic Processes.

610 Quantitative Simulations (a) Introduction to Modelling. (b) Socioeconomic Systems.

615 Management Decision-Making Laboratory Participation in analysis, planning, and decision-making under competitive and fast-time stress using functional and industrial simulations.

618 619 People, Machines and Organizations Interpersonal and group behaviour in systems of people and machines; phenomena of perception, communication, learning, decision-making, morale, conflict resolution, and goal-seeking. Problems in perceiving and modelling behaviour; the human factor in organization design.

639 Introduction to Production Techniques of production planning and control; models of aggregate production and workforce. Interaction of production and inventory control; scheduling algorithms.

632 Operations Research in Processing Industries Representation of single and multi-unit processing facilities; simulations including economic factors; sensitivity analysis, production planning and control; capital resource evaluation; process optimisation.

640 Strategies of Research Review of factors influencing the effect of research and design on a business or national economy. Economic measurement; information flow; organization theory; psychology of discovery and innovation. Case histories of technological changes.

660 Introduction to Corporate Finance Considerations; investment psychology, strategic and probabilistic considerations in financial planning.

662 Advanced Corporate Finance

665 Introduction to Corporate Law Legal concepts as expressed in laws pertaining to company organizations, contracts, securities, and patents. Court administration and procedure. Information retrieval and O.R. applications in legal and legislative procedures.

680 Advanced Stochastic Models Properties and characteristics of stochastic models, with emphasis on
682 Network Methods
Advanced network methods, with maximal flow algorithms as related to production control, plant location.

684 685 Advanced Mathematical Programming
Review of non-linear, quadratic, and integer programming, also convex programming. Extension of linear programming with possibly non-linear objective functions and constraints: and integer solutions.

686 Quantitative Economics and Econometrics
Mathematical treatment of managerial economics, including aspects of benefit-cost analysis.

690 Corporate Planning
Modelling as an approach to problem identification and solution in corporate planning: organization, capital budgetting, forecasting. Case studies in corporate development, dynamics of growth and contraction, strategic decision making.

692 Public Sector Management
Operations and systems analysis in public administration. Case studies in governmental and institutional decision-making.

695 Evaluation of Current Research
Seminar: review of current literature in Operations Research, Systems, Management Science, etc.

801 Oral examination for the Ph.D.
803 Comprehensive examination.
804 Language requirements for the Ph.D.
807 Management Sciences M.A.Sc. project
808 Research Thesis for the M.A.Sc.
809 Research Thesis for the Ph.D.

In Electrical Engineering Student studying antenna patterns.
Faculty of Mathematics

Department of Applied Analysis and Computer Science

**Associate Professor**


**Chairman of the Department**

**Professor**

J. Aczel, Ph.D. (Budapest), Habil. D.Sc. (Hung. Academy of Science)

**Professor**

J.A. Brzozowski, M.A.Sc. (Toronto), Ph.D. (Princeton)

**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)

(Applied Mathematics and Computer Science)

**Professor**

T. Pietrzykowski, M.A. (Warsaw University), Ph.D. (Polish Academy of Sciences)

**Associate Professor**


**Associate Professor**

J.D. Lawson, B.A.Sc. (Toronto), Ph.D. (Waterloo)

and Associate Dean of Graduate Studies

**Associate Professor**


**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**

R.B. Roden, M.A. (Toronto), Ph.D. (Cambridge)

(Computing Centre and Mathematics)

**Assistant Professor**

J.C. Wilson, B.A.Sc. (Toronto), Ph.D. (Waterloo)

(Computing Centre and Mathematics)

**Assistant Professor (Part-time)**

J.H. Vellinga, B.A. (Western), M.A. (Waterloo)

**Lecturer**

P. Brillinger, B.Sc. (McMaster), M.A. (Waterloo)

**Lecturer**

P.H. Cress, B.Sc. (Toronto), M.Sc. (Waterloo)

**Lecturer**

P.H. Dirksen, M.Sc. (Waterloo)

**Lecturer (Part-time)**

D.K. Banerji, M.Sc. (University of Ottawa)

**Lecturer (Part-time)**

D.J. Cohen, M.Sc. (Technion-Haifa)

**Lecturer (Part-time)**

B.L. Ehle, B.A. (Whitman College), MS. (Stanford)

**Lecturer (Part-time)**

R. Kingsley, M. Math. (Waterloo)

**Lecturer (Part-time)**

J. Kovari (Mrs.), Dipl. Math. & Physics (Budapest)

**Lecturer (Part-time)**

B.O Nash, B.Sc. (Illinois), M.A. (Waterloo)

**Lecturer (Part-time)**

T.C. Wilson, M.Sc. (University of Chicago)

**Lecturer (Part-time)**

C.R. Zarnke, M.A. (Waterloo)

**Research Associate**

D. Lovelock, Ph.D. (University of Natal, Durban)

(Spring Term 1968)

Department of Applied Mathematics

**Associate Professor**

P.J. Ponzo, M.A. (Toronto), Ph.D. (Illinois)

**Chairman of the Department**

**Professor**

J.A. Barker, D.Sc. (University of Melbourne), F.A.A. (Fellow of the Australian Academy of Science)

**Professor**

D.J. Henderson, B.A. (U.B.C), Ph.D. (Utah), F. Inst. P.

(Applied Analysis and Computer Science and Applied Mathematics)

M.A. McKiernan, M.A. (Loyola), Ph.D.
Faculty of Mathematics

Professor D.G. Wertheim, B.A. (McMaster), Ph.D. (Toronto)
Associate Professor C.F.A. Beaumont, B.A. (McMaster), M.A. (Toronto)

Associate Dean of the Faculty of Mathematics

Associate Professor S.G. Davison, Ph.D. (Manchester), A. Inst. P.
Associate Professor J.J. McGee, B.A.Sc. (Toronto), M.Sc. (Waterloo), Ph.D. (Yale)
Associate Professor R.A. Wenzell, B.Sc. (Acadia), Ph.D. (Western)
Assistant Professor J. Froese, B.A. (Manitoba), M.A. (Queen’s), Ph.D. (U.B.C.)
Assistant Professor G.J. Lastman, M.A. (British Columbia), Ph.D. (Texas)
Assistant Professor M.E. Snyder (Mrs.), B.Sc. (Western), M.A.Sc. (Waterloo)
Assistant Professor J. Wainwright, B.Sc. (University of Natal), Ph.D. (University of South Africa)

Lecturer V.M. Bobetic, M.A. (University of Zagreb, Yugoslavia)
Lecturer (Part-time) F. Burkowski, M.Sc. (Waterloo)
Lecturer (Part-time) D.I. MacLeod, M.A. (Waterloo)
Lecturer (Part-time) D.W. Trim, M.Sc. (Waterloo)

Post-Doctorate Fellow S. Kim, B.Sc. (Seoul National University), M.Sc. (University of Idaho), Ph.D. (Waterloo)

Post-Doctorate Fellow M. Steslicka, Ph.D. (Warsaw)
Post-Doctorate Fellow R.O. Watts, B.Sc. (University of London, England), Ph.D. (Australian National University, Canberra)

Department of Combinatorics and Optimization

Professor G. Berman, Ph.D. (Toronto)

Chairman of the Department [On Sabbatical Leave 1968-1969]
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

Professor R.C. Mullin, B.A. (Western), Ph.D. (Waterloo)
[On Sabbatical Leave 1968-1969]
Professor C.St. J. Nash-Williams, Ph.D. (Cambridge)
Professor W.T. Tutte, Ph.D. (Cambridge), F.R.S.C.

Associate Professor C.E. Haff, B.S. (Stanford), Ph.D. (Waterloo)
Associate Professor D. Younger, Ph.D. (Columbia)
Assistant Professor R.A. Honsberger, B.A. (Toronto), M.A. (Waterloo)
Assistant Professor U.S.R. Murty, B.A. (Osmania), Ph.D. (Indian Statistical Institute)
Lecturer R.N. Burns, B.Sc. (Toronto), M.A. (Waterloo)
Lecturer R.G. Dunkley, B.A. (Western)

Assistant to the Dean
Lecturer G.B. Faulkner, B.Sc. (Toronto), M.Sc. (Waterloo)
Lecturer W.I. Miller, B.A. (Queen’s)

Assistant to the Dean
Lecturer (Part-time) T.A. Jenkyns, B.Sc. (University of Alberta), M.Sc. (University of Calgary)
Lecturer (Part-time) P.A. Kelly, B.Sc. (University of Windsor, M.Sc. (University of Calgary)
Lecturer (Part-time) J.K. Vranch, M.Sc. (Waterloo)

Post-Doctorate Fellow J.A. Bondy, Ph.D. (Oxford)

Department of Pure Mathematics

Associate Professor H.H. Crapo, A.B. (Michigan), Ph.D. (Massachusetts Institute of Technology)
**Faculty of Mathematics**

**Dean of Graduate Studies**
- **Professor**
  - G.E. Cross, M.A. (Dalhousie), Ph.D. (British Columbia)

**Professor**
- D.Z. Djokovic, Ph.D. (University of Beograd)
- R.A. Staal, Ph.D. (Toronto)
- D.B. Sumner. M.Sc. (Cantab). D. Phil. (Witwatersrand)

**Associate Professor**
- D. Dankert, Dipl. Math. (T.U. Hanover). Ph.D. (University of Cologne)
- P. Hoffman, B.A. (Toronto). Ph.D. (Manchester)
- F.C.Y. Tang, B.Sc. (Hong Kong), MS. (South Carolina), Ph.D. (Illinois)

**Associate Professor of Foundations of Mathematics**
- S. Burris, Ph.D. (Oklahoma University)
- L.J. Cummings, Ph.D. (British Columbia)
- D. Higgs, B.Sc. Hons. (Witwatersrand), M.A. (Cantab)
- E.M. Moskal, B.A. (Toronto), Ph.D. (Illinois)
- D. Mowat, Ph.D. (Waterloo)

**Assistant Professor**
- K.A. Rowe, B.A. (Toronto), MS. (Wisconsin). Ph.D. (Illinois)
- J. Malzan, M.A. (Toronto)
- L.J. Brady, B.S. (University of New South Wales)
- J.C. Robinson, M.A. (Western), Ph.D. (Toronto)

**Department of Statistics**

**Professor**
- D.A. Sprott. Ph.D. (Toronto)

**Chairman of the Department and Dean of the Faculty of Mathematics**
- V.P. Godambe, M.Sc. (Bombay), Ph.D. (London U.)
- J.S. Minas, B.A.-(Wayne), Ph.D. (Illinois)

**Associate Professor**
- G.W. Bennett, Ph.D. (Adelaide)
- M.D. Vogel-Sprott, B.A. (McMaster). Ph.D. (Toronto)

**Assistant Professor**
- M.A. Bennett, B.A. (Nottingham), A.S.A.
- R.V. Thysell, B.S. (Montana), Ph.D. (State University of Iowa)
- J.B. Whitney, M.A. (Western), Ph.D. (Toronto)

**Lecturer**
- H.J. Allen, M.A. (Toronto)
- E. Haag, B.Sc. (Queen’s), M.A. (Waterloo)
- J.S. Huang, B.A. (Taiwan Univ.), M.B.A. (University of Georgia)
- J.C. Robinson, M.A.Sc. (Waterloo), P. Eng.
- Lecturer C. Springer, M.Sc. (McGill)
- Lecturer V. Taht, M.A. (Toronto). A.S.A.
Faculty of Mathematics

Lecturer (Part-time) J.F. Lawless, M.Sc. (Waterloo)

Adjunct Professor P. Robinson, Dipl. Math. Stat. (Cambridge), Ph.D. (University of Cape Town)

Visiting Professors 1968-1969

Professor H.J. Boom, Doctorandus, Math. & Physics (University of Amsterdam), A.S.A.

Professor C. Froese Fischer (Mrs.), M.A. (British Columbia), Ph.D. (Cambridge)

Professor P.C. Fischer, M.B.A. (University of Michigan), Ph.D. (Massachusetts Institute of Technology), F.S.A.

Professor T. Kovari, M.Sc. (University of Budapest) Ph.D. (University of London)


Associate Professor J. Cizek, RNDr. (Charles University of Prague), C.Sc. (Institute of Phys. Chem., Czechoslovakian Academy of Science Prague)

Associate Professor T.D. Howroyd, Ph.D. (University of Melbourne)

Associate Professor J. Paldus, RNDr. Fac. of Mod. & Physics (Charles Univ. of Prague), C.Sc. (Institute of Phys. Chem., Czechoslovakian Academy of Sciences, Prague)

Associate Professor K.R. Shah, M.A. (University of Bombay), Ph.D. (Indian Statistical Institute)

Associate Professor M. Tomasek, Ph.D. (Charles University of Prague). C.Sc. (Czechoslovakian Academy of Science)

Associate Professor J.W. Tucker, B.Sc. (King's College, London). Ph.D. (Birkbeck College, University of London)

Assistant Professor I.Z. Bouwer, M.Sc. (University of Stellenbosch), Ph.D. (Toronto)

Assistant Professor W.H. Cherry, Ph.D. (University of Melbourne)

Assistant Professor R.J. Fabian, Ph.D. (Case Institute of Technology)

Assistant Professor J. Sheehan, Dipl. of Stat. & Corn. Analysis, Ph.D. (University College of Swansea, Wales)
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.

2  hours lectures, 1.5  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, 1.5  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 Numerical Methods  Introduction to the programming language FORTRAN IV with examples of simple numerical algorithms for polynomial interpolation, numerical integration, root-finding procedures and the solution of systems of equations.
1  lecture, 2  hours problems, one term.

3  hours lectures.

32 Numerical Analysis  Solution of non-linear equations, systems of linear equations, determinants, eigenvalue problems. Interpolation, numerical integration and the solution of ordinary differential equations, A basic knowledge of FORTRAN is assumed. The use of library subroutines is introduced.
Prerequisite: Mathematics 23
2  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.
Prerequisites: Math 22, 31
3  lectures. one term.

3 lectures, one term.

44 Complex Variable  Cauchy-Riemann equations, the Cauchy integral theorems, conformal mapping, the Taylor and Laurent series, contour integration.
2 lectures, 1 hour problems, one term.

3 lectures, 2 hours problems, one term.

Note  The following two courses, Mathematics 81 and 82, have been designed primarily for elementary school teachers taking a degree at the University of Waterloo.


82 Introduction to Algebra  Properties of real numbers including inequalities and absolute value. Systems of equations in two and three variables including linear, quadratic, and cubic equations. Complex numbers and polar representation. Exponents. Permutations and combinations. The Binomial Theorem. Sequences and series.

Note  These 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 toward a B.Math. degree.

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.

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, matrices, groups of transformations.
3 hours lectures.

2 lectures.

3 lectures.

2 lectures. 1 hour problems.

2 hours lectures.

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.

(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.

2 lectures.
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 Applications in Computer Science Some numerical methods are introduced in the first term and programmed for the computer using FORTRAN IV. Concepts of Numerical Errors. Methods in Interpolation, numerical integration, solution of nonlinear equations, linear systems of equations.
In the second term non-numeric computing is introduced including simulation, the concept of a list and elementary list processing techniques, sorting, symbol manipulation.
2 hours lectures. 1 hour problems

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 and 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.

2 hours lectures.

330 (8) Projective Geometry (b) Non-Euclidean Geometry Finite geometries, Distance geometry, convex sets.
3 lectures.

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.
334 Numerical Methods
2 lectures. 2 hours laboratory.

335 Differential and Difference Equations.
Differential equations with constant coefficients, systems of equations, D-operator methods, variation of parameters, solution in series, an introduction to the Laplace transform. Finite difference calculus, summation, numerical integration, finite difference equations.
2 hours lectures.

336 Life Contingencies (a) An advanced course on problems with single lives.
3 hours lectures. 1 term.
(b) An advanced course on problems with multiple lives; population and multiple decrement theory.
3 lectures. 1 term.

338 Mathematical Statistics
An advanced mathematical course including the multivariate normal distribution and related distributions. Normal Regression Theory. Application to hypothesis testing and analysis of variance. Maximum likelihood and large sample theory.
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, multi-processing, dynamic memory allocation, time-sharing. Special purpose computer systems and simulation of computer systems. Peripheral equipment. Introduction to the theory of sequential machines and the logical design of computers.
2 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, equicontinuity. 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; theory of Laplace transforms; solution of differential equations by integrals.
2 hours lectures.

344 Point Set Topology
345 **Topics in Pure Mathematics**

Elementary introduction to cardinal and ordinal numbers; convexity and its applications to optimization; introduction to the main concepts of projective geometry, metric and topological spaces.

351 **Introduction to Graph Theory**

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**

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, transportation network theory. Applications to production planning, inventory problems, growth and survival models, scheduling problems, replacement policies and reliability optimization of complex systems.

360 (a) **Tensor Analysis**


2 hours lectures. Fall term.

(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.

(b) **Mechanics**


2 hours lectures. Winter term.

363 **Differential Equations**


2 hours lectures.

399 **Reading in Mathematics**

410 **Rings and Modules**

**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.

2 hours lectures.

2 hours lectures.

**425 Introduction to the Theory of Numbers** 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.

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 hour lectures.

2 lectures.

2 hours lectures.

**433 Measure and Integration** Measure in Euclidean n-space, the Lebesque 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 Construction of Contingency Tables  (a) Accidental death and disability benefits. Pension fund mathematics. Methods of analysing data to produce raw rates for mortality tables.
2 hours lectures. 1 term.

(b) Methods of graduating mortality tables.
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.

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.

2 lectures, Winter term.

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.
447 **Statistical Mechanics** Applications of probability theory to theoretical Physics.  
2 lectures. Fall term.

448 **Differential Geometry** Curves in space. Gaussian curvature. **Tensorial** notation. Introduction to differentiable manifolds.  
2 lectures.

449 **Experimental Design** Similar to Mathematics 439 but with more accent on the logic and methods than on the mathematics. Primarily for students in the Sciences.  
2 hours lectures.

2 lectures.

2 hours lectures.

2 hours lectures.

2 hours lectures.

454 **Game Theory** Classification of games. Zero-sum matrix games. Infinite zero-sum games. n-person co-operative and non-co-operative games.  
2 hours lectures.

455 **Mathematical Programming** An introduction to the methods and applications of integer programming, non-linear programming and dynamic programming.  
2 hours lectures.

457 **Applied Combinatorial Mathematics** 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.  
2 hours lectures.

458 **Topological Graph Theory** Selected topics within the general area of graphs and maps in the plane and on other surfaces, the four colour problem, connectivity and separation in graphs, thickness and **genus** of graphs etc.
459 **Algebraic Graph Theory**
Graphs and matroids. Applications of algebraic techniques (e.g. matroids, matrices, chain groups) to graph theory or related combinatorial topics. Applications of graph theory to algebra.
2 hours lectures.

460 **Combinatorics**
Enumerative mathematics. Combinatorial properties of various mathematical structures (e.g. graphs, geometries, etc.)
2 hours lectures.

461 (8) **Advanced Actuarial Theory**
(a) Risk Theory
Stop-loss reinsurance premiums. Monte Carlo methods.
2 hours lectures, 1 term.

(b) Actuarial Laboratory
A tutorial course for the advanced actuarial student.
2 hours problems, 1 term.

442 (a) Measure and Integration
The theory of measure and the Lebesgue integral.
2 hours lectures. Fall term.

(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.
2 hours lectures. Fall term.
Faculty of Mathematics

472a Introduction to Automata Theory

Prerequisite: Consent of instructor.
2 hours lectures. Fall term.

472b Introduction to Turing Machines and Computability Theory
Prerequisite: Mathematics 472a 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

While the faculty offers graduate work over a broad spectrum of the various branches of Mathematics, fields of special interest include: Abstract Algebra, Combinatorial Analysis, Computer Science, Differential Equations, Differential Geometry, Foundations, Functional Analysis, Functional Equations, Graph Theory, Harmonic Analysis, Mathematical Logic, Number Theory, Numerical Analysis, Optimization, Probability, Statistical Inference, Switching and Automata Theory.

The University of Waterloo has at present four computer systems, namely an IBM System /360 Model 75, and IBM System /360 Model 44, 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.

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.

Research in compiler construction has produced the WATFOR fast FORTRAN IV compiler currently being used by over one hundred System /360 Computing Centres throughout the world. Over seventy installations are using a similar compiler developed in 1965 for 7040-7044 Series machines (Communications of the ACM, January, 1967).

Among the problems investigated in the areas of Formal Languages, Automata and Switching Theory are the algebraic theory of languages, regular languages and finite automata, structure theory of sequential machines, design of arithmetic units for residue number systems, and computer-assisted theorem proving.

Topics currently being studied in Computability Theory are Turing machines, complexity classifications of computable functions, abstract models of digital computers and hierarchies of subclasses of recursive functions.

Our Graphic Display unit is promoting research in new techniques of graphic programming, computer-assisted instruction, design procedures and analogue simulation.

In Numerical Analysis, algorithms for two-point boundary problems, stiff systems of differential equations, atomic structure equations, unilateral matrix equations and optimization problems are under investigation at the present time.

Research in the field of Machine Organization and Fault Diagnosis includes the development of software aids to fault diagnosis, the investigation of unorthodox machine organizations from the viewpoints of fault diagnosis and system availability and the selfdiagnosis problem for digital processors. Also under study are system problems arising from time sharing, and the problem of hyper-efficient compiling.

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.

At the University of Waterloo the research being done in functional equations includes general methods of solution, uniqueness theorems and applications in differential geometry, homological algebra, functional analysis, theories of continuous groups, quasigroups and nets, complex functions, nomography and the theory of distributions.

Applied Mathematics

Research in this department is being carried out in a number of areas directly or indirectly applicable to problems in the Physical Sciences. The range of interests of the members of the department reflects the diversity of problems of a mathematical nature which arise in the real world.


Pure Mathematics

Current research in this area includes studies in sheaf theory and cate-
groups, theory of integration and measure, topological vector spaces, Banach algebras, logic and foundations of set theory.

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.

Closely related to this research, there is active interest in problems of experimental design, with particular reference to incomplete designs, multivariate analysis, estimation theory, mathematical genetics and stochastic processes.

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 departments of Chemistry, Physics and Psychology 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.

Graduate Courses

Note 1 An asterisk (*) indicates courses given in 1968-1969 academic year. Other graduate courses may be given from time to time as demand warrants.

Note 2 All courses with title “Topics in...” are indicated by dagger (†) to mean that the course material is subject to yearly change.

500. Survey of Algebra and its Applications.
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.
745. Galois Theory.
749. Topics on Rings and Fields.†
764. Differential Geometry.*
766. Differentiable Manifolds.
768. Topological and Lie Groups.
778. Special Topics in Geometry.
779. Topics in Topological Structures.*†
788. Combinatorial Analysis.
782. Combinatorial Graph Theory.*
783. Analytic Graph Theory.
784. Linear Graphs.*
785. Planar Graphs.
797. Extrema in Graphs.
798. Directed Graphs.
799. Matroid Theory.*
810. Seminar in Graph Theory.*
828. Topics in Classical Analysis.†
829. Topics in Functional Analysis.†
830. Potential Theory.
832. Ordinary Differential Equations.*
834. Introduction to Partial Differential Equations.
848. Topics in Potential Theory.†
849. Topics in Differential Equations.†
850. Functional Equations for Functions of One Variable.*
852. Functional Equations for Analytic Functions.*
855. Integral Equations.
858. Seminar on Functional Equations.*
859. Topics on Functional Equations. Functional Equations for Trigonometric Functions.*†
869. Calculus of Variations.
862. Vector and Tensor Analysis.
864. Integral Transforms.
867. Theory of Approximation.
869. Survey of Numerical Analysis.*
870. Numerical Solution of O. D. E.*
873. Problems in Numerical Integration.
876. Seminar in Numerical Analysis.
878. Topics in Applied Analysis: Polynomial Approximation of Analytic Functions.*†
879. Topics in Numerical Analysis.†
888. Seminar in Numerical Analysis.*
Advanced Computer Techniques.
Finite Automata.*
Design of Sequential Machines.
Algebraic Structure of Sequential Machines.
Formal Languages.*
Computability Theory.*
Statistical Information Theory.
Measurement of Information.
Fault Diagnosis of Digital Systems.*
Topics in Information Theory.†
Introduction to Random Variables.
Theory of Probability.
Stochastic Processes.
Seminar in Probability Theory.
Topics in Probability Theory.
Mathematical Genetics.*
Topics in Probability and Biometry.†
Topics in Biometrical Statistics.
Foundations of Statistics.*
Advanced Statistics.
Applied Statistics.
Seminar in Statistics.
Topics in Statistics.
Complex Variable Techniques in Physical Problems.
Group Theory in Physical Problems.
Continuum Mechanics.*
Mathematical Electrodynamics.*
Quantum Molecular Physics.*
Quantum Mechanics.*
Mathematical Theory of Relativity.*
Statistical Mechanics.*
Quantum Surface Physics.*
Control Theory.*
Quantum Crystal Physics.*
Topics in Applied Mathematics.†
Mathematical Optimization.
Directed Graphs and Applications.*
Mathematical Programming.
Network Programming.*
Mathematical Operations Research.
Seminar in Mathematical Operations Research.
Seminar in Optimization.*
Topics in Optimization.†
Data Processing for Behavioral Scientists.
Mathematical Methods for Science and Engineering.
Numerical Methods and Programming.
Seminar in Mathematics Education.
Topics in Mathematical Education.†
Topics in the History of Mathematics.
Topics in the History of Mathematics.
Literature and Research Studies.
M. Phil. Thesis.
Ph. D. Thesis.
Department of Mechanical Engineering

Professor T.A. Brzustowski. B.A., M. (Toronto), A.M., Ph.D. (Princeton)

Chairman of the Department

Professor S.A. Alpay, Dipl. Ing., Dr. Ing. (Berlin)
Professor D.J. Burns, B.S., Ph.D. (Bristol)
Professor G.T. Csanady, Dipl. Ing. (Munich), Ph.D. (New South Wales)
Professor H.L. Evans, M.Sc. (Wales), D.I.C., Ph.D. (London)
Professor M.J. Hillier, B.Sc. (Eng.), B.Sc. (Gen.) (London), D.I.C., M.S. (Eng.) (London)
Professor E.L. Holmes, B.Sc. (Bristol), M.A.Sc., Ph.D. (Toronto)

Associate Dean of the Faculty of Engineering

Professor G.F. Pearce, B.A.Sc. (British Columbia), M.A.Sc. (Toronto)
Associate Professor E. Brundrett, B.S.A. (O.A.C.), B.A.Sc., M.A.Sc., Ph.D. (Toronto)
Associate Professor M.B. Danard, B.A.Sc. (British Columbia), M.A. (Toronto), Ph.D. (Chicago)
Associate Professor D.C. Ferguson, B.A.Sc. (Toronto)
Associate Professor D. French, B.Sc., C.Eng.
Associate Professor A.M. Hale, B.Sc., M.A. (New Brunswick), B.A.Sc. (Toronto), M.A.Sc. (Waterloo), Ph.D. (Waterloo)
Associate Professor C.E. Hermance, B.E. (Yale), M.A., M.S.E., Ph.D. (Princeton)
Associate Professor J.H.G. Howard, B.Sc. (Queen’s), M.Sc., Ph.D. (Birmingham)
Associate Chairman of the Department

Associate Professor W.B. Nicoll, S.M. (M.I.T.)
Engineer (Stanford) Ph.D. (London)
Associate Professor P. Niessen, B.Sc. (McMaster), M.A.Sc., Ph.D. (Toronto)
Associate Professor K.R. Piekarski, Dipl. Ing. (London) Ph.D. (Cambridge)
Associate Professor A. Plumtree, B.Sc., Ph.D. (Nottingham)
Associate Professor R.F. Scrutton, B.Sc., M.Sc. (Melbourne)
Associate Professor D.M.R. Taplin, A.C. T. (Hons.), B.Sc. (Queen’s), B.Sc. (Aston) D. Phil. (Oxford)
Associate Professor M.M. Yovanovich, B.Sc. (Queen’s)
M.S. (Buff.) M.E., M.Sc.D (M.I.T.)

