University of Waterloo
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 113 of the Arts Library Building. 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 reserve the right to make changes in this calendar without prior notice.
University of Waterloo

The University of Waterloo

The Faculty of Arts

The Faculty of Engineering

The Faculty of Science

The Faculty of Graduate Studies

The Department of Physical and Health Education

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General Information

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The University of Waterloo
The University of Waterloo

The University of Waterloo is incorporated as a non-denominational institution of higher learning offering courses, both at the undergraduate and graduate level, in Arts, Engineering, 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 became a member of the National Conference of Canadian Universities and Colleges in June 1961, and of The Association of Universities of the British Commonwealth in November 1961.

St. Jerome's College, a Roman Catholic church-related liberal arts college, which had been affiliated with the University of Ottawa since 1947, entered into federation with the University of Waterloo in July, 1960. It offers a basic undergraduate programme of Arts courses which can be supplemented by courses offered by the University. In September of 1962, St. Jerome's College opened three new buildings on the University Campus; a teaching and administration building; a men's residence with accommodation for one hundred students; and a women's residence with accommodation for fifty-five 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 140 men and 40 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.

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 the Physics and Mathematics Building, the Engineering Building, the Arts Building and Theatre of the Arts. In 1964 construction was completed of the Chemistry-Biology Building and university greenhouse.

Presently under construction for the 1965-66 academic year are a second teaching building for the Faculty of Arts, and the first stage of the University Residence Village. At the focal centre of the campus rises a seven storey Arts Library Building which will be completed in 1965. It will provide immediate accommodation for 140,000 volumes as well as seating space for 400 readers.

A continuing programme of expansion includes additional teachings, an auditorium, and a university centre to be completed within the next few years.
The general administrative offices are temporarily located in the Arts Library Building. The University Cafeteria and the student offices are located in Annex 2, a temporary building east of the Engineering Building.

The athletic facilities of the University are located at Seagram Stadium and include a fully-equipped gymnasium, a regulation quarter-mile track, and a football field.

On-campus residence accommodation for both men and women is provided by the Church Colleges and the University Residence Village.

For students not admitted to residence, off-campus housing in private homes may be arranged, prior to registration, through the University Housing Service.
The Faculty of Arts
The Faculty of Arts

The University of Waterloo offers courses of study in the liberal arts leading to the degree of Bachelor of Arts.

The curriculum is arranged to provide two paths to the B.A. degree. The paths are:

1. General Arts Course, demanding three years of study. The student selects a major area of study for greater concentration of work in his Second and Third Years.

2. Honours Arts Courses, demanding four years of study. The student selects the particular subject or group of subjects in which he wishes to do honours work and pursues studies in his specialized field at greater depth. Students interested in high school teaching qualify later for Type A certification in those subjects where regulations require an honours degree.

The arrangement of the arts curriculum attempts to satisfy the basic requirements of a liberal education. Two of these are the achievement of a liberal breadth of studies and the mastery of a particular discipline or group of disciplines. Working within the principles implied by these requirements, the curriculum must provide also opportunity for the student to satisfy his purposes in attending University. His purpose may be related to opportunity for personal, intellectual, and social growth, whereby he may come to have wider appreciation of and greater satisfaction from life's experiences. He may view a University education as making himself a more effective citizen generally. In many, if not in a majority of cases, a university liberal arts education opens doors to the professions, either directly or by qualifying him to pursue further professional studies.

Working within the above criteria, the curriculum in liberal arts at the University of Waterloo has been arranged to permit all students to study in a variety of disciplines, especially in the First year. The programme of studies does demand also a measure of concentration in both the General Course, and, to a much greater extent, in the Honours Courses.

The University of Waterloo is still a young University. The Arts programme is entering its sixth year of operation. The University is still of a size that makes possible a goodly measure of personal contact between students and members of faculty. Student organizations are becoming established, and offer many opportunities for students who wish to make a creative contribution to the building of the University's activities and traditions.

Degrees

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

Pass Course (3 years)

The General Course in Arts
Honours Courses (4 years)

Economics
English
English and French
English and German
English and History
English and Latin
English and Philosophy
English and Russian
English and Spanish
French and German
French and Latin
French and Political Science
French and Russian
French and Spanish
Geography

Graduation from any of the following courses with at least Second Class Honours standing qualifies a student for admission to the corresponding Type A course at the Ontario College of Education:

Honours English
Honours English and French
Honours English and German
Honours English and History
Honours English and Latin
Honours English and Spanish
Honours French and German
Honours French and Latin
Honours French and Russian
Honours French and Spanish
Honours Geography
Honours History
Honours Mathematics

Admission and Registration

General
Application for admission to the Faculty of Arts should be made as early in the year as possible on forms provided by the Office of the Registrar. 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 documents submitted.

Students wishing to register in the Faculty of Arts through St. Jerome's College or through Renison College may apply directly to the Registrar of the respective Colleges. Students wishing to register in the Faculty of Arts through St. Paul's College or Conrad Grebel College apply to the Registrar, University of Waterloo.
Admission to Year I

In order to qualify for admission to the first year of the Arts programme, ordinarily the applicant should have completed the requirements for the Ontario Secondary School Honour Graduation Diploma (Senior Matriculation) or its equivalent, showing an overall average of 60% in the following papers:

- English
- One language other than English
- Five additional papers chosen wherever possible in accordance with the student's proposed major field of study — or four additional papers, one of which is a language — or three additional papers, two of which are languages.

**NOTE:** For purposes of admission, grades of special Departmental examinations written to make up one-paper deficiencies in English or languages other than English may be used in conjunction with grades of papers previously passed in those subjects, but such special examinations may not be used alone as substitutes for the single combined examination in English and languages other than English.

Additional papers can be selected from any of the optional subjects offered at the Grade XIII level with the qualification that no more than one of the following papers may be counted as an "additional" paper: Accountancy Practice, Secretarial Practice, Mathematics of Investment, Art, or Music (Departmental Examination). The marks received in one of these papers 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 one 'additional paper' on the same terms as these papers except the marks received will not be computed in the average.

The following certificates, recognized as being equivalent to the Ontario Grade XIII certificate, may be accepted insofar as they meet the admission requirements of the University of Waterloo in subjects and percentages:

- Alberta: Senior Matriculation (Grade XII)
- British Columbia: Senior Matriculation (Grade XIII)
- Manitoba: Senior Matriculation (Grade XII)
- New Brunswick: Senior Matriculation (Grade XIII)
- Newfoundland: Year I Memorial University
- Nova Scotia: Senior Matriculation (Grade XII)
- 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 XII)
- England and Wales, West: The General Certificate of Education with passes in at least five subjects, two of which must be at Advanced Level.
- India, North and West Africa: Senior Matriculation (Grade XII)
Admission and Registration

Scotland
United States of America

The Scottish Leaving Certificate
High School Graduation plus an additional year of formal study in subjects comparable to Ontario Grade XIII.

Admission to Advanced Standing

An applicant for admission to advanced standing must submit an official transcript from the University which he has attended, showing in detail the courses he has taken and his standing in each.

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. Each application will be considered on its merits by the Admissions Committee. Under certain circumstances, the applicant may be required to write a qualifying examination.

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, provided he meets the regular admission requirements.

Admission of Students from Other Countries

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

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 16 Thursday Year I
September 17 Friday Advanced Years
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.

If, for reasons acceptable to the Business Manager, the fees for the year cannot be paid in full on the day of registration, they may be paid in two instalments but an extra charge of $5.00 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 the tuition fees plus all incidental fees. The balance must be paid in full on the first day of the second term.

A charge of $2.00 per month will be made on overdue accounts. Failure to pay an overdue account before conclusion of lectures will bar a student from writing examinations or obtaining 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 1964-65 year and at the time of printing is still subject to review and possible change for the 1965-66 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.

### Sessional Fees

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuition</td>
<td>$510.50</td>
</tr>
<tr>
<td>Incidental*</td>
<td>$44.50</td>
</tr>
<tr>
<td>Total</td>
<td>$555.00</td>
</tr>
</tbody>
</table>

### Co-operative Mathematics —

<table>
<thead>
<tr>
<th>Fees per term</th>
<th>Year 1</th>
<th>Other Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuition</td>
<td>$292.50</td>
<td>$317.50</td>
</tr>
<tr>
<td>Incidental*</td>
<td>26.50</td>
<td>26.50</td>
</tr>
<tr>
<td>Total</td>
<td>$319.00</td>
<td>$344.00</td>
</tr>
</tbody>
</table>

### Part-Time Students

- Fee per course (limit, 2 courses per session) $100.00
Examinations and Promotions

Miscellaneous Fees

- Examination — Supplemental, each paper $10.00
- Presiding fee (at an outside centre, each half day) 5.00
- Photograph (at first registration only) 1.00
- Late Registration 10.00
- Transcript of record 1.00
- Degree and Graduation — Final year only 10.00

* Incidental fees include student activities, athletics, health insurance and health services.

The Health Insurance Plan does not include the premiums or benefits of the Ontario Hospital Services Commission. Such coverage is the student's own responsibility.

Residence Fees

Residence fee for both men and women is $725.00 for room and board for the regular academic session (2 terms), or $362.50 per term for co-operative course students. 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 the first term and the beginning of the second. Students occupying residence in this period will be charged an additional $2.00 per day for their room. (Food if available, will be an extra charge).

Rooms may be occupied for twenty-four hours before registration and after the final examination.

Examinations and Promotions

The following regulations govern the practice of the Faculty of Arts in regard to final examinations, promotions and supplemental examinations. These regulations with necessary adaptations apply to part-time students and special programmes.

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 Promotions 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 every year 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 depart-
ment concerned, and 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 supplemental 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. Term Examinations

There will be no formal mid-year examinations in any year. Instructors will
report the progress of all first year students to the Dean before the end of the
first term. Students who are not progressing satisfactorily may be interviewed
by the Dean of the Faculty of Arts of the University and in some cases may
be required to withdraw for the remainder of the session.

3. Standing

(a) Letter grades signify the following standings in individual subjects:

<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 - 74%</td>
</tr>
<tr>
<td>C</td>
<td>60 - 65%</td>
</tr>
<tr>
<td>D</td>
<td>50 - 59%</td>
</tr>
<tr>
<td>F</td>
<td>less than 50%</td>
</tr>
<tr>
<td>S</td>
<td>less than 50%</td>
</tr>
</tbody>
</table>

Supplementals allowed

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

(b) Standing in Year I is indicated by the following terms:

<table>
<thead>
<tr>
<th>Range of average marks</th>
<th>Standing</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>49 or less</td>
<td>F</td>
</tr>
</tbody>
</table>

Supplementals allowed

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

(c) Promotion to the next higher year or to Graduation will be based on pass-
ing the complete year's work in one academic year.

(d) In order to enter Second and subsequent years of the General Arts course
a student must obtain a minimum over-all average of 50% and a minimum of
60% in the subjects of the field of specialization.

(e) In order to enter the second year of an Honours Arts Course, a student
must obtain a minimum over-all average of 60% in his first year studies, and
a minimum of 60% in the proposed field of specialization. To obtain standing
in the second and subsequent years of an Honours Arts Course, a student must
obtain an over-all average of at least 60% and a minimum average of at least 66% in the subjects of his field of specialization unless otherwise specified in a departmental honours programme.

(f) Standing in the second and subsequent years, is indicated by the following terms:

<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</td>
<td>Second Class Honours</td>
<td>B</td>
</tr>
<tr>
<td>60 - 65</td>
<td>Third Class Honours</td>
<td>C</td>
</tr>
<tr>
<td>50 - 59</td>
<td></td>
<td>D</td>
</tr>
</tbody>
</table>

*The marks obtained in the subjects of specialization and related subjects will also be taken into account in assigning standing.

4. Failure

(a) A student who fails more than two full courses at the annual examinations fails his year. He is not eligible for supplemental privileges and may either repeat the year or be required to withdraw if the Faculty Council considers that he will not profit by further study.

(b) A student who achieves 50% in each of his courses in his year, but does not achieve the required over-all standing or the required standing in his field of specialization in either an honours or general programme, fails his year.

(c) Any student granted permission to repeat his year must take a full complement of courses.

(d) A student may be granted the privilege of repeating one year only.

(e) All failing papers are re-read.

5. Supplemental Examinations

(a) To be eligible for supplemental examinations at the end of Year 1, a student

(i) 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;
(ii) must not have failed more than two full courses;
(iii) must not have defaulted the final examination except for a properly certified reason;
(iv) must have obtained a final over-all average of at least 50%.

(b) To be eligible for supplemental examinations beyond Year 1, a student

(i) must have shown satisfactory term work progress to at least grade "C" in the subject in question;
(ii) must not have failed more than two full courses;
(iii) must not have defaulted the final examination except for a properly certified reason;
(iv) must have obtained a final overall average of 50% and an average of 60% in the subjects of specialization in a General Course, and a final over-all average of 60% and an average of 66% in the subjects of specialization in an Honours Course.
(c) A student who fails to obtain at least 40% in a final examination may be granted supplemental privileges only at the discretion of the Council of the Faculty of Arts.

(d) Supplemental examinations are held in late July or early August. Application for these examinations must be filed by June 22nd 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 supplemental examinations must accompany the application and, if the student subsequently decides not to write the examination, this fee is not refunded. Supplemental examinations must be written at the next regular supplemental period.

(e) A student may not write supplemental examinations to raise his standing in courses already passed nor will the results of supplemental examinations be considered in arriving at a student's standing in his year's programme.

(f) A student may write a supplemental once only in any one course.

(g) Failure to write an examination is considered a failure to pass. A student who fails to write a supplemental 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**

1. **How to Select a Programme in Year One of the Faculty of Arts**

In the Faculty of Arts a first-year student faces a more difficult decision in selecting courses than does a freshman in Science or Engineering. Whereas scientific and technical programmes tend to restrict the syllabus for the first-year student, the Faculty of Arts offers approximately twenty first-year courses from which the student may choose 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.
Academic Programmes

This Calendar describes recommended Year 1 programmes for the various Honours courses, beginning on page 23. 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.

For example, the student desiring to enter the four-year Honours programme in English and the student planning to take a three-year General Degree with an English major should both turn to page 23 of the Calendar. Here they will find the syllabus recommended for Year I:

- English 101
- A language other than English
- Philosophy 100 or equivalent
- Psychology 110
- History 100
- Science 100, or a course in Religious Knowledge

To get a brief idea of the content of each of these (or other) courses, he should turn to pages 114 - 243 where course descriptions are listed alphabetically by departments for the entire University. In some cases this programme may not meet the needs or special circumstances of the student. The chairman of the department concerned will be pleased to answer enquiries from students in this regard.

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.

On registration day a professor from each department is available to the student for consultation and assistance in selecting the Year I programme. It is of great assistance if the student has given careful thought to his programme before registration day.

If a student has any further questions about these matters he should write the Registrar or the Dean of the Faculty of Arts.

2. Each student’s programme must be approved at registration day by a faculty advisor from the Faculty of Arts.

3a. Once the student has completed his registration, he may not change his programme, add courses or drop courses, without obtaining permission from the Dean, the Instructor of the course to which he is changing and/or the department chairman of the student’s major. Such changes must be recorded on the official forms available at the Office of the Registrar. Changes in courses are permitted for a period of three weeks from the date of beginning of lec-
tures. The only changes permitted after this period will be dropping of a course previously designated as an extra, or where a student wishes to reduce his programme from honours to general.

b. Extra subjects must be so designated at Registration. They will not be used in computing the year's overall average and they do not carry supplemental privileges. An extra subject may not be used as a substitute for a regular subject.

4. Students may choose courses from the following groups:
   
a. (i) English, History and Philosophy.
    (ii) French, German, Greek, Italian, Latin, Russian, Spanish, a foreign culture civilization course, Classical Civilization;

   b. Economics, Geography, Political Science, Psychology, Sociology;

   c. Mathematics, Courses offered by the Faculty of Science*, Religious Knowledge, Music, Ukrainian.

* Where prerequisites can be met.

**Year One.** (Common to both Honours Courses and the General Courses)

The student must select six courses.

Two courses from Group A
Two courses from Group B
Two other courses.

Notes:

(i) "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.

(ii) A First Year Student who has indicated his intention of entering an Honours Course may postpone one of the required subjects from Group A or Group B until a later year.

(iii) In Year I a student must normally complete the introductory course in the department in which he will major in his later years.

(iv) A student who, in the opinion of the Chairman of his major department, is deficient in English may be required to take a non-credit course in remedial English.

(v) Students entering the General or Honours Mathematics programme will normally take Mathematics 130, 131, 132, in Year I; their programmes will be adjusted to permit this selection.
The General Course

Year I

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

<table>
<thead>
<tr>
<th>Economics</th>
<th>Greek</th>
<th>Political Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>History</td>
<td>Psychology</td>
</tr>
<tr>
<td>French</td>
<td>Latin</td>
<td>Russian</td>
</tr>
<tr>
<td>Geography</td>
<td>Mathematics</td>
<td>Sociology</td>
</tr>
<tr>
<td>German</td>
<td>Philosophy</td>
<td>Spanish</td>
</tr>
</tbody>
</table>

Year II (General)

Each student in Year II 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 III (General)

Each student in Year III must choose at least five courses in consultation with his department chairman:

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

Notes:

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

2. Before graduation each student must take:
   —a minimum of four courses, not all in one subject, from Group A
   —a minimum of two courses from Group A(i)
   —a minimum of one course from Group A(ii). This requirement may be met by a foreign culture civilization course or by a language other than English at the 100 level.

3. "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.
Honours Courses

1. In Year I a student must normally complete the introductory course in the subject in which he will major in later years.

2. Before graduation each student must take:
   —a minimum of four courses, not all in one subject, from Group A
   —a minimum of two courses from Group A(i)
   —a minimum of one course from Group A(ii). This requirement may be met by a foreign culture civilization course or by a language other than English at the 100 level.

3. Students are requested to refer to the detailed programmes following this page for other departmental requirements.

4. “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.
Honours Economics

Prerequisite: It is desirable, but not mandatory, that students planning to enter Honours Economics should offer three Grade XIII papers in Mathematics.

<table>
<thead>
<tr>
<th>Year I</th>
<th>Recommended Programme:</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Economics 100</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Political Science 110</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>English 101</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>History 100, or Philosophy 100 or equivalent</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>A language other than English</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>One Elective *</td>
<td>3</td>
</tr>
</tbody>
</table>

| Year II | Economics 200 | 3 |
|         | Economics 230 | 3 |
|         | Economics 255 or Economics 240 | 3 |
|         | History 100, or Philosophy 100 or equivalent | 3 |
|         | (whichever not elected in Year I) | 3 |
|         | One Elective ** | 3 |

| Year III | Economics 300 | 3 |
|          | Three of Economics 330, 340, 365, 370, 380, 390 | 9 |
|          | One Elective ** | 3 |

| Year IV | Economics 400 | 3 |
|         | Economics 440 | 3 |
|         | Economics 490 | 3 |
|         | Two of Economics 450, 460, 470, 480, a 300 course not previously elected | 6 |

* It is strongly recommended that students elect Mathematics 130 (Calculus)

** If Mathematics 233 (Probability and Statistics) is chosen as the elective in Year II a second elective must be chosen in place of Economics 300 (Statistics) in Year III.

Honours English

<table>
<thead>
<tr>
<th>Year I</th>
<th>Recommended Programme:</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>English 101</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>One of French 160, German 100, Latin 100</td>
<td>3-4</td>
</tr>
<tr>
<td></td>
<td>Philosophy 100 or equivalent</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Psychology 110</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>History 100</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Science 100 or a course in Religious Knowledge</td>
<td>3-4</td>
</tr>
</tbody>
</table>

23
Year II

- English 251, 261, 270, 280: 11
- Classical Civilization 260: 3
- One other supporting course: 3

Year III

- English 350, 360, 370, 380: 11
- Two supporting courses: 6

Year IV

- English 300, 451, 460, 470, 495: 15
- One supporting course: 3
- Comprehensive Examination: 3

Honours English and French

Year I

Recommended Programme: Hours

- English 101: 3
- French 160: 3
- History 100, or Philosophy 100 or equivalent: 3
- One of History 100, Philosophy 100 or equivalent, a course in German, Latin, or Spanish: 3
- Psychology 110 or Political Science 100: 3
- Science 100 or a course in Religious Knowledge: 3-4

Year II

- English 251 and two other English courses (see Note 1): 7-9
- French 250, 260: 6
- One other course (see Note 2): 2-3

Year III

- Two English courses (see Note 1): 4-6
- French 350, 360, 370: 7
- One other course: 3

Year IV

- English 480 and one other English course (see Note 1): 6-7
- French 450, 460, 470, 480: 8
- Senior Honours Essay: 3
- Comprehensive Examination: 3

Note 1: Before graduation students must complete the following English courses: English 101, 251, 270 or 280, 360, 350 or 370, 380 or 451, 300 (or 330J) or 460, and 480.

Note 2: Students planning to enter O.C.E. must choose English 261.
Honours English and German

Year I

**Recommended Programme:**

- English 101
- German 100
- History 100, or Philosophy 100 or equivalent
- Psychology 110 or another social science
- Two other courses

**Hours**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 101</td>
<td>3</td>
</tr>
<tr>
<td>German 100</td>
<td>3</td>
</tr>
<tr>
<td>History 100, Philosophy 100</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 110, Social Science</td>
<td>3</td>
</tr>
<tr>
<td>Two other courses</td>
<td>5-7</td>
</tr>
</tbody>
</table>

Year II

- English 251 and two other English courses (see Note 1)
- German 250, 270, 260
- One other course (see Note 2)

**Hours**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 251</td>
<td>7-9</td>
</tr>
<tr>
<td>Two other English courses</td>
<td>7-9</td>
</tr>
<tr>
<td>German 250</td>
<td>6</td>
</tr>
<tr>
<td>History courses (see Note 2)</td>
<td>2-3</td>
</tr>
</tbody>
</table>

Year III

- Two English courses (see Note 1)
- German 350, 360, 370, 380
- One other course

**Hours**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 251</td>
<td>7-9</td>
</tr>
<tr>
<td>Two other English courses</td>
<td>7-9</td>
</tr>
<tr>
<td>German 350-380</td>
<td>9</td>
</tr>
<tr>
<td>One other course</td>
<td>3</td>
</tr>
</tbody>
</table>

Year IV

- English 480 and one other English course (see Note 1)
- German 450, 460, 470
- Senior Honours Essay
- Comprehensive Examination

**Hours**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 480</td>
<td>6-7</td>
</tr>
<tr>
<td>One other English course</td>
<td>6</td>
</tr>
<tr>
<td>German 450, 460, 470</td>
<td>7</td>
</tr>
<tr>
<td>Senior Honours Essay</td>
<td>3</td>
</tr>
<tr>
<td>Comprehensive Examination</td>
<td>3</td>
</tr>
</tbody>
</table>

Note 1: Before graduation students must complete the following English courses: English 101, 251, 270 or 280, 360, 350 or 370, 380 or 451, 300 (or 330) or 460, and 480.

Note 2: Students planning to enter O.C.E. must choose English 261.

Honours English and History

Year I

**Recommended Programme:**

- English 101
- History 100 or 110
- One of French 100, German 100, Latin 100
- Three of Economics 100, Geography 100, Science 100, and a course in Religious Knowledge

**Hours**

<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 100,</td>
<td>3-4</td>
</tr>
<tr>
<td>Latin 100</td>
<td></td>
</tr>
<tr>
<td>Three of Economics 100, Geography</td>
<td>9-10</td>
</tr>
<tr>
<td>Science 100 and Religious</td>
<td></td>
</tr>
</tbody>
</table>

Year II

- English 251 and two other English courses (see Note 1)
- Two History courses (see Note 2)
- One of Philosophy 100 or equivalent, Psychology 110, an advanced literature course

**Hours**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 251</td>
<td>7-9</td>
</tr>
<tr>
<td>Two History courses</td>
<td>7-9</td>
</tr>
<tr>
<td>One of Philosophy 100</td>
<td>6</td>
</tr>
<tr>
<td>an advanced literature course</td>
<td>3</td>
</tr>
</tbody>
</table>

Year III

- Two English courses (see Note 1)
- Three History courses (see Note 2)
- One other course (see Note 3)

**Hours**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 251</td>
<td>4-6</td>
</tr>
<tr>
<td>Three History courses</td>
<td>9</td>
</tr>
<tr>
<td>One other course</td>
<td>3</td>
</tr>
</tbody>
</table>

25
Year IV

English 480 and one other English course (see Note 1)

Two of History 470-479

One other History course (see Note 2)

Senior Honours Essay

Comprehensive Examination

6-7

4

2-3

3

Note 1: Before graduation students must complete the following English courses: English 101, 251, 270 or 280, 360, 350 or 370, 380 or 451, 300 (or 330J) or 460, and 480.

Note 2: The six courses in History beyond the first year will normally be selected from History 250, 255, 260, 295, 350, 361, 362, 370, 380.

Note 3: Students planning to enter O.C.E. must choose English 261.

Honours English and Latin

Year I

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 100</td>
<td>3</td>
</tr>
<tr>
<td>History 100, or Philosophy 100 or equivalent</td>
<td>3</td>
</tr>
<tr>
<td>Two courses in the social sciences</td>
<td>6</td>
</tr>
<tr>
<td>One further course</td>
<td>3</td>
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</table>

Year II

English 251 and two other English courses (see Note 1)

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latin 250, 260</td>
<td>4</td>
</tr>
<tr>
<td>Classical Civilization 250</td>
<td>3</td>
</tr>
</tbody>
</table>

Year III

Two English courses (see Note 1)

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latin 350, 360, 370</td>
<td>7</td>
</tr>
<tr>
<td>Classical Civilization 260</td>
<td>3</td>
</tr>
<tr>
<td>One other course (see Note 2)</td>
<td>3</td>
</tr>
</tbody>
</table>

Year IV

English 480 and one other English course (see Note 1)

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latin 450, 460, 470</td>
<td>7</td>
</tr>
<tr>
<td>Senior Honours Essay</td>
<td>3</td>
</tr>
<tr>
<td>Comprehensive Examination</td>
<td></td>
</tr>
</tbody>
</table>

6-7

Note 1: Before graduation students must complete the following English courses: English 101, 251, 270 or 280, 360, 350 or 370, 380 or 451, 300 (or 330J) or 460, and 480.

Note 2: Students planning to enter O.C.E. must choose English 261.
Honours English and Philosophy

**Year I**

**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><em>One of</em> French 100, German 100, Latin 100, Greek 100</td>
<td>3-4</td>
</tr>
<tr>
<td><em>One of</em> Philosophy 221/2 or 280/1</td>
<td>2-3</td>
</tr>
<tr>
<td>Psychology 110 or Political Science 100</td>
<td>3</td>
</tr>
<tr>
<td><em>One of</em> History 100 or a foreign language course</td>
<td>3-4</td>
</tr>
<tr>
<td>Science 100</td>
<td>4</td>
</tr>
</tbody>
</table>

**Year II**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 251 and <em>two other</em> English courses</td>
<td>7-9</td>
</tr>
<tr>
<td><em>(see Note 1)</em></td>
<td></td>
</tr>
<tr>
<td><em>One of</em> Philosophy 221/2 or 280/1</td>
<td>2-3</td>
</tr>
<tr>
<td>Philosophy 282/3 and <em>one other</em> Philosophy course</td>
<td>4-6</td>
</tr>
<tr>
<td>One other course</td>
<td>3</td>
</tr>
</tbody>
</table>

**Year III**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Two English courses</em> <em>(see Note 1)</em></td>
<td>4-6</td>
</tr>
<tr>
<td>Philosophy 299, 331, and <em>one other</em> Philosophy course</td>
<td>6</td>
</tr>
<tr>
<td>One other course</td>
<td>3</td>
</tr>
</tbody>
</table>

**Year IV**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 480 and <em>one other</em> English course</td>
<td>6-7</td>
</tr>
<tr>
<td><em>(see Note 1)</em></td>
<td></td>
</tr>
<tr>
<td><em>Three Philosophy courses</em></td>
<td>6</td>
</tr>
<tr>
<td>Senior Honours Essay</td>
<td>3</td>
</tr>
<tr>
<td>Comprehensive Examination</td>
<td></td>
</tr>
</tbody>
</table>

**Note 1:** Before graduation students must complete the following English courses: English 101, 251, 270 or 280, 360, 350 or 370, 380 or 451, 300 (or 330J) or 460, and 480.

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

---

Honours English and Russian

**Year I**

**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>Russian 1-50 or 100</td>
<td>3-5</td>
</tr>
<tr>
<td>History 100, or Philosophy 100 or equivalent</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 110 or another social science</td>
<td>3</td>
</tr>
<tr>
<td>Two other courses</td>
<td>5-7</td>
</tr>
</tbody>
</table>

**Year II**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 251 and <em>two other</em> English courses</td>
<td>7-9</td>
</tr>
<tr>
<td><em>(see Note 1)</em></td>
<td></td>
</tr>
<tr>
<td>Two Russian courses <em>(see Note 2)</em></td>
<td>6</td>
</tr>
<tr>
<td>One other course <em>(see Note 3)</em></td>
<td>2-3</td>
</tr>
</tbody>
</table>
Year III
- Two English courses (see Note 1) 4-6
- Three Russian courses 8
- One other course 3

Year IV
- English 480 and one other English course (see Note 1) 6-7
- Two Russian courses 6
- One other course 3
- Senior Honours Essay 3
- Comprehensive Examination

Note 1: Before graduation students must complete the following English courses: English 101, 251, 270 or 280, 360, 350 or 370, 380 or 451, 300 (or 330J) or 460, and 480.

Note 2: Before graduation students must complete at least 8 (eight) of the following courses: Russian 1-50, 100, 250, 260, 270, 350, 360, 370, 450, 460, 470 and 480.

Note 3: Students planning to enter the Ontario College of Education must choose English 261.

Honours English and Spanish

Year I

Recommended Programme: Hours
English 101 3
French 100 4
Spanish 100 4
History 100, or Philosophy 100 or equivalent 3
Psychology 110 or Political Science 100 3
Science 100, a course in Religious Knowledge, or a second social science 3-4

Year II

English 251 and two other English courses (see Note 1) 7-9
Spanish 250, 260 6
One other course (see Note 2) 3

Year III

Two English courses (see Note 1) 4-6
Spanish 350, 360, 370 7
One other course 3

Year IV

English 480 and one other English course (see Note 1) 6-7
Spanish 450, 460, 470, 480 8
Senior Honours Essay 3
Comprehensive Examination

Note 1: Before graduation students must complete the following English courses: English 101, 251, 270 or 280, 360, 350 or 370, 380 or 451, 300 (or 330J) or 460, and 480.

Note 2: Students planning to enter O.C.E. must choose English 261.
Honours French and German

<table>
<thead>
<tr>
<th>Year</th>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>French 160</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>German 100</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Two of History, English, Philosophy</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>One course in the social sciences</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>One elective (see Note 1)</td>
<td>3</td>
</tr>
<tr>
<td>II</td>
<td>French 250, 260</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>German 260, and one of 250, 270</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Two electives</td>
<td>6</td>
</tr>
<tr>
<td>III</td>
<td>French 350, 360, 370</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>German 350, and two of 360, 370, 380</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>One elective</td>
<td>3</td>
</tr>
<tr>
<td>IV</td>
<td>French 450, 460, 470, 480</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>German 450, 460, 470</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>One elective (see Note 2)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Comprehensive Examination</td>
<td></td>
</tr>
</tbody>
</table>

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

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

2. Required if the student would not otherwise have fulfilled the required minimum number of courses.

Honours French and Latin

<table>
<thead>
<tr>
<th>Year</th>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Latin 100</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>French 160</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Two courses in the social sciences</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>English 110 or History 200</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>One elective</td>
<td>3</td>
</tr>
<tr>
<td>II</td>
<td>Latin 250, 260</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>French 250, 260</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Philosophy 100 or equivalent</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>One elective</td>
<td>3</td>
</tr>
<tr>
<td>III</td>
<td>Latin 350, 360, 370</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>French 350, 360, 370</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>One elective</td>
<td>3</td>
</tr>
<tr>
<td>IV</td>
<td>Latin 450, 460, 470</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>French 450, 460, 470, 480</td>
<td>8</td>
</tr>
</tbody>
</table>
### Honours French and Political Science

**Year I**  
**Recommended Programme:**
- Political Science 110: 3 hours
- French 160: 4 hours
- History 100: 3 hours
- Economics 100: 3 hours
- English 101 or Philosophy 100 or equivalent: 3 hours
- Elective: 3 hours

**Year II**  
- Political Science 270: 3 hours
- Political Science 280: 3 hours
- French 250: 3 hours
- French 370: 3 hours
- History 260: 3 hours
- Elective: 3 hours

**Year III**  
- Two approved Political Science courses: 6 hours
- French 350: 2 hours
- French 360: 3 hours
- History 380: 3 hours
- Elective: 3 hours

**Year IV**  
- Two approved Political Science courses at the 300 or 400 level: 6 hours
- French 450: 2 hours
- French 480: 2 hours
- Two Electives: 6 hours

*Electives may be drawn from additional courses in Political Science or French as well as from other departments. Electives would have to be approved by the departments of French and Political Science.

### Honours French and Russian

**Prerequisite:**  
Students entering Honours French and Russian are strongly advised to offer Grade XIII Latin or German, or Russian, where possible, as well as French.

**Year I**  
**Recommended Programme:**
- French 160: 4 hours
- Russian 1-50 or 100: 3 hours
- Two of History, English, Philosophy: 6 hours
- One course in the social sciences: 3 hours
- One elective (see Note 1): 3 hours

**Year II**  
- French 250, 260: 6 hours
- Russian 260 or 100 and one of 250, 370: 6 hours
- Two electives: 6 hours
Honours French and Russian

Year III
French 350, 360, 370  
Russian 350, and two of 360, 370, 470  
One elective  

Year IV
French 450, 460, 470, 480  
Russian 450, 460, 480  
One elective (see Note 2)  
Comprehensive Examination

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

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

2. Required if the student would not otherwise have fulfilled the required minimum number of courses.

Honours French and Spanish

Prerequisite: Students registering in Honours French and Spanish must present satisfactory standing in Grade XIII English, French and Latin. Those who begin Spanish in the University will take Spanish 1-50 in the first year, and Spanish 100, 250 and 260 in the second year.

Year I  
Recommended Programme:  
French 160  
Spanish 100  
Latin 100 or Italian 12J  
One course in the social sciences  
Two electives

Year II  
French 250, 260  
Spanish 250, 260  
History 260  
Italian 50J (for those who took 12J) or one elective

Year III  
French 350, 360, 370  
Spanish 350, 360, 370  
English 380

Year IV  
French 450, 460, 470, 480  
Spanish 450, 460, 470, 480

Note: Students taking Honours courses involving French and/or Spanish are required to read, independently, a number of books dealing with the history and culture of France and/or Spain and Spanish America, and will be examined on the assumption that the reading has been done.
Honours Geography

(Teaching Option)

<table>
<thead>
<tr>
<th>Year</th>
<th>Recommended Programme</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year I</td>
<td>Geography 100</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>One of French 100, German 100, Spanish 100, Russian 100 (French preferred)</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Four courses chosen after consultation with Department of Geography</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td>Year II</td>
<td>Geography 200*, 260*, 220, 275</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Three courses other than Geography</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Economics 100 if not previously taken)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year III</td>
<td>Geography 300, 310, 375</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Three additional courses (one must be other than Geography)</td>
<td>9</td>
<td>-</td>
</tr>
<tr>
<td>Year IV</td>
<td>Geography 420, 421-29, 480, 490</td>
<td>10-11</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>One course other than Geography</td>
<td>3</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes:
1. This programme is designed to permit students to enter Secondary School Teaching or to continue to graduate work in Geography.
2. Geography 200* and 260* are semester courses. In 1965-66 Geography 260 will be given in the fall term, 200 in the spring term.
3. In all the Geography courses after Year I, some reading assignments will be given in the student's second language.
4. Students are encouraged to obtain summer employment which will provide experience useful to a geographer.

Honours Geography

(Urban, Regional, and Resource Planning Option)

<table>
<thead>
<tr>
<th>Year I</th>
<th>Recommended Programme</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Geography 100</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>One of French 100, German 100, Spanish 100, Russian 100 (French preferred)</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Four courses chosen after consultation with Department of Geography</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td>Year II</td>
<td>Geography 200*, 260*, 220, 275</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Three courses other than Geography</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Economics 100 if not previously taken)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Honours Geography

Year III
Geography 300, 310, 350, 355, 356  9  6
One course other than Geography  3  -

Year IV
Geography 456, 480, 490  7-8  -
One of Geography 345, 420, 421-29, 450  3  -
One course other than Geography  3  -

Notes:
1. This programme is designed for students who intend to do graduate work in Geography and/or Planning, or who intend to go directly into research work with planning agencies, government or business.
2. Geography 200* and 260* are semester courses. In 1965-66 Geography 260 will be given in the fall term, 200 in the spring term.
3. In all the Geography courses after Year I, some reading assignments will be given in the student's second language.
4. Students are encouraged to spend at least one summer working for an agency involved in planning research, or in other work related to planning.