Assistant Professor G.M. Bragg, B.A.Sc. (Toronto), Ph.D. (Cambridge)
Assistant Professor R.N. Dubey, B.Sc. (Hons.) (Patna), B.Sc. (Eng.) (Bihar) Ph.D. (Waterloo)
Assistant Professor H.W. Kerr, B.A.Sc., Ph.D. (Toronto)
Assistant Professor T.A. Ledwell, B.Eng., M.Eng. (Nova Scotia) Ph.D. (Waterloo)
Assistant Professor W.K. Luk, D.I.C. (London), (Dipl. of Hong Kong Tech. College) Ph.D. (Waterloo)
Assistant Professor G.D. Raithby, B.E.Sc., M.E.Sc. (Western), Ph.D. (Minnesota)
Assistant Professor P.R. Lawson, B.A.Sc., M.A.Sc., Ph.D. (Waterloo)
Assistant Professor A.B. Strong, B.A.Sc. (Waterloo), M.Sc. (Imperial College. London) Ph.D. (Waterloo)
Assistant Professor H.F. Sullivan, B.A.Sc. (Waterloo), A.M., Ph.D. (Princeton)
Assistant Professor T.M.L. Wigley, B.Sc., B.Sc. (Hons. Math & Phys.) Ph.D. (Adelaide)
Lecturer K.G. Adams, B.Sc. (Queen’s), M.A.Sc. (Waterloo)
Lecturer G.C. Andrews, B.A.Sc., M.A.Sc., (British Columbia)
Lecturer J.D. Malcolm, B.A.Sc., M.A.Sc. (Waterloo)
Lecturer R.J. Pick, B.A.Sc. (British Columbia), M.S. (Imperial College London)
Lecturer A.B. Thornton-Trump, B.A.Sc. (British Columbia), M.A.Sc. (Waterloo)
Special Lecturer C.J. Beisingnesser, B.Sc., M.A.Sc., Ph.D. (Toronto)
Special Lecturer R.G.R. Lawrence, Q.C.
Laboratory Director J.R. Cook, B.Sc. (Mt. Allison)
Research Associate R. Skarecky, Ing. (Prague), C.Sc. (Brno)
Department of Mechanical Engineering

Undergraduate Programmes

Details of the undergraduate programme in Mechanical Engineering are to be found on page 67. All courses extend over one term only, and consist of 3 hours of lectures per week unless otherwise specified. The hours of the core courses are listed on page 68.

The only prerequisites are the core courses, unless otherwise specified.

Undergraduate Course Descriptions

13 Kinematics A  A basic course in kinematics emphasizing the creative approach. Uniform rotary motion including rolling cylinders, gears and the synthesis of gear trains including planetaries. Non-uniform motion including cams, gears and linkages. Programming non-uniform motion and the synthesis of cam mechanisms, non-circular gear trains and linkages.

21 Mechanics of Machinery  The effects of dynamic forces in machines; introduction to mechanical vibration. Transient forces. Static force analysis, dynamic force analysis, balancing, cam dynamics, dynamics of feedback systems. *Prerequisite: ME 13.*

2 lectures. 3 hours laboratory.

22 Mechanical Design 1  Analysis and synthesis of machine elements. Factors affecting working stresses, fatigue, creep and impact considerations. Design of shafting, springs, screws, clutches, brakes and gears. *Prerequisite ME 21.*

2 lectures. 2 hours laboratory.

23 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. *Prerequisite: ME 22.*

24 Advanced Dynamics A  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.


26 Mechanical Design 3—Human Factors Engineering  The problems of incorporating human beings into engineering systems. The topics discussed are: the human visual, auditory and musculo-skeletal system, multiple sensory inputs, man-machine dynamics, environmental factors, human stress, group dynamics, and work-place design; the evaluation and testing of man-machine systems.


31 Physical Metallurgy 1  Nucleation and growth in metals. Diffusion and sintering.
and ternary eutectic phases. Non-equilibria in metal systems. Surface phenomena. Corrosion and oxidation in metals. 2 lectures.


33 Materials Science Laboratories This course is designed to acquaint students with the experimental methods techniques in Materials Science. For the initial part, the students will be required to perform assigned experiments which demonstrate common physical phenomena in Materials Science. For the remainder of the course, each student will be allowed to work on a small experimental project of his own choice which has been approved by the instructor.
3 hours laboratory.


37 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.


ME 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.

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.

55 Thermodynamics 3 Chemical equilibrium, multiconstituent fluid phases, additional topics in statistical thermodynamics, introduction to thermodynamics of irreversible processes.
Prerequisite: ME 54

56 Heat Transfer 2 Forced and free laminar and turbulent convection heat transfer in internal and external flows. Special topics selected from current applications.

57 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.

58 Internal Combustion Engines Reciprocating SI and CI engines, gas turbines, jets, rockets.
Prerequisite: ME 54

59 Energy Conversion Steam power plants (conventional and nuclear), batteries, fuel cells, solar cells, thermionic conversion, thermoelectric conversion, MHD generators.
Prerequisite: ME 54

ME 60-System Dynamics and Controls Dynamic modelling by lumped elements of physical systems involving the storage and transfer of matter and energy. Unified treatment of mechanical, electrical, fluid and thermal systems and components. Generalized describing equations and solutions for lumped ideal elements. Operational notations, control and feedback systems. System response, characteristic and transfer functions. Introduction to stability in control systems and to fluidic systems.
ME 61-Fluid Control Systems
Analysis of fluid properties and fluid flow as they apply to the design and application of components comprising the fluid system. Proportional, integral, derivative and hybrid type fluid control systems. Theory of energy transducers in fluid control systems. Performance characteristics of various types of pumps and fluid motor units. Diagramatic representation of their control functions.

62 Fluid Mechanics

63 Turbomachines

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.

65 Gas Dynamics

66 Turbulent Flow

67 Aerodynamics of Flight
Airfoils in three dimensions, lifting surfaces. Aerodynamic interference of aircraft components. Stability and control of aeroplanes, missiles, etc. in flight at low and high speeds. Response of aircraft to turbulence.

68 Acoustics

ME 69-Introduction to the Environmental Sciences

ME 70-Geophysical Fluid Dynamics
Equations of motion on a rotating earth, geostrophic balance. Vertical variation of wind and pressure fields in the atmosphere barotropic and
Department of Mechanical Engineering

baroclinic ocean currents, mechanisms of pressure change. Vorticity equation.

**81 Seminar**
Designed to give the student personal experience in oral presentation of technical information. Also provides an opportunity for students to attend seminars on topics of interest presented by recognized workers in the field.
1 hour.

**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.

**ME 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.

**ME 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 copyright, 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.

**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 re-
It is therefore essential that applications be complete 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 supervising committee that his thesis is a substantial original contribution to knowledge and has also demonstrated a high degree of competence in areas of knowledge related to his specialization. The candidate will, to this latter end, take lectures and sit for examinations in a number of courses offered at the graduate level, according to a 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 administered by his supervising committee.

The mechanics of thesis topics selection is very much as described above. Students continuing for a Ph.D., after obtaining the M.A.Sc. at Waterloo, may often continue to work in the same area of specialization.

In order to be admitted to graduate study as a Ph.D. candidate an applicant must have demonstrated his ability to do original research in the course of his Master’s degree work. For this reason, should a graduate with a Master’s degree obtained without producing a research thesis desire to enter out Ph.D. programme, he would have to satisfy the Department that he is able to carry out independent research.

The supervising 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.
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 a student is not English, its knowledge is nor 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.


625-Experimental Mechanics Experimental methods of static and dynamic stress analysis: strain gauges brittle coatings, photo-elasticity, moiré fringes, analogues. Selected related topics: flaw detection, vibration measurement, use of statistical methods, error analysis and curve fitting.

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.


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 This course is designed as an introduction to the fundamentals of Metallography, special optical techniques. X-Ray Microscopy and Microanalysis.

641 Mechanical Metallurgy Principal Topics: Stress-strain relationships in tension, compression shear and torsion. Elastic and plastic properties of single and polycrystals. Fracture. Internal friction. 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-
Impact and instability effects. Limiting conditions in forming operations. Time rate and temperature effects. Approximate technological theories; residual stresses.

647 Manufacturing Science 8

655 Combustion 2
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 of solids and liquids, combustion instability, combustion in jet engines liquid propellant rockets, solid propellant rockets.

662 Laminar Flow
Use of tensor notation, Navier-Stokes and continuity equations, some exact solutions. Two dimensional boundary layer theory, laminar flow along flat walls and in “equilibrium” layers (Falkner-Skan equation) some approximate methods for non-equilibrium layers. Equations of motion with buoyancy term, energy equation, Reynolds analogy. The origin of turbulence, Orr-Sommerfeld equation, 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 II

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).

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


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.

737 Phase Transformations

Phase diagrams, homogeneous and heterogeneous, nucleation, diffusion, phase changes in metals and alloys. Diffusional growth processes, diffusional and shear transformations.

739 Dislocation Theory

Description of 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.

740 Thermodynamics of Solids

This course will deal with the atomistic and thermodynamic interpretation of the fundamental properties of solids such as diffusion, solidification, surface properties and equilibrium in multicomponent systems.

751 Conduction Heat Transfer


Fundamental relationships for internal fluid flow with reference to stationary and rotating co-ordinate systems; vorticity and circulation; compressible inviscid flow with swirl within axisymmetric passages; some effects of viscosity and turbulence. One-, two- and three-dimensional analysis methods for compressible flow in turbomachines; flow in diffusers; secondary Rows in stationary and rotating passages; some characteristics of three-dimensional turbulent boundary layers.

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.

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.

Taylor spiral, scale analysis of equations of motion, geostrophic adjustment, available potential energy, dynamics of the general circulation, barotropic and baroclinic instability.

Oral examination of the thesis for the Ph.D.
Comprehensive Examination
Language requirement for the Ph.D.
Engineering Project 1
Research Thesis for the M.A.Sc.
Research Thesis for the Ph.D.

The major subject areas of current research in the Department of Mechanical Engineering are:
Materials Science
Manufacturing Science
Solid Body Mechanics and Mechanical Design
Natural Fluid Dynamics
Combustion
Turbulent Flow in Boundary Layers and Ducts
Turbomachinery
Fluid Control Systems

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.
Operation of the low speed wind tunnel
School of Optometry

Professor and Director of the School
E.J. Fisher, B.A., M.A. (Toronto)

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)

Associate Professor W.M. Lyle, M.Sc. (Indiana), Ph.D. (Indiana), O.D. (College of Optometry)

Associate Professor M.E. Woodruff, M.Sc. (Indiana), Ph.D. (Indiana), O.D. (College of Optometry)

Adjunct Professor Irving Baker, O.D. (College of Optometry)

Adjunct Professor D.H. Lamont, B.A. (Toronto) Q.C.

Adjunct Professor M. Langer, M.Sc. (Indiana), O.D. (College of Optometry)

Adjunct Professor R.D. Pellowe, O.D. (College of Optometry)

Adjunct Professor B.B. Sparks, M.D. (Toronto)


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 M.G.E. Callender, B.Sc. (S.G.W.U.), O.D. (College of Optometry)

Clinical Associate D.R. Gilhooley, B.Sc. (Saskatchewan), O.D. (College of Optometry)


Clinical Associate Garry Grant, O.D. (College of Optometry)

Clinical Associate R. Hansford, O.D. (College of Optometry)


Clinical Associate M.S. Munn, Dip. Opt.

Clinical Associate Harvey Naftolin, 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 J. Pollock, O.D. (College of Optometry)

Ophthalmic Technician Hartley Thompson

Laboratory 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.
1 lecture, fall term

201* 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, fall term.
202* Introduction to Clinical Optometry

Lectures on the clinical techniques for the examination of the optical properties of the eye. Included will be: measurement of the visual acuity, theory and practice 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, winter term.

204 Anatomy and Histology of the Eye and Related 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 structures 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)

300* Binocular Relations of the Non-Strabismic Patient

Clinical techniques for the examination of the binocular relations, with particular emphasis on 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.

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.

302 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.

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. Epidemiology.

3 lectures, 1 hour laboratory.

306* Advanced Geometrical Optics

An extension of geometrical optics given in Physics 236 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. fall term.

400 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 sequence. Interpretation of the data and a study of the various methods of clinical analysis.
sis 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, 3 hours laboratory.

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 colour. Recent developments in physiological optics.

3 lectures. 3 hours laboratory.

402 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.

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.

405 Ocular Pathology


2 lectures, 2 hours laboratory.

407 Optometrical Specialties

A series of lectures and laboratories on special techniques of clinical examination and of 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.

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.

4 hours clinic.

409 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.

432 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.
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.

Physiological Optics

Consideration will be given to the individual student's special interest. Assignments will include preparing for seminars on topics of interest, reviews, library and laboratory researches by individuals or small groups.

Optometrical Optics

A continuation of the fourth year course in optometrical optics.

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.

Optometrical Jurisprudence and Praxis

Lectures on laws governing the practice of optometry in Canada and on 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.

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.

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 perceptual-motor problems. The problems associated with the low-vision patient.

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.
Department of Philosophy

Professor, 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)

Professor R. J. Butler, B. A., M. A. (New Zealand)

Professor J. A. C. Hergott, M. A. (St. Louis), S. T. D. (Gregorian)

Professor, Dean of the Faculty of Arts

J. S. Minas, B. A. (Woyne), Ph. D. (Illinois)

Faculty of Arts


Professor P. Seligman, B. A., Ph. D. (London)

Professor J. W. Tucker, B. Sc., B. A., Ph. D. (London), 196869

Associate Professor R. A. George, M. A., Ph. D. (Michigan State)

Associate Professor R. Armour, B. A., M. A. (Western Ontario), B. Th. (Huron), Ph. D. (Columbia)

Associate Professor D. D. Roberts, B. A. (Roosevelt), M. A., Ph. D. (Illinois)

Associate Professor B. H. Suits, B. A., M. A. (Chicago), Ph. D. (Illinois)

Assistant Professor W. R. Abbott, B. A. (Kenyon), Ph. D. (Ohio State)

Assistant Professor J. Ashworth, B. A., M. A. (Cambridge), Ph. D., (Bryn Mawr)

Assistant Professor J. F. Centore, B. Sc. (Conisius) M. A. (Maryland) Ph. D. (St. John's)

Assistant Professor P. E. Gamble (Miss), B. A. (Victoria), M. A. (Columbia), B. R. E. (Emmanuel)

Assistant Professor B. P. Hendley, B. A. (Morquette), M. A., Ph. D. (Yale)

Assistant Professor P. D. M. Lochhead, B. Sc., B. D., S. T. M., Ph. D. (McGill)

Assistant Professor A. C. Narveson (Mrs.), B. A. (Radcliffe), M. A., Ph. D. (Harvard)

Assistant Professor J. W. Van Evra, B. A. (Volparoiso), M. A., Ph. D. (Michigan State)

Assistant Professor J. W. Van Evra, B. A. (Volparoiso), M. A., Ph. D. (Michigan State)

Assistant Professor B. A. (Volparoiso), M. A., Ph. D. (Michigan State)

Lecturer J. E. Brown, A. B. (Rockhurst)

Lecturer J. G. T. Campbell, B. A. (Western Ontario), Ph. L. (Loyola)

Lecturer R. H. Holmes, B. A., M. A., Ph. D. (Montana)

Lecturer M. F. McDonald, B. A., (Toronto) M. A. (Pittsburgh)

Note 1 Unless otherwise noted in the course listing, all courses offered by the Department may be taken by any student in the University, subject only to his meeting the specific prerequisites listed in the individual course descriptions.

Note 2 Some of the advanced courses (those numbered 300 or above) will not be available every year. Each Spring, the Department will publish a list of the courses to be offered for the following academic year. This list will include descriptions of courses whose content is not specified below and names of instructors for each course.

Note 3 The attention of all first-year students is called to the fact that several courses in addition to Philosophy 100 or 101 are open to them, any full course 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, p. 37).

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 for course credit.
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.

Notes 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 2. 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. (Not offered in 1969-70)

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

Basic ideas common to all religious beliefs will be discussed from a non-denominational viewpoint. What do we mean by revelation, sin, redemption? Can the existence of a supreme being be proved to the satisfaction of man’s reason? Both 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 I
The classic literature of ethics will be analyzed, and the principal problems brought to light.
No prerequisite:
3 hours.

222* Ethics II
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 predicate calculus, including the theory of identity and of definite descriptions and some attention to the theory of relations. Considerable attention will be devoted to formalization of various applied theories in, e.g., economics, measurement, utility theory, etc.
Prerequisites: None for second-year, and above, students; 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 raking 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 I 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 II 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. (Not offered in 1969-70)

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 I 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. (Not offered in 1969-70)

326 Political Philosophy II 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.
341* Decision and Value Theory  A systematic study of the basic concepts in decision-making theories and their associated value theories. Special emphasis will be devoted to the definition and measurement of utility functions and to the various criteria employed in models of decision-making under uncertainty and under risk. Extensive use will be made of literature from Economics, Political Science, Psychology, and Mathematical Statistics.  
**Prerequisite:** Consent of Instructor.  
3 hours. (Not offered in 1969-70)

346 Philosophy of History  Consideration of various possible views about the ultimate nature of history and historical knowledge. Both classical and contemporary views will be examined.  
**Prerequisite:** One full or two half Philosophy courses.  
3 hours.

350 Epistemology  A systematic course in the analysis of human knowledge. Phenomenalism and various kinds of realism will be considered, as well as other main topics such as the a priori, our knowledge of other minds, and our knowledge of abstract entities.  
**Prerequisite:** One full or two half courses in Philosophy. Students not taking Philosophy as their main subject should consult the instructor.  
3 hours. (Not offered in 1969-70)

358* Introduction to the Philosophy of Science  A discussion of various methodological and substantive topics common to many sciences. These topics include the logical structure of scientific laws, the nature of scientific theories, and the structure of scientific explanation.  
**Prerequisite:** One full or two half courses in Philosophy, or consent of instructor.  
3 hours.

359* Philosophy of the Formal Sciences  A study of philosophical problems concerning mathematics. Topics discussed include formalism, intuitionism, logicism, the mathematical paradoxes, and other topics in foundations and metamathematics.  
**Prerequisite:** Philosophy 358 or consent of instructor.  
3 hours. (Not offered in 1969-70)

362* Philosophy of Social Sciences  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.  
**Prerequisites:** Some previous work in a social science or in Philosophy.  
3 hours. (Not offered in 1969-70)

363 Analytic Philosophy  Contemporary philosophical literature is employed in the exploration of both formal and “ordinary language” analysis. This course should be especially useful for persons contemplating graduate study in Philosophy.  
**Prerequisite:** Consent of instructor, or Honours status in Philosophy.  
3 hours.

365* 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. (Not offered in 1969-70)
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. (Not offered in 1969-70)

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. (Not offered in 1969-70)

390* Medieval Philosophy I

The early period to the thirteenth century.

Prerequisite: Philosophy 280/281.

3 hours.

391* Medieval Philosophy II

The later period, from the thirteenth century.

Prerequisite: Philosophy 390.

3 hours.

398(a-b)* Directed Reading in Special Areas

Students wishing to enrol in 399 should consult the Department.

399 Tutorial for Honours Students

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.

425* Philosophy of the City

A study of selected readings.

Prerequisite: Consent of instructor.

3 hours. (Not offered in 1969-70)

435*-436* 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. (Not offered in 1969-70)

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. (Not offered in 1969-70)

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. (Not offered in 1969-70)

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. (Not offered in 1969-70)
### 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*

#### 101J Philosophy of Man
The nature of the psyche; organic life, sensory life and its philosophy; intellectual life and its philosophy; the nature of modern scientific psychology.

3 hours. *(at Resurrection College only)*

#### 105J Philosophy of Nature A
A general introduction to the science of nature. A study of the principles of natural mobile being which is the subject of natural science, and a study of place and time which are measures extrinsic to mobile being, place and time.

3 hours.

#### 120J Ethics
A study of the principles of ethics, of the norms of human behavior insofar as these pertain to the conduct of the individual. A subsequent study of some moral problems.

3 hours.

#### 140J Logic and Epistemology
Nature and division of Philosophy; nature of logic; the term; the proposition; argumentation; induction and deduction; scientific demonstration. Truth; certitude; evidence; sense and intellectual knowledge; criterion of truth; contemporary theories.

3 hours. *(at Resurrection College only)*

#### 205J Philosophy of Science
A study of the nature and the meaning of the method of experimental science. An attempt to come to grips with its method, through a study of the works (philosophical) of past and present scientists. A comparison of this method with that of the philosophy of nature. A look at the great scientific revolutions and their effect on the method of experimental science.

**Prerequisites:** Philosophy 105J.

3 hours.

#### 238J History of Ancient and Medieval Philosophy
From the Presocratics to the decline of Scholasticism.

3 hours.

#### 241J Logic
The science and art of correct reasoning. A study of the principles of traditional logic and the three operations of the mind: simple comprehension, composition and division, and reasoning.

3 hours.

#### 300J Metaphysics
What is metaphysics? What is its subject? How does it proceed? The science which the ancients called “wisdom”. A study of the principles of beings.
Department of Philosophy

301J Philosophical Psychology A study of the soul, the principle of life. What is life? Relation of body and soul and a study of the different powers of the soul. 
Prerequisite: Philosophy 105J. 
3 hours.

348J Seminar in Philosophy A special study of the principal philosophers of the modern and contemporary eras. 
3 hours.

480J History of Modern Philosophy A study of the teachings and problems of the modern philosophers (from Descartes to existentialism). 
3 hours.

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.

3368 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 secularisation 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 In this course philosophical issues connected with extensionality, modality, and “alternative logics” will be developed systematically in a general framework.

641*-642* Seminar in Logic 
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) - (m) Qualification Area Tutorials for Ph.D. Candidates Ph.D. candidates who have completed their regular course requirements select, with Departmental approval, four of these courses from the Department’s list of areas. Satisfactory completion of the four fulfills the Comprehensive Examination requirement in Philosophy.
a. Aesthetics
b. Epistemology
c. Ethics
d. Existential Philosophy and/or Phenomenology
e. History of Philosophy
f. Logic
g. Metaphysics
h. Philosophy of Religion
i. Philosophy of Science
j. Social and Political Philosophy
k. Studies in a Philosopher
l. Studies in a Philosophical Movement
m. Special Topics #1
n. Special Topics #2

699 (a)-(c) Thesis
Department of Physics

Professor and Chairman of the Department

Professor R.A. Aziz, B.A., M.A., Ph.D. (Toronto)
Professor G.A. Bakos, B.A. (Trnava), M.A. (Bratislava), M.A., Ph.D. (Toronto)
Professor and F.W. Boswell, B.A., M.A. Ph.D. (Toronto)

Associate Dean of the

Faculty of Science

Professor D.E. Brodie, B.Sc., M.Sc., Ph.D. (McMaster)
Professor J.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
(after July 1, 1969)

Professor H.E. Petch, B.Sc. (McMaster), M.Sc., Ph.D. (U. B.C.) F.R.S.C.
Vice-President. Academic

Professor G.E. Reesor, B.A., M.A. (McMaster), Ph.D. (Toronto)
Professor R.A. Snyder, B.Sc., Ph.D. (Western)
Professor S.F. Wang, B.E. (Port Arthur, China), D.Sc. (Nagoya)

Associate Professor A. Anderson, M.A., D.Phil. (Oxon)
Associate Professor S.G. Davison, B.Sc., M.Sc., Ph.D. (Manchester)

(Applied Mathematics and Physics)

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, 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. (Mt. 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)
Instructor A.B. Haner, B.Sc., M.Sc. (Waterloo)
Instructor D. McVicar, B.Sc. (Waterloo)
Instructor L. Young, B.Sc. (Waterloo)

Undergraduate Course Descriptions

Details of the undergraduate programmes offered by the Faculty of Science are to be found on p.
All full-year courses taken by students in the co-operative programme are divided into two terms designated A and B. Each term is considered to be a separate half course.

11 Mechanics and Wave Motion
Vectors, rectilinear motion, plane motion, dynamics of particles, work and energy, linear momentum, rotational motion, statics, angular momentum, harmonic motion, gravitation, wave motion, sound waves.
3 lectures, 3 hours laboratory.

14* Optics
Geometrical optics, interference, diffraction and polarization.
3 lectures, 3 hours laboratory, one term.

15* Modern Physics
The fundamental particles of matter, assemblies of particles, nuclei and atoms, the wave-particle experiments, introductory quantum mechanics and atomic structure.
3 lectures, one term.

43* Nuclear Physics
The atom and its nucleus, radioactive decay, nuclear masses and nuclear stability, nuclear spin and moments, structure of nuclei, gamma radiation processes, alpha decay, beta decay, nuclear reactions, fission, interaction of radiation with matter, counters, particle accelerators and reactors.
3 lectures, one term.

44* Classical Mechanics
3 lectures. one term.

45* Introductory Statistical
Review of essential classical and quantum mechanics, microcanonical, canonical and grand canonical ensembles; quantum statistical mechanics, theory of the density matrix; applications.
3 lectures, one term.

46* Introduction to Quantum
3 lectures. one term.

100 General Physics I
3 lectures. 3 hours laboratory alternate weeks.

131 Mechanics, Wave Motion
Vectors, rectilinear motion, plane motion, dynamics of particles, work and heat and energy, linear momentum, rotational motion, statics, angular momentum, harmonic motion, gravitation, wave motion, sound waves, temperature, heat, first and second laws of thermodynamics, kinetic theory of gases.
3 lectures. 3 hours laboratory.

137* Highlights of Astronomy A
survey course in descriptive astronomy intended for non-science students.
200 General Physics II Electromagnetism, AC. circuits, geometrical and physical optics, introduction to atomic and nuclear physics. 3 lectures, 3 hours laboratory.

232 Electricity and Magnetism Electrostatics, magnetic fields, electromagnetic induction, alternating current theory, the development of Maxwell’s equations. 2 lectures. 1 hour of problems (3 hours laboratory on alternate weeks for students not taking Physics 233.)

233 Laboratory Selected experiments in electricity and magnetism, optics, X-ray diffraction and astronomy. 3 hours laboratory.

234* 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, Schroedinger equation, solutions with potentials, correspondence principle, brief description of transitions and radiation processes. 3 lectures, one term.

235 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. 2 lectures. 3 hours laboratory alternate weeks.

236* 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. 3 lectures. first term. (3 hours laboratory alternate weeks for students not taking Physics 233).

237 Astronomy I This is a two term course consisting of the courses Physics 247 and 257. 3 lectures.

242 Electricity and Magnetism Electrostatics, D.C. circuits, magnetic fields, electromagnetic induction, A.C. circuits, electrical measurements, introductory electronics. 2 lectures, 3 hours laboratory and 2 hours problems on alternate weeks.

243* Electricity and Magnetism Electrostatics, D.C. circuits, magnetic fields, electromagnetic induction, A.C. circuits, electrical measurements. 3 lectures, 3 hours laboratory alternate weeks. one term.

245* Structure of Solids I 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. 3 lectures, second term. (3 hours laboratory alternate weeks for students not taking Physics 233).

247* 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. 3 lectures. fall term.

253 Laboratory Further selected experiments in electricity and magnetism, optics, X-ray diffractions, and astronomy. This course is recommended for students enrolled in Physics 247, 257 and Physics 245.
257* The Stellar System: The stars; stellar motions; clusters; the structure of the Milky Way; exterior systems; cosmogony; radio astronomy.
3 lectures for one term (offered in winter and spring).

316* Cellular Biophysics: Application of the analytical methods of the physical sciences to biology. Emphasis will be placed on describing the nature, function and control of the physical systems which are found in living cells.
Prerequisites: Physics 232 and Mathematics 236 or equivalent.
3 lectures first term.

317* 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 232 and Mathematics 236 or equivalent.
3 lectures, second term.

3 lectures.

332 Electronics: An integrated survey of tube and transistor circuitry. Basic A.C. circuit theory, power supplies, amplifiers, equivalent circuits, oscillators, feedback, and a variety of special purpose circuits. Emphasis on the point of view of the user rather than the designer.
2 lectures. (3 hours laboratory, alternate weeks, for students not taking Physics 333).

333 Intermediate Laboratory: Selected experiments in mechanics, heat, sound, optics, spectroscopy, X-ray, atomic physics, electricity, magnetism, and electronics.
3 hours laboratory.

2 lectures.

3 lectures.

336 Mathematical Physics I: Vector analysis; vector differential operators and associated integral theorems. Introduction to tensors. Curvilinear co-ordinate systems. Partial differential equations of mathematical physics; Laplace’s, wave and diffusion equations; Legendre and Bessel functions. Fourier analysis; eigen-functions.
3 lectures.

337 Astronomy II: This is a two term course, consisting of the courses Physics 347 and 357.
2 lectures.

338 Geophysics I: (Same as Earth Sciences 338) Selected introductory topics on the physical geosciences.

2 lectures.

339 Atomic and Nuclear Physics Fundamentals of modern physics; special theory of relativity, quantization of electromagnetic radiation: wave properties of particles, the hydrogen atom, atomic and X-ray spectra, nuclear structure, nuclear reactions, molecular and solid state physics.

3 lectures.

341* Electronics A one-term course designed for students in the co-operative programme. The topics listed under Physics 332 will be discussed in slightly less detail.

3 lectures and 3 laboratory hours per week for one term.

347* Astrophysics I Selected topics in stellar interiors and atmospheres.

2 lectures, fall term.

353 Intermediate Laboratory Further experiments in mechanics, heat, sound, optics, spectroscopy, X-ray, atomic physics, electricity, magnetism and electronics.

3 hours laboratory.

357* Astrophysics II Selected topics in the structure of galaxies, radio astronomy, cosmogony and cosmology.

2 lectures for one term (offered in winter and spring).

416* Molecular Biophysics Shapes, sizes and internal structure of macromolecules as revealed by physical methods; functions of large molecules in protoplasm, viscosity, transport, energetics, information coding on DNA and RNA molecules. Prerequisites: Physics 232 and Mathematics 236 or equivalent.

3 lectures per week, one term.

417* 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, one term.

431 Classical Mechanics II Review of Lagrangian formulation of mechanics. Rotation of a rigid body; the inertia tensor; Hamilton’s principle; Hamilton’s equations. Classical theory of small vibrations. Dynamics of deformable matter; elasticity; hydrodynamics.

2 lectures.


433 Advanced Laboratory An experimental research project.

6 hours laboratory, both terms.

434 Atomic and Nuclear Physics II Applications of wave mechanics; the harmonic oscillator, the hydrogen atom. Angular momentum. Scattering. Perturbation theory, transitions, the multi-electron atom.

2 lectures.

**436 Mathematical Physics II** Theory of functions of a complex variable; conformal mapping and applications. Boundary value problems on linear partial differential equations; separation of variables; Green’s functions. Linear integral equations. Integral transforms (Laplace, Fourier). 3 lectures.

**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 II** 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.

**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.

**442* Structure of Solids II** 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. 3 lectures, first 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; applications to fluid and elastic systems with simple geometries. 3 lectures. second 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. second term.

**445* Modern Optics** Coherence, interference and optical resonators; quantum optics. amplification and lasers. 3 lectures per week, second term only.

**447 Astronomy III** Spherical astronomy and celestial mechanics. 2 lectures.

**Graduate Studies and Research Programmes**

See page 128 for general There are at present several major areas of study in the Department in
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, superconductivity, 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 IA  A second course in the subject involving a reexamination of the principles of wave and matrix mechanics and application to more complicated systems.

Prerequisite: Physics 434 or equivalent.

Fall 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; 

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.


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 I  The electrostatic and the magnetic field; energy, force and momentum relations in the electromagnetic field; Maxwell’s equations, solutions of the wave equation; radiation.

Fall term.

†636 Electromagnetic Theory II  Relativistic electrodynamics, electron theory, Hamiltonian formulation of the electromagnetic field, selected topics.

Prerequisite Physics 635.

Winter term.


†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 I  Periodic structures; waves in lattices; electronic states, static properties of solids; electron-electron interaction; dynamics of electrons; the Wannier representation.

Fall term.

649 Solid State Physics II  Transport properties; optical properties; the Fermi surface; electronic magnetism; superconductivity.

Winter term.

651 Imperfections in Crystals  Perfect and imperfect crystals, general properties and origins of point defects, radii, ion and electronic states, properties of imperfections.
deformation of crystals and phase transformations, experimental detection and observation of imperfections.

652 **Photoconductivity and Luminescence**

Electron processes in crystals, photoconductive processes. Electrode effects, imperfection and energy band transitions, scattering, traps and trapping effects. Recombination kinetics, luminescence. Experimental methods and analysis.

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**


*Fall term.*

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.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>666 Biophysics of Organ Systems</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>668 Molecular Biophysics</td>
<td>Physical methods of determining macromolecular structure; energetics, intramolecular and intermolecular forces, information storage, DNA and RNA, recognition and rejection of foreign molecules.</td>
<td></td>
</tr>
<tr>
<td>669 Radiation Biophysics</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>670 Special Topics in Biophysics I</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>671 Special Topics in Biophysics II</td>
<td>Selected subjects for advanced study.</td>
<td></td>
</tr>
<tr>
<td>672 Biophysics Laboratory</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>674 Advanced Radiation Biophysics</td>
<td>Radiation problems with tissue cultures and related topics.</td>
<td></td>
</tr>
<tr>
<td>681 Celestial Mechanics</td>
<td>The two body problem.</td>
<td></td>
</tr>
<tr>
<td>682 Celestial Mechanics 2</td>
<td>The three body problem and perturbations.</td>
<td></td>
</tr>
<tr>
<td>683 Astrophysics</td>
<td>Stellar atmospheres and interiors.</td>
<td></td>
</tr>
</tbody>
</table>
684 Stellar Spectroscopy  Description and classification of stellar spectra.

685 Selected Topics in Astronomy and Astrophysics

699 Thesis
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 p. 18) 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 p. 41) 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 as a minor programme 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 Economics and Political Science (p. 22)
(b) Honours French and Political Science (p. 30)
(c) Honours History and Political Science (p. 36)
(d) Honours Philosophy and Political Science (p. 39)
(e) Honours Political Science and Sociology (p. 41)

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.
Department of Political Science

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.

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 method 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.

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.
Prerequisite: An introductory course in Political Science or equivalent.
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 policies in the Stalin and post-Stalin periods, including analysis of Soviet foreign policy.
Prerequisite: Political Science 265*.
3 hours. Winter term.

268* The Government and Politics of China
An examination of the Chinese political system under the Republican, Nationalist, and Communist regimes, with an investigation of the traditional Chinese and contemporary Western thought incorporated in the ideologies of these regimes.
No prerequisite for students in upper years.
281* International Politics  
Sovereignty and internationalism. The adjustment of conflict in the contemporary political environment.  
*Prerequisite: An introductory course in Political Science or equivalent.
3 hours. Fall term.

282* An Introduction to International Institutions  
Concepts and rules of international law relevant to the development of international institutions. The United Nations and regional systems.  
*Prerequisite: An introductory course in Political Science or equivalent.
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 selected from certain major classical and modern political philosophers.
Admission by consent of instructor.
3 hours.

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 and Policy Problems  
An analytical study of the responses of various urban political systems to contemporary metropolitan problems. Emphasis is on research and a critical examination of the theory and practice of municipal government, city politics, patterns of community decision-making, intergovernmental relations and public policies.
Admission by consent of instructor.
3 hours.

353* 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. Some attention will also be given to Marxist and Marxist-Leninist ideology, and non-Communist political systems in which a large or significant Communist party exists.
Admission by consent of instructor.
3 hours. Fall term.

359 Authoritarian Politics  
A study of the organization, tactics and mass appeals of non-democratic and radical movements in competition for political power in developing and modern societies, together with a comparative analysis of the functioning of selected Communist, Fascist and Nationalist political systems.
Admission by consent of instructor.
3 hours.

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.
377* The Mass Media and the Political Process

An examination of the structure and operations of the mass media and their effects upon and role in the political processes of North American, and particularly Canadian, government. Special emphasis is placed upon print, radio, television, film and advertising media and upon problems of audience conditioning and media control.

Admission by consent of instructor.

3 hours. Fall term.

380 Theory and Practice of International Relations

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.

Admission by consent of instructor.

3 hours.

421* The State and Economic Life

An analytical and comparative study of the growth of government intervention in the economic process, and of the development of the welfare state.

Admission by consent of instructor.

3 hours. Fall term.

441* The Politics of French Canada

A study of the principles, practices and personalities of French Canadian politics.

Admission by consent of instructor.

3 hours. Fall term. (Not offered 1969-70).

450 The Politics of the Developing Areas

An analysis of political systems and processes in the transitional societies of Africa, Asia and Latin America. (Students who elect Political Science 450 for credit may not register in Political Science 453* or 454* for credit).

Admission by consent of instructor.

3 hours.

451* Defence Policy and National Security

A study of Canadian and American national defence policy as affected by the constitutional and political setting, as well as its relation to foreign policy. Emphasis will be placed on the role of interest groups like the scientific community in the formulation of defence policy. Some attention will be given to strategic doctrine.

Admission by consent of instructor.

3 hours. Fall term.

452* Comparative Civil-Military Politics

An examination of the relationships between the military establishment and the civilian authority in selected countries. Attention will be given to the role of the military in modernizing or modern society, the nature of the military socialization of society, and the influence of the military on the formation of public policy.

Admission by consent of instructor.

3 hours. Winter term.

453* 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. Fall term.

454* African Politics

An intensive study of the political systems of selected African countries.

Admission by consent of instructor.
455* Comparative Politics in the "Old" Commonwealth
An analytical comparison of institutions and processes as they have developed in various systems of the "old" Commonwealth, such as Britain, Canada and Australia.
Admission by consent of instructor.
3 hours. Fall term.

456* Comparative Politics in the "New" Commonwealth
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.

472* Voting Behaviour
Admission by consent of instructor.
3 hours. Winter term.

480 An Introduction to International Law
A systematic survey of the concepts and rules of International Law.
Admission by consent of instructor.
3 hours.

487* Theories of International Politics
A critical examination of alternative approaches to the study of international politics.
Admission by consent of instructor.
3 hours. Fall term.

488* International Organizations
A study of the nature and functions of International Organizations, and an evaluation of the League of Nations and the United Nations systems.
Admission by consent of instructor.
3 hours. Winter term.

490 Senior Research Seminar
Admission by consent of instructor.
3 hours.

499 Senior Honours Essay
Students wishing to register in Political Science 499 should consult the Department.

Senior Undergraduate and Graduate Courses

Note Courses at the 500 level are open to senior undergraduates and to students in qualifying 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 contrast the classical and modern versions of that understanding. One or more Platonic dialogues and/or one of Aristotle's works will be studied.
3 hours. Winter term.
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.

551* Power and Society  A critical inquiry into the nature, distribution and exercise of power, with particular reference to American and Canadian society. Consideration will be given to analysis and evaluation of various interpretative theories of power; e.g., "elitism," and "pluralism," and the relationship of power to political institutions, both public and private.
3 hours. Fall term.

570 Political Behaviour  An examination of the objectives, characteristics and problems of contemporary research on political behaviour, with emphasis on democratic electoral behaviour.
Full course, half year. Fall 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. (Not offered 1969-70).

577* The Mass Media and the Rule of Law  An exploration of the extent to which the contemporary mass media are incompatible with the concept of the rule of law, of the means of reducing such incompatibility, and of challenges inherent in future media developments.
3 hours. Fall 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)

Deputy Chairman
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 A. de Vos, M.Sc., Ph.D. (Wisconsin)

(Geography and Psychology)
Professor H.D. Kirk, B.S. (City College, New York), M.A., Ph.D. (Cornell)

(Sociology and Psychology)
Professor J.S. Minas, B.A., M.A. (Wayne State), Ph.D. (Illinois)

(Philosophy and Psychology)
Professor R.K. Penney, B.Sci. (Wayne State), Ph.D. (Iowa)

(Statistics and Psychology)
Professor D.A. Sprott, B.A., M.A., Ph.D. (Toronto), F.S.S.

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.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 (part-time) R.R. Ross, B.A., M.A., Ph.D. (Toronto)

Associate Professor R.A. Steffy, B.A. (Albright), M.A., Ph.D. (Illinois)

Associate Professor R.V. Thysell, B.A. (Montana), M.A., Ph.D. (Iowa)

Associate Professor E.E. Ware, B.A., M.A. (Richmond), Ph.D. (Illinois)

Assistant Professor D.M. Amoroso, B.A., M.A. (Toronto), Ph.D. (Waterloo)

Assistant Professor (part-time) P.E. Bowers, Mrs. B.A. (Rosemont), M.A., Ph.D. (Illinois)

Assistant Professor M. Breidenbaugh, Mrs. B.A. (Wittenburgh), Ph.D. (Vienna)

Assistant Professor M. Brown, B.A., M.S. (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 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 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 J.C. Naidoo, B.Sc. (Witwaterstrand), B.Sc. (South Africa), M.A., Ph.D. (Illinois)

Assistant Professor R.D. Seim, B.A. (Queen's), Ph.D. (Waterloo)

Assistant Professor I.W. Silverman, B.A. (Brooklyn), M.S., Ph.D. (Purdue)

Assistant Professor (part-time) J.A. Van Evra, (Mrs.) B.A. (Valparaiso), M.A., Ph.D. (Michigan State)

Assistant Professor T.G. Waller, B.S. M.S. (Southern Missionary), Ph.D. (Waterloo)
Department of Psychology

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 B.J. Gilmore, B.A. (Stanford) M.A. Ph.D. (Yale)
Adjunct Professor J.J. Hartford, M.D. (Toronto)
Adjunct Professor P.M. Learner, 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)
Assistant Professor J.A.C. Firetto, C.R.; B.A. (Western), M.A. (St. Louis), Ph.D. (Loyola)
Lecturer (part-time) A.R. Nicholls, B.A. (Hollins) M.A., Ph.D. (McGill)

Undergraduate Offerings

An introductory course (Psychology 110, 111-112, 150) 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.

A first year student intending to take either an Honours or a General Degree programme in Psychology must select either Psychology 110 or Psychology 150.

In year 2 to 4 Honours students are required to take Psychology 280, 290, 360, 430, and 499 as part of their programme.

In year 2 the General student majoring in Psychology must take Psychology 201-202, and at least one other full-year or two half-year Psychology courses. Psychology 281-282 is strongly recommended in the second year. The general student with a background in Mathematics or who plans to do graduate study in Psychology should substitute Psychology 280 for Psychology 281-282. During Year 3 the student must complete two full-year or four half-year Psychology courses at either the 200 or 300 level, including Psychology 281-282 if it has not been taken previously.

Students in either the Honours or General programme in Psychology should choose their electives after consultation with their advisors in the Department.

Note on Numbering Undergraduate courses ending in 0 and 99 are full-year courses. Courses ending in odd numbers are half-year courses offered in the fall term, while courses ending in even numbers are half-year courses offered in the winter term, with the exception of those courses offered to students in co-operative programmes.

Graduate Offerings

Courses numbered 600-650 are offered on a half-year basis. Courses numbered 699 and above 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.

Candidates with an honours bachelor's degree or equivalent preparation may seek admission via a research-oriented course leading to the Ph.D.
department or a professionally-oriented course leading to a Master of Applied Science (M.A.Sc.) degree.

Available major areas of specialization are: perception and cognition, learning and motivation, biopsychology, child behaviour and development, social and personality, clinical, and counselling. Specific training programmes are constructed to suit the students' interests, goals, and skills through consultation with his advisor. Candidates electing to major in clinical or counselling psychology will be required to complete internship training under conditions approved in advance by the Department.

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.Sc. 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.

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.

110 Introductory Psychology

This course is designed to provide the students with an understanding of the basic concepts and techniques of modern psychology as a behavioural science. The development of behaviour, learning, motivation, emotion, sensation and perception, and individual differences will be studied with reference to physiological correlates and to environmental factors.

3 lectures.

111* Introductory Psychology

This course, together with Introductory Psychology 2, is equivalent to Psychology 110, but is given in two self-contained units. (For Co-opera-

3 lectures.

112* Introductory Psychology 2

(For Co-operative Students only).

3 lectures.

150 Research Methods in Psychology

An introduction to research methods in psychology. Emphasis will be placed on methods of testing, observation, and experimentation. (For students in Honours Psychology or in joint Honours programmes with Psychology. Other students by permission of department only.)

2 lectures, 2 hours laboratory.

201* General Experimental Psychology Learning

An introduction to the data and theories of learning, with learning, with emphasis on experimental methodology. Required of all General Psychology students.

2 lectures, 2 hours laboratory. Fall term.
202* General Experimental Psychology: Perception
An introduction to the data and theories of perception, with emphasis on experimental methodology. Required of all General Psychology students.
2 lectures, 2 hours laboratory. Winter term.

211* Developmental Psychology
An examination of the process and factors of human development from birth to adolescence emphasizing methods of child study.
3 lectures. Fall term.

212* Socialization Processes in the Child
Consideration will be given to a number of topics relating to the development of social behavior in children.
3 lectures. Winter term.

241*. Educational Psychology: The Psychology of Classroom Learning
A consideration of the main variables affecting learning in the classroom with special focus upon the conditions essential to efficient learning.
3 lectures. Fall Term.

242*. Educational Psychology: Learning Disabilities
An analyses of learning disability associated with various categories of exceptionality including mental retardation, emotional problems, and receptive and expressive handicaps.
3 lectures. Winter Term.

253* (Sociology 210) Introductory Social Psychology
The relation between psychological processes and social interaction. Topics to be considered include (1) how we evaluate others’ personalities, (2) determinants of friendship, (3) formation and change of attitudes, (4) conformity and independence, (5) the self-concept.
3 lectures. Fall term.

254* (Sociology 212) Interpersonal Relations
The contribution of social organization to interpersonal processes. Consideration of some “theories” of social interaction. The social system approach to the problem of personal and interpersonal control.
Prerequisite: Psychology 253*.
3 lectures. Winter term.

256* Small Groups
Study of the structure and functioning of small groups and the effects of group membership on the individual. Data from the laboratory are studied in relation to selected theories.
Prerequisite: Psychology 253*.
3 lectures. Winter term.

260 Physiological Psychology
The structure and function of the nervous system and their relation to behaviour.
3 lectures, 2 hours laboratory.

280 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, to inferential statistics, and also to the effective use and interpretation of statistics in the design and understanding of experiments. Required of all Honours Psychology students, except Mathematics students who have taken Mathematics 233.
3 lectures, 1 hour problems.

281* Elementary Statistics
An introduction to descriptive and inferential statistics.
3 lectures. Fall term.
**282* 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 281*.  
3 lectures, Winter term.

**290 Learning**

This course is designed to introduce the student to Learning theory and to provide an understanding of experimental techniques in this area. The course allows the student to carry out independent research in the area. Open only to Honour Psychology students.  
2 lectures, 2 hours laboratory

**331* Individual Differences**

An analysis of individual and group differences in behaviour, with an emphasis on studies of intelligence.  
3 lectures. Fall term.

**332* Applied Psychology**

An introduction to the methods and problems of such applied areas as educational, industrial and counselling psychology.  
3 lectures. Winter term.

**340 Cognitive Processes**

An examination and evaluation of selected topics dealing with human learning, thinking, concept formation, memory and language.  
*Prerequisites: Psychology 201*-202* or Psychology 290.  
3 lectures.

**351* Personality Theory**

An examination and evaluation of some of the outstanding theories of personality and methods of assessment deriving from these theories.  
3 lectures. Fall term.

**352* Psychopathology**

The nature and origin of deviant behaviour will be considered. Time will also be devoted to an examination of current research on behaviour disorders.  
3 lectures, Winter term.

**353* Research in social psychology**

Primary emphasis will be on attempts to integrate data in one area of research. Problems involved in adequate design of research in this area will also be given consideration.  
*Prerequisite: Psychology 253*.  
3 lectures. Fall term.

**354* Social Psychology Theory**

Several theories in social psychology and related research will be discussed.  
*Prerequisite: Psychology 253*.  
3 lectures Winter term.

**360 Sensation and Perception**

A consideration of data and theory concerning sensory and perceptual processes. Topics will include psychophysical methodology, sensory mechanisms, the neuropsychological basis of perception, basic behavioural data and theory relating to such topics as the perception of form and space, perceptual learning, and a consideration of the effect of personality variables in perception. Opportunity for independent research will be provided. (Required of all Honours Psychology students.)  
2 lectures, 3 hours laboratory alternate weeks.

**370 Animal Behaviour**

An in depth study of the behaviour of animals emphasizing both observational and experimental research.  
2 hours lecture, 2 hours laboratory.
380 Advanced Psychological Psychology
Advanced study of the physiological basis of behaviour, with particular reference to function of the central nervous system. Emphasis will be on laboratory work and on practical considerations involved in relating brain function to behaviour.
Prerequisite: Psychology 260.
2 hours lecture, 2 hours laboratory.

390 Human Motivation
An examination of the determinants of the direction, strength and persistence of behaviour. The major emphasis of the course is on the role of individual differences, expectancies and values as, for example, in the study of achievement motivation. Among the theories discussed are those of James, Freud, Lewin, Tolman and Hull-Spence.
1 hour lecture, 2 hours discussion/laboratory.

410 History and Systems
An examination of current theoretical approaches to psychological problems presented in a historical context.
3 hours lectures.

430 Contemporary Issues in Psychology
This course is conducted as a proseminar in which nearly all the faculty give talks on the contemporary issues underlying their current research and thinking. Topics are clustered into three major areas: (1) Study of individual differences, (2) The change of behaviour, (3) Reconsideration of assumptions underlying theories of learning and perception. Required of all Honours Psychology students.
2 lectures.

440 Psychophysiology
The course deals with the study of interrelationships between the physiological and psychological aspects of behavior in human subjects. It covers research by psychologists, physiologists and psychiatrists on physiological responses to stimuli which are designed to influence mental, emotional or motor behavior. The laboratory deals with the physiological and physical principles and methods involved in the measurement of autonomic responses.
2 lectures, 2 hours laboratory.

449 Experimental Design
2 lectures.

480 Directed Studies in Selected 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.
3 hours supervised research.

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 Honours Students in Psychology.

Graduate Course

611* Human Factors Engineering 1
The human being as an element in an engineering system; his physical and mental capabilities and limitations: his assets and liabilities as com-
pared to automatic elements; his physical and mental requirements for optimum functioning as an element in a system.

612* Human Factors Engineering 2

More advanced study of selected problems presented in Psychology 611, together with laboratory demonstrations.

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. The course will also include historical developments, ethical problems and role definition of clinical psychology. A practicum portion of the course involves topical questions in clinical research, and subsequently covers intellectual assessment with lectures pertaining to the development and reliability of, and the validation research on, each of the tests utilized.

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. Practicum work includes supervised examinations of school children on standard measures of intelligence.

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. Practicum work includes discussion and interpretation of protocols secured from hospital and reformatory populations.

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 psychotherapeutic system; their respective views of health-illness, their techniques of intervention, and related research are considered.

626* Psychotherapy practicum

Students will conduct continuing psychotherapy under supervision of the staff. Theoretical and practical issues will be discussed.

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.

629A* Group Psychotherapy

A study of the underlying principles of group therapy with emphasis on the psychodynamics of the individual as he operates in a group situation.

629B* Behaviour Modification

Learning theory is extended in the realm of human behavior with particular emphasis on the use of operant and classical conditioning in the elimination of maladaptive behavior and the production of adaptive behavior.
A number of theoretical approaches to child therapy, ranging from analytical through family to milieu therapies, are examined, particularly in the light of current research.

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.

An advanced introduction to descriptive statistics and statistical inference.

Basic principles used in the design of experiments and the analysis of experimental data, with emphasis on complex analysis-of-variance techniques.

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.

A seminar series surveying some of the major contemporary problems in the area. Both human and animal research will be discussed. Required of all students who major or minor in Perception.

A series of seminars devoted to critical reviews of basic theoretical issues and recent advances in selected topics in learning.

A seminar series dealing with the physiological aspects of human behavior and with relevant animal physiological and behavioral studies. Open only to students obtaining minor credit in comparative and physiological psychology.

A series of seminars dealing with theoretical issues and research findings in the area of social psychology.

A detailed study of theoretical issues and research in the areas of child development and behavior.

A seminar on aspects of cytology, histology, anatomy, embryology, phylogeny and genetics in relation to the behavior of organisms.

Seminars dealing with topics in the comparative, physiological and neurological study of behaviour.

Comparative study of the vertebrate nervous system; detailed study of the central nervous system of mammals including man.

An examination of aspects of physiology and physiological chemistry in various experimental organisms.
710 Advanced Psychometrics An advanced course covering theory of test construction, factor analysis, and scaling methods.

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 subhuman species.

714 Biosychology Survey A course designed for broad coverage of topics related to Biology and Behavior. Current topics to be covered will include those from the areas of: physiology, physiological chemistry, phylogeny, ethology, and comparative psychology.

721, 741 Sensory and Perceptual Processes 2, 3 A series of seminars focusing on a number of specific selected topics. In addition, research going on within the department will be discussed.

725 Child Psychology The first half of this course will deal with concrete descriptions and evaluations of the most widely used research techniques applied to the study of developmental and child behavior. The second half will be concerned with an application of the research methods to the student's own research.

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.

740 Comparative Psychology An advanced course dealing with selected problems in animal behavior.

745 Child Psychology 3 Advanced seminar in Child Psychology.

750 Individual Research Project A supervised experimental study, together with a survey of relevant findings in the literature.

760 Advanced Experimental Psychology Detailed study of selected problems in the student's major area of specialization; e.g. cognition, learning, motivation, perception.

770 Instrumentation for the Behavioural Sciences An introduction to the principles of electricity, relay circuiting, and biological amplifiers.

780 Behaviour of Non-Human Primates A seminar on various aspects of non-human primate behaviour, including learning, concept formation, and social behaviour, accompanied by training in observational and testing techniques appropriate to the area of study.

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.
Department of Psychology

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 interpretations, 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 texts.

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., psychonanalytic, 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.

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.
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.

842 Applied Research
A seminar on methods and issues in applied research.

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.

844 Principles of Behaviour Modification and Programmed Learning
Theory and methodology of learning and behavior 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 Behavior
A consideration of current theories of organizational behavior 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.