Honours German and Russian

Year I
Recommended Programme:
German 100  3
Russian 1-50 or 100  5-3
Two of History, English, Philosophy  6
One course in the social sciences  3
One elective (see Note 1)

Year II
German 260 and one of 250, 270  6
Russian 260 or 100 and one of 250, 270  6
Two electives  6

Year III
German 350, two of 360, 370, 380  8
Russian 350, 360 or 260 and one of 370, 470  8
One elective  3

Year IV
German 450, 460, 470  7
Russian 450, 460, 470, 480  9
One elective (see Note 2)  3
Comprehensive Examination

Note: Each student will normally complete a minimum of at least one course from each of English, History and Philosophy.
1. The student may take the two required Social Sciences in the first year.
2. Required if the student would not otherwise have fulfilled the required minimum number of courses.
Honours History

Prerequisite: It is desirable, but not necessary, for a student planning to enter Honours History to offer Grade XIII papers in foreign languages and Geography in addition to English and History.

Year I

Recommended Programme: Hours
Any first-year programme that fulfills the general requirements (see page 21) is acceptable. A History course should be offered. Courses in English, a language other than English, Economics, Geography and Political Science are recommended.

Year II

Two of History 250, 255, 260 6
One other History course 3
Three other courses (see Note 1) 9

Year III

Three of History 350, (361 or 362), 370, 380 9
Two other courses (see Note 1) 6

Year IV

Two of History 470-479 4
History 499
Three of History or approved alternative senior courses (see Note 2) 9
Comprehensive examination

Notes:
1. By the end of Year III a sequence of at least two full courses should be completed in both the humanities and social sciences in addition to History.
2. Alternative senior courses may be chosen from such fields as Economics, History, Geography, Philosophy, Political Science.
3. Graduation in this course with at least Second Class standing qualifies a student for admission to the Type A course in History at the Ontario College of Education.

Honours History and Philosophy

Recommended Programme: Hours
Year I
One of Philosophy 221/2 or 280/1 2-3
History 100

Year II
One of Philosophy 221/2 or 280/1 2-3
Philosophy 282/3 and one other Philosophy course 4-6
Three of History 250, 260, 270, (274/276) 350, 361, 362, 370, 380 9
Honours History and Philosophy

**Year III**
- Philosophy 299, 325/6  
- Philosophy 345 and one other half course in Philosophy  
- Three of History 250, 260, 270, (274/276), 350, 361, 362, 370, 380  
- Philosophy 399  

**Year IV**
- Three Philosophy courses  
- Two of History 470 to 479  
- History 499

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

Honours Latin

**Recommended Programme:**

<table>
<thead>
<tr>
<th>Year</th>
<th>Courses</th>
<th>Hours</th>
</tr>
</thead>
</table>
| **Year I** | Latin 100  
One of English & Philosophy  
Two courses in Social Sciences  
Classical Civilization 250  
One elective | 3  
3  
6  
3  
3 |
| **Year II** | Latin 250, 260, 360  
Classical Civilization 260  
Two electives | 7  
3  
6 |
| **Year III** | Latin 350, 370, 380  
Classical Civilization 350  
Two electives | 7  
3  
6 |
| **Year IV** | Latin 450, 460, 470, 480  
Two electives | 10  
6 |

*Note: Those intending to obtain a Type A certificate for teaching in Ontario High Schools must take a Minor in addition to their Latin programme. In Greek, as a Minor subject 9 hours are required, in French 15, in English 15, in Italian 15. The Electives provide room for these requirements.*

Honours Mathematics

**Prerequisite:**
Students entering this programme should have an overall average of 66% in the Grade XIII examinations in Mathematics (Algebra, Geometry, and Trigonometry); it is also desirable to have taken Grade XIII Chemistry and Physics. To remain in the Honours Mathematics programme, a student must obtain an overall average of 60% in each year.
<table>
<thead>
<tr>
<th>Year</th>
<th>Recommended Programme:</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Mathematics 130, 131&lt;br&gt;Four other courses, one of which may be Mathematics 132</td>
<td>6</td>
</tr>
<tr>
<td>II</td>
<td>Mathematics 230, 231, 232, 233&lt;br&gt;Three electives, one of which may be chosen from Mathematics 234, 235</td>
<td>11</td>
</tr>
<tr>
<td>III</td>
<td>(Pure Mathematics Option)&lt;br&gt;Mathematics 330, 331, 332, 333&lt;br&gt;One or two additional Mathematics courses&lt;br&gt;Two electives</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>(Statistics and Actuarial Mathematics Option)&lt;br&gt;Mathematics 331, 332, 334&lt;br&gt;Two or three courses from Mathematics 330, 333, 335, 336, 338&lt;br&gt;Two electives</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>(Teaching Option)&lt;br&gt;Mathematics 330, 331, 332, 334&lt;br&gt;One additional Mathematics course&lt;br&gt;Two electives</td>
<td>12</td>
</tr>
<tr>
<td></td>
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</tbody>
</table>
Honours Mathematics

Year IV
(Pure Mathematics Option)
Three courses from Mathematics 425, 430, 431, 432, 433, 434 10
Two or three additional Mathematics courses 4-6
Two electives 6

(Statistics and Actuarial Mathematics Option)
Mathematics 435, 438 5
Three or four courses from Mathematics 430, 433, 436, 437, 439, 440, 446, 447 6-8
Two electives 6

(Teaching Option)
Mathematics 446 2
Four additional Mathematics courses numbered above 200 12
Two electives

Note: 1. Each student will normally include two courses in Physical Science among the elective courses of the second, third, and fourth years.

2. Students may choose their elective courses so as to have a minor field of specialization in addition to Mathematics; for example, Psychology, Economics, German, French, etc., could serve as minors. With the permission of the Dean and the Department Chairman, students may replace one of the Mathematics courses of each of the third and fourth years by a course chosen from the minor field.

Co-operative Honours Mathematics (Actuarial and Computer Options)
For a brochure outlining the Co-operative Mathematics programme in detail, please write to the Department of Mathematics or to the Registrar.

Honours Mathematics and Philosophy

Year I
Recommended Programme: Hours
English 101 3
One of Philosophy 221/2 or 280/1 2-3
A foreign language 3
One course in the social sciences 3
Mathematics 130, 131 6

Year II
Mathematics 230, 231, 232 8
One of Philosophy 221/2 or 280/1 2-3
One of Philosophy 240 or 282/3 2-3
Elective 3

Year III
Mathematics 330, 332, 233, 234 10
One of Philosophy 240 or 282/3 2-3
Philosophy 299 and one other Philosophy course 4

37
Year IV
Mathematics 331, 337, 433, 446 7
Three Philosophy courses 6
Elective (may be another Math.) 2-3

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

Honours Mathematics and Psychology

Prerequisite: Students entering this programme should have an overall average of 66% in the Grade XIII examinations in Mathematics (Algebra, Geometry, and Trigonometry).

<table>
<thead>
<tr>
<th>Year</th>
<th>Recommended Programme:</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lectures</td>
</tr>
<tr>
<td>Year I</td>
<td>Mathematics 130, 131, 132</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Psychology 110</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Philosophy 100 or two of Philosophy 125, 135, 140, 150</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>A language other than English</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Biology (see Note 1)</td>
<td>2</td>
</tr>
<tr>
<td>Year II</td>
<td>Mathematics 230, 231, 232</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Psychology 220</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>One other course in Psychology at the 250-299 level</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Philosophy 240</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Biology or Zoology (see Note 1)</td>
<td>2</td>
</tr>
<tr>
<td>Year III</td>
<td>Mathematics 233, 331, 332</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Psychology 321</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>One other course in Psychology at the 350-399 level</td>
<td>2-3</td>
</tr>
<tr>
<td></td>
<td>Philosophy 340</td>
<td>2</td>
</tr>
<tr>
<td>Year IV</td>
<td>Mathematics 439 or 449</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Two of Mathematics 333, 334, 335, 446</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Psychology 430, 499</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Elective (may be another Math. or Psych.)</td>
<td>2-3</td>
</tr>
</tbody>
</table>

Note 1: Students lacking Grade XIII Biology must take Biology 131. Biology 231 should be completed before the end of Year II.

Note 2: Psychology 150 may be substituted for Psychology 110, with permission of the Department.
Honours Philosophy

PROGRAMME A. (For students electing Philosophy in first year)

Year I

Recommended Programme: 
Philosophy 221/2 and 280/1 4-6
English or History 3
One of French, German, Latin or Greek 3
Two electives 6

Year II

Philosophy 240, 282/3, and 299 or one other Philosophy course 6-8
Three electives 6-9

Year III

Four Philosophy courses (including 299 if not taken in Year II) 8
Two electives 4-6

Year IV

Five Philosophy courses including Philosophy 499 10
One elective 2-3

PROGRAMME B. (For entering at the beginning of Year II)

Year I

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

Year II

Philosophy 221/2, 280/1 and one other Philosophy course 6-9
One of Philosophy 240 or 282/3 2-3
Two electives 4-6

Year III

One of Philosophy 240 or 282/3 2-3
Three other Philosophy courses (including 299) 6
Two electives 4-6

Year IV

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

Honours Philosophy and Literature

Year I

Recommended Programme: 
One of Philosophy 221/2 or 280/1 2-3
French 160 (or German 100) 3
English 101* 3
A Social Science 3
Two of A Natural Science
   Mathematics
   History
   Another language **
   Another Social Science

Year II
   One of Philosophy 221/2 or 280/1
   Philosophy 282/3 and one other Philosophy course
   French 250, 260 (or German 260 and one of German 250, 270)
   One elective (Social Science, if requirement not met in first year)

Year III
   Philosophy 299, 331 and one other Philosophy course
   French 350, 360, 370 (or German 350, 360, 380)
   One elective

Year IV
   Three Philosophy courses
   French 450, 460, 470, 480 (or German 450, 460, 470)
   Senior Essay

*In certain special cases, where the student can prove a high degree of familiarity with English literature he may substitute French or German 100, whichever has not already been chosen.

**Those taking the French option should normally take Latin 100.

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

Honours Philosophy and Psychology

<table>
<thead>
<tr>
<th>Year</th>
<th>Recommended Programme:</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lectures</td>
</tr>
<tr>
<td>Year I</td>
<td>One of Philosophy 221/2 or 280/1</td>
<td>2-3</td>
</tr>
<tr>
<td></td>
<td>Psychology 110</td>
<td>3</td>
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<td>A language other than English</td>
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<tr>
<td></td>
<td>English 101</td>
<td>3</td>
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<tr>
<td></td>
<td>A Social Science other than Psychology</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Mathematics or a Natural Science</td>
<td>2-3</td>
</tr>
<tr>
<td>Year II</td>
<td>One of Philosophy 221/2 or 280/1</td>
<td>2-3</td>
</tr>
<tr>
<td></td>
<td>One of Philosophy 240 or 282/3</td>
<td>2-3</td>
</tr>
<tr>
<td></td>
<td>One other Philosophy course</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Psychology 211, 212, 220</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Psychology 270</td>
<td>2</td>
</tr>
</tbody>
</table>
Honours Philosophy and Psychology

Mathematics, a Natural Science, or a Social Science other than Psychology 3 (see Note 1)

Year III
One of Philosophy 240 or 282/3 2-3
Philosophy 299 and two other Philosophy courses 6
Psychology 311, 351, and 352 or 390 2-3 0-2
Mathematics, a Natural Science, or a Social Science other than Psychology 2-3 0-3 (see Note 1)

Year IV
Two Philosophy courses 4
Psychology 410, 430 5
Senior Honours Essay (Philosophy-Psychology 499)
An elective 2-3

Note 1: Biology 131 is recommended for students who lack Grade XIII Biology; Mathematics 85 for students who lack Grade XIII Mathematics. Students may benefit from including Mathematics 130, 233, 449 and Biology 231 within their programmes. A Physics, Chemistry, Sociology, or Political Science sequence will also be acceptable.

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

Honours Political Science

Year I

Recommended Programme: Hours
Political Science 110 3
One of Economics 100, Psychology 110 3
   Sociology 100, Geography 100 3
One of History 100, another approved History course, Philosophy 100 or equivalent 3
One of English 101, a Foreign Language, a Foreign Culture Course 3
Two other courses to be selected in consultation with the Department 6

Year II

Three Political Science courses at the 200 level selected in consultation with the Department 9
An approved course in History, Philosophy or Economics 3
Two other courses, at least one of which must be a subject taken in Year I 6
Year III

Four Political Science courses selected in consultation with the Department 12
Two other approved courses 6

Year IV

Five Political Science courses, at least three of them at the 400 level 15
One other approved course 3

Honours Psychology

<table>
<thead>
<tr>
<th>Year I</th>
<th>Recommended Programme:</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Psychology 150</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Philosophy 100 or two of Philosophy 125, 135, 140, 150</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Biology (see Note 1)</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>A language other than English (see Note 2)</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Mathematics (see Note 3)</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>A Social Science other than Psychology or a Natural Science other than Biology</td>
<td>2-3</td>
<td>0-2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year II</th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Psychology 220</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Two other full-year courses in Psychology or the equivalent in half-year courses</td>
<td>4-5</td>
<td>2-4</td>
</tr>
<tr>
<td></td>
<td>Philosophy 240 or Mathematics (see Note 3)</td>
<td>2-3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>A language other than English</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>A Natural Science or a Social Science other than Psychology</td>
<td>2-3</td>
<td>0-3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year III</th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Psychology 311, 321,</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Two full-year Psychology courses or their equivalent in half-year courses, at the 250-299 or 350-399 levels</td>
<td>4-6</td>
<td>2-4</td>
</tr>
<tr>
<td></td>
<td>Philosophy or Mathematics (see Note 3)</td>
<td>2-3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>A Natural Science or a Social Science other than Psychology</td>
<td>2-3</td>
<td>0-3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year IV</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Psychology 430, 449 and 499</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>One full-year Psychology course, or two half-year courses at the honour level</td>
<td>2-3</td>
<td>0-2</td>
</tr>
<tr>
<td></td>
<td>A Natural Science or a Social Science other than Psychology</td>
<td>2-3</td>
<td>0-3</td>
</tr>
</tbody>
</table>
## Honours Psychology

### Notes:
1. Students without high school Biology must select Biology 131.
2. Russian is strongly recommended.
3. Students lacking Grade XIII Mathematics are urged to take Mathematics 85 in Year I. All Psychology Honour students should complete Mathematics 130 by the end of Year III. A student wishing to take both Philosophy and Mathematics in Years II, III, IV may omit one of the other recommended courses.
4. This is a recommended programme. Substitutions are permitted in the non-psychology courses with the consent of the Department of Psychology.
5. See also: Honours Biology and Psychology (Faculty of Science), Mathematics and Psychology, Philosophy and Psychology, Psychology and Sociology.

## Honours Psychology and Sociology

<table>
<thead>
<tr>
<th>Year</th>
<th>Recommended Programme:</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lectures</td>
</tr>
<tr>
<td>Year I</td>
<td>Psychology 110</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Sociology 100</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Philosophy 100 or equivalent</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Biology (see Note 1)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>A language other than English</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective (see Note 2)</td>
<td>3</td>
</tr>
<tr>
<td>Year II</td>
<td>Psychology 211, 212, and 220</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Sociology — two courses at the 200 level</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Philosophy 240</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective (see Note 2)</td>
<td>2-3</td>
</tr>
<tr>
<td>Year III</td>
<td>Psychology 311, 351, 352</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Sociology 320 and one other course in Sociology at the 300 level</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Two electives (see Note 2)</td>
<td>5-6</td>
</tr>
<tr>
<td>Year IV</td>
<td>Psychology 410 and 430</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Sociology 450, 465</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>One elective</td>
<td>2-3</td>
</tr>
<tr>
<td></td>
<td>Senior Honours Essay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Psychology - Sociology 499)</td>
<td></td>
</tr>
</tbody>
</table>

### Notes:
1. Students lacking Grade XIII Biology must take Biology 131.
2. Students lacking Grade XIII Mathematics should elect Mathematics 85. Other Electives recommended include Mathematics 130 and 499 and Biology 231.

**Note:** Honours Students are required to have Mathematics 253 or if their preparation permits Mathematics 140 and Mathematics 243.
## Honours Sociology

### Year I

**Recommended Programme:**
- Sociology 100: 3 hours
- History 100: 3 hours
- Philosophy 100 or equivalent: 3 hours
- English 101: 3 hours
- Psychology 110: 3 hours
- A language other than English: 3 hours

### Year II

- Sociology 201, 210 and two other courses in Sociology: 9 hours
- Economics 100: 3 hours
- Two electives: 6 hours

### Year III

- Sociology 320, 325 and two other courses in Sociology: 12 hours
- Two electives: 6 hours

### Year IV

- Sociology 450, 465, 470 and 499: 12 hours
- One elective: 3 hours

**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.
Other Honours Courses

Students interested in taking Honours Courses or combinations of courses not listed in the preceding pages should consult with the Dean. Other Honours Courses which may be offered, should the demand be sufficient are:

- Honours Classics
- Honours Economics (with Mathematics Option)
- Honours Economics (with Management Studies Option)
- Honours Economics and Political Science
- Honours History and German
- Honours History and Russian
- Honours Latin and Greek

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.
III

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 alternately 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 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, as is a substantial part of the work of the second year. Starting with the second year, 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.
Co-operative Graduate Programme in Engineering

The graduate co-operative programme of the Faculty of Engineering of the University of Waterloo is intended to provide means for engineers now in professional employment to undertake formal study on an intermittent basis. This development in engineering studies at the University of Waterloo arises from the nature of recent and current trends in engineering and science, in which new knowledge is displacing established material at an ever increasing pace. It reflects also the unique relationship of the University of Waterloo with Canadian industry achieved through the existing undergraduate co-operative engineering programme. Trends in the past few years have shown that it is becoming increasingly difficult for engineers in professional employment to keep abreast of advances in areas of engineering and science appropriate to their responsibilities — whether technical or administrative. It seems clear that formal study is the most effective approach for both updating courses and for more advanced work.

A feature of this programme is that the available courses include regular graduate level work and, as well, advanced level undergraduate courses that would be of interest to graduates of a few years' standing. All courses will be offered on an intramural basis.

Two basic schedules for credit courses will be available. The first, termed "full-time co-operative study" will entail resident study at Waterloo for at least four days per week in each semester. The second, "part-time co-operative study" will entail resident study at Waterloo one or two days per week in each semester. In addition students located near the University, will be able to follow a special programme allowing them to take individual courses as may be conveniently arranged.

There are three semesters in the calendar year at Waterloo, each lasting fifteen weeks: the fall semester running from September to December the winter semester running from January to early April, and the spring semester running from late April to early August. All individual courses offered may be completed in a single semester, and students can thus arrange study patterns in various semesters to suit their convenience. It would, for instance, be possible for a student to complete work for a Master's degree through resident study in successive winter semesters alone.

Degree requirements of the Faculty of Graduate Studies of the University of Waterloo require, for the Master's degree, at least eight semester-courses, or some smaller number of courses with a research thesis. Up to half the course requirements can be met with advanced level undergraduate courses of acceptable character. It is anticipated that most students in the graduate co-operative programme will be interested either in courses leading to a Master's degree, or in occasional courses for "updating" with no degree credit in mind. It will also be possible to satisfy all formal course requirements for the doctorate through this programme.

Along with the formal graduate co-operative programme described above, the Faculty of Engineering also offers a programme of short courses of one-or-
two-week duration, on various specialized topics. Schedules of these are announced from time to time.

The entire programme of graduate co-operative study and the short course programme are co-ordinated and offered through the Division of Graduate Professional Studies of the Faculty of Engineering of the University of Waterloo. Further information on course content may be obtained directly from this division. Applications for admission should be directed to the Registrar of the University of Waterloo.

Research for credit towards a higher degree can be undertaken in external laboratories if the project can be effectively supervised and is acceptable to a particular Engineering department and has the approval of the appropriate Graduate Council Committee.

Co-operative Graduate Programme
Alternate Arrangement for Study

<table>
<thead>
<tr>
<th>Plan</th>
<th>Full-time</th>
<th>Half-time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of Individual Session</td>
<td>One 15-week Semester</td>
<td>One 15-week Semester</td>
</tr>
<tr>
<td>Attendance per week</td>
<td>Four week days</td>
<td>Two week days</td>
</tr>
<tr>
<td>Average load per session</td>
<td>Four Courses</td>
<td>Two Courses</td>
</tr>
<tr>
<td>Minimum number of Sessions</td>
<td>Two</td>
<td>Four</td>
</tr>
<tr>
<td>for M.A.Sc. Degree</td>
<td>Fall, Winter or Spring Semesters</td>
<td>Fall, Winter or Spring Semesters</td>
</tr>
<tr>
<td>Time of Year Available</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Degrees

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

- Chemical Engineering
- Civil Engineering
- Electrical Engineering
- Mechanical Engineering

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. Work for higher degrees may be pursued either through conventional full-time graduate study, or through the graduate co-operative programme of the Faculty of Engineering. For further details, consult the section of this calendar dealing with the Faculty of Graduate Studies, and special remarks on the graduate co-operative programme on page 49, and as well the particular courses in graduate work in the various departments as listed in Chapter VII.

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>1965</th>
<th>1966</th>
<th>1967</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td>Winter</td>
<td>Spring</td>
</tr>
<tr>
<td>Stream &quot;A&quot;</td>
<td>First Term</td>
<td>Second Term</td>
</tr>
<tr>
<td>Stream &quot;B&quot;</td>
<td>First Term</td>
<td>Work Period</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1968</th>
<th>1969</th>
<th>1970</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winter</td>
<td>Spring</td>
<td>Fall</td>
</tr>
<tr>
<td>Stream &quot;A&quot;</td>
<td>Fifth Term</td>
<td>Work Period</td>
</tr>
<tr>
<td>Stream &quot;B&quot;</td>
<td>Work Period</td>
<td>Fifth Term</td>
</tr>
</tbody>
</table>

All Year I students enrol in September. These Year I 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 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.

Admission and Registration

General
Application for admission to the Faculty of Engineering should be made, as early in the year as possible, on forms provided by the Office of the Registrar. Academic certificates (not diplomas) and other supporting documents should be forwarded as soon as they become available. Admission cannot be granted until all requirements have been met and all documents submitted.

Admission to Year I
In order to qualify for admission to the first year of the Engineering programme the applicant must have completed the requirements for the Ontario Secondary School Honours Graduation Diploma (Senior Matriculation), or its equivalent, showing an overall average of 60% in the Grade XIII papers required for admission and with a minimum of 60% in the five papers in Mathematics and Science. Standing is required in the following papers:

- English
- Mathematics (Algebra, Geometry, Trigonometry)
- Science (Chemistry, Physics)
- Two additional papers - or one single paper in a language if written after 1964.

Note: For purposes of admission, grades of special Departmental examinations written to make up one-paper deficiencies in English or languages other than English may be used in conjunction with grades of papers previously passed in those subjects, but such special examinations may not be used alone as substitutes for the single combined examination in English and languages other than English.

Additional papers can be selected from any of the optional subjects offered at the Grade XIII level with the qualification that no more than one of the following papers may be counted as an "additional" paper: Accountancy Practice, Secretarial Practice, Mathematics of Investment, Art or Music (Departmental Examination). The marks received in one of these papers 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 paper" on the same terms as the above list except the marks received will not be computed in the average.
Admission and Registration

The following certificates, recognized as being equivalent to the Ontario Grade XIII certificate, may be accepted insofar as they meet the admission requirements of the University of Waterloo in subjects and percentages:

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

Senior Matriculation (Grade XII)
Senior Matriculation (Grade XIII)
Senior Matriculation (Grade XII)
Senior Matriculation (Grade XIII)
Year I Memorial University
Senior Matriculation (Grade XII)
McGill Senior Matriculation or Quebec Senior High School Leaving Certificate
Senior Matriculation (Grade XII)
The General Certificate of Education with passes in at least five subjects, two of which must be at Advanced Level. Advanced Level subjects must include Mathematics and either Physics or Chemistry.
The Scottish Leaving Certificate
High School Graduation plus an additional year of formal study in subjects comparable to Ontario Grade XIII.

Admission to Advanced Standing

An applicant for admission to advanced standing must submit an official transcript from the University which he has attended, showing in detail the courses he has taken and his standing in each.

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. Each application will be considered on its merits by the Admissions Committee. Under certain circumstances, the applicant may be required to write a qualifying examination.

Admission of Students from Other Countries

Students from areas where English is not the common language must provide certified translations of academic certificates. In addition, the applicant may be required to take either "The English Proficiency Tests" prepared by the English Language Institution 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 his 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.
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

<table>
<thead>
<tr>
<th>September 9</th>
<th>Thursday</th>
<th>Year I</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 10</td>
<td>Friday</td>
<td>Advanced Years</td>
</tr>
</tbody>
</table>

Once the student has completed his registration, he may not change his course, add subjects, or drop subjects, without obtaining permission from the Dean, the instructor, and processing the change, on the proper forms, through the Office of the Registrar.

Fees

All fees for the academic year are due and payable on the day of registration. Credit for scholarships or bursaries are given only on the authority of the Registrar after presentation of proof of the award.

If, for reasons acceptable to the Business Manager, the fees for the terms cannot be paid in full on the day of registration, they may be paid in two instalments, but an extra charge of $5.00 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, plus all incidental fees. The balance must be paid on or before the eighth week of term.

A charge of $2.00 per month will be made on overdue accounts. Failure to pay an overdue account before conclusion of lectures will bar a student from writing examinations or obtaining 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 fee 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 1964-65 year and at the time of printing is still subject to review and possible change for the 1965-66 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.

<table>
<thead>
<tr>
<th>Fees per term</th>
<th>Year One</th>
<th>Other Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuition</td>
<td>$292.50</td>
<td>$342.50</td>
</tr>
<tr>
<td>Incidental *</td>
<td>26.50</td>
<td>26.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$319.00</strong></td>
<td><strong>$369.00</strong></td>
</tr>
</tbody>
</table>

**Miscellaneous Fees**

- Examination — Supplemental, each paper: $10.00
  — Presiding fee (at an outside centre, each half day): 5.00
- Photograph (at first registration only): 1.00
- Late Registration: 10.00
- Transcript of record: 1.00
- Degree and Graduation - Final year only: 10.00

The Health Insurance Fee is for eight months' protection following each registration, and therefore includes students while off campus in their work periods. The fee is adjusted for the second term when a student remains on campus for two consecutive years.

* Incidental fees include student activities, athletics, health insurance and health services. The Health Insurance Plan does not include the premiums for benefits of the Ontario Hospital Services Commission. Such coverage is the student's own responsibility.

**Residence Fees**

Residence fee for both men and women is $725.00 for room and board for the regular academic session (2 terms), or $362.50 per term for co-operative course students. 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 the first term and the beginning of the second term. Students occupying residence in this period will be charged an additional $2.00 per day for their room (food, if available, will be an extra charge).

Rooms may be occupied for twenty-four hours before registration and after the final examination.

Examinations and Promotions

The Faculty constitutes the examining body for all University examinations. The arrangement of the undergraduate engineering programme is shown on page 51. The first two terms or semesters comprise the “First Year” and courses in the first year extend over the full two terms, with final examinations at the end of the second term. Beyond the first year, all courses are of single term duration, and final examinations are held at the end of each term.

The following regulations govern the conduct of examinations and the promotions policy of the Faculty of Engineering 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.

2. Standings in individual subjects are indicated by numerical grades in the scale 0 to 100, and may be interpreted according to the following:
   - 85 - 100 Excellent
   - 75 - 84 Very Good
   - 66 - 74 Good, Above Average
   - 60 - 65 Fair, Average to Below Average
   - 50 - 59 Passing
   - Below 50 Failing

3. For promotion from the First Year an over-all average of 60% is required. Students failing to secure this average will be required to repeat the year except that if, in the opinion of the Faculty Council, a student is deemed unlikely to profit from further study, readmission will be denied.

4. For promotion in the third and subsequent terms an over-all average of 60% is required in the work of the term. Students failing to secure this average normally will be required to repeat all or part of the work of the term last completed.

Where timetables permit, repeating students may be excused from repeating individual courses in which satisfactory grades have been obtained, and permitted to register in other appropriate courses.

5. Overall average of grades or standings may be interpreted according to the following:
   - 75.0 - 100 First Class Honours
Examinations and Promotions

66.0 - 74.9 Second Class Honours
60.0 - 65.9 Third Class Honours
Conditional - (Supplemental Examination Required)

6. A student must obtain an average standing of 60% as defined in sections 2 or 3 above to qualify for the privilege of writing supplemental examinations. Supplemental examinations will be written in the term immediately following that in which the respective final examinations were written. The results of supplemental examinations are reported and recorded but do not affect the original standing as used in determining averages for promotion. A student may not write supplemental examinations to raise the standing in subjects already passed.

7. 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 express approval of the Examinations and Promotions Committee and the Department in which he is registered. 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.

8. 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.

9. 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. Doctors' certificates, or other documents indicating reasons for absence from examinations must be filed in the Office of the Registrar by the last day of examinations.

10. Final examinations are automatically re-read for all subjects in which failing grades are assigned. Great care is taken not to make errors in assigning and recording grades.

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

12. 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

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 product, 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 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, from which optional programmes may be developed under the guidance of faculty advisors. Engineering Physics programmes, in which studies in engineering are associated with advanced study in Mathematics and Pure Science are thus available, in effect, in every major field, and supplant previous separate courses in Engineering Physics.

It will be noted that, while the work of the first year is indicated in detail, the distribution of other courses between the various terms of the remainder of the course are not indicated precisely, since it is desired to maintain flexibility in order that special programmes can be developed. Individual classes in course will be advised of ordinary course schedules. In most programmes, about sixteen hours a week are spent in lectures, and about ten hours a week are spent in laboratory.

The optional programmes that are made available under the curricula indicated
Academic Programmes

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

It is important to realize that the separation of engineering studies into four basic curricula areas reflects primarily divisions of learning in engineering, rather than divisions by classes of industry, for instance. It is to be noted that the chemical industry, the aeronautical industry, the mining industry, the pulp and paper industry — every major industry in fact — requires engineers from all primary divisions of the profession. Undergraduate study in any of the four basic divisions provided may lead, perhaps with further study or special experience as necessary, to professional activity in consulting work, or to staff positions in any kind of industry or any governmental agency, in research, education, design, design development, or administrative work.

**Year I — Common to all Engineering students**

*(For Admission Requirements see page 52)*

<table>
<thead>
<tr>
<th></th>
<th>First Term Lab or Lect.</th>
<th>Prob.</th>
<th>Second Term Lab. or Lect.</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 12 Calculus I</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Math. 21 Algebra and Solid Geometry</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Phys. 11 Mechanics, Wave Motion and Heat</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 11 General Chemistry</td>
<td>3</td>
<td>3*</td>
<td>3</td>
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<tr>
<td>G.E.21,22 Engineering Graphics, I, II</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>4</td>
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<tr>
<td>G.E. 11 Engineering Synthesis</td>
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<tr>
<td>Arts One of: Economics</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Geography 3</td>
<td>-</td>
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</tr>
<tr>
<td></td>
<td>Political Science 3</td>
<td>-</td>
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<tr>
<td></td>
<td>Psychology 3</td>
<td>-</td>
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<tr>
<td></td>
<td>Sociology 3</td>
<td>-</td>
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</tr>
</tbody>
</table>

Note: * signifies a course given on alternate weeks.

Detailed course descriptions commence on page ??.

All courses are of single term duration unless specifically indicated.

At the completion of the First Year, students are required to select one of the four major divisions of engineering:

- Chemical Engineering
- Civil Engineering
- Electrical Engineering
- Mechanical Engineering

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

Chemical Engineering

The course offered by the Department of Chemical Engineering is intended to prepare students for professional careers in those fields of engineering where physical-chemical transformations of matter play a significant role. The academic curriculum is based on the concept that undergraduate studies, to be most effective in a scientific industrial age, must deal primarily with basic scientific and engineering principles. In the earlier years the subject matter is analytical and closely prescribed—mathematics, physics, and chemistry form the foundation. In the senior years, subjects such as transport processes, process system design, and economic analysis, enables the student to reach a more comprehensive understanding of his previous work. A certain degree of specialization is available in the final year through options oriented towards Chemistry, Chemical Engineering, Applied Mathematics, and Industrial Management. 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 student to obtain maximum experience in industry.

A. Core Programme
   a. Mathematics and Science Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Lect.</th>
<th>Prob.</th>
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</thead>
<tbody>
<tr>
<td>Math. 22</td>
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<td>-</td>
</tr>
<tr>
<td>Math. 23</td>
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<td>Math. 24</td>
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<td>Math. 41</td>
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<td>Math. 51</td>
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<td>Chem. 31</td>
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<tr>
<td>Chem. 35</td>
<td>3</td>
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</tr>
<tr>
<td>Chem. 36</td>
<td>3</td>
<td>3*</td>
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</table>

   b. Engineering Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Lect.</th>
<th>Prob.</th>
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<tbody>
<tr>
<td>G. E. 12 Introduction to Engineering Systems</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>G. E. 41 Mechanics of Deformable Solids</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>G. E. 61 Philosophy of Science</td>
<td>3</td>
<td>-</td>
</tr>
</tbody>
</table>
Chemical Engineering

E. E. 12 Electricity and Magnetism I 2 -
Ch.E. 13 Unit Operations Analysis 3 2*
Ch.E. 11 Chemical Process Principles I 3 2
Ch.E. 12 Chemical Process Principles II 3 -
Ch.E. 13 Unit Operation Analysis 3 2*
Ch.E. 21 Transport Processes I 3 2*
Ch.E. 22 Transport Processes II 3 -
Ch.E. 31 Physical-Chemical Principles 3 3*
Ch.E. 32 Thermodynamics I 3 2*
Ch.E. 33 Thermodynamics II 3 -
Ch.E. 41 Reaction Kinetics I 3 -
Ch.E. 42 Reaction Kinetics II 3 -
Ch.E. 51 Process Dynamics and Control I 3 -
Ch.E. 52 Process Dynamics and Control II 3 -
Ch.E. 61 Engineering Economics 2 -
Ch.E. 62 Process System Design 2 3
Ch.E. 71 Chemical Engineering Lab. I - 4
Ch.E. 72 Chemical Engineering Lab. II - 6
Ch.E. 91 Seminar 1 -

B. Elective Courses

A minimum of 18 hours (lectures and laboratories) must be chosen in addition to the core courses listed above to fulfill the requirements of the Chemical Engineering programme. There is considerable latitude for individual choice but two courses should be chosen from non technical electives. The programme will be selected in consultation with the Chemical Engineering Department. Elective courses may be chosen from the following list, from other undergraduate and graduate Engineering course lists, or from Arts and Science course lists.

<table>
<thead>
<tr>
<th>Lab. or Lect.</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch.E. 23</td>
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<tr>
<td>Ch.E. 34</td>
<td>3</td>
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<tr>
<td>Ch.E. 43</td>
<td>3</td>
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<td>Ch.E. 54</td>
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<td>Ch.E. 73</td>
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<td>Ch.E. 98</td>
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<td>Ch.E. 99</td>
<td>6</td>
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<tr>
<td>Math. 42</td>
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<tr>
<td>Math. 44</td>
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<td>Math. 45</td>
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<td>Math. 55</td>
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<td>Math. 56</td>
<td>3</td>
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<tr>
<td>Chem. 21</td>
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<td>Chem. 37</td>
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<td>Chem. 41</td>
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<tr>
<td>Chem. 45</td>
<td>3</td>
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<tr>
<td>Chem. 46</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 55</td>
<td>3</td>
</tr>
</tbody>
</table>

61
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 ample opportunity to pursue advanced undergraduate study in a variety of areas. For example:

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

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

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

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

(e) Engineering Mechanics—For students with a strong interest in 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.

A. Core Programme

<table>
<thead>
<tr>
<th>Mathematics and Science Courses</th>
<th>Lab. or Lect.</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 22 Calculus II</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Math. 23 Numerical Methods</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Math. 31 Differential Equations</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Math. 32 Numerical Analysis</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Math. 51 Probability and Statistics</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
b. Engineering Courses

G.E. 12 Introduction to Engineering Systems 3 -
G.E. 31 Thermodynamics 3 -
G.E. 32 Fluid Dynamics 3 3
G.E. 41 Mechanics of Deformable Solids I 2 2
G.E. 53 Structure and Properties of Matter I 2 3*
G.E. 54 Structure and Properties of Matter II 2 3*
E.E. 12 Electricity and Magnetism I 2 -
E.E. 13 Electricity and Magnetism II 2 3*

Non-Technical Courses

G.E. 61 History and Philosophy of Science 3 -
2 Arts Electives 6 -

Civil Engineering Core

C.E. 22 Mechanics of Deformable Solids II 2 -
C.E. 31 Theory of Structures 3 3
C.E. 32 Behaviour of Structures 2 3*
C.E. 33 Design of Structures 2 2
C.E. 41 Engineering Measurement 2 4
C.E. 51 Geotechnical Materials 3 3*
C.E. 52 Geotechnical Mechanics 2 3*
C.E. 61 Transportation Engineering 2 -
C.E. 71 Water Resources Engineering 3 2
C.E. 81 Law, Contracts and Specifications 2 -
C.E. 82 Urban Planning 2 -
C.E. 84 Civil Engineering Design Studies I - 6

B. Elective Courses

One of:

C.E. 85 Civil Engineering Design Studies II

or

C.E. 86 Research Project - 9

The Technical Electives, six in number, are to be chosen according to the option selected. Elective courses may be chosen from the list below, or from other Engineering, Arts or Science course lists, in consultation with a Civil Engineering faculty advisor. In particular, sequence chosen from among the courses listed may be formed so as to satisfy a general civil engineering study in addition to the areas of specialization listed above.

G.E. 52 Physical Properties of Materials 2 2
M.E. 64 Hydraulic Engineering 3 -
C.E. 34 Behaviour of Plain and Reinforced Concrete 3 3
C.E. 35 Structural Design 2 -
C.E. 53 Geotechnical Processes 2 3*
C.E. 54 Geotechnical Engineering 2 -
C.E. 62 Highway Engineering 2 -
C.E. 63 Pavement Materials 2 3*
C.E. 64 Pavement Structural Design 2 -
C.E. 72 Environmental Health Engineering 3 -

63
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lect.</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 79</td>
<td>Engineering Hydraulics</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>C.E. 83</td>
<td>Project Management</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>C.E. 609</td>
<td>Advanced Theory of Structures</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>C.E. 610</td>
<td>Inelastic Behaviour of Ductile Members and Structures</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>C.E. 611</td>
<td>Elementary Mechanics of Continua</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>C.E. 612</td>
<td>Experimental Mechanics</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 651</td>
<td>Advanced Soil Mechanics</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>C.E. 654</td>
<td>Engineering Aspects of Surficial Soils</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>C.E. 671</td>
<td>Water Resources Engineering I</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>C.E. 672</td>
<td>Water Resources Engineering II</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Math. 41</td>
<td>Applied Analysis I</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Math. 42</td>
<td>Vector Methods</td>
<td>2</td>
<td>1</td>
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<tr>
<td>Math. 44</td>
<td>Complex Variable</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Math. 45</td>
<td>Applied Analysis II</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Math. 55</td>
<td>Digital Computer Programming</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Math. 56</td>
<td>Matrix Algebra</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Geog. 350</td>
<td>Urban Geography and Settlement Patterns</td>
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<tr>
<td>Biol. 31</td>
<td>Biology for Engineers</td>
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</tbody>
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64
Department of Design

Since January of 1965, the Department of Design has offered Graduate studies and research in Human Physical Environments, leading to the degree of Master of Applied Sciences in Environmental Design.

The programme is unique in that it brings together various academic disciplines, research and working professional designers to achieve educational balance between the laboratory and the development of theory and methodology. The graduate programme has been designed to prepare the student to work in the ever-increasing complexity of the Human Physical Environment and handle multi-factor design problems with intelligence, experience and skill.

The programme consists of Department of Design course work, electives in other University departments and “Field Laboratory” work in the Institute of Design.

The Institute of Design is a financially independent and working Institute that contributes to the development of formal academic programmes, while not acting as a teaching organization. Through the Institute of Design, the student has the opportunity of work and contact with a varied group of professional consultants and the full-time Institute staff that have backgrounds in the areas of Product Design; Psychology; Fine Arts; Films; Civil, Electrical and Mechanical Engineering; and Graphic Design.

The Master’s programme is open to candidates who can satisfy the general requirements for admission to the Faculty of Graduate Studies and the requirements of the Admission Committee of the Department of Design. While admission is generally on an individual basis, the Committee will require:

1. Evidence that the candidate’s undergraduate studies were in one of the following or related major areas:
   
   Architecture  
   Communication  
   Geography  
   Commerce  
   Engineering  
   Economics  
   Psychology  
   Industrial Design  
   Graphics  
   Sociology

2. Evidence of the candidate’s interest and/or experience in Environmental Design through previous course work or as practical experience.

Depending upon the students previous course work and experience, his course selection and thesis topic will relate to one of the following:

1. The Visual and Communication Environment (preferred background in Graphics, Psychology, Sociology).
2. Industrial Products Environment (preferred background in Industrial Design, Engineering, Physics, Chemistry, Economics, Industrial Administration).

The Master’s Programme generally requires two years to complete and consists of the following:

1. Two one-semester courses from Department of Design Group A subjects (see courses offered).
2. One one-semester course from Department of Design Group B subjects (see courses offered)

3. Two one-semester courses from another University Department as approved by the Department of Design.

4. Additional course work or special studies as required by Department of Design, based on the individual candidate’s experience.

5. A thesis which contains the design of a physical object or system and makes an original contribution to the general fields of design methodology and/or theory.

The Diploma Programme

The Department of Design also offers a Diploma programme, leading to a Diploma in Environmental Design. The programme is designed for the individual who is more interested in the technical and feasibility aspects of design than the methodology and theory, yet wishes to study design within the University environment.

All Diploma programmes will be related to the Design of Human Physical Environments; and depending upon the student's background and experience, his course selection and project will relate to one of the following:

1. The Visual and Communication Environment
2. The Industrial Products Environment

Admission to the programme is on an individual basis through the Senate Admissions Committee for Diploma Programmes and the Department of Design.

In general, the committee will require:

1. Evidence from prior education or experience that the student can meet the course requirements.

2. Evidence from prior education or experience that the student has an interest and some skill in Environmental Design or a related design area.

The Diploma programme generally requires two years to complete and consists of the following:

1. A minimum of six courses (four in the Department of Design and two in another University Department as approved or advised by the Department of Design).

2. Additional course work or special studies as required by the Department of Design, based on the individual student's experience.

3. A design project consisting of a physical object or system that demonstrates physical and economic feasibility.

Electrical Engineering

Electrical Engineering encompasses a wide variety of specialized topics as evidenced by the 29 distinct professional groups in the Institute of Electrical and Electronics Engineers, one of the largest professional organizations in North America. Listed in alphabetical order, the professional groups range
Electrical Engineering

from Aeronautical and Navigational Electronics to Vehicular Communications, which still does not include the different areas of power engineering. Such areas as Electronic Computers and Automatic Control Systems, which have helped considerably for the advent of the Space Age, come within the purview of Electrical Engineering.

It has become clearly impossible for any EE curriculum to address itself to narrow specializations centered around technologies, for there are too many of them.

Consistent with modern trends in Electrical Engineering education, Waterloo has endeavoured to stress some of the basic disciplines underlying the various branches of Electrical Engineering. Some such disciplines are:

(a) System Theory;
(b) Field Theory;
(c) Communication Theory;
(d) Analogue and Digital Computation.

The courses on Electro-Mechanics, Network Theory, Electronic Circuits, Control Systems, etc., come under group (a). Transmission Lines, Micro-Wave Circuits, aspects of design, etc., come under group (b); Group (c) includes those areas for which a knowledge of probability and statistics is essential. Group (d), although a discipline in its own entity, is interspersed throughout the other areas.

A. Core Programme

| Lab. or |
| Lect. | Prob. |
|--------|
|        |

a. Mathematics and Science Courses

| Math. 22 | Calculus II |
| Math. 23 | Numerical Methods |
| Math. 24 | Mathematics Problems |
| Math. 31 | Differential Equations |
| Math. 32 | Numerical Analysis |
| Math. 33 | Differential Calculus |
| Math. 34 | Integral Calculus |
| Math. 44 | Complex Variables |
| E.E. 12 | Electricity and Magnetism I |
| E.E. 13 | Electricity and Magnetism II |
| Phys. 15 | Modern Physics |

b. Engineering Courses

| G.E. 12 | Introduction to Engineering Systems |
| G.E. 31 | Thermodynamics |
| G.E. 41 | Mechanics of Deformable Solids |
| G.E. 42 | Dynamics |
| G.E. 51 | Micro-Structure of Materials |
| G.E. 52 | Physical Properties of Materials |
| E.E. 23 | Analogue Computation |
| E.E. 42 | Network Theory II |
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, chemi-
Mechanical Engineering

cals 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 fundamentals in the mathematical,
physical, chemical, and engineering sciences, and also provides an opportunity
(on a limited scale) for specialization in the later years. The degree of
B.A.Sc. in Mechanical Engineering carries exemption from parts I and II 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 pro-
vides elementary courses in Mechanical Engineering and certain branches of
Civil and Electrical Engineering, together with further development in mathemat-
ics and physics. Opportunities for specialization occur during the third and fourth
years, there being a choice of elective subjects available to permit pursuit of indivi-
dual 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 includ-
ing 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) Engineering Mechanics Option — is intended primarily for those interested
in research and development careers in engineering. The courses are oriented
for the student to obtain depth of understanding in the basic sciences (mathemat-
ics, physics, and chemistry) and the engineering sciences (particularly with
respect to the mechanics of solids) and to gain insight and skill in the applica-
tion of these sciences to engineering problems.

(c) Mechanical and Structural Design Option — is intended for the student
with a strong interest in design. The overall system approach to design is
followed. Since mechanical design often extends into the field of structures,
particularly when the unit being designed is large, structural engineering
courses are suggested. Similarly of value are courses in heat transfer and fluid
flow.

(d) Manufacturing Technology 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 operations. It is suggested
for those students primarily interested in the industrial aspects of mechanical
engineering.

(e) 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.

A. Core Programme

a. Mathematics and Science Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Lect.</th>
<th>Prob.</th>
</tr>
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<tbody>
<tr>
<td>Math. 22 Calculus II</td>
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<tr>
<td>Math. 23 Numerical Methods</td>
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<tr>
<td>Math. 31 Differential Equations</td>
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<td>-</td>
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<tr>
<td>Math. 32 Numerical Analysis</td>
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<td>4</td>
</tr>
<tr>
<td>Math. 41 Applied Analysis</td>
<td>3</td>
<td>-</td>
</tr>
</tbody>
</table>

b. Engineering Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Lect.</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.E. 12 Introduction to Engineering Systems</td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td>G.E. 31 Thermodynamics</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>G.E. 32 Fluid Mechanics</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>G.E. 41 Mechanics of Deformable Solids</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>G.E. 42 Dynamics</td>
<td>2</td>
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<tr>
<td>G.E. 53 Structure and Properties of Matter I</td>
<td>3</td>
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<td>G.E. 54 Structure and Properties of Matter II</td>
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<td>3</td>
</tr>
<tr>
<td>E.E. 12 Electricity and Magnetism I</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>E.E. 13 Electricity and Magnetism II</td>
<td>2</td>
<td>3*</td>
</tr>
<tr>
<td>E.E. 32 Electronics</td>
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<td>3</td>
</tr>
<tr>
<td>E.E. 81 Control Systems</td>
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<td>3*</td>
</tr>
<tr>
<td>M.E. 13 Kinematics</td>
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<tr>
<td>M.E. 21 Mechanics of Machinery</td>
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<td>3</td>
</tr>
<tr>
<td>M.E. 53 Heat Transfer I</td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td>M.E. 81 Seminar</td>
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<td>1</td>
</tr>
<tr>
<td>M.E. 82 Mechanical Engineering Projects</td>
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<td>9</td>
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c. Non-Technical Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Lect.</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.E. 61 History and Philosophy of Science</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Two Arts Electives</td>
<td>6</td>
<td>-</td>
</tr>
</tbody>
</table>

B. Elective Courses

Seven elective courses are required in addition to the core courses listed above to fulfill the requirements of the Mechanical Engineering programme. Some of these are prerequisites for other, higher level elective subjects, and should therefore be chosen on the basis of a decision on the part of the student to enter one or other of the options. The subjects offered in the various options are listed below. Higher level electives are offered depending on the availability of faculty. It is not necessary (or even desirable) to choose all electives from a single option. Furthermore, electives may be chosen from the offerings of other Engineering Departments, Mathematics or indeed any other Arts or Science Department, provided only that the timetables are compatible.
a. Thermodynamics — Fluid Mechanics Option
Prerequisites:
M.E. 54 Thermodynamics II
M.E. 62 Fluid Dynamics
Higher level electives:
M.E. 35 Nuclear Engineering
M.E. 55 Statistical Thermodynamics
M.E. 56 Heat Transfer II
M.E. 63 Turbomachines I
M.E. 65 Gas Dynamics I
M.E. 66 Turbulent Flow I
M.E. 631 Fluid Power Control Systems
M.E. 655 Combustion
M.E. 666 Wave phenomena in Fluids
Suggested electives from other options or departments:
Math. 54 Differential Equations of Mathematical Physics
C.E. 79 Engineering Hydraulics
C.E. 611 Elementary Mechanics of Continua

b. Engineering Mechanics Option
Prerequisites:
M.E. 24 Advanced Dynamics
M.E. 62 Fluid Dynamics
Higher level electives:
M.E. 23 Analysis and Synthesis of Machines
M.E. 25 Mechanical Vibrations
M.E. 625 Experimental Mechanics
Suggested electives from other options or Departments:
M.E. 22 Design of Machines
Math. 54 Differential Equations of Mathematical Physics
M.E. 56 Heat Transfer II
M.E. 65 Gas Dynamics
M.E. 66 Turbulent Flow I
M.E. 43 Technology of Manufacture I
C.E. 611 Elementary Mechanics of Continua

c. Mechanical and Structural Design Option
Prerequisites:
M.E. 22 Design of Machinery
M.E. 73 Human Factors Engineering
Suggested electives from other options:
M.E. 41 Technology of Manufacture
M.E. 38 Manufacturing Properties of Materials
M.E. 23 Analysis and Synthesis of Machines
M.E. 25 Mechanical Vibrations
M.E. 56 Heat Transfer II
M.E. 62 Fluid Dynamics
E.E. 61 Electro mechanics I
E.E. 62 Electro mechanics II
d. Manufacturing Technology Option

Prerequisites:
M.E. 41 Technology of Manufacture I
S 502 Mathematical Foundations of Management Science I

Higher level electives:
M.E. 43 Metrology
M.E. 644 Manufacturing Properties of Materials
M.E. 645 Machinery of Manufacture
M.E. 643 Technology of Manufacture II
S 501 Management Science I

Suggested electives from other options and departments:
M.E. 34 Impurities and Imperfections in Solids
M.E. 36 Physical Metallurgy
M.E. 73 Human Factors Engineering
M.E. 631 Fluid Power Control Systems
C.E. 611 Elementary Mechanics of Continua
Soc. 339 Industrial Sociology
Math. 55 Digital Computer Programming

e. Engineering Materials Option

Prerequisites:
M.E. 34 Impurities and Imperfections in Solids
M.E. 36 Physical Metallurgy

Mechanical Engineering Electives:
M.E. 35 Nuclear Engineering
M.E. 37 Ceramics
M.E. 38 Materials in Nuclear Technology
M.E. 641 Theory of Metals
M.E. 642 Behaviour of Materials
M.E. 646 Radiation Effects in Engineering Materials

Suggested electives from other options and departments:
M.E. 41 Technology of Manufacture I
M.E. 73 Human Factors Engineering
M.E. 643 Technology of Manufacture II
C.E. 611 Elementary Mechanics of Continua
E.E. 55 Solid State Electronics
Chem. 25 Polymer Chemistry and Physics
IV

The Faculty of Science
The Faculty of Science

The University issued its first calendar for the Faculty of Science in 1959, and enrolled its first Science students that autumn. By the autumn of 1964 there were 550 full-time undergraduate and 52 graduate students, and a full-time teaching staff of 47. In each year since its inception the Faculty has introduced new programmes and extended its facilities. In 1965 two new developments deserve special mention: one is the creation of a new department, Earth Sciences, and the other is the extension of the General Course to four years in some departments. The Department of Earth Sciences will initially offer a range of courses in geology, extending later, it is hoped, into such fields as meteorology and oceanography. The extended General Course should make possible fuller preparation for teaching, for industrial or government employment, or in outstanding cases for admission to post-graduate studies.

There are four teaching departments in the Faculty of Science: Biology, Chemistry, Earth Sciences, and Physics. Extensive instruction is also given by members of the University's Department of Mathematics. Astronomy is taught in the Physics Department; Biochemistry is offered in the Chemistry Department; Botany and Zoology and certain courses embracing these fields together, and microbiology are taught in the Biology Department. All the departments except Earth Sciences offer post-graduate courses and research facilities and these are listed in Section VII of this Calendar - Course Descriptions. General regulations governing post-graduate studies are set forth in Section V. The majority of the graduates in Honours courses in Science undertake some post-graduate study.

All Science students are enrolled on a full-time basis. All courses in this Faculty except Applied Physics are offered in two terms throughout a conventional academic year. The Applied Physics course is given exclusively on a co-operative basis with alternating terms of academic and industrial work in the same manner as the courses in the Faculty of Engineering (see chart on page 247).

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 academic programmes listed below. The ordinary or pass-level B.Sc. will be awarded on completion of the General Course in either the three or four-year programme. The honours degree, B.Sc. (Honours), will be awarded on completion of any of the honours courses shown under Academic Programmes.
Admission and Registration

General
Application for admission to the Faculty of Science should be made as early in the year as possible, on forms provided by the Office of the Registrar. Academic certificates (not diplomas) and other supporting documents should be forwarded as soon as they become available.

Admission to the faculty cannot be granted until all requirements have been met and all documents submitted.

Admission to Year I
In order to qualify for admission to the first year of the Science programme the applicant must have completed the requirements for the Ontario Secondary School Honour Graduation Diploma (Senior Matriculation), or its equivalent, showing an overall average of 60% in the Grade XIII papers required for admission and with a minimum of 60% in the five papers in Mathematics and Science. Standing is required in the following papers:

- English
- Mathematics (Algebra, Geometry, Trigonometry)
- Science (Chemistry, Physics)

Two additional papers - or one single paper in a language if written after 1964.

Note: For purposes of admission, grades of special Departmental examinations written to make up one-paper deficiencies in English or languages other than English may be used in conjunction with grades of papers previously passed in those subjects, but such special examinations may not be used alone as substitutes for the single combined examination in English and languages other than English.

Students intending to take an Honours course in Mathematics, Physics, or Chemistry and Physics should have a minimum of 66% in the five papers required in Mathematics and Science.

Additional papers can be selected from any of the optional subjects offered at the Grade XIII level with the qualification that no more than one of the following papers may be counted as an “additional” paper: Accountancy Practice, Secretarial Practice, Mathematics of Investment, Art or Music (Departmental Examination). The marks received in one of these papers 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 paper’ on the same term as the above list except the marks received will not be computed in the average.

The following certificates, recognized as being equivalent to the Ontario Grade XIII certificate, may be accepted insofar as they meet the admission requirements of the University of Waterloo in subjects and percentages:

- Alberta Senior Matriculation (Grade XII)
- British Columbia Senior Matriculation (Grade XIII)
Manitoba         Senior Matriculation (Grade XII)
New Brunswick    Senior Matriculation (Grade XIII)
Newfoundland    Senior Matriculation (Grade XII)
Sep         Senior Matriculation (Grade XII)
Nova Scotia      Senior Matriculation (Grade XII)
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 XII)
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 the advanced level in subjects appropriate to the candidate’s intended field of study.
Scotland         The Scottish Leaving Certificate.
United States of America  High School Graduation plus an additional year of formal study in subjects comparable to Ontario Grade XIII.

Admission to Advanced Standing

An applicant for admission to advanced standing must submit an official transcript from the University which he has attended, showing in detail the courses he has taken and his standing in each.

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. Each application will be considered on its merits by the Admissions Committee. Under certain circumstances, the applicant may be required to write a qualifying examination.

Admission of Students from Other Countries

Students from areas where English is not the common language must provide certified translations of academic certificates. In addition, the applicant may be required to take either “The English Proficiency Tests” prepared by the English Language Institution 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 his 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.

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.
Admission and Registration

Registration

September 9     Thursday     Year I (Applied Physics)
September 10    Friday       Advanced Years (Applied Physics)
September 15    Wednesday    All Years (Science)

Once the student has completed his registration, he may not change his course, add subjects, or drop subjects, without obtaining permission from the Dean, the instructor, and processing the change, on the proper forms, through the Office of the Registrar.

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.

If, for reasons acceptable to the Business Manager, the fees for the year cannot be paid in full on the day of registration, they may be paid in two instalments but an extra charge of $5.00 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 the tuition fees plus all incidental fees. The balance must be paid in full on the first day of the second term (or before the eighth week of term for co-operative students).
A charge of $2.00 per month will be made on overdue accounts. Failure to pay an overdue account before conclusion of lectures will bar a student from writing examinations or obtaining 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 one in effect for the 1964-65 year and at the time of printing is still subject to review and possible change for the 1965-66 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.

### Sessional Fees

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuition</td>
<td>$510.50</td>
</tr>
<tr>
<td>Incidental*</td>
<td>44.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$555.00</strong></td>
</tr>
</tbody>
</table>

### Co-operative Physics

<table>
<thead>
<tr>
<th>Fees per term</th>
<th>Year One</th>
<th>Other Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuition</td>
<td>$292.50</td>
<td>$317.50</td>
</tr>
<tr>
<td>Incidental</td>
<td>26.50</td>
<td>26.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$319.00</strong></td>
<td><strong>$344.00</strong></td>
</tr>
</tbody>
</table>

### Part-Time Students

| Fee per course (limit, 2 courses per session) | $100.00 |

### Miscellaneous Fees

<table>
<thead>
<tr>
<th>Fee</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination—Supplemental, each paper</td>
<td>$10.00</td>
</tr>
<tr>
<td>Presiding fee (at an outside centre,</td>
<td>5.00</td>
</tr>
<tr>
<td>each half day)</td>
<td></td>
</tr>
<tr>
<td>Photograph (at first registration only)</td>
<td>1.00</td>
</tr>
<tr>
<td>Late Registration</td>
<td>10.00</td>
</tr>
<tr>
<td>Transcript of record</td>
<td>1.00</td>
</tr>
<tr>
<td>Degree and Graduation - Final year only</td>
<td>10.00</td>
</tr>
</tbody>
</table>

*Incidental fees include student activities, athletics, health insurance and health services. The Health Insurance Plan does not include the premiums for benefits of the Ontario Hospital Services Commission. Such coverage is the student's own responsibility.

For Co-operative Physics students the Health Insurance Fee is for eight months' protection following each registration, and therefore includes students while off campus in their work periods. The fee is adjusted for the second term when a student remains on campus for two consecutive terms.
Residence Fees

Residence fee for both men and women is $725.00 for room and board for the regular academic session (2 terms), or $362.50 per term for co-operative course students. 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 the first term and the beginning of the second term. Students occupying residence in this period will be charged an additional $2.00 per day for their room, (food, if available, will be an extra charge).

Rooms may be occupied for twenty-four hours before registration and after the final examination.

Examinations and Promotions

The Faculty constitutes the examining body for all University examinations. Final examinations for all years 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.

In addition to final examinations, each student in Year I is required to write mid-year tests. These tests are compulsory, and the results obtained are used in determining standing.

The following regulations govern the practice of the Faculty 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 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>

(In this and subsequent sections the term “subject” will apply to individual courses, e.g. Chemistry 131, and the term “course” will apply to groups of subjects, e.g. the Chemistry and Biology Course).

3. Standing in an individual subject 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 subject, a candidate must obtain 50% in his examination
and a minimum of 50% in the combined term mark and examination mark. A student whose term work is deficient in a subject may, at the discretion of the department concerned and the Dean, be barred from writing the final examination in that subject.

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 subjects where a candidate has not passed his year.

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

6. To pass his year clear in the General course, a student must pass in all subjects and obtain an over-all average of 50% and an average of 60% in the subjects of his major field. By this regulation, promotion may be withheld when a student has passed in all subjects but failed to achieve the required standing in his major subjects.

7. An over-all standing in each year will be assigned based on the average of the results of the final examination in the course. This standing will be a class of Honours in Honours courses or a letter grade in the General course. 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>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</td>
<td>Second Class Honours</td>
<td>B</td>
</tr>
<tr>
<td>60 - 65</td>
<td>Third Class Honours</td>
<td>C</td>
</tr>
<tr>
<td>50 - 59</td>
<td></td>
<td>D</td>
</tr>
</tbody>
</table>

8. A student who fails more than two subjects at the annual examination fails his year. He is not eligible for 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.

9. A student repeating a course must repeat all subjects in class unless exemption has been granted by the Dean and the Faculty Council.

10. 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.

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

12. To be eligible for supplemental examination a student:
(a) must have attended lectures in the course in which he proposes to write,
(b) must not have failed more than two full courses,
(c) must not have defaulted the final examination except for a properly certified reason.
Examinations and Promotions

13. A student who fails to obtain 40% in the final examination may be granted supplemental privileges only at the discretion of the Committee on Standings and Promotions.

14. Supplemental examinations will be held in July. Applications for supplemental examinations must be filed by June 22, 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.

15. 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 a supplemental examination in a non-prerequisite subject, he may be granted a pass standing conditioned in this subject, otherwise he must repeat the year.

16. A student who has been promoted with a condition in a subject from the previous year, must clear that condition before being promoted further. In special cases, and on petition to the Faculty Council, a student may be permitted to substitute another subject for one in which he is conditioned.

17. A student may not write supplemental examinations to raise his standing in subjects already passed, nor will the results of supplemental examinations be considered in arriving at a student’s standing in his course.

Academic Programmes

First Year
(for all students whether Honours or General except Honours Applied Physics, for which see page 92)

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 130</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics 131</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry 131</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics 130</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics 131</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology 131</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology 131 (if not elected above) (see Note 1)</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Earth Sciences 130</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics 131 (if not elected above)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Mathematics 132</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychology 110</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In addition to the first four subjects in the above listing which are required of all students, two others must be selected at the time of registration. The choice of these two will be dictated by the field of further study which the

81
student intends to pursue. The following table lists the departmental requirements for each major or honours programme in the Faculty.

<table>
<thead>
<tr>
<th>Major Field of Study</th>
<th>Required in First Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>Mathematics 131</td>
</tr>
<tr>
<td>Physics</td>
<td>Mathematics 131</td>
</tr>
<tr>
<td>Physics &amp; Chemistry</td>
<td>Mathematics 131</td>
</tr>
<tr>
<td>Chemistry</td>
<td>Mathematics 131</td>
</tr>
<tr>
<td>Chemistry &amp; Biology</td>
<td>Mathematics 131, Biology 131</td>
</tr>
<tr>
<td>Biology</td>
<td>Biology 131</td>
</tr>
<tr>
<td>Biology &amp; Psychology</td>
<td>Biology 131, Psychology 150</td>
</tr>
<tr>
<td>Earth Sciences</td>
<td>Earth Sciences 130</td>
</tr>
</tbody>
</table>

Note 1. 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 subject for students in the second year of the General Course with a major in Biology.

Note 3. For those students only who plan to take the Honours programme in Biology and Psychology, Psychology 150 is required rather than Psychology 110.

**Honours Courses**

The normal route to attain professional standing in science is to take an Honours course in the appropriate field or combination of fields. The Honours courses 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 postgraduate study in Canadian Universities. Graduates of certain Honours courses are eligible for admission to Type A (specialist) courses for prospective high school teachers at the Ontario College of Education.

The following Honours programmes are available.

**Honours Biology**

(For Year I, see page 81)

<table>
<thead>
<tr>
<th>Year II</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 233</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertebrate Zoology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 234</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparative Plant Morphology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 235</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Microbiology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 236</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic Chemistry I</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 233</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probability and Statistics</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Arts or Science Elective</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>as specified</td>
</tr>
</tbody>
</table>
Honours Biology Programme

Year III

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 333</td>
<td>Invertebrate Zoology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 335</td>
<td>Microbial Ecology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 336</td>
<td>Cell Biology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 337</td>
<td>General Physiology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 337</td>
<td>Biochemistry I</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Arts or Science Elective as specified

Year IV

Either

five of the courses offered in Biology at the 400 level

Or

four of the courses offered in Biology at the 400 level plus one Science elective.

Honours Biology and Psychology

(For Year I, see page 81 and note 3)

Year II

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 231</td>
<td>Genetics and Evolution</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Biology 233</td>
<td>Vertebrate Zoology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 250</td>
<td>Comparative Psychology (half course)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Psychology 260</td>
<td>Physiological Psychology (half course)</td>
<td>2</td>
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</table>
Psychology 270  Sensation and Perception  2  2  
Chemistry 236  Organic Chemistry I  2  3  
German or Russian  A course at an appropriate level  3  -  

**Year III**

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<thead>
<tr>
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<tbody>
<tr>
<td>Biology 332</td>
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<tr>
<td>Biology 333</td>
<td>Invertebrate Zoology</td>
<td>2 3</td>
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<tr>
<td>Psychology 370</td>
<td>Animal Learning</td>
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<td>Psychology 380</td>
<td>Advanced Physiological Psychology</td>
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<td>Probability and Statistics</td>
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<td>Chemistry 337</td>
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<td>2 3</td>
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**Year IV**

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<td>Biology 436</td>
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<td>Biology 499</td>
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<td>Experimental Design</td>
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<td>Chemistry 437</td>
<td>Biochemistry II</td>
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**Honours Chemistry**

*For Year I, see page 81*

**Year II**

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<td>Chemistry 232</td>
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<td>Chemistry 235</td>
<td>Physical Chemistry I</td>
<td>2 1</td>
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<tr>
<td>Chemistry 236</td>
<td>Organic Chemistry I</td>
<td>2 3</td>
</tr>
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<td>Physics 242</td>
<td>Electricity and Magnetism</td>
<td>2 3</td>
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<tr>
<td>Mathematics 236</td>
<td>Differential Equations</td>
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**Year III**

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<tr>
<td>Chemistry 335</td>
<td>Physical Chemistry II</td>
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<tr>
<td>Chemistry 336</td>
<td>Organic Chemistry II</td>
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<td>Physics 235</td>
<td>Optics</td>
<td>2 3*</td>
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<td>Physics 332</td>
<td>Electronics</td>
<td>2 3</td>
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<tr>
<td><strong>or</strong></td>
<td></td>
<td></td>
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<tr>
<td>Mathematics 233</td>
<td>Probability and Statistics</td>
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Honours Chemistry

Year IV
Six full courses chosen as follows:
Chemistry 431 Inorganic Chemistry II 2 6
Chemistry 439 Advanced Laboratory 0 6
One or both of:
Chemistry 435 Physical Chemistry III 2 1
Chemistry 436 Organic Chemistry III 2 -
Remainder from:
Chemistry 337 Biochemistry I 2 0
Chemistry 445 Polymer Chemistry 2 -
Mathematics 450 Applied Analysis 2 -
Arts Elective as specified
Physics 332 If not chosen above 2 3
Mathematics 233 If not chosen above 1 2
* Indicates a laboratory taken in alternate weeks.

Honours Chemistry and Biology

(For Year I, see page 81)

Year II
Chemistry 231 Chemical Bonding and Structure 2 0
Chemistry 232 Analytical Chemistry 2 6
Chemistry 236 Organic Chemistry I 2 3
Mathematics 236 Differential Equations 2 -
Two of:
Biology 233 Vertebrate Zoology 2 3
Biology 234 Comparative Plant Morphology 2 3
Biology 235 General Microbiology 2 3

Year III
Chemistry 325 General Physical Chemistry 2 3
Chemistry 336 Organic Chemistry II 2 3
Chemistry 337 Biochemistry I 2 0
Physics 242 Electricity and Magnetism 2 3
Two of:
Biology 333 Invertebrate Zoology 2 3
Biology 335 Microbial Ecology 2 3
Biology 336 Cell Biology 2 3
Biology 337 General Physiology 2 3

Year IV
Chemistry 331 Inorganic Chemistry I 2 3
Chemistry 437 Biochemistry II 2 3
Mathematics 233 Probability and Statistics 1 2
**Three of:**

<table>
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<th>Course Code</th>
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<tr>
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<td>Biology 433</td>
<td>Entomology</td>
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<td>Biology 434</td>
<td>Genetics</td>
<td>2</td>
<td>3</td>
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<tr>
<td>Biology 435</td>
<td>Microbial Physiology</td>
<td>2</td>
<td>3</td>
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<tr>
<td>Biology 437</td>
<td>Vascular Plants</td>
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<td>3</td>
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<td>Biology 438</td>
<td>Non-vascular Plants</td>
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**Honours Chemistry and Physics**

*(For Year I, see page 81)*

<table>
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<th>Year II</th>
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<td>Integral Calculus</td>
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### Honours Chemistry and Physics

#### Year III

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<td>Physical Chemistry II</td>
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<td>Probability and Statistics</td>
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<td>Physics 331</td>
<td>Classical Mechanics I</td>
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<td>Atomic and Nuclear Physics I</td>
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#### Year IV

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<tr>
<td>Chemistry 336</td>
<td>Organic Chemistry II</td>
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<td>3</td>
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<td>Physics 332</td>
<td>Electronics</td>
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<td>0</td>
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<td>Physics 333</td>
<td>Intermediate Laboratory</td>
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<td>Physics 434</td>
<td>Atomic and Nuclear Physics II</td>
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**Option A (Chemistry)**

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**One of:**

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<tbody>
<tr>
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**Option B (Physics)**

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*Indicates a laboratory taken in alternate weeks.*

### Honours Mathematics

(With Science Minor)

The course shown below is the Mathematics and Physics programme. Analogous courses are permitted in which Chemistry or Biology is the minor subject.

(For Year I, see page 81)

#### Year II

<table>
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<td>Mathematics 231</td>
<td>Differential Calculus</td>
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<td>0</td>
</tr>
<tr>
<td>Mathematics 232</td>
<td>Integral Calculus</td>
<td>3</td>
<td>0</td>
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<tr>
<td>Mathematics 233</td>
<td>Probability and Statistics</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Physics 232</td>
<td>Electricity and Magnetism</td>
<td>2</td>
<td>3*</td>
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<td>Physics 235</td>
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<td>3*</td>
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**One of:**

<table>
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<th>Lectures</th>
<th>Labs</th>
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<td>Actuarial Mathematics</td>
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87
### Year III (Pure Mathematics Option)

<table>
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<tbody>
<tr>
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<td>Mathematics 331</td>
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<td>Algebra II</td>
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<td>Theory of Functions</td>
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<td>Differential Equations</td>
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#### (Statistics Option)

<table>
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<td>Mathematics 335</td>
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<td>Finite Differences</td>
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**Two of:**

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#### (Applied Mathematics Option)

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* Indicates a laboratory taken in alternate weeks.

#### (Teaching Option)

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<tbody>
<tr>
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<tr>
<td>Mathematics 331</td>
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<td>Algebra II</td>
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### Year IV (Pure Mathematics Option)

#### Three or four of:

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<td>Mathematics 430</td>
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<tr>
<td>Finite Projective Geometries</td>
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<td>Mathematics 432</td>
<td>2</td>
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<tr>
<td>Functions of a Complex Variable</td>
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<td>Mathematics 433</td>
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<td>Theory of Integration</td>
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<td>Mathematics 434</td>
<td>Differential Equations of Mathematical Physics</td>
</tr>
<tr>
<td>Mathematics 448</td>
<td>Differential Geometry</td>
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<td><strong>Two or three Additional Mathematics Courses</strong></td>
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<td>One Science Elective</td>
<td>as specified</td>
</tr>
<tr>
<td>One Non-Science Elective</td>
<td>as specified</td>
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</tbody>
</table>

**(Statistics Option)**

| Mathematics 435 | Laboratory | 0 | 3 |
| Mathematics 438 | Estimation and Hypothesis Testing | 2 | 0 |
| Mathematics 439 | Theory of Experimental Design | 2 | 0 |

**Two or Three Courses from:**

| Mathematics 430 | Finite Projective Geometries | 2 | 0 |
| Mathematics 433 | Theory of Integration | 1 | 0 |
| Mathematics 440 | Advanced Probability | 2 | 0 |
| Mathematics 446 | History of Mathematics | 2 | 0 |
| Mathematics 447 | Statistical Mechanics | 2 | 0 |
| One Science Elective | as specified |
| One Non-Science Elective | as specified |

**(Applied Mathematics Option)**

| Mathematics 432 | Functions of a Complex Variable | 2 | 0 |
| Mathematics 434 | Differential Equations of Mathematical Physics | 2 | 1 |

**Three or Four Courses from:**

| Mathematics 441 | Quantum Theory | 2 | 0 |
| Mathematics 442 | Theory of Relativity | 2 | 0 |
| Mathematics 443 | Electromagnetism II | 2 | 0 |
| Mathematics 444 | Elasticity | 2 | 0 |
| Mathematics 445 | Hydrodynamics | 2 | 0 |
| Mathematics 446 | History of Mathematics | 2 | 0 |
| Mathematics 447 | Statistical Mechanics | 2 | 0 |
| One Science Elective | as specified |
| One Non-Science Elective | as specified |

**(Teaching Option)**

| Mathematics 446 | History of Mathematics | 2 | 0 |
| Four additional Mathematics courses numbered above 200 | as specified |
| One Science Elective | as specified |
| One Non-Science Elective | as specified |

Elective courses both in and outside Mathematics should not be selected by the student before consultation with the Chairman of the Department of Mathematics.
Science electives for the third or fourth years: Biology 131 or 231, Earth Science 130, Physics 338 or 339, or any Mathematics subject not previously taken.