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.
Department of Recreation

Associate Professor and Chairman of Department
R. Dion, B.A. (Ottawa), M.A. (New York)
Assistant Professor
J. Pearse, B.A. (Toronto)

Course Descriptions

100* Introduction to Physical Education and Recreation
A study of the history of physical education and recreation and the role that biological, sociological and psychological principles play in these areas. Reference will also be made to different schools of philosophy and the effect they have on physical education and recreation.
3 lectures

101* Institutional Physical Education and Recreation
This course is designed to acquaint the student with methods and practices in situations outside the normal setting. Discussion will centre around recreation for institutionalized persons such as those in penal institutions, mentally retarded centres, etc.
3 lectures

200* Philosophy of 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

205* 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

210* Principles of Recreation
A course designed to develop an overview of the total field of recreation including fundamental concepts of administration and programmes.
3 lectures

220* Comparative Programmes in Recreation
A study of recreation programmes in Canada, the United States and several European countries.
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 Departments, Y.M.C.A.'s, Therapeutic and Retarded Children's Centres, etc.
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

380 Basic Recreational Skills
Instruction in the basic skills and fundamentals of a wide selection of physical, social and cultural activities including folk and modern dancing; individual and team activities; canoeing, sailing and camp skills; performing and visual arts; music, etc.
4 hours per week per term
420* Growth, Development and Ageing
The changing capacities and interests of man as he grows and develops are studied. 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
Religious Studies

Assistant Professor J.R. Horne, M.A. (Western), B.Th. (Huron), Ph.D. (Columbia)
Acting Chairman

Professor G J.W. Fretz, A.B. (Bluffton), B.D. (Chicago Theol. Seminary),
M.A., Ph.D. (Chicago)

Associate Professor G W. Klaassen, B.A. (McMaster), B.D. (McMaster Divinity School)
D. Phil. (Oxford)

Associate Professor P A.M. McLachlin, M.A. (Toronto), B.D. (Emmanuel),
Th.D. (Emmanuel)

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 J.W. Miller, B.A. (Goshen), M.A. (N.Y.U.),
B.D. (Princeton), Th.D. (Basel)

Lecturer J J.M. Verkuijlen, S.T.L. (Nijmegen)

Note Students majoring in Religious Studies must have their programmes
approved by the programme adviser. Courses should be selected in ac-
cordance 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* or 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).

Undergraduate Courses

50J Grace and the Sacraments Grace; concepts pertaining to all the sacramen-
tal 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

103G* History and Literature of the Bible 1 A study of the history of Israel with special emphasis on Israel's view of
history and its consequences for ethics.

104G* History and Literature of the Bible 2 A study of the life and teaching of Jesus of Nazareth on the basis of the
Synoptic Gospels.

105P Introductory Hebrew An introduction to Hebrew grammar. Translation and exegesis of se-
lected passages from the Old Testament.
3 hours. Not offered in 1969-70.

106P New Testament Greek This course will consist of two parts:
(a) An Introduction to Greek grammar with appropriate grammatical
exercises and development of vocabulary;
(b) An exegetical study of the Greek Text of the Synoptic Gospels,
with Mark as the basis.
3 lectures.
110R History and Philosophy of the World's Major Religions
The history and philosophy of the world's major religions, compared and contrasted with the unique message of Christianity.
3 lectures.

115* Eastern Religious Thought
An introductory study of the history and thought of Hinduism and Buddhism, with particular attention to Zen Buddhism and its effect upon the culture of North America. For students in co-operative programmes.
3 lectures.

116* Western Religious Thought
An introductory study of the history and thought of Judaism and Christianity, with special emphasis upon recent "secularizing" movements in Christianity. For students in co-operative programmes.
3 lectures.

130P* - 131P* Introduction to Theology
A survey of the basic elements of Christian Faith, the relationship between revelation and reason, the authority of Scripture, the doctrine of God, of man, of the Church, of God's activity in history.
3 lectures (Fall & Winter Terms)

Philosophy 135* Fundamentals of the Philosophy of Religion
Basic ideas common to all religious beliefs will be discussed from a non-denominational viewpoint. What do we mean by revelation, sin, redemption? Can the existence of a supreme being be proved to the satisfaction of man's reason? Both classical and contemporary readings will be used.
No prerequisite.
3 hours.

210* World Religions 1
The History and thought of the major religions of India and the Far East.
3 lectures

211* World Religions 2
The History and thought of the major religions of Europe and the Near East.
3 lectures.

220 (History 250) History of Medieval 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.
3 lectures.

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.
3 lectures.
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.

236 The History of Christian Thought to 1800

A consideration of basic Christian statements of belief, and the arguments advanced for them, from the patristic period to the eighteenth century.

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, one term.

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, one term.

250* (Fine Arts 218*) Western Religious Art

An introductory survey of the visual art and architecture of Judaism and Christianity in the Common Era. The development and subsequent changes of style in places of worship and ceremonial objects and ornaments, and the changing forms of religious expression through visual art, will be studied.

300G—Seminar in 20th Century Values (full course)

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.

310 (Classics 370) Myth, Religion and Art

Deities, myths, and sagas correlated with literature, religion, philosophy and art from the 6th century B.C. to the 4th century A.D.

3 lectures

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.
Religious Studies

323* (History 353*)  Medieval Church History from 312 to 1122  3 hours, lectures and seminars.

324* (History 354*)  Medieval Church History from 1122-1449  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.

420 (History 476)  Senior Tutorial in History of Renaissance and Reformation  Prerequisite: History 260 or Religious Studies 223G*-224G*  2 hours

435*-436* (Philosophy  435*-436*)  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.
Science

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. Lavoisier. 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 (p. 94, 95) or equivalent.

2 lectures.

Examination at the school of Optimery Clinic
Department of Sociology and Anthropology

Professor, Chairman of the Department  
G.L. De Gré, B.S.S. (City College N.Y.) M.A., Ph.D. (Columbia)  
(Cated. Hon. (San Marcos, Lima)

Professor  

Visiting Professor  
O. Friedman, Jur. Dr. (Prague), M.Sc. (Econ.) (London)

Professor  
Helen Abell (Miss), M.S. (Cornell), Ph.D. (Columbia)  
Professor (G)  

Professor  
N.H. High, B.S.A. (Toronto), M.S., Ph.D. (Columbia) (On leave)

Professor  
H.D. Kirk, B.S. (City College, New York), M.A., Ph.D. (Columbia)

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  
Wm. B. Roosa, B.A. (Texas Christian), M.A. (New Mexico)  
Ph.D. (Michigan)

Associate Professor  
W.L. Sauer, B.A. (Wayne State), M.A., Ph. D. (Michigan State)

Associate Professor  
W.G. Scott, B.A. (Western) M.A. (Toronto)

Associate Professor  
E.W. Vaz, B.A., M.A. (McGill), Ph.D. (Indiana)

Assistant Professor  
T.S. Aber, B.A. (North Western), M.S. (Wisconsin-Milwaukee)

Assistant Professor  
M.A. Beauchamp, B.A., M.A. (Buffalo)

Assistant Professor  
Dorothy E. Counts (Mrs.), B.S. (S.W. Texas State College), M.A. (Kentucky), Ph.D. (Southern Illinois)

Assistant Professor  
R.D. Lambert, B.A., M.A. (McMaster), Ph.D. (Michigan)

Assistant Professor  
Jean Rogers (Mrs.), B.A. (Radcliffe), M.A. (New Mexico)

Assistant Professor  
Sally M. Weaver (Mrs.), B.A., M.A., Ph.D. (Toronto)

Assistant Professor  
Audrey Wipper (Miss), B.A., M.A. (McGill)

Sessional Lecturer  
M. Johanna Orr (Mrs.), B.A. (McMaster), M.A. (Waterloo)

Undergraduate Courses

Note 1 Students electing an Honours programme or a major in Sociology should register in Sociology 101-102. Students electing to major in Anthropology should register in Anthropology 101 and 102, but Anthropology 101 and 102 cannot be substituted for Sociology 100 towards further work in Sociology.

Note 2 General students who major in Sociology must elect the following courses: Sociology 100, Anthropology 102, Sociology 212, 320, 325, and one other full or two half courses in Sociology. Courses listed under Anthropology are accepted as credit in Sociology.

Note 3 General students who major in Anthropology must elect the following courses: Anthropology 101 and 102, 222 or 223, 225 or 226, Anthropology 350, and at least one other full course in Anthropology at the 300 level. Under certain conditions the following Sociology courses will be accepted for credit in Anthropology: Sociology 230, 251, 260, 270, 300, 301, 320, 331, and 335. Anthropology major must have their full programme approved for the second and third years by an anthropologist in the department.

Note 4 Students who pursue an Honours Programme in Sociology must take the following courses in their 4th year: Sociology 450, 470, 499 and two electives. Courses at the 400 level are normally open to Honours students only, but may be open to General students with the permission of the instructor.

Note 5 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.
Anthropology

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.
3 lectures.

102* Cultural and Social Anthropology
An introductory course on the nature of culture. Data are presented on several primitive cultures.
3 lectures.

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 area will be emphasized.
Prerequisites: 101 or permission of the instructor.
3 lectures.

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.
3 lectures. Offered at least once in 4 years.

225 North American Indians
A survey of North American Indian cultures as they were at the time of European contact. Data on the present-day status of several selected groups will be included.
Prerequisite: 102, or permission of the instructor.
3 lectures, alternate years.

226 Non-Literate Peoples of the World
A survey of non-literate cultures from the Americas, Africa, Asia, and Oceania. A culture area approach will be used.
Prerequisites: 102, 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.
3 lectures, alternate years.

228* Peoples of the Pacific
A survey of the indigenous cultures and societies of the Pacific region, including Australia. Prehistory and post-contact history of the area is considered, but the greater part of the course concerns the cultural systems of the area in the ethnographic present.
Prerequisites: 102 or permission of the instructor.
3 lectures, alternate years.

230* (Art 230*) 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 Australia-Oceania, together with related fields such as folk art, naive art and child art.

320 Introduction to Structural Linguistics
A general introduction to structural linguistics. A survey of linguistic approaches to the analysis and description of languages.
322 Language and Culture
The study of languages as social behaviour including semantic analysis (ethnoscience) and linguistic theory.
Prerequisites 102 or permission of the instructor.

350 Culture Theory
A survey of the historical development of the concepts of culture, cultural evolution, and acculturation.
Prerequisites: 101 and 102.
3 lectures. Offered once in 4 years.

353* Primitive Social Organization
A study of primitive social structure with primary emphasis on kinship systems.
Prerequisites: 102, or permission of the instructor.
3 lectures. Offered of sufficient demand.

356* Primitive Economics
A study of economic systems of bands, tribes, and chiefdoms as contrasted with those of primitive states.
Prerequisites: 102, or permission of the instructor.
3 lectures. Offered if sufficient demand.

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.
3 lectures, alternate years. Offered if sufficient demand.

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.
3 lectures, alternate years.

370* Ethnographic Field Methods
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.
Prerequisites: 102 or permission of the instructor.
3 lectures, alternate years.

390 or 391* Reading in Anthropology
Guided reading in a selected portion of the anthropological literature.
Prerequisites: Anthropology major and permission of the instructor.

450 Honours Seminar
Seminar on selected contemporary issues in anthropology. Open only to Honours Anthropology students.

499 Honours Essay
Directed reading and research in a selected area of anthropological inquiry. Open only to Honours Anthropology students.

Sociology

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 institution, classes and status groups,
sections will be made available in addition 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.
Student should possess a sound knowledge of basic sociological concepts.
3 lectures. alternate years.

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).

202* Sociological Statistics A first course in sociological statistics; sampling, central tendency, probability, co-variance, as illustrated in specifically sociological data.
3 lectures.

205* Social Problems An examination of cultural forces that create social problems and failures in personal and institutional adjustments. Specific attention is paid to the problems of emotional disturbance, addictions, delinquency and crime.
3 lectures.

210* (Psychology 253*) Introductory Social Psychology The relation between psychological processes and social interaction. Topics to be considered include (1) how we evaluate others' personalities, (2) determinants of friendship, (3) formation and change of attitudes, (4) conformity and independence, (5) the self-concept. Prerequisite: Introductory Psychology.
3 lectures. Fall term.

212* (Psychology 254*) Interpersonal Relations The contribution of social organization to interpersonal processes. Consideration of some “theories” of social interaction. The social system approach to the problem of personal and interpersonal control. Prerequisite: Second year standing.
3 lectures. Winter term.

230* Family and Kinship An evaluation of the origin and growth of the family as a social institution; its structures and functions in primitive and modern societies; the effect of modern technology on the family; trends and contemporary problems.
3 lectures.

240* Collective Behaviour The sociological analysis of the behaviour of crowds, mobs, publics, and related phenomena and their relationships to social organization and social change.
3 lectures.

241* Social Movements The sociological analysis of varieties of social movements and their relationships to social organization and social change.
3 lectures.

250* Crime and Society An analysis and criticism of the major theories of criminal behaviour. Emphasis is given to the relationship between social structure and criminal behaviour; types of criminal behaviour such as drug addiction; sta-
Statistics and contemporary research. A sound knowledge of sociological concepts is advisable.
3 lectures, alternate years.

251* Ethnic and Racial Relations
Relations between different racial and cultural groups; analysis of majority-minority group status.
3 lectures.

252* Juvenile Delinquency
A systematic analysis and criticism is presented of biological, psychological, psychoanalytical and sociological theories of juvenile delinquency. Attention is given to statistics and contemporary research with special emphasis on the distribution and types of delinquent subcultures.

260* Population
The study of population as an area of sociological investigation; population size, composition, and distribution; population trends and problems.
3 lectures, offered of sufficient demand.

270* Communication
An analysis of the role of language and other symbol systems in social interaction; the interplay between communication and the social system; the formation of attitudes through language; social and individual disorders as caused by, and reflected in, the breakdown in the communication process.
3 lectures, offered once in four years.

300* Human Communities
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 100 and Anthropology 102.
3 lectures, offered at least once in four years.

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.
3 lectures, alternate years.

310* Group Dynamics
An analysis of natural and experimental groups from a social structural view. The study of processes of differentiation, integration, power, etc., internally; and of nesting of small groups in larger collectivities.
Prerequisite: An honours programme in sociology or permission of the instructor.
3 lectures; fall term.

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 manner's 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.

3 lectures, alternate years.

320 Sociological Research

A systematic treatment of the logic and practice of methods basic to social research. Examination of problems of experimental design, sampling, data gathering, and analysis in the context of case studies of research. Students will be given laboratory experience in several techniques of research.

3 lectures.

325 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 year students majoring in sociology-anthropology, honours sociology-psychology; others admitted by permission of instructor.

3 lectures.

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.

3 lectures.

331* 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.

3 lectures.

339* Industrial Sociology

Sociological analysis of industry, including relationships between labour and management and industry and society.

3 lectures, alternate years.

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.

3 lectures, alternate years.

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* Political Sociology

The sociological analysis of the institutionalization of power, political movements, parties, conflict and its accommodation.

3 lectures.

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.

3 lectures.

450 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.

1 - 3 hours.

465 Readings

Selected readings and essay assignments under the direction of a staff member.

3 - 4 hours.

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.

1 - 3 hours.

499 Senior Honours Essay

Required of all honours students in Sociology or Psychology-Sociology in their fourth year.

Graduate Courses

Programme Leading to The Master of Arts Degree in Sociology:

Admission Requirements

The entrance requirement for the M.A. degree is an Honours degree in Sociology or its equivalent. Applicants not meeting this requirement may, with the approval of the Graduate Committee of the Department be admitted to a programme of qualifying work. This normally means one preliminary year of work in Sociology to insure that the student's training is equivalent to that of an Honours graduate in Sociology.

Course Requirements

a) Two semester courses in Sociological Theory
b) Two semester courses in Methods of Sociological Research
c) Two semester courses in a field of special interest, e.g. Comparative, Economic, Political, Social, etc.
Department of Sociology and Anthropology

Sociology, Social Change and Social Structure, Social Disorganisation and Deviance, Area Studies, Sociology of Religion, Sociology of Knowledge, etc.

d) In addition students will be expected to have completed a course in Introductory Statistics unless they can demonstrate competence through a qualifying examination, or unless in special cases this requirement is waived by the Graduate Committee of the Department.

e) Students whose M.A. theses require familiarity with a subject not given in the Department of Sociology are encouraged to elect an additional course in the appropriate department, e.g. History, Political Science, Geography, Economics, Literature, Philosophy, Psychology, French, (or other language), Mathematics, etc.

Thesis Requirement
The student for the M.A. degree in Sociology must present a thesis to the Department which will be defended before a committee of no less than two members of the Department.

Programme Leading to the Ph.D. Degree in Sociology:

Admission Requirements
For admission to the Ph.D. programme a student must have an M.A. degree in Sociology or its equivalent, plus a better than B average or its equivalent in his course work. The student must also submit his results from the Graduate Record Examination.

Students in the M.A. and Ph.D. programmes are expected to maintain a better than B average (approximately 70%) in their course work. The Graduate Committee of the Department will undertake a complete review of each student's work at the end of his first year in the Ph.D. programme.

Course Requirements
a) The student for the Ph.D. degree is required to enroll for a minimum of one academic year of course work selected in consultation with his graduate faculty adviser. A minimum of six semester courses in Sociology arc required.

b) In addition the candidate for the Ph.D. degree normally will be required to complete a one semester course in Advanced Statistics unless he can demonstrate proficiency in a qualifying examination.

c) Before he submits his dissertation to the Department the student must demonstrate reading proficiency in a language (e.g. French) other than English as specified by the Department.

d) The individual Ph.D. candidate must pass a set of oral and written comprehensive and qualifying examinations in Sociology as determined by the Department.

Thesis
In keeping with University requirements the candidate must submit a Doctoral Dissertation which he will be required to defend in an oral examination.

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 4th yr. honours soc. 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 4th yr. soc. honours students)*

508* Explanation in Sociology  
The writings of sociologists will be studied with a view to identifying among them actual or potential explanatory models and such tests of the theories as may have been devised. Where no testing of theory has been undertaken students are asked to specify possible approaches. *(Open to 4th yr. soc. honours students)*

542 Seminar  
Organization Analysis  
This seminar will study diverse theories, models and methods, and interdisciplinary approaches relevant to the analysis of complex organizations, such as industrial enterprises, public and governmental organizations, educational institutions, etc. Particular attention will be given to problems of productivity and organizational effectiveness, power and human relations, decision-making, innovation, and resistance to change. *(Open to Fourth-Year 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 Method  
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 measurements 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, with particular attention to evolutionism, historicism and functionalism. Theoretical problems are then 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. In order to do so, cross-cultural materials treated as historical examples will be used to develop general principles.

620* Comparative Social Structure  
The course is devoted to the comparative study of Western vs. non-Western societies with their institutions, structure and change in them. Modern sociological theory, which has developed through the last 2
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 thorough going analysis of Mannheim's *Ideology & Utopia* and related studies, the seminar undertakes to develop a general theory of the relation of social thought to social action, comparative value systems and the role of the scientist, artist and intellectual in his society. (Open to 4th yr. honours students who have completed Soc. 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 faith.

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. Kesavan, B.Sc. (Mysore), B.E., M.S. (Illinois), Ph.D. (Michigan)
Professor
T.M. Fraser, M.D., Ch.B. (Edinburgh), M.Sc. (Ohio State), L.M.C.C., F.A.C.P.M.
Professor
Professor
P.H. O’N. Roe, B.A.Sc. (Toronto), M.Sc., Ph.D. (Waterloo)
Professor
G.N. Soulis, B.A.Sc. (Toronto)
Associate Professor
M.L. Constant, B.Sc. (Toronto)
Associate Professor
P.L. Seeley, B.A. Sc. (Toronto)
Assistant Professor
P.H. Meincke, B.Sc. (Manitoba)
Assistant Professor
E.M. Pallett, B.Sc., M. Music (Oregon), Ph.D. (Michigan)
Assistant Professor
D.D. Schleiermacher, Diploma (Technische Hochschule, Munich), Diploma (Hochschule für Gestaltung, Ulm).
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).

Courses offered

Commencing in 1969, the Department of Systems Design will be offering an undergraduate co-operative programme leading to the B.A.Sc. degree. Individual course outlines were not available at the time of printing, however, prospective applicants are urged to contact the Chairman of the Department for a brochure outlining the curriculum and course offerings.

All courses in the department are one semester courses; the lecture and laboratory hours are determined by individual instructors.

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 automotive safety.

An undergraduate programme in Systems Design is currently under development and will be offered starting in the Fall semester of 1969.

Graduate Courses

601 Models and Analogues
Analytic and communicative types, characteristics of types, parameters of various model types, validity of types, economics of model types.

602 Design Heuristics
The role of decisions and information in heuristics, problem solution mazes and “trees”. Known design heuristics, trial and error, directed trial, sub-set grouping, interactive, etc.

603 Creative Synthesis in Design
The role of association and imagery in solution generation. Types of solution generators. Adaptive and substitutional processes. The role of experimentation and analysis in synthesis.

604 Design Morphology
Generation of problem statements, systems identification, generation of...
Department of Systems Design

sensitivity, compatibility and stability analysis; behavior prediction, and solution communication.

605 Decisions, Value and Utility in Design
Decisions under certainty, risk, and uncertainty, preference measures, ranking and transitivity, quality, dimensional analysis of quality, thresholds, simulation methods.

606 Planning of Innovative and Design Processes
Logic of design, determination of operations sequencing, estimates of time, uncertainty, risk and iteration related to design operations and time, determination of design operations nets.

607 The Theory of Human Communications
Man-Man; Man-Machine; Mass and Political. A survey of the structure, functions, philosophy, process and effects of mass and interpersonal communications.

662 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.

621 Statistical Models in Engineering
Review of introductory probability theory, random variables, conditional probability; probability and set theory; bivariate and multivariate distributions, independence of random variables; continuous statistical distributions, discrete statistical distributions, functions of one and more than one continuous random variable; estimating system performance from statistical component data; computational methods and Monte Carlo simulation techniques.

700 Architectural and Spatial
710 Human Systems Engineering
720 Product Manufacturing Design
730 System Theory
740 Communications
750 Socio-Economic Systems
760 Computer-aided Design
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.
808 Research thesis for the Master's degree . . .
809 Research thesis for the Ph.D.

Courses in the 600 series are offered on a regular basis. Courses in the 700 series are offered as and when required.

Additional systems-oriented graduate courses are now under development in the areas of physical systems, human systems engineering, and socio-economic systems.
10 Student Services
The Office of Student Affairs

The character and quality of student life on the campus is the concern of the Office of Student Affairs. This office is challenged to fulfill the responsibilities of the University to each individual student and to respond to the welfare and well-being of each student. Effort is made to attempt to create an atmosphere in the University where scholarship can flourish, while at the same time ensuring that the individual scholar does not become depersonalized in an organization which would be judged by total rather than individual achievement.

Generally this office offers professional services of a non-academic but co-curricular nature to assist all phases of students' personal growth during their University experience. These services are primarily those which students are not able to undertake for themselves or those which relieve them of the obligation to serve in areas in which such activity has rather limited development or educational value. Primarily the office acts as a liaison between the individual student and the larger University community, and offers both facilitating and interpretive contact within the University.

Office of Student Affairs

**University Residences**
- **Warden** H.R.N. Edyt, M.Sc., Ph.D.
- **Director** H.C. Vinnicombe, B.Sc. (Eng.)

**Counselling Service**
- **Director** W.W. Dick, B.A., B.D., M.A., Ph.D.
- **Assistant Director** J.J. Wine, B.A., B.Sc., Ph.D.
- **Dean of Men** (to be appointed)
- **Dean of Women** (Mrs.) H. Marsden, B.A., M.A.
- **Assistant Dean of Women** (Mrs.) H. Taylor, B.Sc., Ph.D.

**Creative Arts**
- **Director** P. Berg
- **Director of Music** A. Kunz, Staatsexamin (Mainz)
- **Director of Drama** (Mrs.) C.S. Hedges, B.A., M.F.A.
- **Director of Art** (Mrs.) N.L. Patterson, B.A.

**Medical Health Service**
- **Director** (to be appointed)
- **Supervisor of Nurses** (Mrs.) P. Livingston, R.N.
- **University Physician** (Mrs.) H. Reesor, B.A., M.D.

**Off-Campus Housing**
- **Co-ordinator** (Mrs.) E. Beausoleil

**International Student Office**
- **Advisor** (Mrs.) E. Beausoleil

---

**University Counselling Service**

It is the goal of the University Counselling Service to provide effective assistance to individual students. More specifically, professionally trained counsellors wish to help students with their vocational, personal, and/or emotional development during their university years. Our aim, first and foremost, is to help students develop their 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 with students to help develop resources and to look for the strength in a problem.
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 a 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 Service's 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), and there is also a counsellor in the Engineering Building, Room 2359, and in the Social Sciences Building, Room 344. Appointments can be made with the secretary for anytime from 9:00-12:00 and 1:00-5:00, Monday through Friday, either in person or by calling extension 2655.

Counselling Service Staff Members

**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. (Toronto), B.D. (Toronto), S.T.M. (Boston)

E. McCavish (Miss), B.A. (Toronto), M.A. (Colorado State)

S. Minas (Mrs.), B.A. (Wayne State), M.A. (Ohio)

J.J.H. Smart, B.A. (R.M.C.), B.A. (Queen's), M.A.Sc. (cand. Waterloo)

J.A. Van Evra (Mrs.), B.A. (Valparaiso), M.A. (Bowling Green State), Ph.D. (Michigan State)

R.J. Walsh, B.A. (Queen's), M.A.Sc. (cand. Waterloo)

J.L. Williams, B.A., M.A. (Alberia), Ph.D. (Missouri)

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.
Medical Health Service

The Medical Health Service provides first-aid and medical care on campus. All full-time registered students are eligible for treatment. Emergency care is given to anyone on campus.

A fully qualified medical staff which includes medical doctors (approximately four hours per day, Monday through Friday) and registered nurses is available for regular out-patient care from 8:00 a.m. to 8:00 p.m. daily. After those hours, Emergency Service Only is provided.

The infirmary section cares for patients requiring full-time care but not eligible for public hospital admission. The infirmary closes from the end of examinations in August until the first registration in September. Infirmary visiting hours are during the afternoon only—ending at 8:00 pm.

Vehicular access to the Medical Centre is via the Church Colleges’ road from Westmount Boulevard.

Health and Accident Insurance

All full-time students are covered from the date of registration by a University Health and Accident Insurance Plan. The premium, which is included in their tuition, is for single coverage only. Students requiring dependent coverage must inquire at the Medical Health Centre.

Regular students are insured from the date of registration for one year or until withdrawal from the course. Co-operative students are covered from date of each registration for a period including their subsequent work periods. Coverage ceases upon withdrawal from the course.

Students who do not wish to be covered by the Health and Accident Insurance Policy which is provided may opt out of the plan within three weeks after registration and have the premium payment refunded by showing proof of adequate alternate insurance coverage, provided no claim for benefits has been presented in this period. This insurance plan does not include the premium or benefits of the Ontario Hospital Insurance Commission plan. Hospital coverage is the student’s own responsibility.

Further information about the University’s Health and Accident Insurance Plan may be obtained from the insurance clerk. Claims are to be submitted to her also.

Student Discipline

The University of Waterloo is a community of men and women who have come together to enjoy the privileges and to accept the responsibilities of University life. The traditional privileges of a University are freedom of inquiry and freedom of expression. To maintain these freedoms it is the obligation of all students to adhere to a standard of responsible social behaviour that shall not reflect discredit upon the University. All students are reminded that they are bound to live in accordance with the laws of the community. Specifically this means respect for University regulations, personal liberty and civil law.

Students are subject to University regulations governing their behaviour at all times while remaining members of the University. Regulations and infractions thereof may be reviewed by a President’s Committee on Student Discipline and University Regulations. The members of this committee include University officers, faculty and students.
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 out 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 is the livingroom of the University. It is the community centre of the campus for all members of the University—students, faculty, administration, staff, alumni and guests.

The Campus Centre provides services and conveniences for the members of the University community and serves as a place where they can freely mix and get to know and understand one another better.