Non-science electives for the third and fourth years: English 230 or 235, German 1-50, History 200, Psychology 110, Russian 1-50, Science 400.

Other electives may be chosen subject to the restrictions of the student's timetable and the consent of the departmental chairman.

Note 1: Students completing this course may qualify for the High School Assistant's Certificate, Type "A", in Mathematics.

Note 2: Students wishing to qualify for High School Assistant's Certificate, Type "A", in Mathematics and Physics must choose courses in Physics for their Science electives in Years III and IV.

Honours Physics

(Numbers and Physics programme)

(For Year I, see page 81)

<table>
<thead>
<tr>
<th>Year II</th>
<th></th>
<th>Lectures</th>
<th>Labs.</th>
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<tbody>
<tr>
<td>Mathematics 230</td>
<td>Algebra I</td>
<td>3</td>
<td>-</td>
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<tr>
<td>Mathematics 231</td>
<td>Differential Calculus</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Mathematics 232</td>
<td>Integral Calculus</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Mathematics 233</td>
<td>Probability and Statistics</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Physics 232</td>
<td>Electricity and Magnetism</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Physics 235</td>
<td>Optics</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Physics 237</td>
<td>Astronomy I</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Physics 331</td>
<td>Classical Mechanics I</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Physics 332</td>
<td>Electronics</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Physics 333</td>
<td>Intermediate Laboratory</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Physics 334</td>
<td>Atomic and Nuclear Physics I</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Physics 335</td>
<td>Thermodynamics, Kinetic Theory of Gases, Statistical Mechanics</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>one Arts or Science Elective</td>
<td>as specified</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

plus Option A†

| Physics 336 | Physical Mathematics I | 2 | - |

or Option B†

| Science Elective | as specified |

Year IV

| Physics 433 | Advanced Laboratory | 0 | 6 |
| Physics 434 | Atomic and Nuclear Physics II | 2 | - |
| Physics 435 | Solid State Physics (half course) | 3 | - |
| Physics 441 | Electromagnetic Theory | 2 | - |

plus Option A†

| Physics 431 | Classical Mechanics II | 2 | - |
| Physics 436 | Physical Mathematics II | 3 | - |

Two of:

| Physics 432 | Physics of Solid State Devices (half course) | 3 | - |
Honours Physics

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 437</td>
<td>Topics in Theoretical Physics (half course)</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics</td>
<td>A suitable course</td>
<td>as specified</td>
</tr>
<tr>
<td>Science</td>
<td>A suitable course</td>
<td>as specified</td>
</tr>
<tr>
<td>Arts</td>
<td>A suitable course</td>
<td>as specified</td>
</tr>
</tbody>
</table>

or Option B†

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 336</td>
<td>Physical Mathematics I</td>
<td>2</td>
</tr>
<tr>
<td>Science 400</td>
<td>History and Philosophy of Science</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry</td>
<td>A suitable course</td>
<td>as specified</td>
</tr>
<tr>
<td>Arts or Science Elective</td>
<td></td>
<td>as specified</td>
</tr>
</tbody>
</table>

† Either option provides a suitable terminal Honours course in Physics, but Option A is recommended for those intending to do graduate work and Option B for those preparing to teach in high schools.

The choice of electives must be made to fit the student's time-table and must be approved by the Chairman of the Department of Physics. The following are recommended subjects for this purpose:

Science electives for the third or fourth year: Chemistry 236 or 325; Earth Science 130; Mathematics 330, 338, or 440; Physics 337, 338, 416, 438; Science 400.

Non-science electives for the third or fourth year: English 235; German 1-50; History 200; Philosophy 100; Russian 1-50.
Honours Applied Physics

For information about the operation of the Co-operative Applied Physics programme see page 81

<table>
<thead>
<tr>
<th>Year I — Term A</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>English 15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics 12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics 21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics 11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G.E. 21</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>General Chemistry</strong></td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td><strong>English Literature</strong></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td><strong>Calculus I</strong></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td><strong>Algebra and Solid Geometry</strong></td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Mechanics, Wave Motion and Heat</strong></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Engineering Graphics I</strong></td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

| Year I — Term B                     |          |       |
| Chemistry 11                        |          |       |
| English 15                          |          |       |
| Mathematics 12                      |          |       |
| Mathematics 21                      |          |       |
| Physics 11                          |          |       |
| Arts Elective                       |          |       |
| **General Chemistry**               | 3        | 3     |
| **English Literature**              | 3        | 0     |
| **Calculus I**                      | 3        | 2     |
| **Algebra and Solid Geometry**      | 2        | 1     |
| **Mechanics, Wave Motion and Heat** | 3        | 3     |
| **3 -**                             |          |       |

| Year II — Term A                    |          |       |
| Mathematics 22                      |          |       |
| Mathematics 23                      |          |       |
| Mathematics 24                      |          |       |
| E. E. 12                            |          |       |
| Physics 14                           |          |       |
| Arts or Engineering Elective        |          |       |
| **Calculus II**                     | 3        | 0     |
| **Numerical Methods**               | 0        | 2     |
| **Mathematics Problems**            | 0        | 2     |
| **Electricity and Magnetism I**     | 3        | 3*    |
| **Optics**                          | 3        | 3     |
| **3 -**                             |          |       |

| Year II — Term B                    |          |       |
| Mathematics 33                      |          |       |
| Mathematics 34                      |          |       |
| Mathematics 51                      |          |       |
| E. E. 13                            |          |       |
| Physics 42                           |          |       |
| **Differential Calculus**           | 3        | 0     |
| **Integral Calculus**               | 3        | 0     |
| **Probability and Statistics**      | 2        | 3     |
| **Electricity and Magnetism II**    | 3        | 3*    |
| **Structure of Solids**             | 3        | 3*    |

| Year III — Term A                   |          |       |
| G.E. 12                             |          |       |
| E. E. 51                            |          |       |
| Physics 331                          |          |       |
| Physics 333                          |          |       |
| Physics 334                          |          |       |
| Physics 335                          |          |       |
| Physics 336                          |          |       |
| Intro. to Engineering Systems       | 3        | 0     |
| Electronics I                       | 3        | 0     |
| Classical Mechanics IA               | 3        | 0     |
| Intermediate Laboratory              | 0        | 6     |
| Atomic and Nuclear Physics IA       | 3        | 0     |
| Thermodynamics, Kinetic Theory of Gases, Statistical Mechanics (A) | 3 | 0 |
| Physical Mathematics IA              | 2        | 0     |

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Honours Applied Physics

Year III — Term B

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. E. 52</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 331</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 333</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Physics 334</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 335</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 336</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>One Arts or Engineering Elective</td>
<td>as specified</td>
<td></td>
</tr>
</tbody>
</table>

Year IV — Term A and B

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 433</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>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 436</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 441</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Two two-term courses or the equivalent chosen from: Physics 416, Physics 432, Physics 442, Mathematics 55, Electrical Engineering 54, other Mathematics or Engineering courses, one Arts elective.

General Courses

In the General Course five subjects are required per year, and there is a lower promotion standard than in the Honours courses. The General Course is designed for students preparing to become secondary-school teachers, or for various industrial positions such as senior laboratory technicians, technical sales representatives, and so forth.

Commencing in 1965-66 the General Course will be available in a four-year programme in certain departments as well as in a three-year programme in all departments. Graduates of the four-year programme who have taken appropriate options 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 admission to Type-A courses at O.C.E. with specialization in a single subject. Where the four-year programme is available, 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 course has been completed. A student who has graduated from the three-year course may apply to register for the four-year course; 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 course who have taken the required subjects are qualified to apply for admission to medical schools in Ontario. Students who has passed the first year of the course with appropriate choice of subjects are qualified to apply for admission to a dental school.
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, Mathematics 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:

### Three Year Course

<table>
<thead>
<tr>
<th>Year</th>
<th>Major Field</th>
<th>Minor Fields*</th>
<th>Arts Elective</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>2 subjects</td>
<td>2 subjects</td>
<td>1 subject</td>
<td>5 subjects</td>
</tr>
<tr>
<td>III</td>
<td>2 subjects</td>
<td>2 subjects</td>
<td>1 subject</td>
<td>5 subjects</td>
</tr>
</tbody>
</table>

### Four Year Course

<table>
<thead>
<tr>
<th>Year</th>
<th>Major Field</th>
<th>Minor Field(s)*</th>
<th>Arts Elective</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>2 subjects</td>
<td>2 subjects</td>
<td>1 subject</td>
<td>5 subjects</td>
</tr>
<tr>
<td>III</td>
<td>2 or 3</td>
<td>1 or 2</td>
<td>1 subject</td>
<td>5 subjects</td>
</tr>
<tr>
<td>IV</td>
<td>2 or 3</td>
<td>1 or 2</td>
<td>1 subject</td>
<td>5 subjects</td>
</tr>
</tbody>
</table>

*Where two minor fields are required or selected they must be in different departments. Minor fields must be subjects for which the student is qualified, offered by a majoring department in the Science Faculty.

The selection of subjects in upper years will be restricted partly by limitations imposed by the timetable, and partly by the necessity in many subjects 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 subjects may be taken provided they fit the student's timetable and are approved by his departmental chairman.

### Extra Subjects

The following regulations apply to both General and Honours programmes. An extra subject 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 subject will not be averaged with those from the required courses for over-all standing.

There will not be supplemental privileges with extra subjects.

### Biology Major

#### Year I

Including Biology 131

#### Year II

Two of: Biology 233, 234, 235
Chemistry 236
Earth Science 130
Arts Elective
Three-year course

Year III

*Two of: Biology 333, 336, 337 (or 332)*
Chemistry 337
One of: Physics 242, 237
Arts Elective

Four-year course

Year III

*Two or three of: Biology 333, 336, 337 (or 332)*
One or two of: Chemistry 337, Physics 242, 237
Arts Elective

Year IV

*Two or three of: Biology 431, 433, 434, 435, 437, 438*
One or two of: Chemistry 437, Physics 416.
Arts Elective

Chemistry Major

Year I

Including Mathematics 131

Year II

Chemistry 236, 242
One of: Mathematics 236 (required for four-year course),
Physics 237
One of: Physics 242, Biology 233
Arts Elective

Three-year course

Year III

Chemistry 325
One of: Chemistry 231, 337
One of: Physics 235, Biology 231
One of: Mathematics 233, Earth Science 130
Arts Elective

Four-year course

Year III

Chemistry 231, 325
Physics 235, or 242 (if not taken previously)
One of: Biology 231
Mathematics 233
Chemistry 336* or 337
Arts Elective

Year IV

Chemistry 331, 335 (3 hours lab.)
One of: Chemistry 336*, 337, or 445
One other subject in Mathematics, Physics, or Biology acceptable to the Department of Chemistry
Arts Elective

*Chemistry 336 must be taken in Year III or Year IV.
Earth Sciences Major

Year I
Including Earth Science 130

Year II
Two of: Earth Science 230, 235, 240
Two of: Chemistry 242, Physics 237, Biology 234, Mathematics 233
Arts Elective

Year III
Two of: Earth Science 330, 335, 338
340
Two of: Chemistry 331 or 325, Biology 231, Physics 242, Mathematics 236
Arts Elective

Mathematics Major

Year I
Including Mathematics 131

Year II
Mathematics 236
One of: Mathematics 132, 230, 233, 235, 330
One of: Physics 235, 237, 242
One of: Biology 131, Chemistry 231, Earth Science 130
Arts Elective

Year III
Mathematics 446
One of: Mathematics 230, 233, 235, 330, 334
One of: Physics 235, 237, 242, 338
One of: Biology 231, Chemistry 325, Earth Science 130
Arts Elective

Physics Major

Year I
Including Mathematics 131

Year II
Physics 235, 242
One of: Mathematics 132, 232, 236
One of: Chemistry 236, Biology 231
Arts Elective

Three-year course

Year III
Physics 339
One of: Physics 237, 332, 338
One of: Mathematics 230, 233
One of: Chemistry 231, 325
Arts Elective

Four-year course

Year III
Physics 339 or 334
One or two of: Physics 237, 332, 335, 338
One or two of: Mathematics 230 or 233; Chemistry 231 or 325
Arts Elective

Year IV
Two or three of: Physics 237, 331, 332, 335, 336, 338, 439, or 434 (if 334 was taken in Year III)
One or two of: Science options not previously elected, or other courses in Mathematics, Chemistry, or Biology acceptable to the Physics Department
Arts Elective

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V

The Faculty
of Graduate Studies
Degrees

Courses leading to the degree of Master of Arts (M.A.) are offered by the departments of French, Geography, German, History, Mathematics, Russian, Philosophy and Psychology.

Courses leading to the degree of Master of Science (M.Sc.) are offered by the departments of Biology, Chemistry, Mathematics, and Physics.

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

Courses leading to the degree of Master of Philosophy (M.Phil.) are at present offered by the following Arts departments: German, History, Mathematics, and Philosophy. The Master of Philosophy degree (M.Phil.) is offered only by the Arts Faculty.
Courses leading to the degree of Doctor of Philosophy (Ph.D.) are offered by the departments of Biology, Chemical Engineering, Chemistry, Civil Engineering, Electrical Engineering, German, Mathematics, Mechanical Engineering, Philosophy, Physics, Psychology, and Russian.

Other departments are planning to offer graduate programmes in the near future. Detailed information concerning specific courses may be obtained from the Dean of the Faculty.

Co-operative Graduate Programme in Engineering — see page 49.

Requirements for the Master's Degree

Each candidate for the Master's Degree shall have his programme approved by the Committee on Programmes for the Master's Degree.

Four full courses, acceptable for graduate credit, or two such courses and a thesis, are required for the Master's Degree. The subject of the thesis research must be approved by the head of the department concerned. Four copies of the candidate’s thesis shall be submitted to the Dean of Graduate Studies to be read and judged by at least two members of the University Faculty.

In the case of a student proceeding to the Master's Degree without writing a thesis, it is recommended that one of the four courses of graduate work be obtained outside his own special field of study and preferably outside his own department. These are minimal requirements and any additional departmental regulations are specifically listed along with the course offerings of the department concerned. Students must obtain an average of at least 66% in the set of courses which they present in fulfillment of course requirements for the degree. The minimum time of registration for the Master's Degree is one academic year from an honours Bachelor's Degree or equivalent. If a candidate is employed in other work that requires more than approximately 15 hours per week, he will not be able to complete the requirements in the minimum time. The requirements for the degree must be completed within a total period of four consecutive academic years.

In exceptional circumstances, extensions may be made beyond the maximum time allowance upon petition to the Graduate Council at least four months prior to the normal date for completion of degree requirements.

Requirements for the Master of Philosophy Degree

The Master of Philosophy degree is especially designed as a scholarly degree intermediate between the M.A. and Ph.D. degrees.

The normal pattern in proceeding to the M.Phil. Degree is B.A., M.Phil., whereas to the Ph.D. degree it is B.A., M.A., Ph.D. The candidate must have an adequate knowledge of at least one language other than English as specified by his department. Seven full courses, acceptable for graduate credit, plus an M.Phil. thesis are required for the M.Phil. degree. Candidates entering after a Master's Degree will have their Master's courses subtracted from this total. Students must obtain an average of at least 66% in the set of courses which they present in fulfillment of course requirements for the degree.
Each candidate shall have his programme of study approved by a committee and will be responsible to a thesis supervisor who shall be appointed from the Faculty of Graduate Studies.

The candidate shall present a thesis embodying the results of study conducted by himself on an approved topic. If, however, the candidate has written a Master's thesis of sufficiently high calibre, the department may permit him to satisfy the degree requirements for the M.Phil. without writing a thesis.

Four copies of the candidate's thesis shall be submitted to the Dean of Graduate Studies to be read and judged by two members of the University Faculty. The candidate shall defend his thesis in an oral examination before a Committee appointed by the Faculty of Graduate Studies.

The minimum period of registration for the M.Phil. degree is two academic years from an Honour Bachelor's degree or its equivalent or one year from a Master's degree or its equivalent. If a candidate is employed in other work which requires more than approximately fifteen hours per week, he will not be allowed to complete the requirements in the minimum time. A candidate who does not complete the requirements in the minimum time must pass a comprehensive examination, as determined by his department, in order to be eligible for the degree. The requirements for the degree must be completed within a total period of six consecutive academic years from the Honours degree level. In exceptional circumstances, extensions may be made beyond the maximum time allowance upon petition to the Graduate Council at least four months prior to the normal date for completion of degree requirements.

A student may transfer from the M.Phil. programme to the Ph.D. programme in the same field, in exceptional circumstances, by petitioning to the Graduate Faculty Council through his department. If the petition should be granted, the Council will specify the requirements which he must fulfill in order to receive the Ph.D. degree.

A student who has become a candidate for the Ph.D. degree and wishes to transfer to the M.Phil. programme in the same field of study must petition the Graduate Council through his department for permission to make this change in his programme. If the petition should be granted, the Graduate Council will specify the requirements which he must fulfill in order to receive the M.Phil. degree. A student who has not passed the Ph.D. comprehensive exams must pass the M.Phil. comprehensive before he can become eligible to receive the M.Phil. degree.

Admission

In addition to fulfilling the general requirements of the Faculty of Graduate Studies, an applicant for the M.Phil. programme must possess either an Honour Bachelor's degree or the equivalent, or a Master's degree or its equivalent.

Requirements for the Ph.D. Degree

The candidate should have an adequate knowledge of at least one language other than English, as specified by the department with which he is enrolled. The candidate shall sit for comprehensive examinations, as determined by the
department in which he is enrolled. The amount of course work which the candidate shall take will be determined by the department, but will normally not be more than four courses beyond the Master's level. Students must obtain an average of at least 66% in the set of courses which they present in fulfillment of course requirements for the degree.

Each candidate shall have his programme of study approved by a Committee, and will be responsible to a thesis supervisor who shall be appointed from the Faculty of Graduate Studies.

The candidate shall present a thesis embodying the results of original research conducted by himself on an approved topic. Four copies of the candidate's thesis shall be submitted to the Dean of Graduate Studies to be read and judged by two members of the University Faculty and an outside examiner, who will be appointed by the Dean of Graduate Studies.

The candidate shall defend his thesis in an oral examination before a Committee appointed by the Faculty of Graduate Studies.

The minimum period of registration for the Doctor's Degree is three academic years from an honours Bachelor's Degree, or, alternatively, two academic years from a Master's Degree or equivalent. If a candidate is employed in other work that requires more than approximately fifteen hours per week, he will not be allowed to complete the requirements in the minimum time. The requirements for the degree must be completed within a total period of six consecutive academic years from the Bachelor's level or five consecutive academic years from the Master's level.

In exceptional circumstances, extension may be made beyond the maximum time allowance upon petition to the Graduate Council at least four months prior to the normal date for completion of degree requirements.

**Admission and Registration**

**General**

Application for admission to the Faculty of Graduate Studies should be made as early in the year as possible on forms provided by the Office of the Registrar. Academic transcripts and other supporting documents should be forwarded as soon as they become available.

Admission to the Faculty cannot be granted until all requirements have been met and all documents submitted.

**Admission**

Applicants for Graduate Study must be admitted by the Admissions Committee for the Faculty of Graduate Studies.

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.
Students who, in the opinion of the Committee on Programmes for the Master's Degree, have insufficient background to permit them to complete the requirements for the 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 Admissions Committee regardless of the institution at which the candidate has completed his previous work.

At the discretion of the Admissions Committee, an applicant may be required to write a set of qualifying examinations.

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 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 his 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.

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.

Registration

All students are required to register at the commencement of each session at the time and place designated by the Registrar.

Fees

All fees for the academic year 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.

If, for reasons acceptable to the Business Manager, the fees for the year cannot be paid in full on the day of registration, they may be paid in two instalments, but an extra charge of $5.00 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 the total fees. The balance must be paid in full on the first day of the second term.

A charge of $2.00 per month will be made on overdue accounts. Failure to pay an overdue account before conclusion of lectures may bar a student from writing examinations or obtaining credit for previous work.

A student who finds it necessary to withdraw from attendance is required to obtain a withdrawal voucher from the Registrar. The voucher, when signed by
the Registrar, may entitle him to a refund of a portion of his fees. No fee 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 one in effect for the 1964-65 year and at the time of printing is still subject to review and possible change for the 1965-66 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.

Fees

Regular full-time graduate students:
- per year of required resident study $375.00
- per term of required resident study 187.50
- additional resident graduate study
  - per year 50.00
  - per term 25.00
- additional non-resident graduate study per year or portion thereof 20.00

Qualifying full-time graduate students:
- per academic year of resident study $510.00

Regular part-time graduate students:
- per each specified registration $135.00
- per each subsequent registration 50.00

Specified registrations for regular part-time graduate students:

<table>
<thead>
<tr>
<th>Degree</th>
<th>Minimum Fee</th>
<th>$135.00 Payable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master's</td>
<td>$540.00</td>
<td>4 times</td>
</tr>
<tr>
<td>Ph.D. (from Master's)</td>
<td>810.00</td>
<td>6 times</td>
</tr>
<tr>
<td>Ph.D. (from Bachelor's)</td>
<td>1,350.00</td>
<td>10 times</td>
</tr>
</tbody>
</table>

Special part-time graduate students:
- per full course $100.00
- per half course or course for one term 50.00

Definitions:

Regular full-time graduate student:
A student possessing an honours Bachelor's degree or equivalent who is classified as a regular student by the Admissions Committee for the Faculty of Graduate Studies.
Qualifying full-time graduate student:
A student, normally not possessing an Honours degree, who is classified as a qualifying student by the Admissions Committee for the Faculty of Graduate Studies.

Regular part-time graduate student:
A graduate student enrolled for not more than one course at any registration. Course in this context represents a full course for students registered on a year basis, and a half course for students registered on a term basis.

Special part-time graduate student:
A student possessing a university degree taking not more than one graduate course but not proceeding to a degree or diploma.

Incidental and Miscellaneous Fees:
- Health services (compulsory for full-time students) $ 4.00
- Health insurance (optional 8 month coverage) 8.50
- Photograph (at first registration only) 1.00
- Late registration 10.00
- Transcript of record 1.00
- Degree 20.00

Notes:  (1) Two or more courses: full-time fee.
     (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.
     (3) Classification of graduate students is made by the Admissions Committee for the Faculty of Graduate Studies.

Residence Fees
Residence fee for both men and women is $725.00 for room and board for the regular academic session (2 terms), or $362.50 per term for co-operative course students. 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 the first term and the beginning of the second term. Students occupying residence in this period will be charged an additional $2.00 per day for their room, (food if available, will be an extra charge).

Rooms may be occupied for twenty-four hours before registration and after the final examination.
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.
VI

The Department of Physical and Health Education
Department of Physical and Health Education

The programme has been designed to provide professional training for University graduates planning to enter one of the many fields of physical education, health and recreation. Graduation from the one year programme with first or second class honours has been approved by the Department of Education of Ontario as acceptable preparation for admission to the Ontario College of Education course leading to the High School Assistant's certificate, Type "A", in Physical Education.

One advantage of the one year post-degree programme is that it enables the student interested in teaching at the Secondary School level to develop two areas of specialty, an academic discipline and professional physical education. An innovation in physical education degree programmes is the inclusion of a skill school to be held the first week of classes. The skill school will include lectures and the beginning of skills training.

The programme is offered in the standard academic year, from September to May, and follows the same schedule of dates as the Faculties of Arts and Science.

The Physical Education programme is supervised by the Senate Committee on Physical Education.

Admission

To qualify for admission to the Bachelor of Physical Education Programme, the applicant must present the following:

1. A Bachelor's degree from a recognized University or College.

2. High School Participation Record — showing intramural, interscholastic and recreational participation; athletic and honour awards won during High School attendance.

3. University Participation Record — showing intramural, interscholastic and recreational participation; athletic and honour awards won during University or College attendance.

4. Two references from active physical education personnel.

5. A recent medical certificate.

It is recommended that a student include some courses in Psychology and Biology in his undergraduate programme in order to provide background for courses he will be taking during the Bachelor of Physical Education Programme.
Fees

All fees for the academic year 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.

If, for reasons acceptable to the Business Manager, the fees for the year cannot be paid in full on the day of registration, they may be paid in two instalments, but an extra charge of $5.00 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 the tuition fees plus all incidental fees. The balance must be paid on the first day of the second term.

A charge of $2.00 per month will be made on overdue accounts. Failure to pay an overdue account before conclusion of lectures will bar a student from writing examinations or obtaining credit for previous work.

A student who finds it necessary to withdraw from attendance is required to obtain a withdrawal voucher from the Registrar. The voucher, when signed by both the Department Head 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 one in effect for the 1964-65 years and at the time of printing is still subject to review and possible change for the 1965-66 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.
Sessional Fees:

<table>
<thead>
<tr>
<th>Service</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuition</td>
<td>$510.50</td>
</tr>
<tr>
<td>Incidental*</td>
<td>$94.50</td>
</tr>
<tr>
<td>Examination — Supplemental, each paper</td>
<td>$10.00</td>
</tr>
<tr>
<td>— Presiding fee (at an outside centre, each half day)</td>
<td>5.00</td>
</tr>
<tr>
<td>Photograph (at first registration only)</td>
<td>1.00</td>
</tr>
<tr>
<td>Late Registration</td>
<td>10.00</td>
</tr>
<tr>
<td>Transcript of Record</td>
<td>1.00</td>
</tr>
<tr>
<td>Degree and Graduation</td>
<td>10.00</td>
</tr>
</tbody>
</table>

* Incidental fees include student activities, athletics, health insurance, health services, skill school, and uniform. The Health Insurance Plan does not include the premiums or benefits of the Ontario Hospital Service Commission. Such coverage is the student’s own responsibility.

Residence Fees

Residences fee for both men and women is $725.00 for room and board for the regular academic session (2 terms), or $362.50 per term for co-operative course students. 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 the first term and the beginning of the second term. Students occupying residence in this period will be charged an additional $2.00 per day for their room only, (food, if available, will be an extra charge).

Rooms may be occupied for twenty-four hours before registration and after the final examination.

Examinations

Final written examinations will be held in April and May. Oral examinations may be required at the discretion of individual instructors. The normal time for written examinations is two hours.

Letter grades signify the following standings in individual subjects:

- A  75 - 100%
- B  66 - 74%
- C  60 - 65%
- D  50 - 59%
- F less than 50% (Failure, no supplemental allowed)
- S less than 50% (Supplemental allowed)
Physical Education Programme

(a) First Term:

PE 400  History and Principles of Physical Education
PE 405  Historical Foundations in Dance (women)
PE 410  Coaching Foundations
PE 425  Public Health and Preventive Medicine
PE 440  Human Anatomy
PE 445  Care and Prevention of Athletic Injuries
PE 460  Measurement and Evaluation
PE 480  Skills

(b) Second Term:

PE 420  Administration of Physical and Health Education
         Programmes
PE 441  Kinesiology
PE 450  Correctives and Adapted Physical Education
PE 455  Physiology of Physical Activity
PE 465  Research Project
Psych 620  Educational Psychology
PE 480  Skills
VII

Course Descriptions
Notes on Numbering of Courses

1. Courses offered to students in the Faculties of Arts and Science numbered:
   - 1-49 are at the beginning level
   - 50-99 are at the Ontario Grade XIII level
   - 100-500 are at the undergraduate level
   - Courses marked with an asterisk are half courses.

2. Courses offered to students in the Faculty of Engineering numbered:
   - 10-99 are at the undergraduate level

3. Courses offered to students in the Faculty of Graduate Studies numbered:
   - below 600 are senior undergraduate courses which may be taken for Graduate credit
   - 600 and above are at the graduate level

2. All courses listed are full courses (two terms) unless otherwise indicated.

3. A symbol following a course number indicates that the course is offered by one of the associated church colleges:
   - G — Conrad Grebel
   - J — St. Jerome’s College
   - R — Renison College
   - P — St. Paul’s College

Department of Biology

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

D. Parkinson, B.Sc. (London), Ph.D. (Nottingham) — — — Professor
W. E. Inniss, M.S.A. (Toronto), Ph.D. (Michigan State) — Associate Professor
G. Power, B.Sc. (Durham), Ph.D. (McGill) — — Associate Professor
H. C. Duthie, B.Sc., Ph.D. (Wales) — — Assistant Professor
H. R. N. Eydt, M.Sc., Ph.D. (McMaster) — Assistant Professor
P. E. Morrison, M.Sc. (Western), Ph.D. (McMaster) — Assistant Professor

Undergraduate Course Descriptions

2 lectures, 3 hours laboratory.

231. Genetics and Evolution. The principles, methods, and application of genetics. The implications of genetics in the modern evolutionary theory. Primarily for students other than Biology majors.
2 lectures, 2 hours laboratory.
233. **Vertebrate Zoology.** The evolution of the vertebrate body as exemplified by both living the fossil members of the group. Laboratory dissections form an integral part of the course.
Prerequisite: Biology 131.
2 lectures, 3 hours laboratory.

234. **Comparative Plant Morphology.** The anatomy, morphology and taxonomy of the plant kingdom with life histories of typical examples. Emphasis on morphogenetic and evolutionary aspects.
Prerequisite: Biology 131.
2 lectures, 3 hours laboratory.

2 lectures, 3 hours laboratory.

332. **Vertebrate Physiology.** An integrated study of the concepts of the cell and its environment and the basic processes of living cells. The physiology of major organ systems of the vertebrate body with emphasis on the human.
Prerequisite: Biology 233, Chemistry 236.
2 lectures, 3 hours laboratory.

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

335. **Microbial Ecology.** Roles of micro-organisms in natural and special environments. Their role as causal agents of disease. Methods for studying the nature and functions of microbial populations.
Prerequisite: Biology 235.
2 lectures, 3 hours laboratory.

Prerequisite: Chemistry 236.
2 lectures, 3 hours laboratory.

337. **General Physiology.** Information transfer, energy production and biosynthesis in living cells. The effects of environment on basic life processes, (e.g. assimilation, growth, reproduction).
Prerequisite: Chemistry 236.
2 lectures, 3 hours laboratory.
(This course and 332 will run together in fall term).

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 331, Biology 332, Biology 333.
2 lectures, 2 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 and its relation to evolution. Particular emphasis will be directed towards biochemical genetics and the physical basis of inheritance.
Prerequisite: Biology 336.
2 lectures, 3 hours laboratory.

435. **Microbial Physiology.** The study of microorganisms with special reference to the structure, physiology and metabolism of bacteria. Structure-function inter-relationships; biosynthetic processes; cellular regulatory mechanisms; quantitative experimental methodology.
Prerequisites: Biology 235, Chemistry 236 or Chemistry 26, Chemistry 337 or Chemistry 37.
2 lectures, 3 hours laboratory.

436. **Neurophysiology.** Selected topics and techniques in Neurophysiology.
Prerequisites: Biology 332 or Biology 337.
2 lectures, 3 hours laboratory.

437. **Vascular plants.** A survey of the higher plants, with emphasis on morphological change and evolutionary advance.
Prerequisite: Biology 234.
2 lectures, 3 hours laboratory.

438. **Non-vascular plants.** A survey of the lower plants with emphasis on variation and the evolutionary advances seen in the algae, fungi and bryophytes.
Prerequisite: Biology 234.
2 lectures, 3 hours laboratory.

439. **Experimental Biology.** Design, execution and interpretation of experiments. The basis of this course will be a year-long project.
Prerequisites: Biology 235, Biology 336 or 337.

499. **Senior Honour 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.

**Graduate and Research Programmes**

There are at present several major areas of study in the department in which graduate students may specialize. These include biochemical microbiology, soil microbiology, freshwater algology, palaeobotany of the Pleistocene, ecology of freshwater invertebrates, invertebrate physiology, fisheries and water pollution. It is hoped that others will have been added by the time this calendar is published.
Fields in which research is in progress in the department are as follows:
The transport mechanisms across the cellular membranes of bacteria and
of the mode of action of chemical inhibitors of microorganisms.

The nature and activity of the microbial populations of forest soils.

Fungi in the root region of crop plants with special reference to root
development and nutrient uptake.

The ecology of the algae in lakes and streams, the dynamics of their
growth and the mechanisms of their distribution and flotation.

The ecology of peat bogs together with their palynology and the plant
composition of the peat.

The invertebrate fauna of running water and the fate of organic matter
in streams.

Reproduction in invertebrates with special reference to the physiological
inter-relationships of nutrition, food reserves, hormones and maturation
of the gonads.

Biology of salmonid fishes and fluviatile forage fishes.

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.

605. Limnology. An advanced discussion of the fresh water environments and
current limnological literature.

606. Algology. A systematic account of the Algae with emphasis on the
ecology of the more important limnetic forms.

607. Advanced Microbiology. A discussion of selected topics in Microbiology.

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

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

613. Mycology. Selected topics in fungal systematics and plant pathology.

614. Soil Microbiology. Nature and functions of microbial populations of
soil organisms and their relationship with higher plants. Methods for studying
soil microorganisms.

615. Ecology and Limnology for Engineers. A study of the terrestrial and
aquatic environment with special reference to the effects of modern man.
667. Molecular Biology. Selected topics of interest to biologists, biochemists and biophysicists will be presented at the advanced level with the aim of evaluating recent work and development in each area. Each will be developed from basic concepts and interrelationships emphasized. Topics will include: the structure of proteins and their properties in solution, transport through biological membranes, cell morphology and physiology, structure and function of selected organelles, biosynthesis of macromolecules, and the chemistry of enzyme action. This graduate course is to be presented by members of the Biology, Chemistry and Physics departments and is intended to cover those areas common to these disciplines (identical to Biology 667 and Physics 667).


Department of Chemical Engineering

D. S. Scott, B.Sc., M.Sc. (Alberta), Ph.D. (Illinois)
Professor and Chairman of the Department

T. L. Batke, B.A.Sc., M.A.Sc., Ph.D. (Toronto)
Professor and Academic Vice-President

A. H. Heatley, B.A.Sc., M.A., Ph.D. (Toronto) - - - - Professor

G. A. Turner, B.Sc. (Welsh College of Advanced Technology),
Dipl. in Chem. Eng. (University College, London),
Ph.D. (Manchester) - - - - - - - - - - Professor

L. E. Bodnar, B.A., M.A. (Saskatchewan), M.Sc. (Texas),
Ph.D. (McMaster) - - - - - - - - Associate Professor

P. L. Silveston, B.S., M.S. (Massachusetts Institute of Technology),
Dr. Ing. (Munich) - - - - - - - - Associate Professor

D. C. T. Pei, B.Eng. (McGill), M.Sc. (Queen's), Ph.D. (McGill)
Associate Professor

K. Enns, B.A.Sc., LL.B., M.A.Sc. (Toronto), Ph.D. (Toronto)
Assistant Professor

T. Z. Fahidy, B.Sc., M.Sc. (Queen's), Ph.D. (Illinois) - Assistant Professor

J. D. Ford, B.Eng. (McGill), M.A.Sc. (Toronto) - - Assistant Professor

C. E. Gall, B.A.Sc. (Toronto), M.A.Sc. (Queen's) - Assistant Professor

R. Hudgins, B.A.Sc., M.A.Sc. (Toronto), Ph.D. (Princeton) Assistant Professor

E. Rhodes, B.Sc. in Chem. Eng., Ph.D. (Manchester) - Assistant Professor

P. M. Reilly, B.A.Sc. (Toronto), D.I.C. (Imperial College),
Ph.D. (London) - - - - - - - - Adjunct Professor

Undergraduate Programmes. Details of the undergraduate programme in Chemical Engineering are to be found on page 60.

Undergraduate Course Descriptions

and energy balances. The simple unit operations such as evaporation, drying, etc.
Prerequisites Chem. 11.
3 lectures, 2 hours problems, one term.

12. Chemical Process Principles II. Introduction to the unit operation concept. The mass and energy balance, utilizing physical-chemical principles, will be applied to the elementary unit operations of solution, dilution, evaporation, etc. Preliminary studies of the stage concept will be presented. Dimensional analysis and modeling are incorporated.
Prerequisite: ChE 11.
3 lectures, one term.

13. Unit Operation Analysis. Analysis and functional design of processing units for distillation, absorption, extraction, drying, humidification, leaching and crystallization.
Prerequisite: ChE 12, ChE 21.
3 lectures, 2 hours problems alternate weeks, one term.

21. Transport Processes I. The transport concept is introduced as a general theory. Fluid dynamics and heat transfer are presented from a co-ordinated basis of transport phenomena and thermodynamics.
Prerequisite: ChE 11.
3 lectures, 2 hours problems alternate weeks, one term.

22. Transport Processes II. Theory of diffusion, Navier-Stokes equations, interphase mass transport, phase transformation, simultaneous heat and mass transport and the analogy between them.
Prerequisite: ChE 21.
3 lectures, one term.

Prerequisite: ChE 22.
3 lectures, one term.

Prerequisite: Chem 11.
3 lectures, 3 hours laboratory, one term.

Prerequisites: ChE 11, ChE 31.
3 lectures, 2 hours problems alternate weeks, one term.

Prerequisite: ChE 32.
3 lectures, one term.
34. Thermodynamics. III. Topics from: Equations of state, Empirical Evaluation of Thermodynamic functions, Statistical Thermodynamics, Physical and chemical equilibrium of multicomponent systems.
Prerequisite: ChE 33.
3 lectures, one term.

41. Reaction Kinetics I. 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 12, ChE 31.
3 lectures, one term.

42. Reaction Kinetics II. 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.

43. Reaction Kinetics III. Kinetics of heterogeneous and catalytic reactions; design and scale up of heterogeneous reactors.
Prerequisite: ChE 42.
3 lectures, one term.

51. Process Dynamics and Control I. The differential equations of common processes are derived and linearized. The dynamic behaviour is analyzed when uncontrolled and when standard process controllers provide feedback control. Optimal controller settings are established for stable operation.
Prerequisite: Math 41, ChE 22.
3 lectures, one term.

52. Process Dynamics and Control II. Open and closed loop behaviour of complex processes is considered. Modern approaches to process control are introduced.
Prerequisite: ChE 51.
3 lectures, one term.

54. Chemical Engineering Analysis. The assembling of often unrelated problems into groups related to base mathematical methods will be stressed. The application of analytic and computational methods to chemical engineering problems in analysis, design and optimization will be examined.
Prerequisite: Permission of the instructor.
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 I. 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 II. 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. Chemical Engineering Laboratory III. Chemical reactors, process dynamics steady-state and transient behaviour, and applications of digital and analog computers.
Prerequisites: ChE 72, ChE 41, ChE 51.
6 hours laboratory, one term.

91. Seminar. Study and presentation of material in recent literature.
1 hour, one term.

98. Research and Design Project I.
3 hours, one term.

99. Research and Design Project II.
Prerequisite: ChE 98.
6 hours, 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 wishing to proceed to the Ph.D. degree, or for those whose primary interest is a career in research.

In addition to 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 co-
sidered 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 specifically for students in this option. Other courses may be chosen either 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.

The minimum period for a full-time student to complete either option is 8 months, and the average time required will be one calendar year.

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 the Faculty of Graduate Studies. 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 successfully passed the Departmental comprehensive examination.

Research Activities

Graduate research may be pursued in a number of areas including heat and mass transfer, reaction kinetics, catalysis and reactor design, thermodynamics, fluid dynamics, computational methods, and process dynamics and control. Examples of specific types of research projects currently underway are:

1. Heat and mass transfer from suspended particles, gas-particle dynamics, radiation to liquid films, transport coefficients of small particles.

2. Behaviour of dense gas-solid mixtures.
Department of Chemical Engineering

Group C — (Topics in Control Theory and Applied Mathematics)

655. Analysis of Non-linear processes
656. Control of Complex Processes (including simulation theory)
657. Optimization Problems in Chemical Processes
658. Applied Statistics in Chemical Engineering
659. Stochastic Processes
660. Advanced Techniques of Analysis
661. Research Thesis for the Master's Degree
662. Research Thesis for the Doctoral Degree

Department of Chemistry

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

Associate Professor and Acting Chairman of Department

W. F. Forbes, D.I.C., Ph.D., D.Sc. (London) - - - - Professor
W. A. E. McBryde, M.A. (Toronto), Ph.D. (Virginia)

Professor and Dean of the Faculty of Science

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

D. Mackay, B.Sc., Ph.D. (Aberdeen) - - - - Associate Professor
J. R. Mills, M.A. (Toronto), Ph.D. (Illinois) - Associate Professor
J. B. Moffat, B.A., Ph.D. (Toronto) - - - - Associate Professor
T. Viswanatha, M.Sc., Ph.D. (Mysore) - - - - Associate Professor
R. G. Woolford, M.Sc. (Western), Ph.D. (Illinois) - Associate Professor
G. F. Atkinson, M.A., Ph.D. (Toronto) - - - - Assistant Professor
D. A. Brisbin (Mrs.), B.Sc. (Alberta), Ph.D. (Toronto) - Assistant Professor
J. B. Capindale, M.A., D.Phil. (Oxford) - - - - Assistant Professor
R. J. Friesen, M.Sc. (Manitoba), Ph.D. (London) - Assistant Professor
G. E. Toogood, B.Sc., Ph.D. (Nottingham) - - Assistant Professor
C. M. Burgess, B.Sc. (Southampton) - - - Senior Demonstrator
M. C. Michael (Miss), B.Sc. (Waterloo) - - - Senior Demonstrator

Undergraduate Course Descriptions

Details of the undergraduate programmes offered by the Faculty of Science are to be found on page 81.
Not all the courses listed as Special Topics will be given in any one year (3 semesters) but several from each of groups A, B and C will be offered each year.

Prerequisite: Chemical Engineering 672 or the equivalent.

672. Advanced Mathematics in Chemical Engineering I. Review of fundamental concepts and methods of advanced mathematical analysis with applications in Chemical Engineering. Cartesian tensors and vector formulations of the equations of change. Review of matrix methods and applications to chemical engineering problems.


Special Topics
Group A — (Topics in Transport Theory)
605. Particle - Fluid Dynamics
606. Turbulence Theory
607. Non-Newtonian Flow
608. Compressible Flow
615. Radiant Heat Transfer
616. Heat Transfer in Two Phase Systems
625. Gas-Liquid Mass Transfer Processes
626. Dissolution and Crystallization
627. Ionic Transport Processes

Group B — (Topics in Thermodynamics and Chemical Kinetics)
635. Topics in Chemical Thermodynamics
645. Physical Processes in Heterogeneous Catalysis
646. Kinetics of Consecutive and Chain Reactions
647. Kinetics of Biological Systems
648. Residence Time Distributions, Reactor Flow Models and Reactor Stability
3 lectures, two terms. Laboratory: A term 3 hours alternate weeks.  
B term 3 hours.

21. **Inorganic Chemistry.** Systematic inorganic chemistry based on the periodic classification, with emphasis on the relationship between properties and structure.  
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.

25. **Polymer Chemistry and Physics.** The organic and physical chemistry of elementary polymerization reactions. A study of the physical properties of polymeric materials as related to molecular structure. An introduction to polymer technology.  
Prerequisite: Chem. 11 and Phys. 15.  
3 lectures, one term.

26. **Organic Chemistry I.** The basic chemistry of the important classes of aliphatic and aromatic compounds.

3 lectures, one term.

Prerequisite: ChE 32, Chemistry 22.  
3 lectures, 3 hours laboratory alternate weeks, 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, 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 36.  
3 lectures, one term.
3 lectures, one term.

45. Surface Phenomena. A study of absorption, wetting, foams, electrical surface phenomena, and principles of heterogeneous catalysis.
3 lectures, one term.

46. Organic Chemistry III. Selected topics in organic chemistry of interest and importance to Chemical Engineering students.
3 lectures, one term.

55. Polymer Physics and Chemistry. The Chemistry and physics of natural and synthetic polymers, covering the following topics: condensation and addition polymers and their reaction kinetics; properties of polymers, their measurement and relation to structure; isotactic polymers, copolymers, and polymer reactions.
3 lectures, one term.

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.
3 lectures, 3 hours laboratory.

2 lectures (For General students, 1 hour problem.)

232. Analytical Chemistry. Theory and practice of quantitative inorganic analysis. Representative classical and instrumental techniques will be carried out and studied with relation to the chemical phenomena which 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.

235. Physical Chemistry I. 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.

236. Organic Chemistry I. 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.

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.

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 based on the electronic configuration of the elements and the periodic properties related thereto. Principles of bonding are reviewed and extended. An introduction to nuclear chemistry and coordination chemistry is included. The laboratory will illustrate methods of synthesis and characterization of typical inorganic compounds.
2 lectures; laboratory for General or Chemistry and Biology students 3 hours for Chemistry students see Chemistry 431; for Chemistry and Physics students see Chemistry 439.

2 lectures, 6 hours laboratory.

336. Organic Chemistry II. Chemistry 236 expanded to stress enolate condensations and alicyclic compounds, stereochemistry, and reaction mechanisms. The laboratory course includes further preparative work and qualitative organic analysis.
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, 3 hours laboratory).

431. Inorganic Chemistry II. A more advanced discussion of recent developments in inorganic chemistry selected from such topics as the stabilities and reaction mechanisms of inorganic complexes, carbonyls and related compounds, iso- and heteropoly-acids, intermetallic compounds and alloys, non-stoichiometric compounds, recent chemistry of the lanthanides and actinides and other less familiar elements. The laboratory will stress the application of physical methods to the determination of the structure and properties of compounds of current interest.
2 lectures, 6 hours laboratory.

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.** A selection of more advanced topics to include heterocyclic compounds, natural products, and theoretical aspects of organic 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.  
Honours Chemistry Students, 6 hours laboratory.  
Honours Chemistry and Physics Students, 3 hours laboratory.

445. **Polymer Chemistry.** The chemistry and physics of natural and synthetic polymers, covering the following topics: condensation and addition polymers and their reaction kinetics; properties of polymers, their measurements and relation to structure; isotactic polymers, copolymers, and polymer reactions.  
2 lectures.

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**Graduate Programme in Chemistry**

For both the M.Sc. and Ph.D. programmes, a student is expected to combine a thesis embodying the results of some original research with course work. A major field of study should be chosen from the following areas: analytical, inorganic, organic (including biochemistry) and physical chemistry. Course work will be appropriate to the area selected and a research director should be chosen from members of the department who are presently engaged in various fields of endeavour as listed.

**Major Areas of Research**

**Analytical Chemistry** - chemical instrumentation based on analog modules; 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.

**Inorganic Chemistry** - studies on inorganic complexes in solution, magnetic susceptibility measurements of metallic complexes; crystal structure of salt hydrates; solutions of metals in molten salts and other non-aqueous media; the chemistry of the lanthanides in non-aqueous solvents.

**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; spectroscopic studies (using infrared, ultraviolet and electron spin resonance techniques) of molecular conformation and hydrogen bonding.
Biochemistry - effects of irradiation on proteins and aminoacids as studied by electron spin resonance and other techniques; the aging process; 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 on organic molecules; 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.

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, programs of study, teaching and research facilities and equipment and is sent to every potential graduate student who applies for admission. New areas of research are usually added each year.

Graduate Course Descriptions

631. Co-Ordination Chemistry. Equilibrium and kinetic aspects of complex species; experimental and calculative techniques; mechanism of reactions of co-ordination 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 stressing the use of spectral and other physico-chemical methods in the determination of structure.

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


646. Theoretical Organic Chemistry. The structure and reactivity of organic molecules emphasizing stereochemistry and reaction mechanisms.


662. Colloquia on Current topics in Inorganic and 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 Inorganic and Analytical faculty.

665. Chemical Spectroscopy. The determination of the structure of polyatomic molecules from the study of infrared and Raman spectra. Applications in thermodynamics.

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

667. Molecular Biology. Selected topics of interest to biologists, biochemists and biophysicists will be presented at the advanced level with the aim of evaluating recent work and development in each area. Each will be developed from basic concepts and interrelationships emphasized. Topics will include: the structure of proteins and their properties in solution, transport through biological membranes, cell morphology and physiology, structure and function of selected organells, biosynthesis of macromolecules, and the chemistry of enzyme action. This graduate course is to be presented by members of the Biology, Chemistry and Physics departments and is intended to cover those areas common to these disciplines (identical to Biology 667 and Physics 667).

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


Department of Civil Engineering

A. N. Sherbourne, B.Sc. (London), B.S., M.S. (Lehigh), M.A., Ph.D. (Cambridge) - Professor and Chairman of the Department
S. T. Ariaratnam, B.S. (Ceylon), B.Sc. (Eng.) (Ceylon), B.Sc., M.S. (London), Ph.D. (Cambridge) - Professor
M. Z. Cohn, C.E., Candidate of Tech. Sc. (Bucharest) - Professor
W. R. Drynan, B.A.Sc. (Toronto), M.S., Ph.D. (Texas) - Professor
N. C. Lind, M.S. (Royal Technical University of Denmark), Ph.D. (Illinois) - Professor
D. T. Wright, B.A.Sc. (Toronto), M.S. (Illinois), Ph.D. (Cambridge)

Professor and Dean of the Faculty of Engineering

C. P. Fisher, B.A.Sc. (Toronto), Ph.D. (Texas) - Associate Professor

W. A. McLaughlin, B.Eng. (Saskatchewan), M.S. (Purdue)

Associate Professor

H. B. Poorooshab, B.Sc. (Manchester), Ph.D. (Cambridge)

Associate Professor

J. D. Scott, B.Sc., (Queen’s), M.S., Ph.D. (Illinois), - Associate Professor

R. Green, B.Sc. (Eng.) (London), M.Sc. (Queen’s), M.Sc.

(Waterloo) - - - - - - - - - - Assistant Professor

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

(Queen’s), M.Sc., Ph.D. (Waterloo) - - - - - - Assistant Professor

H. M. Hill, B.Eng., M.S. (Saskatchewan) - - - - - - Assistant Professor

G. B. Hutchinson, B.E. (Sydney), M.Sc. (Queen’s) - Assistant Professor

J. Shortreed, B.Eng.Sc. (Western), M.Sc. (Queen’s) - Assistant Professor

T. H. Topper, B.A.Sc. (Toronto), Ph.D. (Cambridge) - Assistant Professor

O. L. White, B.Sc. (Melbourne,) M.A.Sc. (Toronto) - Assistant Professor

B. LeLievre, B.Eng. (West Australia), M.A.Sc. (Waterloo) - Lecturer

P. H. Meincke, B.Sc. (Manitoba) - - - - - - Lecturer

Undergraduate Course Descriptions

CE 22. Mechanics of Deformable Solids II. A general treatment of the behaviour of structural components from the study of stress and strain in solids. Topics include Mohr’s circle for stresses, strains and moments of inertia, superposition, theories of failure, elastic and inelastic analysis of unsymmetrical bending, shear centre, torsion of cellular members, columns and stability, virtual work, complementary energy, and an introduction to beams on elastic foundations.

CE 31. Theory of Structures. Analysis of simple determinate and indeterminate structures. Topics include static and moving loads on beams and trusses; influence lines; cables; deflections by virtual work, moment area and Williot Mohr; methods of superposition, slope deflection and moment distribution.

CE 32. Behaviour of Steel Structures. Plastic analysis and the behaviour of structural elements in steel. Topics include inelastic behaviour of steel members, basic theorems of plastic collapse, methods of plastic analysis, beams, tension and compression members, connections.


CE 34. Reinforced Concrete II. Structural considerations in concrete design. Safety, rigidity, stability. Design of redundant beams. Reinforced concrete
frames and arches. One and two way slabs. Flat slabs and flat plates. Silos, bunkers, and tanks. Chimneys, water towers and tall R.C. structures.


54. Geotechnical Engineering. A critical study of the theories of soil mechanics and their use in soil engineering. Procedures for design and construction of earth retaining structures, shallow and deep foundations, stability of slopes, and earth dams are considered. Structures involving rock mechanics are also discussed.


71. **Water Resources Engineering.** General introduction to the physical, chemical and biological bases 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 water quality, measurement and process control.

72. **Environmental Health Engineering.** An introductory course to the engineering principles underlying environmental sanitation. Environmental health problems of the community and of industry are considered, including water, food, and air supplies, disposal of human and industrial wastes, animal and arthropod vectors, lighting, ventilation, noise, accidents, industrial poisons, and ionizing radiations.
Prerequisite: CE 71.


81. **Law, Contracts and Specifications.** Engineering law. The design and composition of contracts and specifications.

82. **Urban Planning.** Urban and regional planning. The control and administration of land use for various purposes. Problems of regional planning and urban growth related to communications, etc.

83. **Project Management.** Separation of planning and scheduling functions, traditional methods, arrow diagramming, calculation of earliest and latest event times, design, delivery, and capital restraints, critical path determination, scheduling and calendar dating, the data flow cycle, linear programming and operational analysis.

84. **Design Studies I.** 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.

85. **Design Studies II.** Advanced studies in civil engineering design related to optional courses offered and direction of special interest.

86. **Research Project.** Introduction to research problems and procedures in various areas of civil engineering, with particular relation to special interests in optional programmes of students concerned.
Graduate and Research Programmes

Both co-operative and conventional graduate study in Civil Engineering can be undertaken, leading to the degrees of Master of Applied Science or Doctor of Philosophy. There are at present four major areas of study in which specialization may be undertaken: Structural Engineering*, Geotechnical Engineering, Water Resources Engineering and Transportation Engineering.

Structural Engineering*. (Ariaratnam, Cohn, Green, Handa, Lind, Poorooshasb, Sherbourne, Topper and Wright). Laboratory facilities include a structural models laboratory, a concrete laboratory, a properties of materials laboratory, and a large structural engineering laboratory equipped with a 100,000 lbs. Losenhausen universal testing machine. A major study in this area is Theoretical and Applied Mechanics. Among the course of study are CE 609 to 620. In addition, students may choose from a variety of appropriate courses in mathematics, physics and mechanical engineering.

Current research in structural engineering and applied mechanics include studies in non-linear vibrations, plastic instability of structures, lateral reinforcement and column ductility in reinforced concrete, model testing in soil mechanics, plasticity and instability in plates and in shell structures, behaviour of metal structures under cyclic loadings of low frequency, large deflection studies of shells and membranes, plastic strain and energy in fatigue, theory of design and safety of structures, inelastic behaviour of framed and shell structures, analysis of latticed space structures, ultimate load studies in reinforced concrete, elastic-plastic strength of pressure vessels, and studies of plastic wave propagation.

Geotechnical Engineering (Poorooshasb, Scott and White). Major subdivisions of study in this area are Soil Mechanics, Foundation Engineering and Engineering Geology. Appropriate courses of study are CE 611, 614, 651 to 654, and 698. The Department has two fully equipped soil mechanics and foundation engineering laboratories.

Current research activities are investigations into the yield behaviour of soils, earth pressure studies, foundation settlement research and model testing in soils, pleistocene geology of southern Ontario areas, and studies of stresses in earth dams.

Water Resources Engineering. (Dryan, Fisher and Hill). Included under this area are studies in Environmental Health Engineering. At the present time there are two laboratories, one of which is equipped for most standard physical, chemical and biological analyses of water and waste water. The second laboratory is reserved for graduate students’ projects and research studies. This laboratory is furnished with specialized equipment built for unit process studies and advanced specialized studies in environmental health. Courses in this area are Biology 31 and 601, CE 671 to 675, 681 and 698.

Transportation Engineering. (Handa, Hutchinson, McLaughlin and Shortreed.) Major subdivisions of study are Highway Engineering, Traffic Engineering and
Urban Planning. Appropriate courses of study are CE-640 to 643 and 698. Supplementary courses in urban and area planning may be taken from the Department of Geography.

**Graduate Course Descriptions:** All courses of one term duration except CE 699 Thesis.


615. **Mechanics of Continua II.** Application of the fundamental principles of mechanics to formulate and solve problems in the mechanics of ideal and viscous fluids, elastic and plastic solids and materials with time-dependent mechanical properties. Electroelasticity. Prerequisite: CE 614 or CE 611.
616. Seminar in Mechanics of Continua. Further individual study of selected topics in the mechanics of continuous media. Presentation of progress and discussion of reports in seminar form. Prerequisite: CE 614.


CE 624. Prestressed Concrete. Principles of prestressed concrete. Steel and concrete used in prestressing. Prestressing procedures. Analysis and design of


CE 642. Transportation Engineering I. (Urban Planning) Land use planning, transportation administration. Basic urban transportation studies including origin, distinction, inventory, use, parking and transit studies.


CE 644. Transportation Engineering II (Urban Planning) Urban transportation systems and standards. Travel characteristics and desires. Transportation planning models. Economics in urban transportation.


CE 646. Transportation Systems II. Analysis of decisions. Methods of operations research and graph theory. Applications to transportation engineering. One term.


652. Measurement of Soil Properties. Laboratory and field work in soil sampling and testing. Measurement of soil mechanics parameters for design and research problems. Experiments include permeability, consolidation, direct shear, and triaxial shear.

653. Soil Engineering. A critical study by the consideration of case histories of the current procedures or design and construction of foundations, earth retaining structures and earth slopes.

654. 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.


675. Air Resources Engineering. The principles of the field of air pollution, health, nuisance, agricultural, etc. Its aspects, causes and sources. Characteristics emission rates and gas flow in ducts and chimneys. The physical properties of particulate matter. The engineering design of air cleaning equipment. Public relations, control ordinances, and zoning. Public administration.


698. Special Directed Studies.

Department of Classics

N. H. High, M.S., Ph.D. (Cornell)
  Acting Chairman of the Department and Dean of the Faculty of Arts
B. J. Graf, C.R., M.A. (Western) - - - - - Professor J
P. G. Keleher, C.R., M.A. (St. Mary's, Kentucky) - Associate Professor J
P. Keresztes, M.A. (Toronto), Ph.D. (Charles Francis
  University, Graz) - - - - - Assistant Professor
R. L. Porter, B.A. (McMaster), M.A. (Princeton) - - Lecturer
G. Rich, C.R., B.A. (Western), S.T.B. (Gregorian, Rome) - Lecturer J
W. H. Schnarr, C.R., B.A. (St. Mary's, Kentucky) - Lecturer J
Sister M. Stella, S.S.N.D., B.A. (Toronto), M.A.
  (Catholic University) - - - - Lecturer J
S. Haag, B.A., M.A. (Queen's) - - Lecturer (part-time)

Except for those numbered below 100, all the following courses are Honours courses, but are also open to students in General Arts.

Greek

10. Introductory Greek. For students who have not matriculated in Greek. 4 lectures.

100. Epic and Philosophy (to Plato). Homer. Iliad, I, VI, IX; Plato. Apology and Crito; prose composition and sight translation. Prerequisite: Grade 13 Greek, Greek 10, or permission. 4 lectures.

250. Prose Composition and Sight Translation. 1 lecture.

260. History, Historiography, and Lyric Poetry. Herodotus VI, VII, 1-25; VIII, the Greek lyric and elegiac poets. 4 lectures.

350. Prose Composition and Sight Translation. 1 lecture.

360. History, Historiography, and Tragedy. Thucydides I-VI (Selections), VII, Euripides, Medea. 3 lectures.

370. Drama and Literary Criticism. Aeschylus, Agamemnon; Sophocles, Oedipus Tyrannos; Aristophanes, Clouds; Aristotle. Poetics. 3 lectures.

450. Prose Composition and Sight Translation. 1 lecture.

460. Philosophy and Political Theory: Plato and After. Plato, Republic (Selections) and Symposium; Aristotle. Ethics and Politics (Selections).
3 lectures.

Latin

10. Introductory Latin. For Students who have not matriculated in Latin. Must be followed by Latin 100 in order to gain credit.
4 lectures.

100. Literature of the Republic. Catullus (Selections); Cicero, *Pro Archia*; Vergil, *Eclogues* and *Georgics I, IV*; prose composition and sight translation. Prerequisite: Grade 13 Latin, or Latin 10, or Latin 50J, or permission.
4 lectures.

250. Prose Composition and Sight Translation.
1 lecture.

3 lectures.

350. Prose Composition and Sight Translation.
1 lecture.

3 lectures.

370. Lyric and Elegiac Poetry. Horace, *Odes* and *Carmen Saeculare*; selections from Tibullus, Propertius, and Ovid.
3 lectures.

3 hours.

450. Prose Composition and Sight Translation.
1 lecture.


3 lectures.
3 hours.

Classical Civilization (Courses in Translation)

250. Greek and Roman History. A survey of the social, political and economic history of Greece and Rome.
3 lectures per week.


350. Classical Art and Archaeology. A survey of art and architecture from the Aegean age through the Roman Empire.
3 lectures.

370. Myth, Religion, and Art. Deities, myths, and sagas correlated with literature, religion, philosophy, politics, and art from the 6th century B.C. to the 4th century A.D.
3 lectures.

Department of Design

G. N. Soulis, B.A.Sc. (Toronto)
Associate Professor and Chairman of the Department

N. J. Chaparos - - - - - Assistant Professor

M. L. Constant, B.Sc. (Toronto) - - - Assistant Professor

M. Krampen, Diploma in Visual Communication (Hochschule fuer Gesaltung, Ulm), Ph.D. (Michigan State) - Assistant Professor

C. K. Hahn - - - - - Lecturer

Courses Offered

All courses offered by the Department are one semester and are lecture and laboratory as determined by individual instructors.

The courses are divided into Group A and Group B subjects. Group A subjects have an emphasis on the theory and methodology of design, while Group B subjects have an emphasis on the practical application of theory and methodology in specific problem situations.

Group A

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.


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.


Group B
651. Problems of Spatial Movement and Human Dynamics
652. Economics of Industrial Product and Structural Design
653. Industrial Product Design
654. Design of Visual and Spatial Environments
655. Design of Communications Media
656. Analysis and Criticism of Environmental Design
657. Special Directed Studies.

Department of Earth Sciences

P. F. Karrow, B.Sc. (Queen's), Ph.D. (Illinois)
Associate Professor and Acting Chairman of the Department

**130. Introductory Geology. Minerals and rocks; geological processes and their effects; structural geology; economic geology; historical geology; mineral and rock specimens; topographical and geological maps; field trips.
2 lectures, 3 hours laboratory.

230. Mineralogy. Crystallography, crystal chemistry, systematic and determinative mineralogy of the ore and rock forming minerals.
2 lectures, 2 hours laboratory.

235. Paleontology. Taxonomy and evolution of fossil plants and animals; paleoecology; fossil specimens.
2 lectures, 2 hours laboratory.

240. Geomorphology. Origin and classification of landforms; erosional and depositional processes; weathering and soil formation; mass wasting; field trips.
2 lectures, 3 hours laboratory.
330. Petrology. Origin and classification of igneous, sedimentary, and metamorphic rocks; intrusion and extrusion; sedimentation; rock facies.
2 lectures, 2 hours laboratory.

335. Stratigraphy. Sedimentary rock sequences; correlation; stratigraphic nomenclature; use of fossils in stratigraphy; field trips.
2 lectures, 3 hours laboratory.

338. Geophysics. An introductory course on the physics of the earth. Origin, heat, and temperature of the earth, study of earthquakes and the earth's interior through earthquake waves; gravity and isostasy; terrestrial magnetism; effects of heat, temperature, and strain on rocks; origin of continents, mountain ranges; the ocean floors; meteorology; geophysical techniques.
2 lectures.

340. Structural Geology. Primary and secondary structures in igneous, sedimentary, and metamorphic rocks; physical properties of rocks and the effects of stress on rocks; structure and topography.
2 lectures, 2 hours laboratory.

**Earth Sciences 130 is pre-requisite to all Earth Sciences' courses, except Earth Sciences 338.

† to be offered in 1966.

**Department of Economics**

W. G. Scott, B.A. (Western), M.A. (Toronto)  
Associate Professor and Acting Chairman of the Department.

N. E. Lavigne, C.R., B.A. (Western), M. Comm. (Ottawa),  
M.B.A. (Detroit)  - - - -  Associate Professor

F. C. Miller, M.A. (Western), Ph.D. (Clark) - - Assistant Professor

L. P. Sydor, B.A. (Western), M.A., Ph.D. (Princeton) - Assistant Professor

15. Economics. A one-semester course in the elementary principles of Economics offered to Engineering students. The subject matter of the course is the same as that of Economics 100. It differs from the latter course, however, in that more use is made of mathematical analysis, and more attention is given to the application of economic analysis to engineering problems.
Winter and Spring Term. 3 lectures.

100. Introduction to Economics. A general survey course in the principles of economics. Among the topics discussed are the determination of prices, the measurement and determination of the level of national income and employment, the monetary and banking system, public finance and fiscal policy, labour unions, international trade, and Canadian economic problems.
3 lectures.
3 lectures.

230. Money and Banking and National Income. A study of the American, British and Canadian banking systems with particular reference to Canadian, central banking and monetary policies since 1935. Some time is also devoted to a discussion of the measurements and determination of the level of national income, employment and prices, money flow accounts, monetary and business cycle theory, the theory of inflation and international monetary economics.
3 lectures.

240. Economic History of Canada. Economic and social problems in the historical development of Canada with emphasis on the period since Confederation.
3 lectures.

255. Principles of Accounting. Double-entry bookkeeping; the bookkeeping cycle; preparation of financial statements; matching revenues and expenses; depreciation methods and inventory-evaluation problems; accounting for bonds, stocks, and dividends; capital budgeting; direct and indirect costs; consolidation; flow-of-funds analysis; interpretation of financial statements.
3 lectures.

300. Statistical Methods. Frequency distributions; measures of central tendency and dispersion; probability theory; tests of hypothesis; sampling techniques; interval estimation of economic parameters; time series; index numbers: linear and curvilinear regression and correlation; identification, serial correlation, and other statistical problems encountered in economics.
3 lectures.

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. Considerable emphasis is given to the role of international transactions in development policies.
3 lectures.

3 lectures.

370. Labour Economics. History of trade unionism, wage and employment theory, collective bargaining, labour law, social security system, unions and democracy, the wage price issue, labour and economic development.
3 lectures.

390. 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. 3 lectures.

400. Advanced Economic Theory. Analysis of the theories of representative economists. Most attention is given to the writings of Marshall, Chamberlain and Keynes. 3 lectures.

440. History of Economic Thought. A survey of the historical development of economic theory. 3 lectures.

450. Economics of Development. Examines economic development and growth as they have been conditioned by innovations, technology, savings, methods of resource allocation, factor endowments, public policy, population. Growth theories, land use, and institutional structuring of society are also considered. Prerequisite: Economics 100 and 250. 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 hypothesis and related problems. 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 nonlinear programming, input-output analysis, and game theory. 3 lectures.

480. Comparative Economic Systems. A comparison of resource allocation methods, growth and development under socialistic and capitalistic systems, and under bureaucratic and market mechanisms. Prerequisite: Economics 100. 3 lectures.

490. Canadian Economic Problems. Topics in important and current economic problems. 3 lectures.
Undergraduate Programmes. Details of the undergraduate programme in Electrical Engineering are to be found on page 66.

Undergraduate Course Descriptions

EE 12. Electricity and Magnetism I. An introductory course in electricity and magnetism.


(b) - Magnetostatics - The Biot-Savart Law, the magnetic induction field, Amperes Law, solenoids. Torque on a current carrying loop, the galvanometer. Magnetic force on moving charges, the d.c. motor.


EE 24. Logic and Switching I. The logical design of relay and electronic switching circuits. Boolean algebra. Algebraic equivalent of switching logic; tables of combinations. Relay contact networks, elementary diode, vacuum tube, transistor, and magnetic core switching circuits. Prerequisite: EE 42, EE 52. 3 lectures, one term.

EE 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, EE 13. 3 lectures, 3 hours laboratory, one term.

EE 42. Network Theory. A continuation of GE 12 restricted to linear systems and dominantly electrical components; correspondence between the time domain, and real and complex frequency domains through the Fourier and Laplace transforms; systematic formulation procedures for the equations of linear systems; network theorems, analytical solutions for simple periodical and non-periodical excitations, transient and steady state response. frequency response; phasor methods for sinusoidal steady state conditions; resonant circuit, two ports, and balanced polyphase circuits. Prerequisite: GE 12. 4 lectures, one term.

EE 44. Pulse and Switching Circuits. The design and analysis of circuits used in the generation and shaping of non-sinusoidal waveforms, including linear and non-linear wave shaping, and gating, voltage and current sweeps, multivibrators and the blocking oscillator. Prerequisite: EE 42, EE 52. 3 lectures, one term.
EE 45. Network Synthesis. Energy functions. Network functions; synthesis of passive one ports; introduction to the synthesis of LC and RC two ports. Prerequisite: EE 43, Math 44 or Math 45.
3 lectures, one term.

EE 51. Electronics I. Introduction to physical principles of conduction phenomena in vacuum tube, gas tube, and solid state devices. Vacuum diode, gas diode, and semiconductor diode characteristics and models. Analysis of simple diode circuits, including rectification, filtering, and detection. Vacuum triode, multi-element vacuum tube, and transistor characteristics; piecewise linear and small signal models. Analysis of simple vacuum tube and transistor circuits. Introduction to other electron devices. Prerequisite: EE 12.
3 lectures, one term.

EE 52. Electronics II. Time domain and frequency domain analysis of various vacuum tube and transistor amplifiers, including RC coupled and feedback amplifiers. Various broad-band low-pass power amplifiers, oscillators, and frequency converters. Amplitude and frequency modulation and detection. Prerequisite: EE 51, EE 42.
4 lectures, one term.

EE 55. Solid State Electronics. Superconduction and superconducting devices, thermoelectric effects, photoconduction and photoconductors, luminescence, principles of maser and laser. Prerequisite: Phys. 15 and GE 51.
2 lectures, 3 hours alternate laboratory.

3 lectures, one term.

EE 62. Electromechanics II. Development of dynamic and steady state equations for the generalized rotary energy conversion device. Study of d.c. and a.c. machines as particular types of the generalized device with particular emphasis on their steady state and transient external characteristics. Prerequisite: EE 61.
3 lectures, one term.

3 lectures, one term.
EE 65. **Power Systems Analysis.** Generation of polyphase power, and power calculations in polyphase systems. Symmetrical component analysis of unbalanced systems, sequence components and impedance systems. Fault and characteristics of transmission lines in steady state.
Prerequisite: EE 62.
3 lectures, one term.

EE 71. **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, cutoff frequency, attenuation. The transmission line-waveguide analogy.
Prerequisite: EE 13.
3 lectures, alternate 3 hours laboratory, one term.

EE 72. **Electromagnetic Fields.** Review of electromagnetic theory; the laws of Coulomb, Gauss, Ampere, and Faraday, the four Maxwell Equations in integral and differential form, scalar and vector potentials. The electromagnetic wave equation; plane waves, wave polarization, the propagation vector, Poyntings vector, reflection and refraction at plane interfaces. Sources of radiation; the dipole, antenna arrays, pattern synthesis.
Prerequisite: EE 71.
3 lectures, 3 hours alternate laboratory, one term.

3 lectures, one term.

EE 75. **Dielectrics and Magnetics.** Polarized fields, dielectric constants and polarizability, dipole relaxation and dielectric losses; ferromagnetism, paramagnetism, diamagnetism, magnetic memory devices.
Prerequisite: Phys. 15 and GE 51.
3 lectures, 3 hours alternate laboratory.

Prerequisite: GE 12, EE 51 or EE 32.
3 lectures, one term.

EE 82. **Control Systems II.** Further study of feedback control systems. Design of control systems, examples taken from electrical and hydromechanical systems. Analogue computer simulation. Introduction to nonlinear systems
analysis, phase plane and describing function techniques. Introduction to statistical systems analysis, optimum system criteria.
Prerequisite: EE 81, EE 23.
3 lectures, one term.

EE 83. Communication Theory. Relation 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 lectures, one term.

EE 91. Electrical Laboratory I. An introduction to the theory and techniques of measuring instruments for electrical quantities, their uses and limitations, errors.
3 hours laboratory, alternate weeks, one term.

EE 93. Electrical Laboratory III. A series of experiments and problems to accompany electrical engineering courses given in semester IIIA (EE 42, EE 51, EE 61).
4½ hours, one term.