The Campus Centre is also a part of the educational programme of the University, providing a home for clubs and organizations, the Federation of Students, The Chevron, and other groups to use the facilities of the building for conferences, debates and meetings.

In short, the Campus Centre serves as a unifying force in the life of the University.

Its facilities include lounges for music listening, reading, games and television. As well, it has a coffee shop, two dining areas and a large lounge suitable for social gatherings and licensed receptions. Conference and meeting rooms, a music practice room and commercial facilities including the Federation's Campus Shop, a branch of the Canadian Imperial Bank of Commerce, a mail room and a sub-post office, a barber shop and beauty salon are also available.

The social and recreational areas are the responsibility of the autonomous Campus Centre Committee which sets policy regarding use and operation of these areas of the building.

Federation of Students

"When a multitude of young persons come together and freely mix with each other, they are sure to learn one from another even if there is no one to teach them; the conversation of all is a series of lectures to each, and they gain for themselves new ideas and views, fresh matter of thought, and distinct principle of action day by day."
The complementary education received from participation in extra-curricular activities, in many cases, has as 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 to those who wish to take advantage of it by the Federation of Students and its various agencies. All students of the University of Waterloo are members of the Federation of Students. The Charter of the Federation of Students which guarantees certain rights and privileges to students was approved by the Board of Governors of the University and then by the Provincial Secretary on April 27, 1967. It supercedes the Constitution of the Federation which was approved in a campus-wide referendum in 1964.

**Objects**

The principal “Objects” of the Federation are:

- To promote the welfare and interests of the students of the University of Waterloo in all matters respecting their common interests.
- To act as the representative of the students.
- To promote and maintain responsible student government.
- To promote and co-ordinate student participation in athletics, cultural and social activities.
- To promote and maintain communication between the student body and the duly elected and appointed authorities of the University of Waterloo.
- To promote and assist in maintaining good conduct and proper discipline.

**The Students’ Council**

Twenty-five elected members plus officers make up the Students’ Council which is the governing body of the Federation. Members representing all faculties, societies and colleges are included.

The functions of the Students’ Council, the governing body of the Federation, include upholding the objects of the Federation, administration and control of finances, and operation and control of all Boards and Committees of the Council. Almost all of the social and cultural activities of the student body are managed by the Students’ Council as well as off campus representation of the student body.

**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 coordinates 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 provides support for the Student United Nations Association of Canada (S.U.N.A.C.), Canadian University Services Overseas (C.U.S.O.), Conference on Inter-American Student Projects (C.I.A.S.P.), and others. The Board also maintains the Federation of Students association with the Canadian Union of Students (C.U.S.), the Ontario Union of Students (O.U.S.), the Indian-Eskimo Association (I.E.A.), and, from time to time, such groups as the Student Union for Peace Action (S.U.P.A.), and Friends of the Student Non-Violent Co-Ordination Committee (Friends of S.N.C.C.).

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 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 student suits, 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
Book Store

on the main floor of the New Food Services and Book Store Building. The Book Store is open week days from 8:30 a.m. to 5:00 p.m. throughout the year. It is our intention to extend Book Store hours from September to May. Please 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.

Career Planning and Placement

The Career Planning and Placement section of the Department of Coordination and Placement provides assistance for graduates from all Faculties who seek permanent employment and 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. Some of these employers also have requirements for 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. A third interview period of two weeks for post graduate students only, is held in March. Undergraduates from all faculties are urged to discuss career opportunities with the placement and career planning officials and to familiarize themselves with company brochures that are on display in the Placement Office. The Career Planning and Placement offices are located on the sixth 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 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.

**Renison College**
Sponsored by the Anglican Church of Canada for students of all denominations and affiliated with the University of Waterloo. Renison College offers credit courses in arts and the social science for the University of Waterloo degree. Applicants for admission to the University's Faculty of Arts through Renison College must be prepared to enrol in the College's academic programme (for details see the Renison calendar). Courses not offered by the College are available in the University. As Renison students are registered for degree purposes with the University, academic applications must be submitted through the University Registrar. Applicants for admission to the University's Faculties of Engineering, Mathematics, Science and to the Schools of Optometry, Architecture, and Physical Education and Recreation may apply to Renison College for residence privileges. They must be prepared to participate in the extra-curricular programmes of the College. Accommodation is available for men and women. Single rooms are reserved for senior students.

<table>
<thead>
<tr>
<th>Fees</th>
<th>Per Academic Year</th>
<th>Per Academic Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>$975</td>
<td>$487.50</td>
</tr>
<tr>
<td>Double</td>
<td>$900</td>
<td>$450.00</td>
</tr>
</tbody>
</table>

**St. Jerome's College**
St. Jerome's College is a Roman Catholic liberal arts college federated with the University of Waterloo. Its residence is on campus and is open to men enrolled in its own General Arts course, or registered in any faculty of the University. Both single and double accommodation is available.
(Single accommodation is not available to first year residents.)

<table>
<thead>
<tr>
<th>Fees</th>
<th>Per Academic Year</th>
<th>Per Academic Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>$950</td>
<td>$475.00</td>
</tr>
<tr>
<td>Double</td>
<td>$875</td>
<td>$437.50</td>
</tr>
</tbody>
</table>

**Notre Dame College**
Notre Dame College is the women's residence of St. Jerome's College. It is open to women registered in St. Jerome's or in any Faculty of the University of Waterloo. Seventeen single and eighteen double rooms, each provided with running water, built-in desks, book shelves, and wardrobes, accommodate fifty-four students. The residence has its own chapel along with 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.

<table>
<thead>
<tr>
<th>Fees</th>
<th>Per Academic Year</th>
<th>Per Academic Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>$950</td>
<td>$475.00</td>
</tr>
<tr>
<td>Double</td>
<td>$875</td>
<td>$437.50</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 various institutions.
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.

Fees:

<table>
<thead>
<tr>
<th></th>
<th>Per Academic Year</th>
<th>Per Academic Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double</td>
<td>$920</td>
<td>$460.00</td>
</tr>
</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 twenty-six houses with a total of 1287 rooms of which 873 are single rooms, 370 interconnecting rooms and eight are double rooms. A House comprises three floors. In addition to the usual facilities, each floor has a lounge and kitchenette and houses sixteen students in twelve single and two 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, four dining halls, chapel, two coffee houses, drugstore, tuck shop, barber shop and pickup service area as well as outdoor recreational facilities.

Village 2: Consists of four hundred eighty double rooms which will accommodate nine hundred and sixty residents. In addition, twenty Don’s suites will be available as well as accommodation for two tutors. Residents will be divided into groups of twenty-four with two groups forming a house. Five houses will form a house. Accommodation in double rooms will be available for two hundred and forty women and seven hundred and twenty men. Although Village 2 will come under the jurisdiction of the Warden, it will be 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 us in pairing off residents, a separate questionnaire will be sent to you after you have been accepted into residence. Careful consideration in filling out this questionnaire will better enable us 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></th>
<th>Per Academic Year</th>
<th>Per Academic Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>$1030</td>
<td>$515.00</td>
</tr>
<tr>
<td>Double (Inter-connecting)</td>
<td>$980</td>
<td>$490.00</td>
</tr>
</tbody>
</table>

Minota Hagey Residence

The Minota Hagey Residence can accommodate seventy-five 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 residence is equipped with a living room, lounge, study rooms, and washrooms. The apartments are equipped with a refrigerator, stove, washing machine, and a telephone. Each apartment is equipped with a living room, lounge, study rooms, and washrooms. The apartments are equipped with a refrigerator, stove, washing machine, and a telephone. Each apartment is equipped with a refrigerator, stove, washing machine, and a telephone.
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, and residents can use the facilities available in the nearby Food Services Building. A kitchen with adjoining small dining room is located in the basement where light meals may be prepared.

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>$295</td>
<td>$590</td>
<td>$885</td>
</tr>
</tbody>
</table>

**Department of University Extension**

One of the responsibilities of a University is to provide opportunities for continuing education for adults. In an atmosphere of directed study, within the environment of academic discipline, these opportunities 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 education for adults, give freely of their time to help in the development 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 scheduling 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 the 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 available 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 education. The
credits. An "Acknowledgement" suitable for framing 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 six 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 two 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 1968-69. 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 1968-69 Programme

Courses
- Field Sales Management (3)
  Sales Management
- Sales & Marketing Management for Industrial Marketers
- Sales & Marketing Management in the Smaller Business
- Training the Sales Trainer (3)
- Problem Analysis & Decision Making (Kepner-Tregoe) (2)

Seminars
- Advertising Management
- Manpower Development
- Marketing Research
- Sales Promotion
- New Product Development
- Marketing Planning
- Physical Distribution
- Product Management
- Sales Office Management
- Finance & Accounting for Marketing
- Computer Applications in Marketing
- Advanced Salesmanship (2)
- New Dimensions in Sales Management
- Innovations in Marketing Management
- Marketing for Non-Marketing Executives

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, Ont., Area Code 519, 744-6111 (Ext. 2577)
11 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 all 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 service 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. Incidental fees are not refundable.

The fee schedule shown is the one in effect for the 1968-69 year and at the time of printing is still subject to review and possible change for the 1969-70 year. 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

<table>
<thead>
<tr>
<th>Faculty or School</th>
<th>Year</th>
<th>Tuition</th>
<th>Incidental* Fees</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arts</td>
<td>All Years</td>
<td>$510.50</td>
<td>$70.00</td>
<td>$580.50</td>
</tr>
<tr>
<td>Engineering</td>
<td>Year One</td>
<td>292.50</td>
<td>36.75</td>
<td>329.25</td>
</tr>
<tr>
<td></td>
<td>Other Years</td>
<td>342.50</td>
<td>36.75</td>
<td>379.25</td>
</tr>
<tr>
<td>Environmental</td>
<td>All Years</td>
<td>342.50</td>
<td>36.75</td>
<td>379.25</td>
</tr>
<tr>
<td>Studies -</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Architecture</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
<td>All Years</td>
<td>510.50</td>
<td>70.00</td>
<td>580.50</td>
</tr>
<tr>
<td></td>
<td>Year One</td>
<td>292.50</td>
<td>36.75</td>
<td>329.25</td>
</tr>
<tr>
<td></td>
<td>Other Years</td>
<td>317.50</td>
<td>36.75</td>
<td>354.25</td>
</tr>
<tr>
<td>Science</td>
<td>All Years</td>
<td>510.50</td>
<td>70.00</td>
<td>580.50</td>
</tr>
<tr>
<td></td>
<td>Year One</td>
<td>292.50</td>
<td>36.75</td>
<td>329.25</td>
</tr>
<tr>
<td></td>
<td>Other Years</td>
<td>317.50</td>
<td>36.75</td>
<td>354.25</td>
</tr>
<tr>
<td>Optometry</td>
<td>All Years</td>
<td>510.50</td>
<td>70.00</td>
<td>580.50</td>
</tr>
<tr>
<td>Physical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education and</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part time</td>
<td>Per Course</td>
<td>100.00</td>
<td>NIL</td>
<td>100.00</td>
</tr>
<tr>
<td>Students</td>
<td>(Limit, 2 courses per session)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Incidental fees included in the above schedule are shown in detail below. The additional fees for photograph, for degree and graduation, will be assessed at the registration as indicated below.

### Incidental*—Compulsory Assessment

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Session</th>
<th>Co-operative 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</td>
<td>6.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Health Insurance (See Note 2)</td>
<td>10.00</td>
<td>6.75</td>
</tr>
<tr>
<td></td>
<td>$70.00</td>
<td>$36.75</td>
</tr>
<tr>
<td>Photograph (At First Registration)</td>
<td>$1.00</td>
<td>$1.00</td>
</tr>
<tr>
<td>Degree and Graduation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(At Final Registration Only)</td>
<td>$10.00</td>
<td>$10.00</td>
</tr>
<tr>
<td>Society Fees (See Note 3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Note 1—Tenth Anniversary Fund

In January, 1968 the Student’s 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 applying to the Federation of Students’ office in the Campus Centre Building within three (3) weeks after registration date.
**Note 2—Health Insurance**

The premium of $10.00 affords coverage for a 12 month period from date of registration. The “co-operative” premium of $6.75 affords coverage for an 8 month period from the date of registration. First year co-operative students registering in January for second term are assessed $3.25 to ensure coverage until the date of next registration. Final year co-operative students, returning from work terms and registering in January, are assessed $3.25 to complete coverage for the final term.

The Health Insurance plan does not include the premium or benefits of the Ontario Hospital Services Commission. Such coverage is the student's own responsibility.

Students who do not wish to take this insurance and who can show proof of adequate coverage elsewhere will be entitled to a refund of the premium if request for premium refund is made within three weeks after registration date, provided no claim for benefits has been presented in this period. Proof of coverage should be presented to the Student Health Services Centre where authorization for a refund will be issued. Payment of fees is required at registration as per assessment.

**Note 3—Society Fees**

The following schedule of fees applies:

<table>
<thead>
<tr>
<th>Society Fee</th>
<th>Co-operative Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arts</td>
<td>$2.50</td>
</tr>
<tr>
<td>Engineering</td>
<td>$3.00</td>
</tr>
<tr>
<td>Mathematics</td>
<td>$1.50</td>
</tr>
<tr>
<td>Science (including Optometry)</td>
<td>$1.50</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
**Fees**

**Schedule of Fees—Graduate Studies**

For specific details of programmes and definitions see the Graduate Studies Section, page 128.

<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>$396.00</td>
<td>$70.00</td>
<td>$466.00</td>
</tr>
<tr>
<td>per calendar year</td>
<td>132.00</td>
<td>33.35</td>
<td>165.35</td>
</tr>
<tr>
<td>Beyond the minimum fee for the programme</td>
<td>60.00</td>
<td>70.00</td>
<td>130.00</td>
</tr>
<tr>
<td>per calendar year</td>
<td>30.00</td>
<td>33.35</td>
<td>63.35</td>
</tr>
<tr>
<td>Beyond the minimum fee for the programme</td>
<td>60.00</td>
<td>70.00</td>
<td>130.00</td>
</tr>
<tr>
<td>per term</td>
<td>30.00</td>
<td>33.35</td>
<td>63.35</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 Mathematics</td>
</tr>
<tr>
<td>Faculty of Science</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 396.00
- b) 'Two year' programme 792.00
- c) 'Three year' programme 1,188.00

**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.

**Incidental*—Compulsory**

<table>
<thead>
<tr>
<th>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</td>
<td>6.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Health Insurance (See Note 2)</td>
<td>10.00</td>
<td>3.35</td>
</tr>
<tr>
<td></td>
<td>$70.00</td>
<td>$33.35</td>
</tr>
</tbody>
</table>

Photograph (At First Registration Only)  $1.00
Degree and Graduation                    300.00
**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 applying to the Federation of Students' office in the Campus Centre Building within three (3) weeks after registration date.

**Note 2—Health Insurance**

The premium of $10.00 affords coverage for a twelve month period from date of registration. The "term" premium of $3.35 affords coverage for a four-month period from date of registration.

The Health Insurance plan does not include the premium or benefits of the Ontario Hospital Services Commission. Such coverage is the student's own responsibility.

Students who do not wish to take this insurance and who can show proof of adequate coverage elsewhere will be entitled to a refund of the premium if request for premium refund is made within three weeks after registration date, provided no claim for benefits has been presented in this period. Proof of coverage should be presented to the Student Health Services Centre where authorization for a refund will be issued. Payment of fees is required at registration as per assessment.

Coverage for dependents is also available at additional premium. For information write to Students Health Insurance c/o University of Waterloo, or enquire at registration.

**Miscellaneous Fees**

<table>
<thead>
<tr>
<th>Late Registration</th>
<th>$10.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transcript of record</td>
<td>$1.00</td>
</tr>
</tbody>
</table>

**Residence Fees 1969-70**

*Per Academic Year (Two Terms)*

<table>
<thead>
<tr>
<th>Residence</th>
<th>Single Room</th>
<th>Double Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Waterloo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Student Village 1 and 2</td>
<td>$1,030.00</td>
<td>$980.00</td>
</tr>
<tr>
<td>- Minota Hagey</td>
<td>590.00*</td>
<td>-</td>
</tr>
<tr>
<td>St. Paul's College</td>
<td>-</td>
<td>920.00</td>
</tr>
<tr>
<td>Conrad Grebel College</td>
<td>-</td>
<td>875.00</td>
</tr>
<tr>
<td>Renison College</td>
<td>975.00</td>
<td>900.00</td>
</tr>
<tr>
<td>St. Jerome's College</td>
<td>950.00</td>
<td>875.00</td>
</tr>
<tr>
<td>Notre Dame College</td>
<td>950.00</td>
<td>875.00</td>
</tr>
</tbody>
</table>

*Excludes Meals

Co-operative students are assessed per term at 50% of above rates. All students may pay residence fees on a term basis; payments are due and payable on or before the day of registration or the first day of each term. This fee does not include the period between the end of a term and the beginning of the next term.

Rooms may be occupied for twenty-four hours before registration and after final examination.

Refunds of fees are made at the discretion of the University.

Information concerning the Residences can be found on page 352.
12 The University Libraries
The University Libraries

University Librarian
William J. Watson, B.A. (Carleton), M.A., B.L.S. (McGill)
Doris E. Lewis, (Mrs.), B.A., B.L.S. (Toronto)
To be appointed
Robert G. Bean, B.A. (Western) B.L.S. (Toronto)

Technical Services

Acquisitions Department

Head
Enid Waterman, (Mrs.) B.A. (McMaster), B.L.S. (Toronto)

Acquisitions Librarian
Paul Dyment, B.A. (Manitoba), B.L.S. (McGill)

Serials Section

Head
Susan Nichols, (Miss) B.A. (Waterloo), B.L.S. (British Columbia)

Serials Librarian
Mary Rivard, (Miss) B.A. (Vermont), M.L.S. (Rosary College)

Bibliographic Searching Department

Head
Joan Scanlon, (Miss) B.A., M.A., B.L.S. (Toronto)

Cataloguing Department

Head
Carolyn Pawley, (Mrs.) B.A. (McMaster) B.L.S. (Toronto)

Assistant Head
Patricia Fitz Gerald, (Mrs.) B.A., B.L.S. (Toronto).
M.S. in L.S. (Western Reserve)

Cataloguers
Daniel Bruce, B.Sc. (Eng.-Phys.) M.Sc. (Dalhousie), B.L.S. (Toronto)
Lesley Sangster, (Miss) B.A. (Adelaide), Dip. Lib. (N.S.W.)
Jeanette Schmidt, (Miss) B.A. (Western), B.L.S. (Toronto)
Amy Chan, (Mrs.) B.A. (Hong Kong), M.L.S. (Western)
Edmund A. McMahon, B.A. (Sir G. Wms.), M.L.S. (Syracuse)
Wasyl Sirskyj, B.A., (Toronto), M.A. (Waterloo), B.L.S. (Toronto)

Public Services Arts Library

Head
Helen McKinnon, (Miss) B.A. (Saskatchewan), B.L.S. (Toronto)
M.L.S. (McGill)

Circulation Department

Head
Elaine Reaman, (Miss) B.A. (McMaster) B.L.S. (Toronto)

Reference Department

Head
M.I. Belle Grant, (Miss) B.Sc. (Columbia), B.L.S. (Wisconsin),
M.A.L.S. (Michigan)

Reference Librarians
Judith Boettger, (Miss) B.A. (Waterloo), B.L.S. (British Columbia)
Rienzi W.G. Crusz, B.A. (Ceylon), B.L.S. (Toronto)
Alison Fitzgerald (Miss) B.A. (Queen's), B.L.S. (Toronto)
Diane Wilkins (Miss) B.A. (Waterloo), M.L.S. (McGill)

Public Services Engineering, Mathematics and Science Divisional Library

Head
T.K. Srinivasa Iyengar, B.S. (Mysore), M.S.L.S. (Simmons)

Circulation Department

Supervisor
Frances Breithaupt, (Mrs.) B.A. (Toronto)

Reference Department

Head
Ada Berti, (Miss) B.A. (Windsor) B.L.S. (Toronto)

Reference Librarians
Emily Chang, (Miss) B.Sc. (Loyola College), M.L.S. (McGill)
Janet Gordon, (Miss) B.A., B.L.S. (Toronto)
The modern university library is a major resource for research and study, and as such shares in the development of academic excellence within the university. It supports teaching and research by acquiring, cataloguing, and making available for use books, periodicals, documents, manuscripts, maps, pamphlets, micromaterials, slides and phonorecords, and by providing reference, interlibrary loan and circulation services for students, faculty, researchers and staff.

There are two centres for library service and study on the campus. The new $2,525,000 Arts Library Building was officially opened in October, 1965 and presently provides accommodation on the second (main) floor and third floor for 175,000 volumes in the Humanities and Social Sciences, as well for seating space for 400 readers and quarters for the library administration and all technical services. Some parts of the first floor are being used for library receiving, binding preparation, serials acquisitions, and storage. University administrative offices are housed temporarily on other floors of the building. Future expansion will provide ten floors with a total area of approximately 167,000 square feet, to accommodate 2,000 readers and 800,000 volumes.

The Engineering, Mathematics and Science Library occupies temporary quarters of some 34,000 square feet on the fourth floor of The Mathematics and Computer Building, which includes seating for about 550 readers. This collection consists of some 100,000 volumes of books and bound periodicals in Science, Mathematics and Technology, about 1500 current journals and a fine collection of indexes, abstracts and other reference materials.

The total library holdings of the University include approximately 310,000 volumes of books and bound journals, 3,600 current periodical subscriptions and many kinds of special materials. The collection is increasing at the rate of 60,000 volumes per year, and more than half a million dollars per year is now being spent to build a collection that will have the richness and depth necessary for the scholarly research required by our undergraduate, post-degree and research programmes.

A staff of professional librarians and supporting personnel, now numbering more than 130, will be happy to assist users of both libraries to make the best possible use of the library collections and facilities. A Student Library Handbook explains the arrangement of library materials, the classification system, circulation procedures, and general rules and regulations. A similar handbook for members of the faculty will soon be issued.

The library has successfully completed its first venture into automation with a computer-produced Serials List, now in its third edition. The annual volume is kept up-to-date with weekly supplements which are available at all service points in the libraries. The annual cumulation is distributed to academic departments and to other academic libraries; and provides quick reference to our serials holdings. The next step in automation, now in the programming stage, will be the mechanization of our circulation system, with acquisition and cataloguing procedures to follow. Computerization will allow the library to provide services not possible with manual procedures, and the computer will perform many routine tasks with speed and accuracy.
Winter Walk
13 The Department of Co-ordination and Placement
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 coordinator 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.

                          G.L. White, B.A.Sc. (Toronto), P.Eng.

Engineering, Applied Physics
and Applied Chemistry

Assistant Director  D.H. Copp, B.A.Sc. (Toronto), P.Eng.

Administrative 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), Eng.
                          R.A. Grant, B.Sc. (Queen's), P.Eng.
                          R. Grant, B.A.Sc. (Toronto), P.Eng.
                          L.B. Jones, B.A.Sc. (Toronto), P.Eng.
                          A.L. Lind, B.Sc. (Queen's), 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.
                          A.R. Dunnet, B.B.A. (New Brunswick)
                          T.H. Fitzgerald, B.A. (St. Lawrence).
                          P.K. Kalbfleisch, B.A. (Waterloo Lutheran)
                          S.R. Stankus, B.Sc. (R.M.C.)

Applied Physics  L.R. Bricker, B.Sc., M.Sc. (Waterloo)

Co-operative Mathematics
Options in Actuarial Science,
Computer Science, Optimization,
and Statistics

Assistant Director  R.J. Wieser, B.Eng. (Saskatchewan) P.Eng.

Co-ordinators  A.R. Dunnet, B.B.A. (New Brunswick)
                          T.H. Fitzgerald, B.A. (St. Lawrence).
                          P.K. Kalbfleisch, B.A. (Waterloo Lutheran)
                          S.R. Stankus, B.Sc. (R.M.C.)

Option for Prospective High School Teachers

Co-ordinator  B.A. McCallum, B.A. (Western)

Co-operative Applied Psychology

Co-ordinator  R.J. Walsh, B.A. (Queen's)
Co-operative Physical Education and Recreation

Co-ordinators

M.A. McMartin, B.A. (Western)
B.E. Orton, B.P.H.E. (Toronto)
J.D. Paton, B.A. (U.N.B.), Rec. Cert. (Western)

Environmental Studies

—Architecture

Co-ordinator J.W. Hoag, B. Arch. (Toronto).

Career Planning and Placement

Director

E. Zapf, B.Ed. (Saskatchewan), B.S.W. (Toronto)
C.F. Burk, M.A.Sc. (Toronto), P.Eng.
Miss E. McTavish, B.A. (Toronto), M.A. (Colorado State)

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 for 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.

Operation of the Plan

The necessary arrangements for the integration of the work terms, the securing of potential employers of the students, the arranging of interviews, the professional guidance involved, the grading of “work reports” 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 introduce students to the necessary discipline of work and responsibility.

The Work-Study Sequence

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. The division at the end of the first term of study is based upon student preference, financial considerations of students, etc. As far as possible students' choices of A or B streams will
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 below:

<table>
<thead>
<tr>
<th></th>
<th>1969</th>
<th>1970</th>
<th>1971</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fall</td>
<td>Winter</td>
<td>Fall</td>
</tr>
<tr>
<td>Stream</td>
<td>1A</td>
<td>1B</td>
<td>1A</td>
</tr>
<tr>
<td>“A”</td>
<td></td>
<td></td>
<td>2A</td>
</tr>
<tr>
<td>Stream</td>
<td>3A</td>
<td>4</td>
<td>3A</td>
</tr>
<tr>
<td>“B”</td>
<td></td>
<td></td>
<td>4A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

Co-operative Physical and Health Education operates on “A” steam only, and variations of the standard programme are used for Environmental Studies—Architecture, the option in Co-operative Mathematics for Prospective High School Teachers, and Co-operative Applied Psychology.

**Co-operative Work Assignments**

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 co-operating employers.

Students and employers’ representatives choose each other through the Department’s placement process. 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.

Although the Co-ordination Department does not guarantee placement of students, every effort is made to ensure that appropriate employment sources are available.
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, 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.

Students in co-operative courses are required to return for a second work term when acceptable to employers. 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.

Satisfactory co-operative work assignments are a requisite to graduation and poor performance is thoroughly investigated. No student may continue in a co-operative course at the University of Waterloo if he is not capable of acceptable progress in his work assignments. The failure of a student in two work terms will result in a thorough investigation of his performance. 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 the faculties, with employers and with the students, so that a valid assessment of a student's progress can be made by members of the Department.

The student is required to prepare a "work report" on some phase of his current employment during each work assignment. A report must be submitted each time a student returns to the University for an academic term. The report must be approved by the employer and submitted to the Co-ordination Department at the times set forth in work report instructions.

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. The work report together with an evaluation report from the employer forms the basis for grading the student's performance on his work assignment.

**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 his course and the University of Waterloo.
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.

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.

At Waterloo, students entering a co-operative programme feel they are not merely "at school," but are already launched in their careers.

Thus in co-operative education, the University and society, through its numerous institutions, co-operate to produce a richer educational experience for university undergraduates. The task of the University is to engage their minds in demanding and fundamental studies, while the role of those who co-operate with the University is to engage their minds and youthful enthusiasm in the complementary discipline of well-ordered work experience.

It is this concept that forms the basic philosophy and underlying principle of co-operative education.

It is the Department of Co-ordination and Placement that provides the student with assistance and counselling necessary to ensure proper integration of the academic and practical phases of his education.