EE 94. Electrical Laboratory IV. A series of experiments and problems to accompany electrical engineering courses given in semester IIIB (EE 52, EE 62, EE 71).
4½ hours, one term.

EE 95. Electrical Laboratory V. A series of experiments and problems to accompany electrical engineering courses given in semester IVA (EE 72 plus electives).
6 hours approximately, one term.

EE 96. Electrical Laboratory VI. A series of experiments and problems to accompany electrical engineering courses given in semester IVB (EE 82 plus electives).
6 hours approximately, one term.

EE 99. Seminar. Each student is required to write a paper and present a short talk on some current engineering topic of his own choice. Additional talks or panel discussions may be arranged by the Department Chairman or by the students.

Graduate and Research Programme

Graduate Credit in Electrical Engineering

Graduate credit is measured in "units." A unit is a course at the graduate level taken for one semester, and which requires, as a prerequisite, preparation at the Bachelor's level. Two units are given to a graduate course which continues for two semesters. Senior undergraduate courses as approved by the
Electrical Engineering Department may be allowed as credit for graduate students at one-half unit per semester. For each student, no more than two units total credit can be given to undergraduate courses.

Students transferring from other universities of recognized standing may be allowed a maximum of two units for graduate courses previously taken. No graduate credit is given for any undergraduate course taken at other universities.

A full-time student is permitted to take a maximum load of five units for a semester. For part-time students, the maximum load is reduced from five units per semester by one unit for each seven hours per week of employment or outside work. A co-operative graduate student attending two full days per week may be allowed up to 3 units.

The Master's Degree Programme

The Master's degree programme in Electrical Engineering is designed to be flexible, and to accommodate regular full-time and part-time students, and co-operative graduate students from industry.

A complete programme consists of at least ten units. Each student's programme must be approved by the Electrical Engineering Department, and is worked out in advance with a professor who acts as an advisor.

The student's course work is considered unsatisfactory, and he is required to discontinue, if more than one course in Electrical Engineering receives a grade below 66%, or more than two courses in fields other than Electrical Engineering receives a grade below 66%.

An essential ingredient in a graduate programme is opportunity for individual work. To be recommended for a Master's degree in Electrical Engineering, a candidate must submit either a Research Thesis (EE 699) or an Engineering Report (EE 698). Topics are worked out in discussion with the faculty, and the project is done under the direct supervision of a professor of the Electrical Engineering Department, and is finally approved and accepted by that professor. A thesis under EE 699 may count either four or five units, and a project under EE 698, either one or two units. It is not possible to obtain credit under both EE 698 and EE 699 for the same degree.

All course work and thesis for Master's degree must be completed within four consecutive academic years. It is possible for a full-time student of exceptional ability to complete the requirements for the Master's degree in two semesters, or one academic year.

The Ph.D. Programme

The major objective of the Ph.D. programme is to emphasize the importance of performing original research of high calibre. The requirements of the comprehensive examination, the supervising committee, course work, and the language examination, are all considered aids to performing satisfactory research. Facilities for Ph.D. programmes are available in most fields of study described under Research.
Research
In the Electrical Engineering Department, research of a varied and fundamental nature is in progress in the following fields:
1. Antennas and microwaves
2. Communication and control.
3. Computers
4. Electric and magnetic materials
5. Electric circuit theory
6. Music and speech analysis and synthesis
7. Network synthesis
8. Nonlinear control
9. Solid state electronics
10. System theory
11. Lasers

Graduate Course Descriptions
One term.

One term.

One term.


One term.
EE 606. **Network Synthesis II.** A continuation of EE 604 to include the approximation problem, time domain synthesis, active synthesis through negative impedance converters, etc.  
Prerequisite: EE 604.  
One term.

EE 607. **Statistical Theory of Communications.** Generalized harmonic analysis; correlation functions and spectral densities; statistical properties of message ensembles; optimum linear systems; filtering and prediction; correlation detection.  
Prerequisite: EE 83.  
One term.

EE 608. **Information Theory.** Advanced concepts of information theory; coding and filtering; properties of information measure; relationship with thermodynamic entropy; language studies; informational redundancy and adaptive system.  
Prerequisite: EE 607 and EE 613.  
One term.

EE 609. **Electromagnetic Engineering I.** 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, supergain, pattern synthesis.  
One term.

EE 610. **Electromagnetic Engineering II.** Boundary value problems; Green's functions, integral equations, variational techniques, Rayleigh-Ritz methods. Microwave circuits; cylindrical waveguide mode expansion, waveguide junctions, network and impedance concepts, scattering matrix, waveguide discontinuities. Introduction to the theory of partial coherence; mutual coherence function, quasi monochromatic analysis, coherent and incoherent limits.

EE 611. **Advanced Electronics Circuits I.** 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. Short-cut methods are introduced, based on these concepts.  
Prerequisite: EE 42 and EE 52.  
One term.

EE 612. **Advanced Electronics Circuits II.** A continuation of EE 611 to include clamping and clipping circuits, flip flops, twin T configurations, butterworth filters, break point analysis of complex diode circuits, etc.  
Prerequisite: EE 611.  
One term.
EE 613. Information Transmission. Sampling and quantization of data; information measure; communication entropies and mutual information; coding efficiency and redundancy; noise and error probabilities in transmission channels; block codes and error correction; channel capacity.
Prerequisite: EE 83.
One term.

Prerequisite: Phys. 431 or equivalent.
2 hours, two terms.


EE 617. Communication Systems Engineering. Consideration of the factor related to the design of communication systems; summary of the historical development of the art; system performance requirements; consideration of channel characteristics; modulation and reception techniques; comparisons of overall system configurations; criteria for optimum performance including reliability, costs, convenience, availability, and economic factors.
Prerequisite: EE 83.
Two hours per week, one term.

EE 619. Electroacoustics. Physical and physiological fundamentals of audio vibrations; properties and applications of electroacoustics transducers; analysis and measurement of sound; recording and reproduction of sound, synthesis of sound.
Prerequisite: EE 42, EE 52.
One term.

2 hours, one term.

EE 623. Quantum Electronics. Angular momentum and momentum matrices, time-independent and time-dependent perturbations, Einstein transition probabilities, interaction between matter and radiation, line breadth, Raman effect, Larmer theorem, Ziemann and Stark effects, Dirac's wave equation, electron paramagnetic resonance, ammonia beam maser, solid state maser, gaseous and solid state lasers, quantum tunneling through thin films and across junctions between similar or dissimilar materials.
Prerequisite: Phys. 431 or equivalent.
3 hours, one term.

One term, 3 hours.

EE 632. Nonlinear Control Theory II. Relaxation oscillations - discontinuous theory of relaxation oscillations (with applications to electrical and mechanical problems) theory of Vogel, asymptotic methods. Special topics - the maximum principle of Pontryagin, statistical design, sampled-data systems, optimum switched systems, adaptive control systems.
Prerequisite: EE 631.
One term, 3 hours.

EE 633. Nonlinear Systems with Random Inputs. Least mean square smoothing and prediction, optimum linear systems; direct and transform methods applied to nonlinear devices; characteristic functions, correlation functions, and power law representation; detection theory, matched filters and maximum likelihood detection.
Prerequisite: EE 607

EE 636. Adaptive Control Systems. Classification of adaptive systems, description in terms of functional expansion, the problem of process identification, connection between process models and linear and nonlinear filters.

EE 638. Process Control and Optimization. Electronic instrumentation for control and measurement in industrial processes, data processing and computer control, sampling and quantization, problems of automatic optimization.

EE 698. Special Problems in Electrical Engineering. Directed study of a special topic of interest to the individual student; may be an experimental or design project, or an engineering application related to a particular problem. Credit given as for a course upon completion of a satisfactory engineering report. Individual supervision. Not a reading course. One or two terms.

EE 699. Thesis. Research leading to the submission of a thesis as part of the requirements for an advanced degree.

Department of English

H. T. Cox, M.A. (Akron), Ph.D. (Pennsylvania) - - Professor
J. W. McCutchan, A.B. (Davidson), A.M., Ph.D. (Virginia) - - Professor
C. F. MacRae, B.A. (Western), M.A. (McMaster), Ph.D. (Toronto) - - - - Professor
W. K. Thomas, M.A., Ph.D. (Toronto) - - - - - Professor
L. A. Cummings, A.B. (Washington), M.A. (Missouri), Ph.D. (Washington) - - - - Associate Professor J
W. R. Martin, M.A. (Natal), D.Litt & Phil. (South Africa) Associate Professor
J. A. Carscallen, B.A. (Toronto), B.Litt. (Oxon.), Ph.D. (Toronto) - - - - Assistant Professor
A. I. Dust, M.A., Ph.D. (Illinois) - - - - Assistant Professor
Sister M. Leon, S.S.N.D., B.A. (Toronto), M.A. (Detroit) - - - - Assistant Professor J
(Mrs.) Ruth Levitsky, B.S.Ed. (Central Missouri S.C.), M.S.Ed. (Illinois Normal), Ph.D. (Missouri) - Assistant Professor (Part time) J
J. S. Stone, M.A. (British Columbia) - - Assistant Professor
R. R. Dubinski, B.A. (Western), M.A. (Toronto) - - Lecturer
John Firth, B.A. (Western, Toronto), M.A. (McMaster), Ph.D. (Ottawa) - - - - Lecturer (Part-time) J
D. Keppel-Jones, B.A. (Natal), M.A. (Queen's) - - Lecturer R
A. M. MacQuarrie, B.A. (Acadia), M.A. (Toronto) - - Lecturer
P. Morris, C.R., B.A. (Western), M.A. (St. Louis) - - Lecturer J
(Mrs.) May S. Scott, B.A., B.Ed. (British Columbia),
M.A. (Illinois) - - - - - Lecturer (Part-time) J
(Mrs.) Mary Thysell, M.A. (Montana) - - - - - Lecturer
Eugene M. Uram, C.R., B.A. (Western), M.A. (St. Louis) Lecturer (Part-time) J
(Mrs.) Catherine Davison, B.A. (Toronto) - - Part-time Assistant
W. R. Macnaughton, B.A. (Toronto), M.A. (Wisconsin) - Part-time Assistant

English Major and Note on Numbering

English Major in General Arts

In Year I the prospective English major should select English 101, Philosophy 100, Science 100, at least one of French 100, German 100, and Latin 100, and other subjects in accord with the general regulations.

For the session 1965-66 the following regulations obtain:

(1) The English major in Year II shall complete at least English 201 and 251.

(2) The English major in Year III shall complete (a) two English courses chosen from the whole range of courses offered (except 225 and 335) and (b) either English 345 (Senior Essay) or an Honours English course. He shall also write a comprehensive examination in the general field of English literature.

For the session 1966-67 the following regulations will obtain:

In Year II the English major shall complete at least English 201 and 251.

In Year III he shall complete (a) English 301, (b) another English course chosen from the whole range of courses offered (except 225 and 335), and (c) either English 345 (Senior Essay) or an Honours English course.

Note on numbering: English 101 and 300 are designed for both Honours and General students. Otherwise courses numbered 250-299, 350-399, and 450-499 are Honours courses, and all others are General courses.

D. Course Descriptions

15. English Literature. Designed for students in Applied Physics 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 on topics related to the literature studied. 3 lectures.
50J. Preliminary Year English. General literature and composition; the Ontario Grade 13 curriculum will be followed.
4 lectures.

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.
3 lectures.

130. The Types of English Literature. An examination of the humanistic content of English literature and the various forms in which it is expressed. (Primarily for Science students.)
3 lectures.

201. Masterpieces of English Literature, I. A study of the masterpieces of English literature from the Middle Ages to the latter part of the eighteenth century.
3 lectures.

210. The Novel. A study, through selected authors, of the principal techniques and movements in the development of the English novel from its beginning to the present day.
3 lectures.

215. The Development of Drama to 1660. A study of the origins and development of English drama, with special concentration on the contribution of the sixteenth and early seventeenth centuries.
3 lectures.

220. 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.
3 lectures.

225. Principles of Dramatic Production. An introduction to directing, acting, and staging, with practical experience in the University's Theatre of the Arts. 3 hours a week.

235. Selections from the Literature of Ideas. This course, which deals chiefly with the moral implications of scientific, political, social, and economic thought, is designed both to stimulate thought and to improve the student's ability to express himself in a clear, organized fashion. Students are required to write essays and seminar papers on the topics discussed. (Primarily for Science students, but open to General Arts students.)
3 lectures.

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 Italian and French critics. The other part provides a training in the application of critical principles to the works of literature.
3 hours a week.
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. 3 lectures.

270. Middle English, with Special Emphasis on Chaucer. A study of Middle English literature, partly in translation and partly in the original, with special emphasis on the works of Chaucer, which will be read in the original. 3 lectures.


300. American Literature. This course has as its objective the survey of the development of American literature from the beginning to the present time. Secondly, through exploration of the themes of such major figures as Poe, Emerson, Thoreau, Hawthorne, Melville, Whitman, Clemens, James, and Faulkner, an attempt will be made to demonstrate the tangential relationship of literature to the main currents of American thought: philosophical, religious, sociological, economic, and political. 3 lectures.

301. Masterpieces of English Literature, II. A study of the masterpieces of English literature from the end of the eighteenth century to the present day. (Effective September, 1966) 3 lectures.

310. Literature of Canada and the Commonwealth. A survey of Canadian and Australasian poetry and prose, with some consideration of the literatures, in English, from South Africa and the West Indies. 3 lectures.

330J. American and Canadian Literature. The literature and literary history of British colonial America, of the Revolution and early American republic, and of the nineteenth and twentieth centuries in the United States and Canada, with some attention to cultural history, studied by means of lectures, reports, tutorials, quodlibets, papers, and tests. 3 meetings per week.

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. 3 lectures.

340. Nineteenth-Century Literature. Designed to complement English 301, this course provides a more intensive study of Romantic and Victorian literature. 3 lectures.
345. **Supervision of Senior Essay.**
3 hours a week.

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.
2 lectures.

360. **Drama to 1642.** The rise of the drama and dramatic form; the work and influence of Shakespeare's predecessors; the life and works of Shakespeare; the post-Shakespearian drama to the closing of the theatres.
3 lectures.

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 Johnson.
3 lectures.

380. **The Romantic Movement.** A critical study, in seminars, of the principles and practice of the Pre-Romantic and Romantic authors (poets, novelists, and essayists) from Gray to Keats.
3 lectures.

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.
2 lectures.

451. **Literature of the Victorian Age.** 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), on the more important novelists (Dickens, Thackeray, Eliot, James), and on writers of general and critical prose works of lasting significance (Newman, Ruskin, Mill, Huxley).
4 lectures.

460. **Twentieth-Century Literature.** A critical study of the principal works of Shaw, Yeats, Eliot, James, Conrad, D. H. Lawrence, and others of the modern period.
3 lectures.

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.
2 lectures.

475. **English Linguistics.** The principles of good English usage as approached through a discussion of modern linguistic theories. The first third of the course deals with historical and comparative linguistics, with particular application to the history and development of English; the latter two-thirds stress structural
linguistics, with reference to English grammar. The class is limited to 20 students.
3 lectures.

480. Senior Seminar. Designed specifically for fourth-year students in programs combining Honours English with a fraternal discipline, this course provides a study of the major works in those periods of English literature in which students have not taken Honours courses. Individual syllabi are prescribed for each student, and the course is conducted on a seminar basis, with students presenting and criticizing reports.
3 hours a week.

495. Supervision of Senior Honours Essay.
3 hours a week.

Note: Upon securing the consent of the departmental chairman and the instructor concerned, Science and Engineering students may choose courses from those offered to Arts students.

Department of French

Frances K. Montgomery (Miss), B.A., M.A. (Western), D. de l’U. de Paris
Professor and Chairman of Department

M. I. Kieffer, C.R., B.A. (St. Louis), M.A. (McGill),
J.C.D. (Gregorian) - - - - - - Professor J

Dorothea Walter (Mrs.), B.A., M.A. (Queen’s) - - Professor

Associate Professor

J. R. Finn, C.R., B.A. (Western), M.A. (Toronto), Ph.D. (Illinois)
Associate Professor J

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

Z. T. Ralston, C.R., B.A. (Western), M.A. (Laval),
Ph.D. (Catholic U. of America) - - Associate Professor J

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

D. H. Gauthier, B.A. (Queen’s) - - - - Lecturer

C. E. Jose, B.A. (Western), M.A. (Toronto) - - - Lecturer

A General Arts student majoring in French will complete French 160, 200 and 300 (or 220 and 330, or 310J and 320J) and any two Honours courses chosen in consultation with the departmental chairman.

50J. Preliminary Year French. Authors and Composition. The Ontario Grade 13 curriculum will be followed.
4 lectures.
100. A Survey of French Literature from the Middle Ages to the Present Day. Oral practice in the language laboratory. Prerequisite: Grade 13 French. (This course is open to any qualified student not honouring or majoring in French). 3 lectures.

160. French Literature of the First Half of the 19th Century. Lectures and written reports. Intensive grammar review with the use of the language laboratory. Prerequisite: Grade 13 French. (This course is open only to students honouring or majoring in French). 4 lectures.


220. French Literature from the Pléiade to the Encyclopédistes. Prerequisite: French 100. 3 lectures.

250. Grammar and Prose Composition; Phonetics and Oral Practice. Prerequisite: French 100 or French 160. 2 hours of lectures and 1 hour of phonetics and oral practice.

260. French Literature and Culture of the Seventeenth Century. Lectures, reports, discussions in French. Prerequisite: French 160. 3 lectures.

300. Survey of the French Drama. A study of typical examples of French drama from the 17th century to the present. Prerequisite: French 100. 3 lectures.

310J. Survey of Twentieth Century French Literature. Prerequisite: French 100. 3 lectures.

320J. Survey of Nineteenth Century French Literature. Prerequisite: French 100. 3 lectures.


350. Grammar and Prose Composition. Prerequisite: French 250. 2 lectures.
360. French Literature of the Eighteenth Century. Lectures, readings, reports in French.  
Prerequisite: French 260.  
3 lectures.

370. French Literature from Balzac to 1900. Lectures, readings reports in French.  
Prerequisite: French 160.  
3 lectures.

450. Advanced Composition and Oral Practice. The language laboratory will be used.  
Prerequisite: French 350.  
2 lectures.

460. Sixteenth Century French Literature. Lectures and seminars in French.  
Prerequisite: French 360.  
2 lectures.

Prerequisite: French 360.  
2 lectures.

480. French Literature Since 1900. Lectures and seminars, in French.  
Prerequisite: French 370.  
2 lectures.

600. Literary Criticism in French (Problems and Methods)

601. History of the French Language

602. Medieval French Literature

603. Literature of the Renaissance in France

606. Classical Tragedy in Seventeenth Century France

607. Comedy at the time of Molière

608. The Theatre in Eighteenth Century France

609. Rousseau or Diderot

610. Romanticism in Nineteenth Century French Literature

611. Realism and Naturalism in the Nineteenth Century Novel

620. Twentieth Century French Literature

625. The Literature of French Canada

604. Reading Course in approved topics


Note: All courses above 599 with the exception of the Thesis are considered half-courses.
General Engineering

11. Engineering Synthesis. Principles of problem statement, analysis and concept creation. Discussion of the planning function, as applied to physical and economic feasibility, concept selection and project design. Discussions of the control function as related to project realization. Applications of the data flow cycle and linear programming to the above.
3 hours lectures (including discussion and problem sessions) one term, first year.

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.

13. Management Science I. A basic survey course on the concepts of the management process and the manner in which scientific method can be used to optimize the results achieved. Topics: the management process; resources; limits on the use of resources; planning, scheduling, and control procedures; the use of mathematics and machines; decisions and the feedback cycle; accuracy of data; time-cost and the method of job performance; the project concept; cyclical repetitive procedures; the corporate planning cycle; the nature of a management information system; the nature and role of Operations Research; an example of an O.R. technique; C.P.M. and project planning and scheduling; arrow diagrams; the Critical Path; project time and cost; the dynamic management cycle.
2 hours per week, one term.

2 hours, one term.

21. Engineering Graphics I. The course is designed to teach manipulation of drawing instruments and to develop manual drafting skills. Problems include orthographic, axonometric, oblique, isometric, and perspective methods of graphic presentation.
4 hours, one term.

22. Engineering Graphics II. This course supplements the course in Engineering Graphics I with further instruction in graphical methods. Graphical methods for solving problems involving vector quantities. The design, construction, and use of graphs and special charts, with various applications.
The use of specially graduated scales, and the design of slide rules and nomograms. Graphical and mechanical methods of integration.

Prerequisite: GE 21.

4 hours, one term.


32. Fluid Mechanics. Physical properties of fluids and fundamental concepts of fluid flow. Dimensional analysis and similarity, 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.


52. Physical Properties of Materials. Lattice vibrations, phonon and electronic specific heats, thermal conduction, phases, elasticity, plasticity, mechanical properties, electric conduction in metals, semiconductors and superconductors. 2 hours lectures, 3 hours laboratory.

53. Structure and Properties of Matter I. 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. 1½ hours laboratory, 1 term.

54. Structure and Properties of Matter II. 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 hours lectures, 1½ hours laboratory, 1 term.

3 lectures, one term.

Department of Geography

Professor and Chairman of Department

Professor

Associate Professor

Associate Professor

Assistant Professor

R. M. Irving. B.A. (Toronto). M.A. (Toronto)  
Assistant Professor

Assistant Professor

N. Pearson. B.A. (Dunelm)  
Assistant Professor

155. Survey 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, sources 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; and urban growth and land use planning.
3 lectures, half course.

100. Introductory Physical and Cultural Geography. This course is designed to introduce the student to the field of modern geography, its methods, concepts, materials and point of view. A major part of the course is devoted
to a systematic examination of the elements of the natural environment, (including landforms, weather, and climate), and their distribution and significance in the human habitat. Selected aspects of economic and political geography are then considered. Note: Geography 100, or its equivalent, is normally a prerequisite for other courses in geography.

2 lectures, 2 hours laboratory.


2 lectures, 2 hours laboratory. (Half course, given in spring 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 interrelationships. Amongst the many factors which are discussed are the utilization of natural resources, the effects of increasing population density, the occupancy and utilization of urban and rural land, and the effects of man's tools, techniques, and institutions on the earth's surface.

3 lectures.

260*. Cartography. Cartographic principles, techniques, and basic mapping procedures; scales, map projections and design analysis or cartographic presentation, drafting.

3 hours seminar and laboratory. (Half course, given in fall term).

275. Air Photo Interpretation and Field Methods. Air photo interpretation; field analysis of landforms, soils, natural vegetation; urban and agricultural land-use mapping.

4 hours field work, laboratory and seminars.

300. Geomorphology. Advanced study of the processes of geomorphology. Analysis of the development and distribution of landforms, with emphasis on pleistocene deposits. The relationships between landforms and natural vegetation, climate, soils, water resources, and man's economic activities.

2 lectures, 2 hours laboratory.

310. Geography of World Resources and Industries. A geographical analysis of man's economic activity; the nature and occurrence of resources, problems of resource development and conservation; world distribution of primary production, and structure of world trade; major industrial regions and locational factors affecting representative industries.

2 lectures, 2 hours seminar.


3 lectures.
Department of Geography

345. Political Geography. A study of differences from place to place in political phenomena. Subjects covered include, the interrelationships of states and nations, centripetal and centrifugal "forces" within states, electoral geography, boundary and frontier problems, the location of capital cities, internal organization of states, external relations, and geopolitics.
3 lectures.

350. Urban Geography and Settlement Patterns. A description and analysis of the geographic characteristics and relationships of urban centres, their origin, development, distribution, functions, internal structure, economic and political organization; industrial and commercial locational factors; the effects of transportation on settlement patterns.
2 lectures, 2 hours seminar.

355. Resource Development and Conservation. Regional approach to resource development, land-use planning, and conservation; resource inventory methods; some principles of biogeography and their application to resource management problems.
2 lectures, 2 hours seminar.

356. Urban and Regional Planning - Landscape Design and Analysis. Principles and fundamentals of design as they relate to urban and regional planning problems. Civic and landscape design; construction and layout of planning models; sketching, perspective, and projections.
3 lectures.

375. Senior Research Seminar.
2 hours seminar.

420. Regional Geography of Canada. The physical environment, resource base, settlement patterns, cultural characteristics, economic development and regional structure of the nation.
3 lectures.

421-429. Geographic Analysis of Selected World Regions. Detailed study of physical, cultural, economic and political geography; geographic basis of current problems.
3 lectures.
(N.B. One region only will be offered each year.)

421. Europe and the Mediterranean. (offered in 1965-66)
422. Eastern Europe and the Soviet Union.
423. Middle East.
424. Asia.
425. Oceania.
426. Africa.
427. Latin America.
428. United States of America.
429. Polar Lands.
450. Agricultural and Soils Geography. Classification, analysis and distribution of major soil groups, catenas, series and types. Soil capability ratings and relationships to crop and livestock distribution. Soil management problems. Physical and economic factors of agricultural production. 3 lectures.

456. Urban and Regional Planning - Political and Administrative Processes. Historical development of planning legislation in various parts of the world. Provincial and federal legislation affecting urban, regional and resource planning in Canada. Jurisdiction of provincial government bodies and agencies, municipal planning boards and councils; economic and political problems associated with the implementation of planning policies and decisions. 3 lectures.

470. Area Studies Seminar. 1 - 2 hours seminar.

475. Special Readings and Seminar on Selected Topics. 1 - 3 hours seminar.

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. 2 hours seminar.

490. Senior Honours Essay or Research Project Related to Teaching. 2 - 3 hours seminar.

600. Physical Geography.

610. Economic Geography.

620. Regional Geography.

645. Political Geography.

650. Urban Geography.


656. Urban and Regional Planning.

657. Agricultural Land-Use Problems.


Department of German and Russian

J. W. Dyck, A.B. (Bethel), M.A. (Missouri), Ph.D. (Michigan)  
Professor and Chairman of the Department

J. Winkelman, M.A. (New York), Ph.D. (Michigan) - Professor (German)

E. Heier, M.A. (British Columbia), Ph.D. (Michigan)  
Associate Professor (Germ./Russ.)
Department of German and Russian

I. Levitsky, A.B. (Rochester), M.A. (Buffalo) Ph.D. (Duke)  
   Associate Professor (Germ./Russ.)
S. P. Hoefert, B.A., M.A., Ph.D. (Toronto)  -  Assistant Professor (German)
W. Shelest. Diploma (Munich), M.A. (Ottawa)  -  -  Lecturer (Russian)
M. Richter, Staatsexamen (Berlin and Bonn), M.A. (Toronto)  
   Lecturer (Germ./Russian)

German

Notes: (1) All courses are designed to acquaint the student with the thoughts, feelings, and ideas that have been expressed in German, Austrian, and Swiss literature. Particular consideration has been given to critical analysis of literary texts and their contribution to European thought and to the whole of civilization. The programmes for German major and Honours students are intended to give a coherent and complete picture of German literature.

(2) All courses above 100 are honours courses. Those marked with a † are particularly recommended for general students.

(3) German 270 meets the requirement otherwise referred to in the calendar as cultural or civilization course.

Undergraduate Course Descriptions

1. Beginner's German. For Engineering students with no previous knowledge of German. The elements of German grammar, reading and translation.  
   3 lectures.

10. Scientific German. For Graduate Students with no previous knowledge of German. Usage and structure of German scientific writings. Translation in fields of specialization.  
   3 lectures.

1-50. Beginner's German. For Arts and Science students with no previous knowledge of German. The elements of German grammar, reading, oral practice, composition.  
   Arts - 5 lectures. Science - 3 lectures.

15. Scientific German. A review of the fundamentals of grammar followed by a more advanced study of grammatical 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. (For Engineering students. Can be taken together with German 50 for Science students.)  
   Prerequisite: German I or equivalent.  
   3 lectures.
50. Scientific German. A review of the fundamentals of grammar is followed by a more advanced study of grammatical 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. (For Science students. Can be taken jointly with German 15 for Engineering students.)
Prerequisite: German I or equivalent.
3 lectures.

100. Introduction to German Literary Movements. Reading and interpretation of representative works of major German authors from the beginning to the present. Oral practice, composition, grammar. This course is conducted primarily in German.
Prerequisite: Grade 13 German or equivalent. First Class Honours in Grade 12 or permission of the Department Chairman.
3 lectures.

250. 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.
Prerequisite: German 100, First Class Honours in Grade 13 or permission of the Department Chairman.
3 lectures.

Prerequisite: German 100.
3 lectures.

270. German Cultural Periods. A study of the major thought movements and masterpieces of philosophy, literature, music, art, etc. This course is taught in English.
3 lectures.

Prerequisite: German 250 or equivalent.
1 lecture.

360. German Realism. Reading, interpretation, and critical analysis of prescribed prose, drama and poetry. (Fontane, Hebbel, Keller, Storm, etc.)
Prerequisite: German 100 or equivalent.
3 lectures.

370. Introduction to the History of the German Language with Readings in Middle-High German Literature. (Walther von der Vogelweide, Hartmann, Wolfram, Gottfried, etc.
Prerequisite: German 100 or equivalent.
3 lectures.
380. Enlightenment. Reading, interpretation and critical analysis of prescribed prose, drama, and poetry. (Bodmer, Gellert, Gottsched, Lessing, Wieland, etc.) Prerequisite: German 100 or equivalent. 3 lectures.

450. Advanced Conversation, Grammar and Composition. This course is conducted in German and provides intensive practice in spoken German on the advanced level. Prerequisite: German 350 or equivalent. 1 lecture.

460. Modern German Literature. Reading and interpretation of prescribed works. (Hauptmann, Hofmannsthal, Rilke, Kafka, Mann, Brecht, etc.) Prerequisite: German 100 or equivalent. 3 lectures.

470. German Poetry. A study of the main thoughts, themes, forms and schools in German poetry throughout the ages. Texts: The Oxford Book of German Verse, Echtermeyer-von Wiese. Prerequisite: German 100 or equivalent. 3 lectures.

480. Renaissance-Baroque. Reading, interpretation and critical analysis of prescribed prose, drama, and poetry. (Tepl, Luther, Sachs, Grimmelshausen, Gryphius, etc.) Prerequisite: German 100 or equivalent. 3 lectures.

495. Reading Course in Approved Topics.

Graduate Courses

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 1887.
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.
695*. Reading Course in Approved Topics.
All the courses with the exception of the Thesis are one term courses.

Russian

Notes: (1) All courses above 100 are Honours courses. Those marked with a † are particularly recommended for general students.
(2) Russian 270 meets the requirement otherwise referred to in the calendar as cultural or civilization course.

1. Beginner's Russian. For Engineering students with no previous knowledge of Russian. The elements of Russian grammar, reading and translation.
3 lectures.

Russian 10. Scientific Russian. For Graduate students with no previous knowledge of Russian. Usage and structure of Russian scientific writings. Translation in fields of specialization.
3 lectures.

1-50. Beginner's Russian. For Arts and Science students with no previous knowledge in Russian. The elements of Russian grammar, reading, oral practice, composition.

15. Scientific Russian. A review of the fundamentals of grammar is followed by a more advanced study of grammatical structure and idiom. Readings and translation from contemporary scientific writings 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. (For Engineering students—can be taken together with Russian 50 for Science students).
Prerequisite: Russian 1 or equivalent.
3 lectures.
25. **Russian Thought and Culture** (taught in English). This course is divided into two parts. Part I deals with the chronological development of art, literature, social, political and religious aspects during the time of Imperial Russia. Emphasis will be placed on the Byzantine influence and Mongol domination which caused the eventual isolation of Russia from Western culture. Special lectures are devoted to the "Westernization" of Russia under Peter the Great and Catherine II, the coming of the Slavophiles and the Russian Intelligentsia, a thorough discussion of social and political conditions, literary and philosophical contributions of the 19th century which ultimately led to the overthrow of the Czarist regime. Part II is entirely devoted to the Soviet Union - cultural, political, nationality problems, the establishment of new social institutions, education, Soviet philosophic thought and scientific achievements are discussed in detail.

3 lectures.

50. **Scientific Russian.** This course aims to make it possible for students of the Physical Sciences to read scientific writing. Emphasis will be placed on translation and reading skill. The fundamental principles of Russian grammar will be reviewed. (For Science students - can be taken jointly with Russian 15 for Engineering students.)

3 lectures.

100. **Introduction to Russian Literary Movements.** Reading and interpretation of representative works of major Russian authors from Pushkin to the present. Oral practice, composition, grammar.

Prerequisite: Grade 13, Russian 1-50 or equivalent.

3 lectures.

250.+ **Introductory Russian Conversation, Composition and Phonetics.** Review of grammar, presentation of oral and written reports.

Prerequisite: Russian 100, first class honours in Grade 13 or equivalent.

3 lectures.

260. **A Survey of Russian Literature.** Reading in Russian of selected texts of 18th, 19th, and 20th century authors: Radishchev, Karamzin, Gogol'ev, Nekrasov, Turgenev, Tolstoy, Pasternak, etc.

270.+ **Russian Thought and Culture.** A study of the major thought movements and masterpieces of philosophy, literature, history, music, art, etc. The second half of the course will place emphasis on developments during the last forty years. This course is taught in English.

3 lectures.

350.+ **Intermediate Conversation and Composition.** Written reports on prescribed themes and topics. Oral drill.

Prerequisite: Russian 250 or equivalent.

2 lectures.

360.+ **Russian Realism.** (Gogol', Turgenev, Tolstoy, Dostoyevsky, Chekhov, etc.) Reading, interpretation and critical analysis of prescribed prose, drama and poetry.

Prerequisite: Russian 100.

3 lectures.
370. *The Golden Age of Russian Literature.* (Krylov, Zhukovsky, Pushkin, Lermontov, etc.) Reading, interpretation and critical analysis of prescribed prose, drama, and poetry.
Prerequisite: Russian 100.

380. *The Peoples of the Soviet Union.* Especially emphasized will be the influence of the non-Slav peoples (the Uralic, Mongol, Caucasian, etc.) on Russian race and culture. 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.
3 lectures.

390. *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.
3 lectures.

450. *Advanced Conversation, Composition, Grammar and Phonetics.* This course is conducted in Russian and provides intensive practice in spoken Russian on the advanced level.
Prerequisite: Russian 350 or equivalent.
2 lectures.
Department of German and Russian

460. Soviet Literature. (Gorki, Mayakovksy, Babel, Fedin, Pasternak, Sholokhov, etc.) Reading, interpretation and critical analysis of prescribed prose and drama. Prerequisite: Russian 100. 3 lectures.

470. Russian Literature in Translation. Major works by Pushkin, Gogol, Turgenev, Tolstoy, Dostoyevsky, Chekhov, and Gorki. Prerequisite: At least one course in any other literature. 3 lectures.

480. Russian Poetry Throughout the Ages. A study of themes, forms and schools. (Pushkin, Lermontov, Essenin, Mayakovksy, Pasternak, etc.) Prerequisite: Russian 100. 2 lectures.

Graduate Courses

600*. Russian Literary Criticism. (Problems and Methods)

601*. Pushkin or Lermontov.

620. Church Slavonic.

621. History of the Russian Language.

630*. Tolstoy.

631*. Dostoevski.

640*. The Russian Drama.

641*. Reading Course in approved topics.

650*. Contemporary Soviet Literature.

651*. Early Russian Literature (the Epics, the Byliny, the Chronicles.)


Note: All 600 courses are one term courses with the exception of 620, 621, and 699.

Ukrainian

Ukrainian 200. Introduction to Ukrainian Literature. Review of Ukrainian grammar; the place of Ukrainian in the Slavic family of languages; reading and interpretation of representative selections chosen from the works of Skovoroda, Kotliarevsky, Shevchenko, Franko, L. Ukrainka, Stefanyk, Kobylians'ka, Tychyna, Ryl's'ky, and other contemporary writers. 3 lectures. Admission by consent of the instructor.
Department of History

P. G. Cornell, E.D., M.A., Ph.D. (Toronto)  
Professor and Chairman of the Department

K. A. MacKirdy, M.A. (British Columbia), Ph.D. (Toronto)  
Professor

A. W. Rees, M.A. (Wales)  
Professor R

H. MacKinnon, B.A. (Montreal), Ph.L. S.T.L. (Gregorian), M.A. (Toronto), D.Phil. (Oxon)  
Professor

Ph.D. (Washington)  
Associate Professor

E. P. Patterson, B.A. (Baylor), M.A. (Kansas), Ph.D. (Washington)  
Assistant Professor

Y. F. Zoltvany, B.A. (Loyola), M.A. (Montreal), Ph.D. (Alberta)  
Assistant Professor

Assistant Professor

D. A. Davies, B.A., Ph.D. (Washington)  
Lecturer

P. E. Dembski, M.A. (Toronto)  
Lecturer J

1. **General Course.** Students majoring in History will normally choose their courses from History 100, 201/202, 211/212, 221/222, 231/232, 301/302, 303/304, 311/312. They will fulfill the requirement History 349.

Students in the General Course in any field with a standing of at least B average in their previous year may, with the permission of the department, be admitted to any History course.

2. **Honours Course.** The Honours History programme recommended on page 34 is the standard prescription. The programme for each student must be worked out in consultation with the department.

A student in Honours in any discipline other than History can be admitted to any History course with the permission of the department.

3. **Master of Arts.** In History there are two programmes leading to the degree of Master of Arts.

In proceeding to the degree by courses alone the candidate will offer: (a) History 600, and (b) three other graduate courses selected in consultation with the staff. Subject to departmental approval, one of the courses may be selected from graduate courses in another department. The candidate will also be required to have a reading knowledge of an appropriate second language.

In proceeding to the degree by courses and a thesis the candidate will offer:

(a) History 600, (b) a minor field (a second graduate course) 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.

4. Not all the courses listed below are offered each year.
Undergraduate Course Descriptions

100. An Historical Introduction to the Ideas of Western Civilization. Designed especially for freshmen.
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. One significant theme or limited historical period will be dealt with in some depth.
3 hours, lectures and seminars.

201.* Expansion of Europe since 1400 - The American Phase.
3 hours, half course.

202.* Expansion of Europe since 1400 - The Afro-Asian Phase. Surveys the course of Portuguese, Spanish, Dutch and French colonial expansion as compared to the historical development of British overseas institutions (1400 to the 20th century).
3 hours, half course.

211.* British History, 800 A.D. to 1714.
3 hours, half course.

212.* British History, 1715 to the present.
3 hours, half course.

221.* Modern European History: Central Europe from the Peace of Westphalia to the Revolutions of 1848. Political, social and economic problems will be stressed.
3 hours, half course.

222.* Modern European History: Eastern Europe with an emphasis on Russian history from the seventeenth century. Political, social and economic problems will be stressed.
3 hours, half course.

231.* European History 1815-1867.
3 hours, half course.

232*. European History 1867 to the present. Select problems in the political, industrial and cultural development of Western Europe.
3 hours, half course.

250. History of Medieval Europe.
3 hours, lectures and seminars.

3 lectures.

3 hours, lectures and seminars.
270. Asian History.
3 hours, lectures and seminars.

274.* Modern Russian History. The course will focus on important aspects in the development of the Russian state and society from the founding of the Romanov dynasty. Particular attention will be given to: (a) the growth of Tsarist autocracy, (b) the expansion of the Russian empire, (c) the evolution of serfdom, (d) the rise of the intelligentsia, (e) The Russian Revolution. 3 hours, half course.

276.* Modern German History. The course will cover in some depth selected topics during the period 1600 to 1850. (a) The Thirty Year's War; its causes and consequences. (b) The rise of Brandenburg-Prussia. (c) Two great rivals: Maria Theresia and Frederick II. (d) The Habsburg realm and Prussia in the early 19th century (domestic changes). (e) The Habsburg realm, Prussia and the German Confederation 1848 to 1850. 3 hours, half course.

277. History of France.
3 hours, lectures and seminars.

280. History of French Canada.
3 hours, lectures and seminars.

3 hours, lectures and seminars.

3 hours.

295.* History of the United States to 1865.
3 hours, half course.

296.* History of the United States since 1865. The growth of a new nation; the territorial and economic expansion of the United States from the Revolution to the Second World War; inter-relationship of economic, social, political, and intellectual developments.
3 hours, half course.

301.* Canadian History to 1840.
3 hours, half course.

302.* Canadian History since 1840.
3 hours, half course.

303.* American History to 1865.
3 hours, half course.

304.* American History since 1865.
3 hours, half course.

3 hours, half course.
3 hours, half course.

349. Senior Essay. Required of all History majors in the third year of the general course.
1 hour.

3 hours, lectures and seminars.

361. Modern British History to 1660.
3 hours, lectures and seminars.

362. Modern British History since 1660.
3 hours, lectures and seminars.

3 hours, lectures and seminars.

380. Canadian History.
3 hours, lectures and seminars.

450. History of the United States. Selected periods in the history of the United States of America (History 295, normally a prerequisite).
2 hours.

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. Historiography and the History of Historical Writing.
3 hours, lectures and seminars.

470. Senior Tutorial in English History.
2 hours.

471. Senior Tutorial in Canadian History.
2 hours.

472. Senior Tutorial in Medieval History.
2 hours.

473. Senior Tutorial in Imperial and Colonial History.
2 hours.

474. Senior Tutorial in German History.
2 hours.

475. Senior Tutorial in Asian History.
2 hours.
476. Senior Tutorial in History of Renaissance and Reformation. 
2 hours.

477. Senior Tutorial in the History of Native Response to Colonial Rule. 
2 hours.

478. Senior Tutorial in Russian History. 
2 hours.

499. Senior Honours Essay. (Required of all History honours students in their fourth year.)

Graduate Courses

600. Historiography and the History of Historical Writing.

610. Canadian History: The Conservative Tradition.

611. Canadian History: The French-Canadian Tradition.

615. Colonial and Imperial History.

620. Modern English History.

621. German History.

622. Medieval History.


Italian — see page 243.

Department of Mathematics

R. G. Stanton, B.A. (Western), M.A., Ph.D. (Toronto) 
Professor and Chairman of the Department, 
Dean of the Faculty of Graduate Studies

K. D. Fryer, B.A. (Western), M.A., Ph.D. (Toronto) 
Professor and Associate Chairman of the Department

G. Berman, M.A., Ph.D. (Toronto) - - - - Professor 

H. Rund, B.Sc., Ph.D. (Cape Town), Dr. Habil. (Freiburg) 
Visiting Professor

W. T. Tutte, M.Sc., M.A., Ph.D. (Cambridge) - - Professor

G. E. Cross, M.A. (Dalhousie), Ph.D. (British Columbia) - Associate Professor

H. F. Davis, S.M., Ph.D. (Massachusetts Institute of Technology) 
Associate Professor

M. A. McKiernan, M.A. (Loyola), Ph.D. (Illinois Institute of Technology) 
Associate Professor

C. St. J. A. Nash-Williams, M.A., Ph.D. (Cambridge) 
Visiting Associate Professor
Department of Mathematics

C. L. Siegfried, C.R., B.A. (Western), M.Sc. (Michigan)  
Associate Professor

R. A. Staal, M.A., Ph.D. (Toronto)  
Associate Professor

D. G. Wertheim, B.A. (McMaster), M.A., Ph.D. (Toronto)  
Associate Professor

C. F. A. Beaumont, B.A. (McMaster), M.A. (Toronto)  
Assistant Professor

A. Kerr-Lawson, B.A. (Toronto), S.M. (Chicago), Ph.D. (McMaster)  
(on leave of absence, 1964-65)  
Assistant Professor

R. C. Mullin, B.A. (Western), M.A., Ph.D. (Waterloo)  
Assistant Professor

P. J. Ponzo, B.A.Sc., M.A. (Toronto), Ph.D. (Illinois)  
Assistant Professor

K. A. Rowe, B.A. (Toronto), M.S. (Wisconsin), Ph.D. (Illinois)  
Assistant Professor

E. R. Bishop, B.Sc. (Acadia), M.Sc. (Queen's)  
Lecturer

T. M. K. Davison, B.Sc. (Sir George Williams), M.A. (Toronto)  
Lecturer

R. A. Honsberger, B.A. (Toronto)  
Lecturer

W. P. Kotorynski, B.Sc. (Western), M.A. (Toronto)  
Lecturer

R. B. Reed, B.A.Sc. (Toronto), M.Sc. (Waterloo)  
Lecturer

R. P. Rigelhof, B.E. (Saskatchewan), M.Sc. (Waterloo)  
Lecturer

G. N. Robertson, M.Sc. (Manitoba)  
Lecturer (part-time)

Lecturer

K. Salkauskas, B.A.Sc. (Toronto), M.Sc. (Waterloo)  
Lecturer

Computer Science Division

J. W. Graham, M.A. (Toronto)  
Associate Professor and Director of Computing Centre

J. D. Lawson, B.A.Sc. (Toronto), M.Sc. (Waterloo)  
(on leave of absence, 1964-65)  
Assistant Professor

D. D. Cowan, B.A.Sc. (Toronto), M.Sc. (Waterloo)  
Lecturer

P. W. Shantz, B.Sc., M.A. (Waterloo)  
Lecturer

Statistics Division

G. Menges, Dr.rer.pol. (Frankfurt)  
Visiting Professor

D. A. Sprott, M.A., Ph.D. (Toronto)  
Professor

M. Behara, M.Sc. (Utkal), Dr.rer.oec. (Saarland)  
Assistant Professor

G. W. Bennett, B.Sc., Ph.D. (Adelaide)  
Assistant Professor

J. G. Kalbfleisch, B.Sc. (Toronto), M.Sc. (Waterloo)  
Lecturer

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Undergraduate Course Descriptions

12. Calculus I. Functions and limits, the derivative. Differentiation formulae. Applications to tangents, rates, extrema. The indefinite and definite integrals, fundamental theorem of integral calculus. Applications to area, volume, centroids, moments of inertia, fluid pressure, work, potential. Introduction to the trigonometric, inverse trigonometric, exponential, logarithmic functions. Transcendental functions. Parametric and polar equations. Formal integration and applications to physical problems. Students will work selected problems under supervision. A certain proportion of the problems will include mathematical formulation of physical problems.
3 lectures, 2 hours problems.

2 lectures, 1 hour problems.

Prerequisite: Math 12.
3 lectures, one term.

2 hours problems, one term.

2 hours problems, one term.

Prerequisite: Math 22.
3 lectures, one term.

Prerequisite: Math 23.
2 lectures, 4 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.

Prerequisites: Math 22, 31.
3 lectures, one term.

3 lectures, one term.

Prerequisites: Math 22, 31, and consent of instructor.
2 lectures, 1 hour problems, one term.

44. Complex Variable. Cauchy-Riemann equations, the Cauchy integral theorems, conformal mapping, the Taylor and Laurent series, contour integration.
Prerequisite: Math 33, 34.
2 lectures, 1 hour problems, one term.

45. Applied Analysis II. A continuation of some topics listed in Math. 41, complex variables, calculus of variations.
2 lectures, one term.

Prerequisite: Math 22.
2 lecturers, 3 hours problems, one term.

3 lectures, one term.

Prerequisites: Math 22, 31, and consent of instructor.
2 lectures, 1 hour problems, one term.

55. **Digital Computer Programming.** Fundamentals of digital computers, including memory types, arithmetic components, input-output and control units. Binary numbers, floating-point arithmetic, flow charting, machine-language coding. Automatic coding, including assemblers, compilers, and translators. Interpretive routines. Prerequisite: Math 32. 3 lectures, one term.


100. **Fundamental Concepts of Mathematics.** A terminal course designed for Arts students who wish to learn something of the fundamental ideas of mathematics but who will not be encountering technical problems of application. The course will include discussion of the fundamental concepts involved in a selection of topics chosen from mathematical areas such as Calculus, Statistics, Probability, Projective Geometry, Non-Euclidean Geometry, Set Theory, Group Theory, Field Theory, Boolean Algebra, Mathematical Logic, Vector Spaces, Matrices, Numerical Analysis. 3 lectures.

130. **Calculus.** Functions and limits. The derivative. Differentiation of algebraic functions. Applications to tangents, rates, minima and maxima. Integration as the limit of a sum. Fundamental theorem of integral calculus with applications to areas, volumes, and moments. Power series. Partial differentiation. 3 lectures.


140. Calculus. The topics of Mathematics 130, presented with a view to the special needs of Social Science students. Emphasis will be on basic concepts rather than on the more difficult manipulative techniques. 3 lectures.

230. Algebra I. Introduction to the theory of sets and groups. Introduction to rings and fields. Vector spaces and matrices. 3 lectures.


236. Elementary Differential Equations. An introduction to first order differential equations. Applications to growth, decay, reactions. Linear equations
2 lectures.

243. Statistics for the Social Sciences. The topics of Mathematics 233 presented with a view to the special needs of Social Science students. Emphasis will be on basic concepts rather than on the more difficult manipulative techniques.
Prerequisite: Mathematics 140 or equivalent.
3 lectures.

253. Concepts of Statistics. The topics of Mathematics 243 treated without the use of Calculus. In addition to the basic statistical methods, emphasis will be placed on the nature of evidence and inference.
3 lectures.

3 lectures.

331. Abstract Algebra II. Vectors and vector spaces; transformations and matrices; quadratic and Hermitian forms. Algebraic structures; rings and ideals. Matrices with entries from a ring. Canonical forms and eigenvalues; the orthogonal group.
2 lectures.

3 lectures.

2 lectures.

2 lectures, 2 hours laboratory.

335. Finite Differences. A theoretical course in the calculus of finite differences to include summation, the differences of zero, numerical integration, the relation between integration and summation. An introduction to difference equations.
2 lectures.
Department of Mathematics

336. Life Contingencies. An advanced course on problems of single lives and on the death and survival of multiple lives. 3 lectures.


425. Introduction to the Theory of Numbers. 2 lectures.


427. Graph Theory. Introduction to basic concepts and theorems, connectivity, planarity, arboricity, directed graphs, partial orderings, girth and regularity, the four-colour problem.


431. Algebra III. A continuation of course 331. 2 lectures.


433. Metric Spaces and Integration. Theory of metric spaces, completeness and compactness, 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 the 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. **Graduation and Mortality.** Methods of constructing and graduating mortality tables. 2 lectures.

438. **Estimation and Hypothesis Testing.** The mathematics and logic of estimation and hypothesis testing. Information. Consistency. Efficiency. Sufficiency. Fiducial and confidence intervals. The problems of large and small samples. 2 lectures.


440. **Advanced Probability.** Recurrent events. Markov processes and applications to Physics and Biology, including diffusion processes and epidemics. 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.

443. **Electromagnetism II.** Applications of the Maxwell equations. Reflection and refraction. Introduction to wave guides and antennae. 2 lectures.


446. **History of Mathematics.** The development of Mathematics from ancient to modern times, including study of prominent mathematicians and their works. Problems will be worked using both modern and historical approaches. 2 lectures.
2 lectures.

2 lectures.

2 lectures.

2 lectures.

Graduate and Research Programmes


Extensive computer facilities are available in the Computer Centre and include an IBM 1401, an IBM 1620, an IBM 1710 system, and an IBM 7040. Each year, one or more Visiting Professors spend a term with the Department. Recent Visitors include: G. Temple (Oxford), W. B. Pennington (Aberystwyth), H. Rund (South Africa), G. Menges (Saarbrucken), C. St. J. Nash-Williams (Aberdeen).

Extensive opportunities for fellowship assistance are available through National Research Council Fellowships and Province of Ontario Graduate Fellowships. In addition, the Department of Mathematics offers a number of Teaching Fellowships which may be held singly, or in conjunction with other Fellowships. For details, correspondence should be addressed to the Department Chairman.

Candidates for the degrees of M.A., M.Sc., M.Phil. and Ph.D. are accepted under the general regulations set forth in the section of the calendar pertaining to the Faculty of Graduate Studies. Candidates for the M.A. or M.Sc. degrees in Mathematics are normally advised to take the degree by course work rather than by thesis.

Graduate Course Descriptions

601. A series of courses in Numerical Analysis.
(a) Introduction to Numerical Analysis
   1 term.

(b) Solution of Ordinary Differential Equations
   1 term.

(c) Constructive Theory of Functions (Approximation Theory)
   1 term.

(d) Numerical Methods in Linear Algebra
   1 term.

(e) Solution of Partial Differential Equations
   1 term.

(f) Problems in Numerical Integration
   1 term.


611. A series of courses in Probability.
(a) Introduction to Random Variables. Probability, random variables, distribution functions, expectation, discrete transform methods.
   1 term.
(b) Theory of Probability. Measures on a sample space, types of convergence, limit theorems, laws of large numbers.
   1 term.
(c) Stochastic Processes I. Discrete space — discrete time processes. Discrete space — continuous time processes. Applications in Physics, Biology, Queuing Theory, etc.
   1 term.
(d) Stochastic Processes II. Mathematical foundations of stochastic processes, continuous space processes. Time-series analysis.
(e) Special Topics in Probability.
   1 term.

614. A series of courses in the applications of Analysis.
(a) Integral Equations
   1 term.
Department of Mathematics

(b) Integral Transforms
   1 term.

(c) Complex Variable Techniques
   1 term.

(d) Fourier Series and Orthogonal Functions
   1 term.

(e) Group Theory in Physical Problems
   1 term.

615. Group Characteristics and Representation Theory.


624. Advanced Statistics.

625. Galois Theory.


632. Topics in Variational Theory.

634. Topics in Ordinary Differential Equations.

635. Algebraic Numbers.

639. Functional Equations.


(a) Special Methods. Algebra of probability distributions; Monte Carlo methods; application to queuing theory, replacement theory, and inventory control.
   1 term.

(b) Model Analysis. Partially ordered models, stochastic models, general model logic; examples from business, industry, and the military including the Leontief model from Economics; construction of models, optimization, computational methods.
   1 term.
A selection of topics from game theory, gaming, and decision theory.
1 term.

642. Optimization Techniques.
(a) Analytic Methods. Review of classical methods; optimization of discrete functions, inequalities, introduction to linear programming, steepest descent and optimal control.
1 term.
(b) Search Techniques. Selected topics including Fibonacci search, steepest ascent, partan, pattern search, Robbins-Monro procedure.
1 term.
(c) Linear Programming. Simplex method; flows in networks; application to transportation problems; assignment problems, and project cost curves.
1 term.
(d) Programming. A selection of topics from non-linear programming including the simplex method for quadratic programming, Lagrangian differential, gradient and gradient projection; introduction to integer programming and dynamic programming.
1 term.

644. Mathematical Genetics.

645. Rings and Ideals.

649. Functional Analysis.

(a) Partial Differential Equations
1 term.
(b) Hyperbolic Partial Differential Equations
1 term.
(c) Elliptic Partial Differential Equations
1 term.
(d) Parabolic Partial Differential Equations
1 term.

655. Combinatorial Analysis.

659. Linear Operators.

663. Mathematical Logic.


665. Topics in Number Theory.

669. Harmonic Analysis.
672. Statistical Information Theory.
673. Transfinite Arithmetic.
674. Statistical Decision Theory.
675. Linear Graphs. Definitions and basic theorems. Planar graphs and Kuratowski's theorem. Selected topics from advanced graph theory.
676. Analytic Graph Theory.
679. Abstract Measure Theory.
684. Topics in Decision Theory.
685. Topics in Graph Theory.
688. Special Topics in Algebra.
694. Foundations of Statistics
695. Lie Groups.
698. Special Topics in Analysis.

Department of Mechanical Engineering

G. T. Csanady, Dipl. Ing. (Munich), Ph.D. (New South Wales)  
Professor and Chairman of Department

S. Alpay, Dipl. Ing., Dr. Ing. (Berlin)  -  -  -  Professor
W. B. Heginbotham, B.Sc., Ph.D. (Manchester)  -  -  Visiting Professor
H. L. Evans, M.Sc. (Wales), D.I.C., Ph.D. (London)  -  Associate Professor
T. A. Brzustowski, B.A.Sc. (Toronto), A.M., Ph.D. (Princeton)  
Associate Professor

M. J. Hillier, B.Sc. (Eng.), B.Sc. (Gen) (London),  
D.I.C., M.Sc. (Eng.) (London)  -  -  Associate Professor
J. H. G. Howard, B.Sc. (Queen's), M.Sc., Ph.D. (Birmingham)  
Associate Professor

W. B. Nicoll, S.M. (Massachusetts Institute of Technology)  
Engineer (Stanford)  -  -  -  Associate Professor
G. F. Pearce, B.A.Sc. (British Columbia), M.A.Sc. (Toronto)  
Associate Professor

A. A. Bruneau, R.A.Sc. (Toronto), D.I.C., Ph.D. (London)  
Associate Professor
J. W. Church, B.Sc. (Queen's), M.A.Sc. (Toronto)  -  Associate Professor
D. E. Coates, B.A.Sc. (Toronto), M.S. (Illinois)  -  Assistant Professor
G. D. McPherson, B.A.Sc. (Toronto), M.S. (Ottawa) Ingenieur en Genie Atomique (Institut National des Sciences et Techniques Nucleaires, Saclay, France) - Assistant Professor (on leave of absence)

A. Plumtree, B.Sc., Ph.D. (Nottingham) - - Assistant Professor

K. R. Piekarski, Dipl. Ing. (London) - - Assistant Professor

G. K. Fleming, B.Eng. (Nova Scotia Tech. College), M.A.Sc. (British Columbia) - - - - Lecturer

V. Kuppu Rao, B.E. (Bangalore), M.S. (Cornell) - - Lecturer

A. B. Strong, B.A.Sc. (Waterloo) - - - - Lecturer

Undergraduate Programmes

Details of the undergraduate programme in Mechanical Engineering are to be found on page 68. All courses extend over one semester only.

3 lectures, 3 hours laboratory.

21. Mechanics or Machinery. The effects of dynamic forces in machines; introduction to mechanical vibrations. Transient forces. Static force analysis, dynamic force analysis, balancing, cam dynamics, dynamics of feedback systems. Prerequisite: ME13.
2 lectures, 3 hours laboratory.

22. Design of Machines. Theory and application of mechanics of solids to machine parts. Design of machine elements; power screws, shafting, bearings, belts, gears, flywheels, clutches and brakes, crankshafts, springs, lubrication, ball and roller bearings.
Prerequisite: ME21.
2 lectures, 2 hours laboratory.

23. Analysis and Synthesis of Machines. Principles of optimum design, optimizing for minimum cost, maximum power capability, minimum weight, effects of manufacturing errors on product performance, statistical consideration for the factor of safety, optimum design of machine elements; torsion shafts, beams, gears, etc. Fluctuating loads, impact forces. Analog methods.
Prerequisite: ME 22.
3 lectures.

3 lectures.

35. **Nuclear Engineering.** An introductory course in nuclear reactor theory and design, isotope applications and fusion. Topics covered will include fission and the chain reaction, reactor principles, reactor components and materials, heat transfer, reactor design, uses of isotopes, applications of nuclear power and the fusion process. Radiation hazards and shielding. 3 lectures.


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. 3 lectures.

38. **Materials in Nuclear Technology.** Mechanical and physical requirements of materials used as fuels, moderators, shields and structural components in reactors. Special problems related to corrosion, radiation damage and high temperatures. Materials selection. Radioactive waste disposal. 2 lectures.


43. **Metrology.** Theory and practice of high precision mechanical 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; photography as a mensuration tool for moving (dynamic) conditions, stroboscopic measurements for frequency drift in rotating machinery. 2 lectures.

53. **Heat Transfer I.** Introduction to heat transfer mechanisms. The formulation of heat transfer problems. Temperature distributions in solids under steady and transient heat conduction. Laminar forced convection, the use of boundary layer theory and the integral method for evaluating the heat transfer...
coefficient. Laminar and turbulent free convection, empirical correlations and introductory analysis. Reynolds and Colburn analogies.

3 lectures, 3 hours laboratory, alternative weeks.

54. Thermodynamics II. Review of the basic concepts and postulates of thermodynamics and the conditions for equilibrium. Reactive systems. An introduction to irreversible thermodynamics. Applications to selected engineering systems including direct conversion devices, gas turbines.

Prerequisite: GE 31.

2 lectures, 3 hours laboratory.


Prerequisite: GE 31.

3 lectures.


Prerequisite: ME 53.

3 lectures.


3 lectures.


3 lectures.


3 lectures.

3 lectures.

73. 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 workplace design; the evaluation and testing of man-machine systems.

3 lectures.

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 supervisors. In selecting and assigning 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.

Graduate and Research Programmes

A. The Master's Degree. Two types of Master's degree are awarded in mechanical engineering: one based on a research thesis, type R, supplemented by some course work, the other based entirely on course work or "scholarship", type S.

Master's degree by course work: Type S in intended mainly for the student entering after some years in industry to bolster his technical background. Part-time or full-time co-operative graduate students may be particularly interested in this degree. The requirements for the degree consist of not less than 8 one-semester courses which must be passed with an average of 66% or better. The courses are selected with a view to ensuring that the student becomes a competent specialist in a certain branch of engineering science. Areas of specialization in which a Master's degree, type S, is offered are, at present.

1) Materials Science
2) Thermodynamics and Heat Transfer
3) Fluid dynamics
4) Manufacturing Technology
A student desirous of entering this programme is advised to consult the co-ordinator of the area of specialization in which he is interested. Course work programmes for the degree are drawn up by the co-ordinator in consultation with the student.

No financial assistance, in the form of teaching or research fellowship is offered to candidates working toward a Master's degree, type S.

The Master's degree, type S, is regarded as a terminal qualification and it is not normally contemplated to admit a graduate having this degree to our Ph.D. programme.

Master's degree by research work: The Master's degree, type R, may, on the other hand, also be regarded as the first year of a coherent three-year course of study toward the Ph.D. degree. However, this is not intended to mean that such is the exclusive purpose of a type R Master's degree: many students may wish to proceed no further than this degree. Also from the University's point of view the M.A.Sc. is a complete qualification and students attaining it are not necessarily admitted to further study toward a Ph.D. degree, but only if they have demonstrated the required ability to carry out independent fundamental research.

In a field of applied science such as mechanical engineering the heart of any graduate work, excepting the Master's degree, type S, described before, involves a thesis project with substantial experimental content. The freshly registered graduate student interviews several faculty members active in research in a field of possible interest to him and chooses a thesis project with the concurrence of some faculty member who will then act as his supervisor. Normally such a faculty member also arranges financial support for the graduate student with the aid of externally obtained research grants. For this reason it is difficult to arrange such financial support before the student's arrival on the campus. The choice of the thesis project is an important decision, because a later change in the student's field of research usually entails loss of time. Active fields of research in which students may at present be accepted are listed and described in the departmental research 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 faculty expands while some projects are completed or abandoned.

Once a thesis project has been chosen, a suitable programme of course work to support the research work is agreed upon between the student and the supervisor. When approved by the Faculty of Graduate Studies, this programme, together with the thesis project, constitutes the official set of requirements for obtaining the degree sought by the student.

Candidates registered for an M.A.Sc. degree, type R, 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 official set of requirements for the award of a Master's degree, type R, are: (a) that the candidate obtains a pass in all prescribed subjects (b) that his thesis be accepted.

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. Approximately at the end of his first year of residence as a Ph.D. candidate a comprehensive oral examination is administered to him by his supervising committee.

The mechanics of thesis topic selection is very much as described under the Master's degree and very often a candidate proceeds from study for a Master's degree type R, to Ph.D. work in the same area of specialization. In order to be admitted to graduate study as a Ph.D. candidate he must have demonstrated his ability to do original research in the course of his Master's degree work. For this reason, should a graduate with a Master's degree, obtained without producing a research thesis, desire to enter our Ph.D. programme, he would have to satisfy the Department that he is able to carry out independent research. To this end he would at first be registered as a candidate for an M.A.Sc. degree, with research thesis. After one year his case would be reviewed and if he would have demonstrated the required ability to carry out independent
research he would be permitted to change his registration to Ph.D. candidacy with credit, meaning that his course of study would have the minimum length of two academic years counted from his registration for an M.A.Sc. degree with research thesis. In other words, one year of residence would be credited to him towards the total of three required to obtain a Ph.D. degree, on the strength of his course-work type Master's degree as is ordinarily done if the Master's degree involves a research thesis.

The supervising committee of 5 consists of the supervisor and four other members appointed on the advice of the supervisor. One of these is usually appointed from outside the university, another one from outside the department (often from Mathematics or Physics).

Comprehensive Examination: Comprehensive examinations will normally be held in September, approximately 12 months after the candidate has embarked on his Ph.D. programme. It will be an oral examination and will be administered by the supervising committee, except that the external assessor may be replaced by a member of the university faculty. On the basis of the examination, the committee will decide whether:

a) The scholarly competence of the candidate in his chosen field of specialization and in closely related fields is adequate,

b) The candidate should be instructed through his supervisor to extend his reading of specified fields or even to take further specific courses,

c) The candidate is so lacking in competence in his chosen field that his registration as a Ph.D. candidate should be terminated.

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 not normally acceptable as satisfying the foreign language requirements, except when the native tongue is French, German or Russian.

Examination of the Thesis: Upon completion of the research the candidate shall be required to submit four typed copies of the final draft of his thesis to the supervising committee. The thesis shall be read by each of the members of the Committee. One copy of the four shall be filed with the Graduate Studies office for three weeks and be available for all members of the faculty of the University of review. Recommendations of the readers of the thesis shall be in one of four categories.

a) Acceptance as submitted.

b) Acceptance with minor modifications as noted

c) Conditional acceptance with major modifications usually requiring a re-submission

d) Complete rejection

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Department of Mechanical Engineering

Public Presentation: The candidate shall give a public presentation of his thesis before a colloquium held by his major department. This public delivery shall be well advertised in advance throughout the University and possibly at nearby institutions. Although this shall not be construed as an examination, an adequate time shall be allowed for questions from the floor.

Graduate Course Descriptions
(All one semester courses)


2 lectures.

645. Machinery of Manufacture - Design and Utilization. Modular design vs. composite design; multiple purpose design vs. special function design; tooling design as a parameter in machine tool design; machine tool efficiency analysis by percentage time of cutter contact; effect of climb compensation on tooling costs; three dimensional development by elective etching and tape control. Discussions of actual problems in machine tool applications in Canadian industry.


3 lectures.


698. Specially Directed Studies.

Active Research Projects

Materials Science.

In one project a plasma torch is used, which is an electric discharge maintained in a controlled atmosphere, in this case of Argon gas. Very high temperatures (up to 30,000° C) may be maintained in the plasma torch with the aid of which, in the precisely controlled atmosphere surrounding the torch, single crystals of ceramic materials may be induced to grow.

Four projects are under way in the area of the plasticity of single crystals. In one the occurrence of stable dislocation walls between blocks of material
slipped on different systems is being studied. In particular the strain rate dependence of the interactions involved and the lattice rotation resulting from the formation of the wall, or kink boundary, are being investigated. In another project photoelastic techniques are being employed to investigate the internal stress patterns resulting from different slip modes in deformed beams of transparent ionic single crystals. The preparation of crystals with clean surfaces is under way and the influence of surface cleanliness on plastic and fracture behaviour is being studied in another project. The fourth project is concerned with the influence of slip direction as opposed to dislocation-dislocation or dislocation-point defect interactions on observed work hardening rates in single crystal beams which have one active slip system, the orientation of which is controlled relative to beam geometry.

A project is planned in the area of the plasticity of polycrystalline ceramic materials of very high density. Research in the area of the design of two phase materials and the optimization of desired properties in such materials is expected to be underway soon.

**Fluid Power Control Systems.**

One active project in this area is a theoretical and experimental investigation of a hydraulic control spool valve. The flow of hydraulic fluid through a spool-type valve may be highly unstable, resulting in erratic operation of the system in which it is the chief control element. It is the purpose of the investigation to study the flow and to determine methods by which the instability may be alleviated.

Other projects planned in this area include an experimental investigation of fluid jet control valve and of a submerged jet impinging normally on an eccentric orifice.

**Combustion and Heat Transfer.**

Several projects are under way in combustion and heat transfer. One is a study of the combustion of liquid fuel droplets above the critical pressure of the fuel. Of particular interest here are the transient effects associated with phase change in a non-equilibrium compressed liquid-dense gas system.

Two further projects are concerned with the combustion of metals. One deals with the effect of electric fields on the vapour-phase combustion of Mg and Al and on the subsequent behaviour of the oxide smoke. The other is a study of radiant and convective heat transfer from a metal-powder flame to an immersed solid surface.

An investigation of one phenomenon occurring in solid-propellant rocket motors is being undertaken in a subliming-solid simulator. The purpose of the study is to examine the acoustical stability of a cavity at whose walls a solid-gas phase change is taking place.

Research is now being started in the area of forest fires. The first project is the study of flame spread in a combustible layer on an arbitrary surface. Later
Department of Mechanical Engineering

studies will examine time-temperature histories of tree trunks exposed to ground fires, thermal radiation properties of leaves and barks, and models of flame spread in crown fires. Field work will become an important part of this study. The research into forest fires is being planned as a project involving members of both the Biology and Mechanical Engineering departments.

Nuclear Engineering.

The development of reactor and economic models for the optimization of power reactor operation; and the control of reactor stability under perturbations in the xenon-poison load using analog and digital models, are two aspects of nuclear engineering research which make use of the University of Waterloo computing facilities. Experimental work includes the study of heat conduction and removal in fuel elements and of the properties of some materials used in nuclear fuel elements.

Turbomachinery.

The object of the research projects in this field is the investigation of fundamental fluid flow phenomena in turbomachinery components. The project at present under way is the study of the generation of secondary flows in a rotating passage of a centrifugal impeller. The initial stage will use flow visualization techniques to study the flow pattern with water as the working fluid. Improved analysis and design techniques for impellers should be the eventual result of this project. Further projects planned for the near future include investigation of radial diffuser flow and skewed boundary layers.

Air Pollution.

One project is entitled “Atmospheric Dispersal of Heavy Particles” and is concerned with the rate of spread of dust clouds emitted from chimneys. In the experimental work, glass microspheres are blown into the atmosphere at the top of a 60 foot mast and collected on adhesive tape exposed in a grid pattern surrounding the mast. The glass spheres can be identified under a microscope and counted. Another project is concerned with the rise of a hot smoke plume: owing to their buoyancy, hot gases from a chimney rise to some height before dispersing.

Work on the Great Lakes.

Turbulence and Diffusion. Fluorescent dye released at a point-source may be detected in very low concentrations and enables a study of mixing processes to be made.

Internal waves. During summer the lakes become stratified, a warm, relatively light surface layer lying on top of a colder and heavier mass below. The interface, the “thermocline”, behaves much like a free surface (air/water interface) in that wave motions may be observed on it.

Lake currents. Winds and atmospheric pressure disturbances produce a variety of complicated current patterns. These are investigated using “drogues,” i.e., two metal sheets assembled at 90° so as to offer a high drag and attached to small surface floats.
Surface waves. Spectra of waves and associated subsurface orbital movements are observed by a variety of techniques. The ultimate purpose of these activities is to increase our knowledge of the Great Lakes environment in connection with pollution, water supply, marine construction, problems, etc.

Aerodynamic Noise.
The turbulence of the flow at the exit of a nozzle is responsible for the noise of jet engines. In order to understand the physical mechanism by which noise suppressors work, the turbulence at the exit from an open jet windtunnel is disturbed by extraneous vortices and the details of the changes are observed. The work involves the use of some extensive hot-wire anemometry equipment experimentally, and is supported by theoretical work concerning the "source terms" in the acoustics equation, generated by the turbulence of the flow.

Manufacturing Technology.
Research in this field is concerned primarily with applied plasticity, and limiting conditions in mechanical forming operations. Typical projects presently the subject of study include: (1) Instability of forming processes in a pressurized atmosphere. (2) Limiting conditions in deep drawing. (3) Bulge forming in a pressurized atmosphere. (4) Interstand detection of buckles in cold rolled strip.

Music
100. Music of the 18th, 19th, and 20th Centuries and its relationship to the Arts.
Prerequisite: Gr. XIII Music or the equivalent, and consent of the instructor. 3 lectures.

Department of Philosophy
L. Armour, B.A. (British Columbia), Ph.D. (London)
Associate Professor, Acting Chairman 1964/5
C. A. Hergott, C.R., M.A. (St. Louis), S.T.D. (Gregorian) - Professor J
Z. Adamczewski, B.A. (London), A.M. (Columbia), Ph.D. (Harvard) - - - - Associate Professor
R. J. C. Burgener, M.A., Ph.D. (Toronto) - - Associate Professor
J. S. Minas, A.B., M.A. (Wayne), Ph.D. (Illinois) - Associate Professor
P. Seligman, B.A., Ph.D. (London) - - Associate Professor
J. R. Horne, M.A. (Western Ontario), B.Th. (Huron), Ph.D. (Columbia) - - - Assistant Professor R
B. J. Murphy, C.R., B.A. (Western Ontario), M.A., Ph.D. (Ottawa) - - - - Assistant Professor J
J. F. Narveson, B.A. (Chicago), M.A., Ph.D. (Harvard) - Assistant Professor
D. D. Roberts, B.A. (Roosevelt), M.A., Ph.D. (Illinois) - Assistant Professor
J. Wubnig, B.A. (Swarthmore), M.A., Ph.D. (Yale) - Assistant Professor
A. L. Dobos, B.A. (Western Ontario), Ph.L. (St. Louis) - Lecturer J
Notes:
(1) 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.