**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:

Mr. A.J. Fisher Fiberglas Canada Limited  
*Chairman*

Mr. H.L. Hinchcliffe Shell Canada Limited  
*Vice-Chairman*

Mr. L.J. Eskritt Ball Brothers Limited  
*Secretary*

Mr. A.E. Ades Air Canada  
Mr. H.J. Baker Aluminum Company of Canada Limited  
Mr. W.R. Coulter Coulter Copper & Brass Co. Ltd.  
Dr. H.R.L. Streight Du Pont of Canada Limited  
Mr. W.T. Whelan Chair of the Council
Mr. W.D. Walker  Hawker Siddeley Canada Limited
Mr. W.H. Bechtel  Kaufman Footwear Limited
Mr. C.C. Wright  Kimberly-Clark Pulp & Paper Co. Ltd.
Dr. F.S. Eadie  Northern Electric Company Limited
Mr. H.W. Adcock  Ontario Department of Highways
Mr. C.C. Parker  C.C. Parker and Associates
Mr. D.H. Stevens  Pigott Construction Company Limited
Mr. A. Staig  Proctor & Redfern
Dr. D.H. Laughland  Public Service Commission
Mr. C.P. Layard  The Steel Company of Canada Limited
Mr. H.P. Connor  Woods, Gordon and Company

Advisory Council for Option in Co-operative Mathematics for Prospective High School Teachers.

Mr. W.H. Baxter,  Grand River Collegiate Institute, Kitchener.
Mr. H.B. Dean,  Deputy General Secretary, O.S.S.T.F.
Mr. H.G. Dearborn,  Burnhamthorpe Collegiate Institute, Etobicoke.
Mr. J.J. Del Grande,  Co-ordinator of Mathematics, North York.
Mr. A.F. Duncan,  Superintendent of Education, Kitchener-Waterloo.
Mr. J.W. Fencott,  R.H. King Collegiate Institute, Scarborough.
Mr. J.G. Gardner,  Principal, Woodroffe High School, Ottawa.
Mr. N.J. Hill,  St. Mary's Collegiate Institute, St. Mary's.
Mr. E.G. Marcy,  Ancaster High and Vocational School, Ancaster.
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.

University members

Dr. H.E. Petch,  Academic Vice-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,  Mathematics Co-ordinator.
Dr. S.G.B. Robinson,  Liaison Officer, Secondary Education.

Organizations Employing Co-operative Architectural Students

H.G. Acres & Company Limited
Gordon S. Adamson & Associates
Affleck, Dimakopoulos, Lebensold Architects
Balharrie Helmer Gibson, Architects
Barnett & Rieder Associates
G.E. Bemi & Associates
Betts, Beaudoin, Cash & Nobbs
Boigon and Heinonen Architects
Bolton Elwood & Aimers, Architects
R. Calvin Clendaniel
Central Mortgage and Housing Corporation
Department of Transport, Architectural Department
Louis N. Fabbro, Architect
John J. Farrugia, Architect & Town Planner
Gerencser & Russell
Gilleland & Janiss
Govan Kaminker Langley Keenleyside
Melick Devonshire Wilson, Architects
Hancock Little Calvert Associates
William E. Keenan, Architect
Mrs. Gail E. Lamb
John E. Lingwood
Lithwick Lambert Sim & Johnston, Architects
Marani, Routhwaite & Dick, Architects
Mathers & Haldenby, Architects
J. Manfred May
Moffat, Moffat & Kinoshita
Ronald E. Murphy, Architect
James A. Murray, Architect
Murray & Murray
Page & Steele
John B. Parkin & Associates
Pfohl, Roberts & Biggie
Robbie Vaughan & Williams, Architects
Kevin Roche, John Dinkeloo & Associates
Saxby & Pokorny
Shore, Moffat & Partners
Warren M. Smale
R. Stewart Smith, Architect
Texaco Canada Ltd.
Turley, Stievater, Walker & Mauri
University of Waterloo-Department of Design
Warner, Burns, Toan & Lunde
Webb, Zerafa, Menkes, Architects

Organizations Employing Co-operative Mathematics Students

A.G.T. Management Systems Consultants
Actuarial Consultants of Canada Limited
H.G. Acres & Company Limited
Air Canada
Allied Towers Merchants Limited
Aluminum Company of Canada, Limited
A.E. Ames & Company
Atlas Steels Company
Atomic Energy of Canada, Limited
Automatic Electric (Canada) Limited
Bata International Centre
Beaver Lumber Company Limited
The Board of Education
Borough of North York
City of Hamilton
Bell Canada
The British American Oil Company Limited
Budd Automotive Company of Canada Ltd.
Burroughs Business Machines Ltd.
CAF Industries Limited
The Canada Life Assurance Company
Canada Permanent Trust
Canada Trust-Huron & Erie
Canadair Limited
Canadian Canners Limited
Canadian General Electric Company Limited
Canadian Imperial Bank of Commerce
Canadian Industries Limited
Canadian Ingersoll-Rand Company Limited
Canadain International Paper Co.
Canadian Kodak Co., Limited
Canadian Marconi Company
Canadian National Railways
Canadian National Telecommunications
Canadian Pacific
Canadian Pittsburgh Industries Ltd.
Canadian Tire Corporation Limited
Cockshutt Farm Equipment of Canada Ltd.
Computel Systems Ltd.
Computing Devices of Canada Limited
Confederation Life Association
The Consumers' Gas Company
Continental Can Co. of Canada Limited
Control Data Canada Limited
Co-operators Insurance Association
Crown Life Insurance Co.
DCF Systems Limited
The Dehavilland Aircraft of Canada Ltd.
Deloitte, Plender, Haskins & Sells
Dominion Dairies Limited
Dominion Foundaries and Steel Limited
Dominion Life Assurance Company
Dominion Stores Limited
Dominion Textile Company Limited
Domtar Limited
Domtar Packaging Limited
Doubleday Canada Limited
Dunlop Canada Limited
Dupont of Canada Limited
The T. Eaton Co. Limited
City of Edmonton
Electric Reduction Company of Canada Ltd.
Emco Limited
The Empire Life Insurance Company
The Excelsior Life Insurance Company
Falconbridge Nickel Mines Limited
Firestone Tire & Rubber Company of Canada, Ltd.
Ford Motor Company of Canada, Limited
Frigidaire Products of Canada Limited
Galt Metal Industries 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 Co. of Canada Limited
Government of Canada...
Department of Co-ordination and Placement

Dept. of Energy, Mines & Resources
Dept. of Finance
Dept. of Forestry
Dept. of Indian Affairs and Northern Development
Dept. of National Defence
Dept. of National Health & Welfare
Dept. of National Revenue
Dept. of Transport
Dominion Bureau of Statistics
National Energy Board
Post Office Department
Great-West Life Assurance Company
University of Guelph
Honeywell Controls Limited
I-T-E Circuit Breaker (Canada) Limited
The Imperial Life Assurance Company of Canada Limited
Imperial Oil Limited
Imperial Tobacco Company of Canada Limited
Industrial Acceptance Corporation Limited
International Business Machines Company Limited
International Harvester Company of Canada, Limited
The International Nickel Company of Canada Ltd.
Kellogg Company of Canada Limited
Charles A. Kench & Associates Ltd.
Kingsway Transports Ltd.
John Labatt Limited
Lever Brothers Limited
Liquor Control Board of Ontario
London Life Insurance Company
Manitoba Hydro
The Manufacturers Life Insurance Company
McKinnon Industries Limited
Metropolitan Life Insurance Company
Minnesota Mining & Manufacturing of Canada Limited
Bank of Montreal
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 Research Council of Canada
National Trust Company
North American Life Assurance Company
Northern & Employers Group
Northern Telephone Limited
The Bank of Nova Scotia
Province of Nova Scotia
Dept. of Provincial Secretary
Ontario Hydro
Ontario Institute For Studies in Education
Province of Ontario
Department of Education
Department of Highways
Treasury Board
Oshawa Wholesale Limited
University of Ottawa
Dominion Mining Corporation of Canada Ltd.
County of Peel  
Philips Electronics Industries Limited  
Polymer Corporation Limited  
The Procter & Gamble Company of Canada Limited  
The Prudential Assurance Company Limited  
The Public Service Commission of Canada  
Quebec Hydro  
Queen’s University  
Recording & Statistical Corporation Limited  
Richardson, Bond & Wright Limited  
Robin Hood Flour Mills Limited  
Rothmans of Pall Mall Canada Limited  
The Royal Bank of Canada  
Ryerson Polytechnical Institute  
S.D.I. Associates Limited  
Samsonite of Canada Limited  
Saskatchewan Government Insurance Office  
Borough of Scarborough  
Score Scientific-Commercial Research Services  
J.M. Schneider Limited  
I.P. Sharp Associates Limited  
Shell Canada Limited  
Simpsons-Sears Limited  
The Sovereign Life Assurance Company of Canada  
The Steel Company of Canada Limited  
Sun Life Assurance Company of Canada  
Sunshine Uniform Supply Co. Limited  
Texaco Canada Limited  
The City of Toronto, Finance Dept.  
The Toronto Stock Exchange  
Toronto Traffic Control  
Toronto Transit Commission  
The Toronto-Dominion Bank  
Trans-Canada Pipe Lines Ltd.  
Union Gas Co. 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-Canada, Division of Sperry-Rand Limited  
Wabush Mines  
University of Waterloo  
Dept. of Civil Engineering  
Computer Centre  
Management & Systems Engineering  
Dept. of Mechanical Engineering  
University of Western Ontario  
Workmen’s Compensation Board  
York University  

Organizations Employing Co-operative  
Physical Education and Recreation Students  

Angelstone Limited  
Arnprior District High School  
Base Borden Recreation Council  
Brampton, Town of - Recreation Department  


Department of Co-ordination and Placement

Burlington Y.M.C.A.
Camp Tamarack
Camp Tawingo
Camp Wikwetonee
Central (Toronto) Branch Y.M.C.A.
Centre Wellington District High School Board
Children's Aid Society of Metropolitan Toronto
Cochrane, Town of—Recreation Committee
Conestoga College of Applied Arts & Technology
Duke of York Day Care Centre
Eastview (Toronto) Branch Y.M.C.A.
Elliot Lake Recreation Committee
Elmira District Secondary School
Espanola High School
Etobicoke, Borough of - Board of Education
Fort France, Town of - Recreation & Parks Department
Fort William, City of - Civic Recreation Committee
Fort William Ski Club
The Frontier College
Grand River Conservation Authority
Gymnasium & Health Equipment
C.M. Hincks Treatment Centre
Holiday Inns of Ontario
Humber College of Applied Arts & Technology
Kitchener, City of - Parks & Recreation Department
Kitchener & Waterloo High School Board
Kitchener-Waterloo Y.M.C.A.
Lambton College of Applied Arts & Technology
London, City of - Board of Education
Major Holdings & Development Limited
Metropolitan Toronto Association for Retarded Children
Midwestern Regional Children's Centre
Mississauga, Town of - Parks & Recreation Committee
Nepean, Township of - Recreation Department
Niagara College of Applied Arts & Technology
Oakville, Town of - Recreation Committee
Ontario Hospital School, Orillia
Ontario, Province of
Department of Lands & Forests
Department of Education, Youth & Recreation Branch
Ontario Society for Crippled Children
Oshawa, City of - Hillsdale Manor
Ottawa, City of - Recreation & Parks Department
Ottawa Collegiate Institute Board
Orillia Y.M.C.A.
Owen Sound, City of - Recreation Department
Paignton House (Resort)
Port Arthur Y.M.-Y.W.C.A.
Port Colborne High School
Port Elgin, Town of - Recreation Committee
Preston High School
Sault Ste. Marie, City of - Board of Education
Sheridan College of Applied Arts & Technology
St. Jerome's High School
St. Joseph's Hospital, Sarnia
St. Mary's, Town of - Recreation Committee
Stratford Shakespearean Festival Foundation
Sudbury High School Board
Swiss Chalet Park
Toronto, City of - Parks & Recreation Department
Trent University, Peter Robinson College
University Settlement, Toronto
University of Waterloo, Department of Kinesiology
Waterloo, City of - Community Service Board
Waterloo-Oxford District Secondary School
West Scarborough Boys' Club
Woodgreen Community Centre
Workmen's Compensation Board
York, Borough of - Board of Education
York, Borough of - Parks & Recreation Department

Organizations Employing Co-operative
Applied Psychology Graduate Students

Canadian Imperial Bank of Commerce, Toronto
Centre for Vocational Services, Hamilton
Conestoga College of Applied Arts & Technology, Kitchener
Government of Canada
Public Service Commission, Ottawa
Dept. of Veterans Affairs, Queen Mary Veterans Hospital, Montreal
Hamilton Mental Health Clinic for Children & Adolescents
Hydro Electric Power Commission of Ontario, Toronto
Jewish Vocational Service of Metropolitan Toronto
The Kitchener Separate School Board
Kitchener and Waterloo High School Board
Kitchener-Waterloo Hospital, Department of Psychiatry
McMaster University, Dept. of Psychiatry, Hamilton
North York, The Board of Education for the Borough of
Ontario, Province of
Dept. of Civil Service, Training & Personnel Research Branch
Dept. of Health, Lakeshore Psychiatric Hospital
Dept. of Health, Adult Occupation Centre, Barrie
Dept. of Correctional Services
Oshawa, The Board of Education of the City of
Ottawa, Public School Board, City of
Rehabilitation Foundation for the Disabled, Toronto
St. Michael's Hospital, Dept. of Psychological Services, Toronto
Sutherland Educational Clinic, Toronto
Toronto, Board of Education for the City of
Toronto Metropolitan Separate School Board
The Workmen's Compensation Bd., Hospital & Rehabilitation Centre, Toronto
Y.M.C.A. Counselling Services, Toronto

Organizations Employing Co-operative Engineering,
Applied Physics and Applied Chemistry Students

Abex Industries of Canada Limited
Abitibi Power and Paper Company Limited
H. G. Acres & Company Limited
Ainley & Associates
Aldershot Contractors Equipment Rental Limited
The Algoma Steel Corporation, Limited
Allied Chemical (Canada) Limited, Brunner Mond Division
Aluminum Company of Canada, Limited
Aluminum Goods Limited
Aluminum Laboratories Limited
Amalgamated Electric Corp. Ltd.
American-Standard Products (Canada) Ltd.
R. V. Anderson & Associates Limited
Andrew Antenna Company Limited
Angelstone Limited
Anglo Canadian Pulp & Paper Mills, Limited
Anthes Eastern Limited
A P Parts Canada Ltd
C. G. Russell Armstrong
Armco Drainage & Metal Products of Canada Limited
Armstrong Brothers Construction Company
Armstrong-Lang Laboratories Ltd.
S. A. Armstrong Ltd.
Atkins Hatch & Associates Limited
Atlas Steels Company
Atomic Energy of Canada Limited
Automatic Electric (Canada) Limited
Automotive Hardware Limited
Babcock-Wilcox Canada Limited
Bailey Meter Company Limited
Ball Brothers Limited
Barber-Colman of Canada Ltd.
Barringer Research Limited
Barton Tubes Limited
Bata Engineering
Bata Limited
Baxter Laboratories of Canada Ltd.
Beatty Bros., Division of General Steel Wares Ltd.
Beaver Construction (Ontario) Limited
The Beaver Wood Fibre Company, Limited
The Bell Telephone Company of Canada
Beller Steel Company
Bendix-Eclipse of Canada Limited
Benning & Wright Contractors Limited
Bick's of Canada Limited
Biltmore Hats Limited
Black-Clawson-Kennedy Ltd.
Black and Decker Manufacturing Company Ltd.
Black & McDonald Limited
Blacktop Paving Company Limited
Blenkorn and Sawle Limited
Boeing (Canada) Limited
The Borden Chemical Company (Canada) Ltd.
Borg Fabrics Ltd.
Borg-Warner (Canada) Limited
Brampton, Town of
Brandoflex Limited
Brant, County of
Brantford, The Corporation of the City of
Brantford Trailer & Body Limited
B.P. Refinery Canada Limited
The British American Oil Company Limited
British-American Research & Development Company
Brockville Chemical Industries Ltd.
Brown Forest Industries Limited
Bruce, County of
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
Burlington, Public Utilities Commission of
Burndy Canada Limited
Burroughs Corporation
Butts, Ross & Associates, Ltd.
Calvert Distillers Limited
Canbar Wood Tank Company - Division of Canada Barrels & Kegs Ltd.
Canada Foils Limited
Canada Foundries & Forgings, Limited
Canada Machinery Corporation, Limited
The Canada Metal Co., Limited
Canada Packers Limited
Canada Sand Papers Limited
Canada Starch Company Limited
Canadair Limited
Canadian Admiral Corporation, Ltd.
The Canadian Blower & Forge Company Limited
Canadian Blue Bird Coach Limited
Canadian Broadcasting Corporation
Canadian Canners Limited
Canadian Carborundum Company Limited
Canadian Coleman Company, Limited
Canadian Copper Refiners Limited
Canadian Electrolytic Zinc Company Limited
Canadian General Electric Company Limited
Canadian Gypsum Company Limited
Canadian Hanson & Van Winkle Company Ltd.
Canadian Industries Limited
Canadian Johns-Manville Co., Limited
Canadian Marconi Company
Canadian Mitchell Associates Ltd.
Canadian National Railways
Canadian Pacific
Canadian Pacific Telecommunications
Canadian Pittsburgh Industries Ltd.
Canadian Refractories Limited
The Canadian Salt Company Limited
Canadian Steelcase Company Limited
Canadian Timken, Division of the Timken Roller Bearing Co.
Canadian Vegetable Oil Processing Ltd.
Canadian Vickers Limited
Canadian Westinghouse Company Limited
Canadian Wilbur B. Driver Limited
Canron Limited
The Carling Breweries Limited
Wm H. Carr, O.L.S.
Catalytic Construction of Canada Limited
CDC Engineering
Ceilcote Canada Limited
Cello Products (Preston) Div.
The Center of Forensic Sciences
Chatham, City of
Chemcell Limited
Chicago Rawhide Products Canada Limited
Chinook Chemicals Corporation Limited
Jack Chisvin & Associates Ltd.
CLM Industries, Division of McGraw-Edison (Canada) Limited
Clevite Limited
Coin Acceptors Canada Ltd.
Columbian Carbon (Canada) Ltd.
Columbus McKinnon Limited
Combustion Engineering-Superheater Limited
Cominco Ltd.
Computing Devices of Canada Limited
Conestoga College of Applied Arts & Technology
Consolidated-Bathurst Limited
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
R.L. Crain Limited
Crane Canada Limited
Crane Packing Company, Limited
Creamery Package Mfg. Co. of Canada Ltd.
Crouse-Hinds Company of Canada Limited
Croven Limited
Crowe Foundry Limited
Crump Mechanical Contracting Ltd.
Cryovac Limited
CSA Testing Laboratories
Cunningham-Limp Limited
Curtis Products Ltd.
Cutler-Hammer Canada Limited
Cyanamid of Canada Limited
D & J Machine Shop
Damas & Smith Limited
Dashwood Planing Mills Ltd.
Daymond Co. Ltd.
Dearborn Chemical Company Ltd.
Decca Radar (Canada) Limited
John Deere Welland Works
De Laval Company Limited
De Leuw, Cather & Company of Canada, Limited
Delmar Chemicals Limited
Deloro Stellite, Division of Deloro Smelting & Refining Co. Ltd.
Diesel Equipment Ltd.
Digital Equipment of Canada Ltd.
M. M. Dillon & Company Limited
Dilworth Secord Meagher & Associates Limited
D & J Machine Shop
P. D. Dirksen Limited
Doerner Products Ltd.
Dome Petroleum Ltd.
Dominion Bridge Company Limited
Dominion Chain Limited
Dominion Foundries and Steel, Limited
Dominion Glass Co. Limited
Dominion Magnesium Limited
Dominion Road Machinery Co. Limited
Dominion Steel & Coal Corp. Ltd.
Domtar Chemicals Limited
Domtar Construction Materials Ltd.
Domtar Fine Papers Ltd.
Domtar Limited
Domtar Newsprint Limited
Donald Inspection Limited
Dorr Oliver-Long Ltd.
Dow Chemical of Canada, Limited
Walter Dow & Company Ltd.
Dowdell & Associates
Draavo Corporation
Dryden Chemicals Limited
Dryden Paper Company Limited
Dufferin Materials & Construction Limited
Dunker Construction Limited
Dunlop Canada Limited
Dunlop Research Centre
Du Pont of Canada Limited
Eagle Star Group
Eastern Steel Products Company - Div. of Turnbull Elevator Ltd.
T. Eaton Company Limited
Eckstall Mining Company Ltd.
The E. B. Eddy Company
Edo (Canada) Limited
Eldorado Nuclear Limited
Electric Reduction Company Canada Limited
Electrical Bureau of Canada
Electrohome Limited
Électronic Controls Limited
W. R. Elliott Limited
Ellis-Don Limited
Erie Iron Works Co. Ltd
Erie Technological Products of Canada, Ltd.
Etobicoke, Borough of
The Exolon Co.
Extrusion Machine Co. Ltd.
Fabricon Mfg. Company
Fairgrieve and Son, Limited
Falconbridge Nickel Mines Limited
The Falk Corporation of Canada Limited
Ferranti-Packard Electric Limited
Ferro Engineering Limited
Fiberglas Canada Limited
Firestone Tire and Rubber Company of Canada Limited
Fischbach and Moore of Canada Ltd.
Fischer Bearings Manufacturing Ltd.
Fischer and Porter (Canada) Limited
Fisher Governor Company of Canada Limited
Fisher Scientific Co. Limited
Ford Motor Company of Canada, Limited
Foster Wheeler Limited
The Foundation Company of Canada, Limited
Frankel Structural Steel Limited
The Frontier College
Fruehauf Trailer Company of Canada Limited
John Gaffney Construction Company Limited
W. J. Gage Limited
Galt, City of
Galt Metal Industries Limited
Gamma Engineering Ltd.
Garland Commercial Ranges Ltd.
Garlock Company of Canada Limited
Garrett Manufacturing Limited
Gaspe Copper Mines Limited
Gates Rubber of Canada Ltd.
Genaire (1961) Ltd.
General Concrete Ltd.
General Foods Limited
General Motors of Canada, Limited
General Sound and Theatre Equipment Ltd.
General Spring Products Limited
Gerencser and Russell
Giffels Associates Limited
Gilvesy Construction Limited
Goodkey Weedmark and Associates Limited
B. F. Goodrich Canada Limited
The Goodyear Tire and Rubber Company of Canada, Limited
Gore and Storrie Limited
Gould-National Batteries of Canada Limited
Government of Canada:
Analytical Chemistry Research Service
Department of Energy, Mines and Resources
Department of Fisheries
Department of National Health and Welfare
Department of Trade and Commerce
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.
Guelph, City of
Guelph, University of
Physical Resources Dept. Engineering Section
H and O Centerless Grinding Limited
Hamilton, The Corporation of the City of
Hamilton Hydro-Electric System
Hans Das Electronics
Harding Carpets Limited
B.A. Hastings Ltd.
Hawker Siddeley Canada Limited
Hawley Engineering Ltd.
Hayes-Dana Limited
R. R. Higgins and Associates Limited
The Hobart Manufacturing Company Limited
Holstead and Orendorf
The Hoover Company Limited
Horton Steel Works Limited
Huron Chemicals Ltd.
Hydraulic Machinery Company Limited
Hydro Mississauga
Imperial Oil Enterprises Ltd.
Imperial Oil Limited
International Business Machines Company Limited
International Harvester Company of Canada Limited
International Nickel Company of Canada, Limited
International Systcoms Limited
International Waxes Limited
Iron Ore Company of Canada
Jeffrey Manufacturing Company Limited
J M G Manufacturing Ltd.
Johnson Controls Ltd.
S.C. Johnson and Son Limited
Jones and Laughlin Steel Corporation - Adams Mine
Joy Manufacturing Company (Canada) Limited
Kam-Kotia Mines Limited, Cobalt Refinery Division
Kaufman Footwear Limited
Keeslutter's Limited
Kilborn Engineering Limited
Kimberly-Clark of Canada Limited
Kimberly-Clark Pulp and Paper Company Limited
Kitchener, City of
Kitchener Water Commission
Kitchener-Waterloo Hospital
Konvey Construction Company Limited
Kruschen and Dailey
John Labatt Limited
Lake Ontario Steel Company
Legatt Aircraft Limited
Leigh Instruments Limited
Lenkurt of Canada Co. Ltd.
Lennox Industries (Canada) Limited
Lever Brothers Limited
Lincoln, County of
Litton Systems (Canada) Limited
Lofthouse Brass Manufacturing Ltd.
Logan Contracting Limited
London, City of
W.P. London and Partners
London, Public Utilities Commission of
Long Manufacturing Company Limited
Looby Construction Ltd.
The Lummus Company Canada Ltd.
Lundy Steel Products
Robert McAlpine Limited
McCavour Developments Limited
McConnell and Jackson, O.L.S.
McCormick and Rankin Limited
W.A. McDougall Ltd.
H.J. McFarland Construction Co. Ltd.

Department of Co-ordination and Placement
Department of Co-ordination and Placement

McGregor Associates Limited
McIntyre Porcupine Mines, Limited
A.M. MacKay and Associates Limited
Arthur G. McKee and Company of Canada Ltd.
McKinnon Industries Limited
James F. MacLaren Limited
MacLeod Cockshutt Gold Mines Limited
McNamara Marine Limited
McPhar Geophysics Ltd.
M and T Products of Canada Ltd.
Madsen Red Lake Gold Mines Ltd.
Mallory Battery Company of Canada Limited
Mansfield-Denman General Limited
Marbon Chemical Division, Borg-Warner (Canada) Limited
A.D. Margison and Associates Limited
Markham, Township of
Marshall Macklin Monaghan Limited
Marsland Engineering Limited
V.K. Mason Construction Co. Ltd.
Massey-Ferguson Limited
Mathews Conveyor Company Limited
Mattagami Lake Mines Limited
Mead Johnson of Canada Ltd.
Medical Computer Company
Metcan Products Ltd.
John Metz, Surveyor
Midland Ross of Canada Ltd.
Milltronics Limited
Milner Refrigeration Division,
Canadian Tyler Refrigeration
Minnesota Mining and Manufacturing of Canada Limited
Mississauga, Town of
Mississauga Water Commission
O.G. Moffat Limited
Moffats Limited
Mollenhauer Contracting Co. Ltd.
Moison's Brewery (Ontario) Limited
Monsanto Canada Limited
Monteith Ingram Engineering Ltd.
Montgomery Elevator Company, Limited
Montreal Engineering Company Limited
Moore Business Forms Ltd.
National Research Council
National Sewer Pipe Limited
Niagara Falls, City of
R.H. Nichols Co. Limited
Nisbet, Letham Ltd.
Norak Steel Construction Ltd.
Noranda Mines Limited
Noranda Research Centre
North Bay, City of
Northern Electric Company Limited
Northern Telephone Limited
Norton Research Corporation (Canada) Ltd.
Nova Scotia Technical College
Oakville, Town of
Oakville, Public Utilities Commission of
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 Mines
Ontario Water Resources Commission
Orchan Mines Limited
Orillia Water, Light and Power Commission
Ortho Pharmaceutical (Canada) Ltd.
The Public Utilities Commission of the City of Oshawa
Otis Elevator Co. Ltd.
Parke, Davis and Company, Limited
C. C. Parker and Associates Limited
Peacock Contracting Limited
County of Peel, Assessment Dept.
Peel Village Developments Co. Ltd.
Peterborough, City of
E. M. Peto and Associates Limited
Philips Electronics Industries Ltd.
Pigott Construction Company Limited
Pioneer Electric Eastern Limited
Pioneer Saws Limited
C. A. Pitts General Contractor Ltd.
Jos. F. M. Poelman and Associates Limited
Polymer Corporation Limited
H. K. Porter Company (Canada) Limited
Potter and Brumfield - Division of AMF Canada Limited
The Powers Regulator Company of Canada, Limited
Powertronic Equipment Limited
Pre-Con Murray Limited
Preston, Town of
Preston Sand and Gravel Co. Ltd.
Price Brothers and Company, Limited
Procor Limited
The Proctor and Gamble Company of Canada, Limited
The Proctor and Redfern Group
Pro-Eco Limited
Purolator Products (Canada) Limited
The Quaker Oats Company of Canada Limited
Quan, Carruthers, King and Quan Limited
Quebec North Shore Paper Company
Quemont Mining Corporation, Limited
Ralston-Purina of Canada Ltd.
Ramsden Manufacturing Limited
Raponi Eastwood Paving and Construction Limited
Raytheon Canada Limited
RCA Victor Company, Ltd.
Reid Crowther and Partners Limited
Reliance-Reeves-Master Limited
Reuter-Stokes Canada Limited
Wm. Roberts Electric Limited
P.L. Robertson Manufacturing Co. Limited
Robertson-Yates Corporation Limited
E.S. and A. Robinson (Canada) Limited
Rohn and Haas Company of Canada Limited
Royal Military College of Canada
Rybka, Smith and Ginsler Ltd.
Ryco Cape Company
Ryerson, Joseph T.
St. Lawrence Cement Co.
The St. Lawrence Seaway Authority
St. Thomas, City of
St. Williams Preservers Limited
Sarco Canada Limited
Sarnia Scaffolds Limited
Scarborough Hydro and Water Commission
F. Schaeffer and Associates Limited
Scheil Industries Ltd.
J.M. Schneider Limited
Schwenger Construction Limited
Joseph E. Seagram and Sons Limited
Sehl Engineering Limited
Selco Exploration Company Ltd.
Shawinigan Chemicals Limited
Shell Canada Limited
The Sherwin-Williams Co. of Canada
M.V. Shore and Associates
Shore and Moffat and Partners
Sick Children's Hospital
A. Simard Inc.
A.C. Simmonds and Sons Ltd.
Simpson-Sears Limited
Sinclair Radio Laboratories Ltd.
Sinterings Limited
Site Investigation Services Limited
Smith and Sokolowski Ltd.
C.R. Snelgrove Co. Ltd.
Aden B. Snyder Electric Limited
Southam Murray Printing and Gravure Limited
Sperry Gyroscope Co. of Canada, Ltd.
A.M. Spriet and Associates
Spruce Falls Power and Paper Co. Limited
Square D Company Canada, Limited
Standard Paving and Materials Ltd.
Standard Tube and T.I. Limited
Stanley Steel Co. Ltd.
The Stanley Works of Canada, Limited
Starr and Tarasick
The Steel Company of Canada, Limited
Steep Rock Iron Mines Limited
Stephens-Adamson Mfg. Co. of Canada, Limited
Sterling Drug Ltd.
Stratford, City of
Sudbury, City of
Sun Oil Company Limited
Syntron (Canada) Limited
T-Scan Limited
Texaco Canada Limited
Texas Instruments Inc.
Timberland-Ellicott Limited
T M C (Canada) Limited
Toronto, City of
Board of Education
Department of Public Works
Toronto, The Corporation of the Township of
Toronto Foundry Limited
Toronto, Municipality of Metropolitan
Department of Works
Traffic Engineering Department
Toronto Star Limited
Toronto Transit Commission
Toronto, University of Physics Department
Totten, Sims, Hubicki and Associates Ltd.
Trans-Canada Pipe Lines Limited
Trenton Dyeing and Finishing Co. Ltd.
W.A. Trow and Associates Limited
Trump Hydraulics Ltd.
Paul Tuerr Construction Limited
Union Carbide Canada Limited
Union Drawn Steel Company, Limited
Union Gas Company of Canada, Limited
UniRoyal (1966) Limited
United Aircraft of Canada Limited
Vickers-Sperry of Canada Ltd.
Wabush Mines
Wallaceburg Brass Limited
Walter, Eull and Elliott Ltd.
Walter, Fedy and Associates Ltd.
L.W. Ward and Associates
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 Design
Dept. of Electrical Engineering
Dept. of Mechanical Engineering
Dept. of Physics
Engineering Computing Centre
Management and Systems Engineering
Physical Plant and Planning
Water Resources Institute
Jervis B. Webb Company of Canada, Ltd.
Welland, County of
John Wheelwright Limited
Willroy Mines Limited
George Wimpey and Company Limited
Wimpey-Wingate (Canada) Limited
Department of Co-ordination and Placement

York, Borough of
Yorkville Sound Ltd.

Co-operative Civil Engineer on work term assignment
14 Scholarships, Bursaries, Prizes and Financial Aid
Undergraduate Scholarships

King George VI and Queen Elizabeth Scholarship
The Province of Ontario will award this Scholarship to the student graduating from Grade 13 with the highest aggregate marks in the number of papers required for an Ontario Scholarship and who enrolls in a degree course, other than Divinity, at an Ontario University in the month of September following the award. The Scholarship has a value of $500 a year, for a maximum of four years, provided at least second class honour standing is maintained. No application is required.

Ontario Scholarship Programme
The Province of Ontario awards an Ontario Scholarship to all students who achieve an average of 80 per cent or better in papers worth seven credits, as required for the Ontario Secondary School Honour Graduation Diploma, and written in June of the year of completion of Grade 13. These students will be designated "Ontario Scholars" and will receive an award of $150.

The American Optical Co. 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, 1968.

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 (value $500.00)
The Centennial Optical Company provides a scholarship to a deserving Ontario student entering the first year in the School of Optometry.
Application for this Scholarship should be submitted to the Scholarship Committee before July 31st, 1968.

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.

The 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, 1969.

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 $300 per year at the University of Waterloo.
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, Mechanical 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, Ontario. Renewals for the second year will be subject to attainment of academic standards satisfactory to the Scholarship Committee of the University.

Concordia Club Scholarship in German 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 University Registrar.

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 what 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 one hundred and fifty dollars.

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 two thousand dollars, payable at the rate of five hundred dollars annually, renewable each year, provided that 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 $1,500, 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
Undergraduate Scholarships

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 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 $1,200.00, being $300.00 per year over the four professional years (years 2, 3, 4 and 5) provided 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, 1969.

Rotary District 709 Overseas Student Scholarship

Rotary District 709 offers a scholarship to a graduate or undergraduate student from a foreign country. The value of this scholarship is $1,300. Applicants should have high scholastic ability, proficiency in English and ability to speak in public.

Application should be made before April 30, 1969, to the Awards Officer, Office of the Registrar, University of Waterloo.

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 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 (Value $400.00)

The Saskatchewan Optometric Association presents an annual scholarship of $400.00 to a Saskatchewan student enrolling in the School of Optometry.

Application for this Scholarship should be submitted to the Scholarship Committee before July 31st, 1969.

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

This Scholarship of $100 will be awarded annually to an outstanding full-time student who attains the highest academic standing in a Ukrain-
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.

APA 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 needy students. The funds are to be distributed to students in all faculties, who, because of extenuating circumstances, are deserving of financial help, and would not be in a position to continue their studies without some assistance. Awards will be made by the Scholarships Committee. Application for a bursary should be made through the Office of the Registrar.

Atkinson Charitable Foundation “In Course” Bursaries  The Atkinson Charitable Foundation has established an “In Course” bursary programme which gives assistance to students of merit and proven financial need. Awards are made only to students who are bonafide residents of the Province of Ontario. Further information and application forms may be obtained from the Office of the Registrar.

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. Application forms may be obtained either from the High School Principal or from the Office of the Registrar at the University of Waterloo.

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 Office of the Registrar.

IBM—Thomas J. Watson Memorial Bursaries  The University of Waterloo has been invited to participate annually 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 Office of the Registrar.
Undergraduate Bursaries

Interprovincial Pipe Line 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 Office of the Registrar.*

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 Office of the Registrar.*

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 Office of the Registrar.*

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 Office of the Registrar.*

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. Application for a bursary should be made to the Office of the Registrar.*

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 Office of the Registrar.*

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 Office of the Registrar. Selection will be made by the Senate Committee on Scholarships and Student Aid.*

Ontario Culvert Bursary

One bursary, valued at $500 (i.e. $250 per academic term), if offered annually by the Ontario Culvert and Metal Products Company Limited The bursary will normally be awarded to a student registered in Third or Fourth Year Civil Engineering who maintains a satisfactory academic standing.

*Awards will be made by the Scholarships Committee. Application for a bursary should be made to the Office of the Registrar.*
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 Office of the Registrar.

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 Office of the Registrar.

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 Office of the Registrar.

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 bursary should be made to the Office of the Registrar.

The St. Quentin Chapter I.O.D.E. Bursary
The St. Quentin Chapter I.O.D.E., Waterloo, offers an annual bursary of $100 to a second or third year student in the Faculty of Science, with preference being given to a Resident of Kitchener or Waterloo. Application should be made through the Office of the Registrar by October 15.

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 Office of the Registrar, University of Waterloo.

Systems And Procedures Association The Toronto Chapter Bursary In Computer Science
The Systems and Procedures Association offers a bursary of $250. to a student in Co-operative Honours Mathematics (Computer Science Option) who is entering the fourth year of studies. The basis on which the awards are made includes:

a) academic excellence
b) an indication that the student intends to enter the business world in the area of Computer Science and Data Processing.
c) performance in industry during co-operative work periods. The award is made by the Senate Committee on Scholarships and Student Aid in co-operation with the Applied Analysis and Computer Science...
Undergraduate Bursaries

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 to 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 Office of the Registrar.

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 Office of the Registrar.

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 $50.00.

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 $200.00 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 $100.00 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 the contributions of the following Canadian Suppliers and Laboratories:
Bausch and Lomb Optical Company (Canada) Limited Toronto, Ontario.
Dominion Contact Lens Laboratory New Toronto, Ontario.
Imperial Optical Company Limited Toronto, Ontario.
Kahn Optical Company Limited Toronto, Ontario.
Monarch Optical Company Limited Toronto, Ontario.

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.
Undergraduate Prizes

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 Prize (Value approximately $75.00)

This is awarded to the graduating student in the School of Optometry who has made the greatest contribution to the profession during his undergraduate course.

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.

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 $50.00 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 Kelley 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 evince, in addition to a competent handling of the subject, the qualities of grace, clarity, and gentlemanly ease which characterize 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

Canada Student Loans Plan

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 following extract from the brochure under the heading “How do I establish that I need a loan” sets out in a general way the basis on which need is determined:

“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 and at all secondary schools. 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 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 high school principal or registrars 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 Office of the Registrar.

Engineering Society ‘A’ Student Loan Fund

This fund was established by the Engineering Society ‘A’ to assist students in need of short term loans. Further enquiries should be directed to the Awards Officer.

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 Office of the Registrar.

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 Office of the Registrar.

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 Office of the Registrar. These loans are interest free and should be repaid within two years after graduation.

Graduate Scholarships and Fellowships

University of Waterloo Teaching Fellowships

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 1968 these fellowships carried a stipend up to a maximum of $2600 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.

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.

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.

Rotary Foundation offers a Fellowship for one fully paid academic year of graduate study abroad. Applicants of high scholastic ability and attainment must hold a Bachelor's Degree by the time the Fellowship is to begin. Further information may be obtained from the Awards Officer, Office of the Registrar, University of Waterloo. Application for the 1969/70 Fellowship should be made before April 15, 1968, to the Awards Officer, Office of the Registrar, University of Waterloo.

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 allowances 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, 1968.

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).
Graduate Scholarships and Fellowships

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 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 $3500 each plus $100 to the Dept. 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
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 fulltime 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. Studics.

Further information may be obtained from the School of Architecture.

**The British American Oil Company Limited Graduate Fellowships**

The British American Oil Company 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 $4500 annually of which $3800 is payable to the Fellow and $700 to the Department for materials and equipment to support the research.

The Fellowships are open to students who are proceeding to either the Master's or Doctor's degree and whose research will be concerned with basic science intrinsically related to the following specializations: Chemistry or Physics of Metals or Minerals.
Graduate Scholarships and Fellowships

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.
15 Governing Bodies and Staff
The Board of Governors

Officers
C.A. Pollock—Chairman
J.W. Brown—Secretary

Ex-Officio Members
The Chancellor
The President
The Mayor of the City of Kitchener
The Mayor of the City of Waterloo
The Warden of Waterloo County

Members Appointed by the
Lieutenant-Governor in Council
William H. Evans Toronto, Willowdale
G.R. Henderson Sarnia

Elective Members

Donald S. Anderson Toronto
A.S. Ballingall Brantford
W.A. Campbell Oakville
George H. Craig Toronto
J. Craig Davidson Toronto
George H. Dobbie Galt
R. Fraser Elliott Montreal
Lewis Hahn New Hamburg
E.L. Healy Toronto
Colonel H.J. Heasley Waterloo
P.R. Hilborn Preston
P.J. Ivey London, Ontario
A.R. Kaufman Kitchener

R. Bruce Marr Kitchener
Wm. W. McGrattan Islington
John E. Motz Kitchener
C.A. Pollock Kitchener
W.M. Rankin Toronto
A.I. Rosenberg Kitchener
J.W. Scott Kitchener
E.J. Shoemaker Kitchener
J. Kenneth Sims Kitchener
James G. Thompson London
J.P.R. Wadsworth Montreal
C.N. Weber Kitchener
J. Leo Whitney Waterloo

Vacancies—4
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 (Pro Tem)—H.E. Petch, B.Sc., M.Sc., Ph.D., F.R.S.C.
The Academic Vice-President—H.E. Petch, B.Sc., M.Sc., Ph.D., F.R.S.C.

The Principal of each Federated or Affiliated College
J.R. Finn, C.R., M.A., Ph.D. (President, St. Jerome's College)
J.W. Fretz, B.A., M.A., B.D., Ph.D.
(Assistant, Conrad Grebel College)
A.M. McLachlin, M.A., B.D., Th.D.
(Principal, St. Paul's United College)
A.W. Rees, M.A. (Principal, Renison College)

The Dean of each Faculty or School of the University
J.S. Minas, B.A., Ph.D. (Dean of Arts)
A.N. Sherbourne, B.Sc., M.S., M.A., Ph.D. (Dean of Engineering)
D.A. Sprott, M.A., Ph.D. (Dean of Mathematics)
W.B. Pearson, M.A., D.Phil., D.Sc., F.R.C.S. (Dean of Science)
D.J. Pugliese, B.A., B.P.E., Ed.M. (Director, School of Physical Education and Recreation)
G.E. Cross, M.A., 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—W.J. Watson, B.A., M.A., B.L.S.
The Chairman of the Board of Governors—C.A. Pollock, B.A.Sc., B.S.
The Registrar—C.T. Boyes, B.A.
The Director of Extension—A.A. Beveridge, B.A.

Faculty Representatives

Elective Members
To 1969
R.L. Myers, B.A., M.A., Ph.D. (Arts)
T.A. Brzustowski, B.A.Sc., A.M., Ph.D. (Engineering)
K.D. Fryer, B.A., Ph.D. (Mathematics)
J.B. Moffat, B.A., Ph.D. (Science)
N.J. Ashton, B.Sc., M.S. (Physical Education & Recreation)
J.B. Bullbrook, C.R., B.A., M.A. (St. Jerome's)

To 1970
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)

To 1971
J.C. Gray, B.A., M.A., Ph.D. (Arts)
H. Mackinnon, B.A., Ph.L., S.T.L., M.A., D. Phil. (Arts)
L.A.K. Watt, B.Sc., M.S., Ph.D. (Engineering)
G.W. Bennett, Ph.D. (Mathematics)
W.S. Long, B.A., O.D. (Science)
P.E. Morrison, M.Sc., Ph.D. (Science)
Alumni Representatives

To 1969
T.W. Boyle, B.Sc.
B.W. Hansler, M.A.Sc.
B.L. Hayes, C.R., B.A. (St. Jerome’s)

To 1970
A.K. Bose, M.A.Sc.
P.D. Copeland, B.A.
J. Bullbrook, B.A. (Barr.) (St. Jerome’s)

To 1971
J.H. Shaw, B.A.Sc.
R.C. VanVeldhuisen, B.A.Sc.
P.A. Boucher, C.R., B.A.

Secondary School Representatives

To 1969
R.L. Shaver, B.P.H.E. (Grand River Collegiate Institute - Kitchener)

To 1970
A.F. Meiklejohn, B.A. (Delta Secondary School, Hamilton)
Administrative Offices

President

President and Vice Chancellor
H.E. Petch, B.Sc., M.Sc., Ph.D., F.R.S.C.

(Vice pro tem)

Vice-President, Academic

Vice-President, Academic
H.E. Petch, B.Sc., M.Sc., Ph.D. F.R.S.C.

Faculty of Arts

Dean of Arts
J.S. Minas, B.A., Ph.D.

Associate Dean
J.C. Gray, B.A., M.A., Ph.D.

(Undergraduate Affairs)

Associate Dean
M.P. Bryden, S.B., M.Sc., Ph.D.

(Graduate Affairs)

Deputy Dean
K.L. Ledbetter, A.B., M.A., Ph.D.

Assistant to the Dean
M.C. Taylor, B.A.

Faculty of Engineering

Dean of Engineering
A.N. Sherbourne, B.Sc., M.S., M.A., Ph.D.

Associate Dean
E.L. Holmes, B.Sc., M.A.Sc., Ph.D.

Assistant to the Dean
J.D. Weller, C.A.

Faculty of Mathematics

Dean of Mathematics
D.A. Sprott, M.A., Ph.D.

Associate Dean
C.F.A. Beaumont, B.A., M.A.

Associate Dean
K.D. Fryer, B.A., M.A., Ph.D.

Assistant to the Dean
R.G. Dunkley, B.A.

Assistant to the Dean
W.I. Miller, B.A.

Faculty of Science

Dean of Science
W.B. Pearson, M.A., D.Phil., D.Sc., F.R.S.C.

Associate Dean
R.G. Woolford, M.Sc., Ph.D.

(Undergraduate Affairs)

Assistant to the Dean
R.V. McIntyre, B.A.

School of Physical and Health Education

Director
D.J. Pugliese, B.A., B.P.E., Ed.M.

Director of Athletics
C.A. Totzke, B.A.

Director of Women's Athletics
R.E. Priddle, (Mrs.) B.P.H.E.

University Graduate Office

Dean of Graduate Studies
G.E. Cross, M.A., Ph.D.

Associate Registrar
B. Ingram, B.A.

(Graduate Studies)

Assistant to the Dean
W.K. Brooke, B.A.

University Extension

Director
A.A. Beveridge, B.A.

Assistant Director
W.A. O’Leary, B.A.
Vice-President, Academic

Centre for Continuing Studies in Marketing

**Director**  
R.M. Barbour

**Associate Director**  
D.V. Deverall, B.A.

Computing Centre

**Director**  
J.W. Graham, M.A.

**Assoc. Director, Data Processing**  
M.G. Howe, B.A.

**Assoc. Director, Academic Service**  
R.B. Roden, M.A., Ph.D.

**Assoc. Director, Operations**  
J.C. Wilson, B.A.Sc., Ph.D.

**Assistant Director, Computing Centre**  
S.C. Hope (Miss), B.Sc., M. Math. (Education Training)

**Assistant Director, Computing Centre**  
J.P. Sprung, B.A.Sc., M.A. (Administration)

Academic Services

**Director of Academic Services**  
D.P. Robertson, B. Comm.

Audio Visual Centre

**Director**  
G. Downie

Co-ordination and Placement

**Director**  
A.S. Barber, B.I.E. (GMI), P.Eng.

**Associate Director**  

**Associate Director**  
G.L. White, B.A.Sc., P.Eng.

**Assistant Director**  

**Assistant Director**  

Library

**University Librarian**  
William J. Watson, B.A., M.A., B.L.S.

**Collections Development**  
Doris E. Lewis (Mrs.), B.A., B.L.S.

**Assistant to the Librarian**  
(to be appointed)

**Systems Librarian**  
Robert G. Bean, B.A., B.L.S.

Technical Services

**Head, Acquisitions Department**  
Enid Waterman (Mrs.), B.A., B.L.S.

**Head, Bibliographic Searching Department**  
Joan Scanlon (Miss), B.A., M.A., B.L.S.

**Head, Cataloguing Department**  
Carolyn Pawley (Mrs.), B.A., B.L.S.

Public Services, Arts Library

**Head**  
Helen McKinnon (Miss), B.A., B.L.S., M.L.S.

**Head, Circulation Department**  
Elaine Reaman (Miss), A.T.C.M., B.A., B.L.S.

**Head, Reference Department**  
M.I. Belle Grant (Miss), B.Sc., B.L.S., M.A.L.S.

Public Services, Engineering, Mathematics & Science Divisional Library

**Head**  
T.K. Srinivasa Iyengar, B.S., M.S.L.S.

**Supervisor, Circulation Department**  
Frances Breithaupt (Mrs.), B.A.

**Head, Reference Department**  
Ada Berti (Miss), B.A., B.L.S.
Vice-President, Operations

Office of the Registrar

Registrar
C.T. Boyes, B.A.

Associate Registrar, Admissions
B.A. Lumsden, B.A.

Associate Registrar, Records
J.P. Roos, B.A.

Co-ordinator of Scheduling
A.R. Grenier, B.Sc.

Assistant Registrar - Arts
J.F. Bird, B.A.

Assistant Registrar - Engineering
G.J. Smiley, B.A.

Environmental Studies
R.J. Bullen, B.Math.

Assistant Registrar - Science, Physical Education and Recreation
S.G.B. Robinson, B.A., B.Paed., L.L.D.

Student Awards Officer
A.R. Dejeet

Systems Analyst
W.G. Ullman

Vice-President, Operations

Vice-President, Operations
A.K. Adlington, B.A.

Assistant to the
H.C. Mecredy, B.A.

Vice-President, Operations

Administrative Services and Ancillary Enterprises

Director
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

Bookings Supervisor
L. Bonson (Miss), B.A.

Development

Director
J.O. Hemphill

Information Services

Director
J.D. Adams, B.A.

Personnel Services

Director
E.S. Lucy, B.A.

Assistant Director, Training
R.L. Knight, B.A.

Assistant Director, Salary Administration
C.A. Cline, B.A., M.B.A.

Assistant Director Recruiting
R.J. Elliott, B.A.

Physical Plant and Planning

Director

Assistant Director (Physical Plant)
A.T. Cairncross, B.Sc., P.Eng.

Assistant Director (Planning)
A.E. Lappin, P.Eng.

Safety

Director
N. Ozaruk

Security

Director
A.E. Romenco, B.A.
Student Affairs

Warden of Student Village
H.R.N. Eydt, M.Sc., Ph.D.
Assistant Warden
H.C. Vinnicombe, B.Sc. (Eng.)

Administration-Student Village
Dean of Men
H.R.N. Eydt, M.Sc., Ph.D.
Dean of Women
H.C. Vinnicombe, B.Sc. (Eng.)
Director of Counselling Services
W.W. Dick, B.A., B.D., M.A., Ph.D.
Director of Housing and Overseas Student Activities
E. Beausoleil (Mrs.)
Director of Creative Art Activities
P. Berg
Director of Music
A. Kunz
Director of Drama
to be appointed
Director of Art
to be appointed
University Physician
H. Reesor, (Mrs.) B.A., M.D.

Treasurer
Treasurer
A.B. Gellatly, B.A., C.G.A.
Research Grants
V.E. Leavoy (Miss)

Business Office
Comptroller
A.H. Headlam, C.A.
Accountant
D.T. McClurkin, C.A.
Assistant to Comptroller
D.J. Battae (Miss)
Assistant to Accountant
J. Shewchuk (Mrs.)

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.
16 Faculty
Faculty

Aasen, C.
Abbott, C.C. (Mrs.)
Abbott, W.R.
Aubell, H. (Miss)
Aber, T.S.
Aczel, J.
Aczel, S. (Mrs.)
Adamczewski, Z.
Adams, K.G.
Ages, A.
Ages, R.S. (Mrs.)
Albright, S.
Allen, H.J.
Alpay, S.A.
Amoroso, D.M.
Anderson, A.
Anderson, J.E.
Anderson, J.H.
Andracki, S.
Andrews, G.C.
Andrews, W.R.
Anthes, R.G.
Appleyard, E.C.
Ariaratnam, S.T.
Armour, L.
Ashton, N.J.
Ashworth, J.
Atkinson, G.F.
Aziz, R.A.
Baker, D.H.
Baker, I.
Baker, J.A.

Bakos, G.A.
Balasubramanian, A.
Ballock, A.J.
Banerji, D.K.

Banks, R.K.
Barcsay, T.
Barker, J.A.
Barnes, C.R.
Barnes, D.S.
Barrett-Lennard, G.T.
Bater, J.H.
Batke, T.L.
Beachey, R.W.
Beam, P.D.
Beauchamp, M.A.
Beaumont, C.F.A.
Beingessner, C.G.
Bennett, G.W.
Bennett, K.M.H.
Bennett, M.A.

Environmental Studies—Architecture
Classics and Romance Languages
Philosophy
Geography and Planning
Sociology and Anthropology
Applied Analysis and
Computer Science
Pure Mathematics
Philosophy
Mechanical Engineering
Classics and Romance Languages
German and Russian
Optometry
Statistics
Mechanical Engineering
Psychology
Physics
Political Science
Electrical Engineering
Political Science
Mechanical Engineering
Optometry
Electrical Engineering
Earth Sciences
Civil Engineering
Philosophy
Kinesiology
Philosophy
Chemistry
Physics
Chemical Engineering
Optometry
Applied Analysis and
Computer Science
Physics
Chemistry
Optometry
Applied Analysis and
Computer Science
Psychology
History
Applied Mathematics
Earth Sciences
Psychology
Psychology
Geography and Planning
Chemical Engineering
History
English
Sociology and Anthropology
Applied Mathematics
Mechanical Engineering
Statistics
Economics
Berman, G. Combinatorics and Optimization
Bierman, R. Psychology
Binamé, J.J. Classics and Romance Languages
Bishop, P.J. Kinesiology
Bjornstad, T.E. Environmental Studies—Architecture
Bobier, V.M. Applied Mathematics
Bock, R.R. Optometry
Bodnar, L.E. Optometry
Boeschenstein, H. Chemical Engineering
Bondy, J.A. German and Russian
Boom, H.J. Combinatorics and Optimization
Boswell, F.W. Mathematics
Bouwer, I.Z. Physics
Bowers, K.S. Psychology
Bowers, P.E. Psychology
Boyd, E.M. (Miss) English
Brady, L.J. Pure Mathematics
Bragg, G.M. Mechanical Engineering
Breidenbaugh, M. Psychology
Brillinger, P. Applied Analysis and
Brisbin, D.A. (Mrs.) Computer Science
Brodie, D.E. Chemistry
Brown, B.A. Physics
Brown, E. Philosophy
Brown, M. Psychology
Brundrett, E. Mechanical Engineering
Bryant, P.R. Electrical Engineering
Bryden, M.P. Psychology
Brzozowski, J.A. Applied Analysis and
Brzustowski, T.A. Computer Science
Buchner, E.L. Management Sciences
Budesinsky, B. Philosophy
Bullbrook, J.B. Psychology
Bullock, R.A. Mechanical Engineering
Burke, F.E. Electrical Engineering
Burkowski, F. Psychology
Burnett, E.F.P. Applied Analysis and
Burns, C.M. Computer Science
Burns, D.J. Mechanical Engineering
Burns, R.N. Combinatorics and Optimization
Burris, S. Pure Mathematics
Butler, R.J. Philosophy
Byars, W.J. Chemistry
Byerley, J.J. Chemical Engineering
Cadell, T.E. Psychology
Callender, M.G.E. Optometry
Cameron, W.A. Chemistry
Campbell, G.T. Philosophy
Capindale, J.B. Chemistry
Carmone, F.J. Economics
Carson, B.B. (Mrs.) Chemistry
Carter, J.C.H. Biology
Carty, A.J. Chemistry
Castle, J.B.H. Management Sciences
Centore, F.
Chamberlain, S.G.
Chang, K.S.
Charles, A.M.
Chen, S.H.
Cherniavsky, M.T.
Cherry, W.H.
Choate, N.L.
Chow, Y.L.
Cizek, J.
Clarke, S.G.
Clough, D.J.
Coghlan, B.I.D.
Cohen, D.J.
Cohen, R.S. (Mrs.)
Cohn, M.Z.
Coltheart, M.
Constant, M.L.
Cook, J.R.
Corbett, J.M.
Cornell, J.M.
Cornell, P.G.
Corning, W.C.
Cornwall, G.M.
Counts, D.E. (Mrs.)
Cowan, D.D.
Cowan, J.A.
Crapo, H.H.
Craton, M.J.
Cress, P.H.
Cross, G.E.
Csanady, G.T.
Cummings, L.A.
Cummings, L.J.
Dagg, I.R.
Danard, M.B.
Dankert, D.
Davies, D.A.
Davies, M.A. (Mrs.)
Davis, H.F.
Davis, K.R.
Davis, P. (Miss)
Davison, S.G.
De Armon, E.J.
De Gré, G.L.
de Vos, A.
Delahey, W.A.
Dembski, P.E.
Diem, A.
Dion, R.
Dirksen, P.H.
Dixon, A.E.

Philosophy
Electrical Engineering
Chemical Engineering
Biology
Physics
History
Mathematics
Sociology and Anthropology
Electrical Engineering
Mathematics
Economics
Management Sciences
German and Russian
Applied Analysis and
Computer Science
Applied Analysis and
Computer Science
Civil Engineering
Psychology
Design
Mechanical Engineering
Physics
Psychology
History
Psychology
Civil Engineering
Sociology and Anthropology
Applied Analysis and
Computer Science
Physics
Pure Mathematics
History
Applied Analysis and
Computer Science
Pure Mathematics
Mechanical Engineering
English
Pure Mathematics
Physics
Mechanical Engineering
Pure Mathematics
History
German and Russian
Combinatorics and Optimization
History
Kinesiology
Physics
Kinesiology
Sociology and Anthropology
Geography and Planning
Kinesiology
History
Geography and Planning
Recreation
Applied Analysis and
Computer Science
Physics
Donskov, A.
Dorney, L.C. (Mrs.)
Dorney, R.S.
Drynan, W.R.
Dubey, R.N.
Dubinski, R.R.
Dufault, G.J.
Dugan, J.R.
Dullien, F.A.L.
Dumbroff, E.B.
Dumont, J.
Dunkley, R.G.
Dust, A.I.
Duthie, H.C.
Dyal, J.A.
Dyck, J.W.
Eagles, K.D.
Eastman, P.C.
Edington, R.V.
Edmonds, C.J.
Edmondson, L.G.E.
Ehle, B.L.
Ellenton, H.K.
Ellis, J.B.
Elsdon, W.L.
Engel, G.R.
Enns, K.
Epstein, D.F.
Erb, D.K.
Estok, M.J.
Evans, H.L.
Eydt, H.R.N.
Fabian, R.J.
Fahidy, T.Z.
Fairbrother, J.A.V.
Fallking, H.J.
Farquhar, G.J.
Fasick, F.A.
Faulkner, G.B.
Fenz, W.D.
Ferguson, D.C.
Fernandez, C.M. (Mrs.)
Fernando, C.H.
Field, J.A.A.
Finn, J.R.
Firetto, A.
Firmnau, G. (Mrs.)
Fischer, C.F. (Mrs.)
Fischer, H.
Fischer, P.C.
Fisher, F.J.
FitzGerald, M.P.
Fletcher, L.P.
Forbes, W.F.
Ford, J.D.
Fournier, H.S. (Mrs.)

German and Russian

English

Geography and Planning

Civil Engineering

Mechanical Engineering

English

Electrical Engineering

Classics and Romance Languages

Chemical Engineering

Biology

Classics and Romance Languages

Combinatorics and Optimization

English

Biology

Psychology

German and Russian

History

Physics

Political Science

Civil Engineering

Political Science

Applied Analysis and

Computer Science

Physics

Electrical Engineering

Chemistry

Psychology

Chemical Engineering

Political Science

Geography and Planning

English

Mechanical Engineering

Biology

Mathematics

Chemical Engineering

Physics

Sociology and Anthropology

Civil Engineering

Sociology and Anthropology

Combinatorics and Optimization

Psychology

Mechanical Engineering

Classics and Romance Languages

Biology

Electrical Engineering

Classics and Romance Languages

Psychology

German and Russian

Mathematics

German and Russian

Mathematics

Optometry

Physics

Economics

Chemistry

Chemical Engineering

Classics and Romance Languages
The Faculty

Fournier, R.J.  Classics and Romance Languages
Fraser, T.M.  Design
Fraser-Reid, B.O.  Chemistry
French, D.  Mechanical Engineering
Fretz, J.W.  Sociology and Anthropology
Frew, R.S.  Environmental Studies—Architecture
Friedman, O.  Sociology and Anthropology
Friesen, R.J.  Chemistry
Froese, J.  Applied Mathematics
Fryer, K.D.  Combinatorics and Optimization
Fulford, G.D.  Chemical Engineering
Gall, C.E.  Chemical Engineering
Galloway, D.R.  English
Gamble, E.B. (Miss)  Religious Studies
George, R.A.  Philosophy
Gertler, L.O.  Geography and Planning
Gilbert, W.J.  Pure Mathematics
Gilhooley, D.R.  Optometry
Gilmore, B.J.  Psychology
Godambe, V.P.  Mathematics
Gold, L.  Optometry
Goldstaub, J.  Geography and Planning
Gordon, D.R.  Political Science
Gosselink, R.N.  English
Gough, T.E.  Chemistry
Gounard, J.F.  Classics and Romance Languages
Graf, B.J.  Classics and Romance Languages
Graham, J.W.  Applied Analysis and Computer Science
Graham, R.D.  Kinesiology
Grant, G.  Optometry
Gray, J.C.  English
Green, R.  Civil Engineering
Green, H.J.  Kinesiology
Grey, E.  Classics and Romance Languages
Grierson, D.E.  Civil Engineering
Griffin, G.A.  Psychology
Grindlay, J.  Physics
Guest, R.M.  Chemistry
Haag, E.  Statistics
Haag, S. (Mrs.)  Classics and Romance Languages
Haas, R.C.G.  Civil Engineering
Haff, C.E.  Combinatorics and Optimization
Hahn, C.K.G.  Design
Hale, A.M.  Mechanical Engineering
Handa, V.K.  Civil Engineering and Design
Haner, A.B.  Physics
Hansen, R.W.  Political Science
Hansford, R.R.  Optometry
Hanson, J.  Electrical Engineering
Harrison, A.D.  Biology
Hartford, J.J.  Psychology
Haruki, H.  Applied Analysis and Computer Science
Haworth, H.E. (Mrs.)  English
Haworth, L.L.  Philosophy
Hayes, D.  Kinesiology
Heatley, A.H.  Chemical Engineering
Hedges, D.L.  English
Heier, E.  German and Russian
Hemming, D.  Physics
Henderson, D.J.  Physics
Hendley, B.P.  Philosophy
Hergott, C.A.  Philosophy
Hermance, C.E.  Mechanical Engineering
Higgs, D.  Pure Mathematics
High, N.H.  Sociology and Anthropology
Hill, H.M.  Civil Engineering
Hillier, M.J.  Mechanical Engineering
Hinchcliffe, J.C. (Mrs.)  English
Hinchcliffe, P.M.  English
Hoefert, S.  German and Russian
Hoffman, P.  Pure Mathematics
Holmes, E.L.  Mechanical Engineering
Holmes, R.H.  Philosophy
Holubec, I.  Civil Engineering
Honeyford, B.N.  English
Honsberger, R.A.  Combinatorics and Optimization
Hopkins, P.  Kinesiology
Horne, J.R.  Philosophy
Horne, W.C.  Psychology
Horton, D.  History
Horton, J.T.  Geography and Planning
Howard, J.H.G.  Mechanical Engineering
Howroyd, T.D.  Mathematics
Huang, J.S.  Statistics
Huang, R.Y-M.  Chemical Engineering
Hudgins', R.R.  Chemical Engineering
Hudspeth, W.J.  Psychology
Hutchinson, B.G.  Civil Engineering
Hynes, H.B.N.  Biology
Innes, L.G.  Design
Inniss, W.E.  Biology
Irish, D.E.  Chemistry
Irving, R.M.  Geography and Planning
Isenor, N.R.  Physics
Jenkyns, T.A.  Combinatorics and Optimization
Johnson, L.A.  History
Joseph, J.R.  Management Sciences
Joyce, L.S.  Optometry
Kalbfleisch, J.D.  Statistics
Kalbfleisch, J.G.  Statistics
Kalra, S.N.  Electrical Engineering
Kameda, T.  Electrical Engineering
Kamthan, P.K.  Pure Mathematics
Kannappan, P.L.  Applied Analysis and Computer Science
Kapoor, N.N.  Biology
Karasek, F.W.  Chemistry
Kardasz, S.W.  Economics
Karrow, P.F.  Earth Sciences
Keeler, J.S.  Electrical Engineering
Kelly, P.A.  Combinatorics and Optimization
Kemp, F.D.  Psychology
Faculty

Kempton, A.G. Biology
Kendrick, W.B. Biology
Keppel-Jones, D.S. English
Keresztes, P. Classics and Romance Languages
Kerr, H.W. Mechanical Engineering
Kerr-Lawson, A. Pure Mathematics
Kersell, J.E. Political Science
Kerton, R.R. Economics
Kesavan, H.K. Design
Kim, S. Applied Mathematics
Kingsley, R. Applied Analysis and
Kirby, M. Computer Science
Kirk, H.D. Optometry
Klaassen, W. Sociology and Anthropology
Koppel, J.L. History
Kovari, J. (Mrs.) Chemistry
Kovari, T. Applied Analysis and
Krishnasamy, S.G. Computer Science
Krueger, R.R. Mathematics
Kruvu, J. Civil Engineering
Kubat, D. Geography and Planning
Kuxdorf, M. Physics
Lafrence, J. (Miss) Sociology and Anthropology
Lambert, R.D. German and Russian
Lamont, D.H. Classics and Romance Languages
Landré, L. Sociology and Anthropology
Langer, M. Optometry
Larkworthy, D.R. Classics and Romance Languages
Lastman, G.J. Optometry
Lavigne, N.E. Applied Mathematics
Lawless, J.F. Economics
Lawrence, R.G.R. Statistics
Lawson, D.E. Mechanical Engineering
Lawson, J.D. Earth Sciences
Lawson, W.M. Applied Analysis and
Leech, J.W. Computer Science
Ledbetter, K. Management Sciences
Ledwell, T.A. Physics
Leisch, J.E. English
Lefcourt, H.M. Mechanical Engineering
LeLievre, B. Civil Engineering
Lennox, W.C. Psychology
Leslie, J.D. Civil Engineering
Letson, D. Physics
Levitsky, I. English
Levitsky, R. (Mrs.) German and Russian
Lim, C.C. English
Lind, N.C. Physics
Lister, R. (Mrs.) Civil Engineering
Lochhead, D.M. English
Logan, H.M. Optometry
Long, W.S. Applied Analysis and
Lovelock, D. Computer Science
<table>
<thead>
<tr>
<th>Name</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lunsky, M.</td>
<td>Optometry</td>
</tr>
<tr>
<td>Lyle, W.M.</td>
<td>Optometry</td>
</tr>
<tr>
<td>MacGillivray, R.C.</td>
<td>History</td>
</tr>
<tr>
<td>Mackay, D.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>MacKenzie, D.C.</td>
<td>Classics and Romance Languages</td>
</tr>
<tr>
<td>MacKenzie, K.D.</td>
<td>Economics</td>
</tr>
<tr>
<td>MacKinnon, G.E.</td>
<td>Psychology</td>
</tr>
<tr>
<td>MacKinnon, H.</td>
<td>History</td>
</tr>
<tr>
<td>MacLeod, D.I.</td>
<td>Applied Mathematics</td>
</tr>
<tr>
<td>MacNaughton, W.R.</td>
<td>English</td>
</tr>
<tr>
<td>MacPhie, R.H.</td>
<td>Electrical Engineering</td>
</tr>
<tr>
<td>MacQuarrie, A.M.</td>
<td>English</td>
</tr>
<tr>
<td>MacRae, C.F.</td>
<td>English</td>
</tr>
<tr>
<td>Malcolm, J.D.</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Malzan, J.</td>
<td>Pure Mathematics</td>
</tr>
<tr>
<td>Manning, E.G.</td>
<td>Applied Analysis and Computer Science</td>
</tr>
<tr>
<td>Manske, R.H.F.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>Marsden, H. (Mrs.)</td>
<td>German and Russian</td>
</tr>
<tr>
<td>Marsh, C.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Martens, Helen (Miss)</td>
<td>Fine Arts</td>
</tr>
<tr>
<td>Martin, L.</td>
<td>Geography and Planning</td>
</tr>
<tr>
<td>Martin, W.R.</td>
<td>English</td>
</tr>
<tr>
<td>Mathie, W.R.</td>
<td>Political Science</td>
</tr>
<tr>
<td>Matyas, E.L.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Maynes, A.D.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>McBryde, W.A.E.</td>
<td>Philosophy</td>
</tr>
<tr>
<td>McDonald, M.F.</td>
<td>Design</td>
</tr>
<tr>
<td>McGeeary, D.G.</td>
<td>Applied Mathematics</td>
</tr>
<tr>
<td>McGee, I.J.</td>
<td>Classics and Romance Languages</td>
</tr>
<tr>
<td>McKegney, J.C.</td>
<td>Applied Analysis and</td>
</tr>
<tr>
<td>McKiernan, M.A.</td>
<td>Computer Sciences</td>
</tr>
<tr>
<td>McLaughlin, W.A.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>McLeod, H.G.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>McLellan, A.G.</td>
<td>Geography and Planning</td>
</tr>
<tr>
<td>McNiece, G.M.</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>McReynolds, W.P.</td>
<td>Management Sciences</td>
</tr>
<tr>
<td>McVicar, D.</td>
<td>Physics</td>
</tr>
<tr>
<td>Meichenbaum, D.</td>
<td>Psychology</td>
</tr>
<tr>
<td>Meikle, W.N.</td>
<td>Electrical Engineering</td>
</tr>
<tr>
<td>Meincke, P.H.</td>
<td>Design</td>
</tr>
<tr>
<td>Merkle, P.M.</td>
<td>Psychology</td>
</tr>
<tr>
<td>Michael, M.C. (Miss)</td>
<td>Chemistry</td>
</tr>
<tr>
<td>Miller, J.W.</td>
<td>Religious Studies</td>
</tr>
<tr>
<td>Miller, W.I.</td>
<td>Combinatorics and Optimization</td>
</tr>
<tr>
<td>Mills, J.R.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>Minas, J.S.</td>
<td>Philosophy</td>
</tr>
<tr>
<td>Mitchell, W.B.</td>
<td>Geography and Planning</td>
</tr>
<tr>
<td>Mitra, T.K.</td>
<td>Physics</td>
</tr>
<tr>
<td>Moffat, J.B.</td>
<td>Chemistry</td>
</tr>
<tr>
<td>Moore, J.B.</td>
<td>Management Sciences</td>
</tr>
<tr>
<td>Moore, R.A.</td>
<td>Physics</td>
</tr>
<tr>
<td>Morrison, H.M.</td>
<td>Physics</td>
</tr>
<tr>
<td>Morrison, P.E.</td>
<td>Biology</td>
</tr>
<tr>
<td>Morton, J.K.</td>
<td>Biology</td>
</tr>
<tr>
<td>Moskal, F.M.</td>
<td>Pure Mathematics</td>
</tr>
</tbody>
</table>
Faculty

Mowat, D.
Mullin, R.C.
Munk, J.J.
Munn, M.S.
Murty, U.S.R.
Myers, R.L.
Naftolin, H.
Naidoo, J.C.
Narveson, A.C. (Mrs.)
Narveson, J.F.
Nash, B.O.

Nash-Williams, C.St.J.
Needham, W.R.
Nelson, A.D.
New, J.F.H.
Nicholls, A.R.
Nicoll, W.B.
Niessen, P.
Norman, R.W.
North, J.S.
Noton, A.R.M.
Ober, W.U.
Officer, E.R.
Ord, J.L.
Orr, M.J. (Mrs.)
Paldus, J.
Palenik, G.J.
Pallett, E.M.
Panthei, H.W.
Parsons, A.C.

Pasternak, J.J.
Patterson, E.P.
Patterson, N.-L. (Mrs.)
Pearce, G.F.
Pearse, J.D.
Pearson, P.M.
Pearson, W.B.
Pei, D.C.T.
Pellowe, R.D.
Penney, R.K.
Perry, E.
Petch, H.E.
Pick, R.J.
Pieckarski, K.R.
Pietrzykowski, T.

Pinder, J.T.
Pintar, M.M.
Plumtree, A.
Pollock, J.
Ponzo, P.J.
Poorooshashb, H.B.
Porter, R.L.
Power, G.
Prasad, T

Pure Mathematics
Combinatorics and Optimization
Management Sciences
Optometry
Combinatorics and Optimization
Classics and Romance Languages
Optometry
Psychology
Philosophy
Philosophy
Applied Analysis and
Computer Science
Combinatorics and Optimization
Economics
Political Science
History
Psychology
Mechanical Engineering
Mechanical Engineering
Kinesiology
English
Electrical Engineering
English
Geography and Planning
Physics
Sociology and Anthropology
Mathematics
Chemistry
Design
German and Russian
Environmental Studies
— Architecture
Biology
History
Fine Arts
Mechanical Engineering
Recreation
Civil Engineering
Chemistry
Chemical Engineering
Optometry
Psychology
English
Physics
Mechanical Engineering
Mechanical Engineering
Applied Analysis and
Computer Science
Civil Engineering
Physics
Mechanical Engineering
Optometry
Applied Mathematics
Civil Engineering
Classics and Romance Languages
Biology
Civil Engineering
Faculty

Priddle, R.E. (Mrs.)
Pruesse, M.G.
Pugliese, D.J.
Qayum, A.
Qualter, T.H.
Raithby, G.D.
Ralston, Z.T.
Ramshaw, R.S.
Ratz, H.C.
Rawling, K.E. (Miss)
Ray, W.H.
Rees, A.W.
Reesor, G.E.
Reeve, J.
Reeves, L.W.
Reilly, P.M.
Rhodes, E.
Rich, S.G.
Richter, M.
Roberts, D.D.
Roberts, R.G.
Robinson, J.C.
Robinson, P.
Roden, R.B.
Roe, P.H.O’N.
Rogers, J. (Mrs.)
Roe, P.H.O.N.
Romanyschyn, O.
Roorda, J.
Roosa, W.B.
Ross, R.R.
Roulston, D.J.
Rowe, K.A.
Rowe, P.M.
Rudin, A.
Russwurm, L.H.
Saleh, S.D.
Salter, D.L.
Sauer, W.L.
Scharer, J.M.
Schleiermacher, D.D.
Schroeder, J.
Scott, D.S.
Scott, W.G.
Scrutton, R.F.
Seeley, P.L.
Seim, R.D.
Seligman, P.
Sengupta, S.S.
Shah, K.R.
Sharma, H.D.
Sharon, H.N.
Sheehan, J.
Shelest, W.
Faculty

Shortreed, J.
Silver, E.A.
Silverman, I.W.
Silveston, P.L.
Singh, A.D.
Sister M. Leon
Skarecky, R.
Slawson, P.R.
Slethaug, G.E.
Smale, W.M.

Smith, H.J.T.
Smith, J.G.
Smith, P.
Snieckus, V.A.
Snyder, M.E. (Mrs.)
Snyder, R.A.
Soulis, G.N.
Sparks, B.B.
Spink, D.R.
Spree, L.
Springer, C.
Sprott, D.A.
Srivastava, K.D.
Staal, R.A.
Steffy, R.A.
Steiner, H.D.
Steslicka, M.
Stevens, R.G.
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.
Tauber, L.E.
Thedchanamoorthy, N.
Thomas, W.K.
Thompson, H.
Thompson, H.C.
Thompson, J.E.
Thornton-Trump, A.B.
Thysell, M.G. (Mrs.)
Thysell, R.V.
Tomasek, M.
Tomlinson, G.
Toogood, G.E.
Topper, T.H.
Torney, D.J.
Torrie, B.H.
Totzke, C.A.W.
Trim, D.W.
Tucker, J.W.
Turnour, N.C.
Turner, G.A.
Tuyn, H.
Uhde, J.
Unny, T.E.
Uram, E.M.
van der Hoff, B.M.E.
Van Evra, J.A. (Mrs.)
Van Evra, J.W.
van Heeswijk, R.G.
Vaz, E.W.
Vellinga, J.H.

Verkuijlen, J.M.
Vetter, W.J.
Viswanatha, T.
Vogel-Sprott, M.D.
Vogt, E.R.
Vranck, J.K.
Vuorinen, P.A.
Wahl, J.M.
Wainwright, J.
Walker, D.F.
Waller, T.G.
Walter, D. (Mrs.)
Wang, S.F.
Ware, E.E.
Watson, R.B.
Watt, L.A.K.
Watts, R.O.
Weaver, S.M. (Mrs.)
Wei, L.Y.
Wentzell, R.A.
Wertheim, D.G.
Wetzel, R.M.
White, O.L.
Whitney, J.B.
Whiton, J.
Widmeyer, W.N.
Wigley, T.M.L.
Wilkinson, B. (Miss)
Williams, J.L.
Wills, B.L.
Wilson, J.C.

Wilson, J.M.
Wilson, T.C.

Wilton, R.C.
Wine, J.J.
Wipper, A. (Miss)
de Witte, P.
Woodruff, M.E.
Wooldford, R.G.
Woolner, K.A.
Wright, D.T.
Wubnig, J. (Miss)
Wynne, R.E.
Faculty

Young, M.M.  Chemical Engineering
Younger, D.  Combinatorics and Optimization
Yovanovich, M.M.  Mechanical Engineering
Zachariah, K.  Biology
Zarnke, C.R.  Applied Analysis and
Zweers, A.  Computer Science
    German and Russian
17 Academic Calendar
Academic Calendar

The University of Waterloo reserves the right to change its academic calendar at any time.

June 30, 1969  Monday  Lectures Begin—Post Degree Programme
July 21  Monday  Supplemental Examinations Begin
August 2  Saturday  Examinations Begin—Co-operative Programmes
August 7  Thursday  Examinations—Post Degree Programme
August 8  Friday  Examinations End—Co-operative Programmes
August 22  Friday  Spring Work Term Ends—Co-operative Programmes
August 25  Monday  Fall Work Term Begins—Co-operative Programmes
September 1  Monday  Labour Day—University Buildings Closed
September 6  Saturday  Registration (Morning Only)—Part-time Undergraduates
September 10  Wednesday  Registration
September 11  Thursday  Registration
September 12  Friday  Registration
September 15  Monday  Lectures Begin
September 22  Monday  Registration—Graduate Studies
October 9  Thursday  Meeting—Board of Governors
October 9  Thursday  Meeting—Senate Executive Committee
October 13  Monday  Thanksgiving Day—University Buildings Closed
October 23  Thursday  Meeting—University Senate
October 24  Friday  Fall Convocation
November 10  Monday  Supplemental Examinations Begin—Co-operative Programmes
December 4  Thursday  Meeting—Senate Executive Committee
December 16  Tuesday  Lectures End
December 17  Wednesday  Examinations Begin—Fall Term
December 18  Thursday  Meeting—University Senate
December 23  Tuesday  Examinations End—Fall Term
December 25  Thursday  Christmas Day—University Buildings Closed
December 26  Friday  Fall Work Term Ends—Co-operative Programmes
December 29  Monday  Winter Work Term Begins—Co-operative Programmes
December 29  Monday  Supplemental Examinations—Post Degree
January 1, 1970  Thursday  New Year’s Day—University
               Buildings Closed
January 5  Monday  Registration—Undergraduate
               Co-operative Programmes
               Environmental Studies, Mathematics,
               Physical Education and Recreation,
               Science
January 6  Tuesday  Registration—Undergraduate
               Co-operative Programme—Engineering
January 7  Wednesday  Lectures Begin
January 9  Friday  Registration—Winter Term—
               Graduate Students
January 15  Thursday  Meeting—Board of Governors
February 5  Thursday  Meeting—Senate Executive Committee
February 19  Thursday  Meeting—University Senate
March 16  Monday  Supplemental Examinations Begin—
               Co-operative Programmes
March 27  Friday  Good Friday—University Buildings
               Closed
April 9  Thursday  Meeting—Senate Executive Committee
April 10  Friday  Lectures End
April 11  Saturday  Examinations Begin
April 16  Thursday  Meeting—Board of Governors
April 23  Thursday  Meeting—University Senate
May 1  Friday  Winter Work Term Ends—
               Co-operative Programmes
May 1  Friday  Examinations End
May 4  Monday  Spring Work Term Begins—
               Co-operative Programmes
May 5  Tuesday  Registration—Undergraduate
               Co-operative Programmes
May 6  Wednesday  Lectures Begin—Co-operative Programmes
May 8  Friday  Registration—Graduate Students
               Spring Term
May 29  Friday  Convocation—Arts, Mathematics,
               Physical Education and Recreation
May 30  Saturday  Convocation—Engineering, Science
June 18  Thursday  Meeting—Board of Governors
Campus Guide

1) South Campus Hall
2) Chemical Engineering
3) Engineering Lecture Hall
4) Engineering
5) Physics
6) Central Stores and Services
7) Mathematics and Computer Science
8) Chemistry
9) Biology
10) Campus Centre
11) Physical Education
12) Health Services Centre
13) Dana Porter Arts Library
14) Arts Lecture Hall
15) Modern Languages & Theatre of the Arts
16) Isaiah Bowman (Social Sciences)
17) Humanities (Arts III)
18) Minota Hagey Residence
19) Student Village
20) Student Residences
21) St. Jerome's College
22) Renison College
23) St. Paul's United College
24) Conrad Grebel College
25) Columbia Street
26) University Avenue
27) Westmount Road
### Calendar for 1969

<table>
<thead>
<tr>
<th>S M T W T F S</th>
<th>S M T W T F S</th>
<th>S M T W T F S</th>
<th>S M T W T F S</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>JAN.</strong></td>
<td><strong>APRIL</strong></td>
<td><strong>JULY</strong></td>
<td><strong>OCT.</strong></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

### Calendar for 1970

<table>
<thead>
<tr>
<th>S M T W T F S</th>
<th>S M T W T F S</th>
<th>S M T W T F S</th>
<th>S M T W T F S</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>JAN.</strong></td>
<td><strong>APRIL</strong></td>
<td><strong>JULY</strong></td>
<td><strong>OCT.</strong></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

### Calendar for 1971

<table>
<thead>
<tr>
<th>S M T W T F S</th>
<th>S M T W T F S</th>
<th>S M T W T F S</th>
<th>S M T W T F S</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>JAN.</strong></td>
<td><strong>APRIL</strong></td>
<td><strong>JULY</strong></td>
<td><strong>OCT.</strong></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>