(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 (see hyphenated course numbers) and names of instructors for each course.

(3) The attention of all first-year students is called to the fact that several courses in addition to Philosophy 100 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. They appeal to various academic interests which might be less adequately served by the broad survey provided in Philosophy 100. Of these, the courses numbered 221/222, 240 and 280/281 are especially recommended for the student envisaging further study in Philosophy. (See recommended Honours programmes on pp. 39).

Undergraduate Course Descriptions

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, full course.

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, half course.

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, half course.

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, half course.
3 hours, half course.

221.* Ethics I. The classic literature of ethics will be analyzed, and the principal problems brought to light. No prerequisite.
2 - 3 hours, half course.

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.
2 - 3 hours, half course.

240. Logic. Rigorous and systematic treatment of truth-functional and quantificational logic, with some treatment also devoted to such topics as formal systems, formal semantics, proof theory, set theory, metamathematics, and model systems. Gives ample preparation for further work in mathematical logic, linguistics, and general philosophical analysis. Prerequisite: None for students above year I; first-year students must have consent of instructor. Philosophy 140 is useful but not essential.
2 - 3 hours, full course.

280.* History of Ancient Philosophy I. From the beginnings to Plato.
Prerequisite: Consent of instructor for students not taking philosophy as their main subject.
2 - 3 hours, half course.

281.* History of Ancient Philosophy II. From Aristotle to the close of classical antiquity.
Prerequisite: Philosophy 280.
2 - 3 hours, half course.

282.* History of Modern Philosophy I. Earlier period beginning with Descartes.
Prerequisite: One full or two half philosophy courses, preferably 280/281.
2 - 3 hours, half course.

283.* History of Modern Philosophy II. Later period including Kant.
Prerequisite: Philosophy 282.
2 - 3 hours, half course.

299. Tutorial for Honours students. Students wishing to enroll in 299 should consult the Department.

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.
2 hours.
Department of Philosophy

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.
2 hours, half course.

326.* Political Philosophy II. A detailed discussion of contemporary theories.
Prerequisite: Philosophy 325.
2 hours, half course.

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.
2 hours, half course.

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.
2 hours, full course.

335.* Philosophy of Religion. A philosophical approach to the basic ideas of great world religions. The phenomenology of religious experience and mysticism as well as the nature of religious symbolism and language will be discussed.
Prerequisite: One full or two half Philosophy courses.
2 hours, half course.

345.* 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.
2 hours, half course.

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.
2 hours, half course.

361. Philosophy of Science. Logical analysis of scientific methods and concepts. Some special topics are also considered, e.g., the role of mathematics in empirical science, problems arising from the relations among some of the sciences, such as those employing theoretical as opposed to observational concepts, and comparison of science with other human activities.
Prerequisite: Philosophy 240 (which may be taken concurrently), or consent of instructor.
2 hours, full course.
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.  
2 hours, full course.

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: One full or two half Philosophy courses.  
2 hours, half courses.

370* — 372.* **Special Subjects.** One or more half courses will be offered at different times as announced by the Department.  
Prerequisite: Consent of instructor.  
2 hours.

380* — 389.* **Studies in the History of Philosophy.** Various half courses dealing with a particular philosopher, a selected work or period; one or more of these will be offered each year as announced by the Department.  
Prerequisite: Philosophy 280/281 and 282/283.  
2 hours.

390.* **Medieval Philosophy I.** The early period to the thirteenth century.  
Prerequisite: Philosophy 280/281.  
2 hours, half course.
391.* Medieval Philosophy II. The later period, from the thirteenth century. 
Prerequisite: Philosophy 390.
2 hours, half course.

440* - 444.* Studies in Logic. Various half courses dealing with special topics; 
one or more of these will be offered each year as announced by the Department. 
Prerequisite: Philosophy 240 or Mathematics 436.
2 hours.

455. Metaphysics. Theories of reality, mainly of the last hundred years. 
Prerequisite: Two full courses (or equivalent) in Philosophy.
2 hours, full course.

Prerequisite: Consent of instructor.
2 hours, full course.

471* - 473.* Problems. One or more half courses will be offered at different 
times, as announced by the Department.
Prerequisite: Consent of instructor.
2 hours.

480* — 489.* Advanced Studies in the History of Philosophy. Various half 
courses dealing with a particular philosopher, a selected work or period; one or 
more of these will be offered each year as announced by the Department.
Prerequisite: Consent of instructor.
2 hours.

499. Tutorial and Honours Essay. Students wishing to enrol in 499 should 
consult the Department.

Graduate Course Descriptions

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 suffi-
2 hours.

621. Seminar in Ethics.
2 hours.

625. Seminar in Political Philosophy.
2 hours.

630. Seminar in Aesthetics.
2 hours.

635. Seminar in Philosophy of Religion.
2 hours.

640. Seminar in Logic.
2 hours.
650. Seminar in Epistemology.
2 hours.

655. Seminar in Metaphysics.
2 hours.

660 — 662. Seminar in Philosophy of the Sciences
2 hours.

670. Specially Directed Studies.
2 hours.

2 hours.

1 hour per week consultation.

Note: Depending on what is appropriate in a given case, 600 courses may be for a full academic year's duration or for one semester only. In the latter case they will be counted as “half-courses” in the interpretation of general calendar requirements.

The following courses are offered by St. Jerome's College:

100J. Introduction to Philosophy. A study of St. Thomas and his writings; fundamental Thomistic principles.
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.

200J. Cosmology and Philosophy of Science. Corporeal bodies and change; quantitative and qualities characteristic; motion; time, space; hylomorphic theory. Nature of science; abstraction; necessity; foundation and object of science; scientific method; hypothesis and theory.
3 hours.

240J. Ethics. End of Man; the human act; law, conscience; morality; rights and duties; duties of a man as an individual and as a member of society.
3 hours.

300J. Metaphysics and Natural Theology. The notion and analogy of being; the primary principles of being; the properties, division, and causes of being. Demonstration of existence of God; His nature and attributes; the divine intelligence and will; creation and providence.
3 hours.
340J. History of Philosophy. A survey of Philosophy from Presocratics to contemporary philosophers.

348J. Seminar in Philosophy. A special study of the principal philosophers of the modern and contemporary eras.
3 hours.

Department of Physical and Health Education

D. J. Pugliese, B.A., B.P.E. (McMaster), Ed.M. (Buffalo)
Assistant Professor and Chairman of the Department

P. J. Galasso, B.A., B.P.H.E. (Queen's), M.A.
(Michigan) - - - - - Assistant Professor

C. A. W. Totzke, B.A. (Western) - Special Lecturer, Director of Athletics

D. Hayes, B.Sc., B.P.E. (Springfield) - - Assistant Professor

W. A. Delahey, B.A. (Western) - - - - - Lecturer

(Miss) Ruth Hodgkinson, B.P.H.E. (Toronto) - - Lecturer

400. History and Principles of Physical Education. A study of the history of physical education and of the principles and problems involved in present day physical education programmes.
3 lectures, first term.

405. Historical Foundations in Dance. A study of the history of the dance from its origin in prehistoric times to the present. An examination of the materials, growth and function of the dance in society.
3 lectures, first term.

410. Coaching Foundations. A study of the history of coaching and its underlying principles applied to physical education today. An examination of different methods and problems connected with coaching specific teams and individual sports.
3 lectures, first term.

420. Administration of Physical and Health Education Programmes. The function of administration with respect to planning, staff, public relations, facilities, equipment, legal responsibilities, intramural and interscholastic programmes. The drafting of schedules and the organization and conduct of tournaments and meets. The study of special problems of health and physical education pertinent to the administrator.
3 lecturers, second term.

425. Public Health and Preventive Medicine. A course designed to acquaint the student with the medical resources of the community and the function of the school medical services. Problems of mental health in school and community, and medical statistics as they relate to the illness of different age groups. Certain topics relating specifically to health education, such as alcoholism, the use of tobacco or drugs, are made the subjects of seminars.
Nutrition and its relation to health and modern concepts of preventive medicine are reviewed in a general manner. Visits to schools and clinics which are relevant to the course will be arranged.
3 lectures, first term.

440. Human Anatomy. A study of the system of the human body as to structure with particular emphasis on the skeleton, joints and muscles. The functions of these and other systems will be studied in relationship to the needs of physical education.
3 lectures, 2 hours laboratory, first term.

3 lectures, second term.

445. 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. Laboratory work includes the clinical use of physiotherapy equipment, massage and advanced training methods used in the care of personnel injured in the various skill courses, recreational, intramural and varsity activities.
3 lectures, first term.

450. Corrective and Adapted Physical Education. A study of common postural and structural defects with appropriate preventive and remedial exercises. A study of pathological defects and their relationship to physical education. The principles involved in adapting physical education programmes for the handicapped and the convalescent.
3 lectures, second term.

455. Physiology of Physical Activity. Physiological changes in human organism due to physical exercise, including a study of muscle tissue, muscle training, nerve control, the role of oxygen in activity, energy cost and efficiency, respiration and artificial respiration, blood composition and circulation, the heart and pulse rate, fatigue, staleness and physical fitness.
3 lectures, second term.

2 lectures 1 laboratory, first term.

465. Research Project. Selection of an approved topic in health, physical education or recreation to be studied for research purposes. Direction in methods of research and the presentation of findings in seminar and report form.
1 lecture 2 laboratories, second term.

620. Educational Psychology. An application of psychological principles to educational problems, together with a survey of relevant research findings con-
Department of Physical and Health Education

cerning child and adolescent behaviour.
3 lectures second term.

480. Skills:

Team Skills — Teaching and practice of the basic fundamentals of the following activities: soccer, football (men), field hockey, track and field, lacrosse (men), low organizational games, officiating.

Dual Skills — Teaching and practice of the basic fundamentals of the following activities: tennis, judo.

Individual Skills — Teaching and practice of the basic fundamentals of the following activities: canoeing, sailing, gymnastics, aquatics, archery, weight training, isometrics.
12 hours first term.

Team Skills — Teaching and practice of the basic fundamentals of the following activities: volleyball, basketball, hockey, curling and officiating.

Dual Skills — Teaching and practice of the basic fundamentals of the following activities: badminton, wrestling (men), dance.

Individual Skills — Teaching and practice of the basic fundamentals of the following activities: gymnastics, aquatics, golf, skiing.
12 hours second term.

Skill School:

Orientation of the students to the skills programme with an introduction to the basic fundamentals of the following activities: sailing, canoeing, orienteering, tennis, badminton, golf, archery, track and field, field hockey.
50 hours first week.

Department of Physics

J. A. Cowan, B.Sc. (Manitoba), M.A., Ph.D. (Toronto)

Professor and Chairman of the Department

F. W. C. Boswell, B.A., M.A., Ph.D. (Toronto) - - - Professor
G. E. Reesor, B.A., M.A., (McMaster), Ph.D. (Toronto) - Professor
R. A. Aziz, B.A., M.A., Ph.D. (Toronto) - - Associate Professor
D. E. Brodie, B.Sc., M.Sc., Ph.D. (McMaster) - Associate Professor
I. R. Dagg, B.Sc. (Manitoba), M.S. (Penn. State), Ph.D. (Toronto) - Associate Professor
P. C. Eastman, B.Sc., M.Sc. (McMaster), Ph.D. (U.B.C.) - Associate Professor
D. J. Henderson, B.A. (U.B.C.), Ph.D. (Utah) - Associate Professor
N. R. Isenor, B.Sc. (Acadia), M.Sc., Ph.D. (McMaster) - Associate Professor
M. G. Rochester, B.A., M.A. (Toronto), Ph.D. (Utah) - Associate Professor

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R. A. Snyder, B.Sc., Ph.D. (Western Ontario) - Associate Professor
S. H. Chen, B.S. (Taiwan), M.S. (Tsing-Hua), M.S. (Michigan), Ph.D. (McMaster) - Assistant Professor
H. K. Ellenton, B.Sc. (Western), M.A. (Toronto) - Assistant Professor
(on leave of absence).
J. D. Leslie, B.A.Sc. (Toronto), M.S., Ph.D. (Illinois) - Assistant Professor
C. C. Lim, B.A. (DePauw), M.A. (Nebraska), Ph.D. (Toronto) - Assistant Professor
J. L. Ord, B.A.Sc. (Toronto), M.S., Ph.D. (Illinois) - Assistant Professor
H. J. T. Smith, B.Sc., Ph.D. (London) - Assistant Professor
K. A. Woolner, B.Sc. (London) - Assistant Professor
P. A. Barnes, B.A.Sc., M.Sc. (Waterloo) - Lecturer
J. M. Corbett, B.A.Sc., (Toronto), M.Sc. (Waterloo) - Lecturer
S. G. Davison, B.Sc., M.Sc., Ph.D. (Manchester) - Lecturer and Research Associate
J. R. Richardson, B.Sc. (Queen's), M.Sc. (McGill) - Lecturer

3 lectures, 3 hours laboratory.

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.

42. Structure of Solids. 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, 3 hours laboratory, alternate weeks, one term.

3 lectures, one term.

3 lectures, one term.

3 lectures, one term.

3 lectures, one term.

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, 3 hours laboratory and one hour problems on alternate weeks.
Note: Students in Honours Physics take 3 hours laboratory or problems weekly.

235. Optics. An elementary course in geometrical and physical optics. Refraction and reflection 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.

Note: Students enrolled in the Chemistry and the Chemistry and Physics courses take laboratory work in alternate weeks.

237. Astronomy I. A survey course in astronomy. Aspects of the sky; motions of the earth; the earth and the moon; the solar system; gravitational astronomy; the sun; the stars; stellar motions; comets; meteors; meteorites; interstellar matter; the structure of the galaxy; exterior systems; cosmogony; radio astronomy.
3 lectures.

2 lectures, 3 hours laboratory and 2 hours problems on alternate weeks.

331. Classical Mechanics I. Foundations of Newtonian mechanics. Dynamics of a particle; harmonic oscillator; central force motion; conservative force;
3 lectures.

332. **Electronics.** A survey of electronic circuits. Basic A.C. circuit theory; rectifiers and filter circuits; triode, pentode and transistor amplifiers; equivalent circuits; feedback and oscillators; regulation; electronic measuring devices; pulse circuits.
2 lecturers, 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.
6 hours laboratory.

334. **Atomic and Nuclear Physics I.** Special theory of relativity, growth of atomic concepts, quantum theory of thermal radiation, particle aspects of electromagnetic radiation. Rutherford atom, Bohr atom, wave aspects of particles, wave mechanics, solution of Schroedinger's equation, one-electron atoms.
3 lectures.


3 lectures.

336. **Physical Mathematics 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; eigenfunctions.
2 lectures.

337. **Astronomy II.** Selected topics in astrophysics, cosmogony, and radioastronomy.
2 lectures.

338. **Geophysics I.** An introductory course on the physics of the Earth. Origin, heat and temperature of the Earth, study of earthquakes and the Earth's interior through earthquake waves; gravity and isostasy; terrestrial magnetism; effects of heat, temperature and strain on rocks; origins of continents, mountain ranges, the ocean floors, meteorology; geophysical techniques.
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.

416. **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 organisms.
3 lectures.

2 lectures.

432. **Physics of Solid State Devices.** Review of vacuum tube electronics, statistics of electrons in semiconductors, transport properties, minority carrier injection, theory of pn junctions, transistors, tunnel diodes, field effect devices; applications.
3 hours per week, second term.

433. **Advanced Laboratory.** Selected experiments in atomic and nuclear physics, solid state physics, thermodynamics; electrical and electronic measurements; vacuum techniques. In addition, a short research problem will be assigned.
3, 6 or 9 hours laboratory.
434. Atomic and Nuclear Physics II. Multi-electron atoms: identical particles and the Pauli principle, the helium atom, Hartree theory of multi-electron atoms, the periodic table, the vector model. Nuclear physics: particle acceleration and detection, nuclear structure, the decay of unstable nuclei, nuclear reactions, elementary particles.
2 lectures.

435. Solid State Physics. Atomic bonding; crystal structure and space lattices; symmetry; crystal geometry; defects; physical properties of crystals; free electron theory of metals; band theory; properties of semiconductors and insulators.
3 hours per week, first term.

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. Metal Physics. The course will provide explanations of the physical properties and behaviour of metals and alloys from the viewpoint of atomic physics. Topics included are: solidification of pure metals, perfect and imperfect crystals, alloys, phase diagrams, diffusion, solid state phase transformations, the iron-carbon system, physical properties of metal crystals, elastic and plastic deformation, twinning, radiation damage, recovery and recrystallization creep, fatigue, fracture, internal friction, free electron and zone theories of metals. electrical, thermal and magnetic properties.
2 lectures.

Graduate and Research Programmes
See page 98 for general information.

There are at present several major areas of study in the Department in which graduate students may specialize. These include:
Low temperature physics: experimental studies of condensed inert gases, liquid helium, superconductivity, energy gap and Fermi surface determinations.

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.

Laser Research: ruby laser research, solid state injection lasers.

Microwave research: dielectric constant measurements, field induced adsorptions, microwave spectrometry.

Theoretical Physics: geophysics, theory of liquids, theoretical solid state physics

Special Topics: biophysics, character recognition of speech.

Graduate Course Descriptions

Three lectures, first term.

Three lectures, second 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.
Three lectures, one term.

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, Feynman-Schwinger quantization of this theory. The radiation field, the electron field. Interaction of these fields. The S-matrix; Compton scattering, Coulomb scattering. The magnetic moment of the electron, the Lamb shift. Renormalization.
Three lectures, one term.

627. Atomic Spectra. The fine and hyperfine structure of one-electron and many-electron atoms, the Zeeman and Stark effects.
Three lectures, one term.

Three lectures, one term.
Three lectures, one term.

Three lectures, one term.

635. Electromagnetic Theory I. The electrostatic and the magnetic field, Maxwell's equations, energy, force and momentum relations in the electromagnetic field, the wave equation and plane waves, cylindrical and spherical waves, waveguides, resonators, solution of inhomogeneous wave equation. Hertz potential, multipole radiation, the special theory of relativity, the electromagnetic tensor and the transformation properties of the field vectors, the field of moving charges.
Three lectures, first term.

636. Electromagnetic Theory II. Radiation reaction, electromagnetic mass, equations of motion, dispersion and scattering, propagation in anisotropic media, magnetohydrodynamics, plasma physics, superconductors. Formulation of the field equations and electrodynamics from the action principle, Lagrangian and Hamiltonian forms of the theory, quantization of the electromagnetic field, selected topics.
Three lectures, second term.

640. Electron Optics and Electron Microscopy. Electrons in electrostatic fields, the electrostatic lens, the magnetic lens, aberrations, the electron microscope, theory of image contrast, Fresnel diffraction and image contour phenomena, electron diffraction and dark-field microscopy, experimental methods in electron microscopy.
Three lectures, one term.

Three lectures, one 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.
Three lectures, one term.

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.
Three lectures, one term.

650. Solid State Physics. An introductory undergraduate course in classical
solid state physics, or equivalent, is assumed. The free electron model in
metals, band theory of solids, application of Brillouin zone theory, semicon-
ductors, optical properties of solids and devices of current interest are some of
the topics which are covered.
Three lectures, second term.

651. Imperfections in Crystals. Perfect and imperfect crystals, general proper-
ties and origins of point defects and dislocations, stacking faults, interactions
of imperfections, influence of lattice imperfections on physical properties and
their role in deformation of crystals and phase transformations, experimental
detection and observation of imperfections.
Three lectures, one term.

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.
Three lectures, one term.

653. Inert Gas Solids. Theory of crystal lattices: quantum mechanical basis,
interatomic potentials, stability, dynamics of cubic close-packed lattices,
thermodynamics of ideal crystals, anharmonicity. Experimental properties.
Three lectures, one term.

654. Advanced Quantum Theory of Solids. Theoretical and experimental
techniques for determination of the band structure of metals and semicon-
ductors; electrical and thermal conduction processes and electron-lattice inter-
actions.
Three lectures, one term.

665. Biophysics I. The behavior of some physical systems encountered in
living organisms. Simple cell models: the cell membrane, diffusion problems,
respiration, motion, instability and cell division, radiation damage.
Three lectures, one term.

666. Biophysics II. Specialized cells and organs: the nerve impulse and its
propagation, muscle contraction, the red blood corpuscle, haemodynamics,
selective filtration of ions, sensory transducers, temperature regulation, the
central nervous system.
Three lectures, one term.

667. Molecular Biology. Selected topics of interest to biologists, biochemists
and biophysicists will be presented at the advanced level with the aim of
evaluating recent work and development in each area. Each will be developed
from basic concepts and interrelationships emphasized. Topics will include:
the structure of proteins and their properties in solution, transport through
biological membranes, cell morphology and physiology, structure and func-
tion of selected organelles, biosynthesis of macromolecules, and the chemistry of enzyme action. This graduate course is to be presented by members of the Biology, Chemistry, and Physics Departments and is intended to cover those areas common to these disciplines (identical to Biology 667 and Chemistry 667).

670. Physics of the Earth's Interior. Selected topics in theoretical geophysics; seismology, rheology of the Earth, geomagnetism, the Earth's rotation.
Three lectures, one term.

Three lectures, one term.

Department of Political Science

T. H. Qualter, B.A. (New Zealand), Ph.D. (London)
Associate Professor and Acting Chairman of Department

L. G. E. Edmondson, B.Soc.Sc. (Birmingham) - Assistant Professor

N. E. Lavigne, C.R., B.A. (Western), B.Comm. (Ottawa), M.B.A. (Detroit) - Assistant Professor

A. D. Nelson, A.B., A.M., PhD. (Chicago) - Assistant Professor

J. M. Wilson, B.A., M.A., (Toronto) - Assistant Professor

W. D. K. Kernaghan, B.A. (McMaster), M.A. (Duke) - Lecturer

Note: Students electing an Honours programme or a Major in Political Science, or an Honours Programme in such related subjects as History, Economics, Sociology or Psychology are encouraged to register in Political Science 110 in their first year. Other students are encouraged to register in Political Science 100. Either of the 100 level courses will serve as a prerequisite for senior courses in Political Science.

100. Introduction to Political Science. A study of the origin, nature and impact of contemporary political doctrines including Communism, Fascism, Democratic Socialism and Democratic Capitalism, together with a study of the institutions and practices of modern government, with particular reference to the governments of Canada, the United States and Great Britain.
3 lectures.

110. Democratic Government. A study of the theory and practice of the modern constitutional democracy. The relationship between the basis political objectives and general features of organization, procedure and practice will be emphasized, with reference to Great Britain, Canada and the United States.
3 lectures.
250. The History of Political Theory. A survey of the history of western political theory from the time of Socrates to the present day.
3 lectures.

260. International Politics. An introduction to the study of International Relations as a discipline, and an analysis of the nature and problems of international politics, components of national power, and methods employed in the pursuit of national and collective interests.
3 lectures.

270. 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 processes.
3 lectures.

3 lectures.

3 lectures.

282. British Government and Politics. The theory and practice of government and politics in Great Britain, compared with other selected government systems.
3 lectures.

283. The Theory and Practice of Totalitarian Government. A study of the principles and practices of the fascist and communist governments of the twentieth century.
3 lectures.

361. International Organization. A study of the bases of international organization; its development through the League of Nations to the United Nations; the development of international law through international organization; and the development, varieties and significance of regionalism and functionalism (NATO, OAS, West European political and economic integration, etc.).
Prerequisite: Political Science 260.
3 lectures.

371. Local and Provincial Government. A study of the development, structure, functions, machinery and finances of Canadian local and provincial governments.
3 lectures.

381. The State and Economic Life. A study of the interrelation of political and economic theory and of the political-economic consequences of the welfare state.
3 lectures.

382. Federalism - Classical and Co-operative. A study of the evolution, structure and functions of modern federalism in selected countries.
3 lectures.
390. Parties and Pressure Groups in the Modern State. An analytical and comparative treatment of the structure and role of political parties and pressure groups in the modern state. 3 lectures.

391. The Electoral Process. An analytical and comparative treatment of electoral machinery and law, election strategy and tactics and voting behaviour. 3 lectures.

450. Political Theory. A detailed study of the political theory of one selected period or school. (1965-66) English political theory of the seventeenth century. Prerequisite: Political Science 250 or consent of instructor. 3 lectures.

480. Politics of Developing Areas. Analysis of political systems and processes in the transitional societies of Africa, Asia, and Latin America. Special attention will be directed to newer Commonwealth members. 3 lectures.

490. Public Opinion and Propaganda. A detailed study of the nature of public opinion and the attempt to control it through propaganda. 3 lectures.

491. Political Behaviour. An examination of the objectives, characteristics, problems and results of contemporary research of political behaviour, with emphasis on democratic electoral behaviour. Prerequisite: Any one of the following: Political Science 390, 391; Sociology 240, 330; Psychology 212, 311. 390; or consent of the instructor. 3 lectures.

498. Senior Research Seminar.

Department of Psychology

R. H. Walters, B.A., Dip.Ed., M.A. (Bristol), B.Phil. (Oxford), Ph.D. (Stanford), F.R.Ps.S. - Professor and Chairman of the Department

D. A. Sprott, B.A., M.A., Ph.D. (Toronto) Professor (Mathematics and Psychology)

M. P. Bryden, S.B. (Massachusetts Institute of Technology), M.Sc., Ph.D. (McGill) - - - - Associate Professor

J. S. Minas, A.B., M.A. (Wayne State), Ph.D. (Illinois) Associate Professor (Philosophy and Psychology)

E. A. Salzen, B.Sc., Ph.D. (Edinburgh) - - - - Associate Professor

R. K. Penney, B.Sci. (Wayne State), Ph.D. (State University of Iowa) - - - - - - Associate Professor

P. M. Rowe, B.A. (Toronto), M.A. (Dalhousie), Ph.D. (McGill) Associate Professor

M. D. Vogel-Sprott, B.A. (McMaster), M.A., Ph.D. (Toronto) Associate Professor
A first-year student intending to major in Psychology must select Psychology 110 and Philosophy 100 or two of Philosophy 125, 135, 140, 150. Students without high school Biology should include Biology 131 in their programmes. Students with less than three Mathematics papers in Grade XIII are, in addition, advised to take Mathematics 85.

In Year II the Psychology major must take Psychology 220 and one other full-year or two half-year Psychology courses; during Year III he must complete Psychology 321 and one other full-year or two half-year Psychology courses at either the 200 or 300 level. Students who expect to proceed to graduate study in Psychology are strongly recommended to include the following courses in their programme: Biology 231; Mathematics 140, Philosophy 220. Prerequisites may be taken concurrently with courses for which they are prescribed.

Note on numbering: Courses numbered 250-299, 350-399 are Honours courses. Ordinarily, General Course students will take the courses numbered 200-249 or 300-349. Honours students may take a limited number of 200-249 and 300-349 courses but Honours standing will be required.

All courses numbered 600-650 are offered on a half-year basis. Courses numbered 699 and above are full-year courses.
Two full-year psychology courses (or their equivalent) at the graduate level, a course in experimental design, and a thesis are required for the Master's Degree. Candidates for the Ph.D. degree are required to take 4 full-year graduate courses (or the equivalent in half-year courses) and submit a thesis. If Ph.D. candidates are entering with an M.A. degree from another university, they will be required in addition to take a course in experimental design. This requirement may, however, be waived if the candidate can pass an examination set by the instructor in charge of this course.

Ph.D. candidates must pass a general examination plus an examination in their major and their minor field of specialization. The areas of specialization are: sensory and perceptual processes, learning, physiological and comparative, child, social, and clinical. Students electing the clinical specialty will be required to complete internship training under conditions approved in advance by the Department.

Undergraduate Course Descriptions

15. Introductory Psychology. A short introduction to the methodology and basic principles of some of the major areas of modern psychology such as learning, emotion, and perception. (For Engineering students only).
3 lectures, half course.

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 behavioral 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.

150. Experimental Methods in Psychology. An introduction to experimental methods in psychology. In respect to content, emphasis will be placed on the fields of learning, perception, and physiological psychology. (For students in Honours Psychology and Honours Biology and Psychology. Other students by permission of Department only.)
2 lectures, 2 hours laboratory.

211.* Development Psychology. The genesis and development of behaviour of the human will be traced from conception to maturity.
3 lectures, half-year course.

212.* Social Motivation. An analysis of the motivational aspects of human behaviour from a developmental point of view.
3 lectures. half-year course.

220. Principles of Learning. This course is designed to introduce the student to learning theory and also to provide an understanding of experimental techniques in this area.
2 lectures, 2 hours laboratory.
250.* Comparative Psychology. An introduction to the study of animal be-
haviour in natural and laboratory situations. Cross-species comparisons.
2 lectures, 2 hours laboratory, half-year course.

260.* Physiological Psychology. The relationship between patterns of behavior
and physiological processes.
2 lectures, 2 hours laboratory, half-year course.

270. Sensation and Perception. The characteristics of sensation and perception
will be studied in relation to the physics of the stimuli and physiology of
the sensory apparatus.
2 lectures, 2 hours laboratory.

311. Social Psychology. In this course the student will study socialization,
social perception, interaction within and between groups, and the communica-
tion process.
3 lectures.

321. Statistical Inference. An introduction to problems and techniques
of measurement. The role of descriptive statistics and simple tests of inference
in psychological assessment and research, and the concepts of reliability and
validity will be discussed.
2 lectures, 1 hour laboratory.

351.* Personality Theory. An examination and evaluation of some of the out-
standing theories of personality.
3 lectures, half-year course.

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.
Prerequisite: 351.
3 lectures, half-year course.

353.* Individual Differences. The basic problems in measuring individual
differences in intelligence, personality, and other characteristics, will be studied.
2 lectures, two hours laboratory, half-year course.

370. Animal Learning. More advanced study of learning principles, together
with a presentation of, and practice in, the techniques of experiments with
animals.
2 hours lectures, 2 hours laboratory.

380. Advanced Physiological Psychology. More advanced study of the physio-
logical basis of behaviour, with particular reference to the functioning of the
nervous system.
Prerequisite: 260.
2 hours lectures, 2 hours laboratory.

390.* Motivation and Emotion. Past experience, the social environment, and
physiological responses as determinants of motivated behaviour.
Prerequisite: 220.
2 hours lectures, 2 hours laboratory, half-year course.
410. **History and Systems.** An examination of current theoretical approaches to psychological problems presented in a historical context. 3 hours lectures.

430. **Problems in Contemporary Psychology.** Conducted, for the most part, as a seminar class, the purpose of this course will be to examine the latest developments in psychology, chiefly through journal publications, in order to evaluate contemporary trends in research and theory. 2 lectures.


499. **Senior Honours Essay.** Each student will work under the direction of a member of the department on an experimental study. The results 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. 5 hours supervised research, seminar.

**Graduate Course Descriptions**

611. **Human Factors Engineering I.** The human being as an element in an engineering system; his physical and mental capabilities and limitations; his assets and liabilities as compared to automatic elements; his physical mental requirements for optimum functioning as an element in a system.

612. **Human Factors Engineering II.** More advanced study of selected problems presented in Psychology 609, together with laboratory demonstrations.

620. **Educational Psychology.** An application of psychological principles to educational problems, together with a survey of relevant research findings concerning child and adolescent behaviour.

621. **Introduction to Clinical Psychology.** A critical evaluation of concepts and principles of particular concern to the clinical psychologist. The course will include historical developments, ethical problems, and role definition. Practicum involves presentation of clinical test materials with lectures pertaining to the development and reliability of, and the validation research on, each test.

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 and report writing.

623. **Personality Assessment.** This course deals with the nature, validity, and underlying assumptions of the major "diagnostic" clinical tests. Emphasis is
Department of Psychology

placed on the more difficult "projective" tests. Practicum work includes discussion and interpretation of protocols secured from hospital and reformatory populations.

624. Psychopathology. Course materials concern orientations to psychopathology, problems in current approaches, and suggestions for other theoretical systems. Practicum work involves collection of clinical data in a clinical setting under supervision of staff persons.

625. Psychotherapy. A detailed coverage of psychotherapeutic systems and theories of personality change and of related research.

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 I. This seminar is designed to enable individual staff members to present their current points of view and research contributions.

628. Seminar in Clinical Psychology II. Presentations by individual staff members supplementary to those given in 627.

629. 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.

630. Directed Study. This course offers an opportunity for students who have previously taken a half-year course in a specific area to explore selected problems in greater depth.

640. Selected Topics in Psychology.


702, 722, 742. Learning I, II, III. A series of seminars devoted to critical reviews of basic theoretical issues and recent advances in selected topics in learning.

703, 723, 743. Physiological and Comparative, I, II, III. A series of seminars in which implications of recent experimental advances in brain research and animal behavior will be presented and discussed.

704, 724, 744. Social Psychology, I, II, III. A series of seminars dealing with theoretical issues and research findings in the area of social psychology.

705, 725, 745. Child Psychology, I, II, III. A series of seminars dealing with recent experimental advances in the area of child psychology and with theoretical issues and research in the areas of child development and behavior.

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 students' major area of specialization, e.g., cognition, learning, motivation, perception.
## Religious Knowledge

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>50J</td>
<td>Grace and the Sacraments</td>
<td>Grace; concepts pertaining to all the sacraments; the meaning of sacramental life to the individual and to society. 3 lectures.</td>
</tr>
<tr>
<td>100G</td>
<td>Christian Foundations</td>
<td>An introductory survey course of the Old and the New Testament. It seeks to provide a unified view of the development of our Christian heritage from the history and faith of Israel through the life and teachings of Jesus. 3 lectures.</td>
</tr>
<tr>
<td>100J</td>
<td>Christian Apologetics</td>
<td>Establishment of the claims of Christianity; the divinity of Christ; the Church; sources of dogma; faith; God and His nature the divine attributes; the Trinity; Incarnation; Redemption; Mariology. 3 lectures.</td>
</tr>
</tbody>
</table>
| 100P        | 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. |
| 110P        | Christian Doctrine | An introductory survey of the basic tenets of Christian belief, including the doctrines of Revelation, of the Trinity, of Man of God's activity in History, of the Church, of Scripture. 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. |
| 200G        | 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. |
200J. Sacred Scriptures. Inspiration; origin; the canon of the Scriptures; manuscripts and versions; Biblical history of the Old and New Testaments. 3 lectures.

210G. Christian Heritage. A history of the Christian Church. Especially emphasized are: New Testament literature reflecting the Life and thought of the first-century church; developments in form and doctrine in the second to fifth centuries; the late medieval church; the Reformation, special attention being given to the Anabaptist movement by comparison with Roman, Anglican, Lutheran, and Reformed Christianity. 3 lectures.

220R. Christianity in Contemporary Humanism. An analysis of positive and negative emphases given to Christian themes in serious secular literature of the present day, particular attention being paid to secular and religious interpretations of the motif of love. 3 lectures.

300J. Catholic Social Doctrines. The Church and society; the pronouncements of the Church on civil, domestic, professional and international societies. 3 lectures.

Russian — See page 174.

Science

100. Introduction to General Science. A survey course for Arts students the first half of which is designed to give a basic grounding in the principles of physics and chemistry, and the historical development of scientific concepts.
and methods. The second half of the course is devoted to a study of science in the Twentieth Century, an examination of some of the more important recent developments, such as relativity, the quantum theory, nuclear physics, organic and biochemistry, genetics and evolution.

3 lectures per week.

400. The History and Philosophy of Science. The nature of science; science and technology in Egypt and Babylon. The development of science in Greece; the Orphic mysteries and the Ionian philosophers. Plato and Aristotle; Archimedes. The Alexandrian school and the separation of science and philosophy. Technology under the Roman Empire. The mediaeval attitude toward science. The Renaissance, Copernicus and Galileo. Sir Isaac Newton. The physical and biological sciences during the 18th century. Developments during the 19th century in Physics, Chemistry, Technology, Geology. Evolution, and the rise of modern Genetics. The 20th century revolution in pure science and technology.

2 lectures.

Department of Sociology and Anthropology

W. G. Scott, B.A. (Western), M.A. (Toronto)
Associate Professor and Acting Chairman of Department

J. W. Fretz, A.B. (Bluffton), M.A. Ph.D. (Chicago),
B.D. (Chicago Theol. Seminary) - - - Professor G.

N. H. High, B.S.A. (Toronto), M.S., Ph.D. (Cornell)
Professor and Dean of the Faculty of Arts

H. D. Kirk, B.S. (City College, New York), M.A.,
Ph.D. (Cornell) - - - - - Professor

W. L. Sauer, B.A. (Wayne State), M.A.,
Ph.D. (Michigan State) - - - - Associate Professor

A. J. Muntean, B.A. (Youngstown), M.A. (Michigan State)
Assistant Professor

N. L. Choate, C.R., B.A. (St. Mary's, Kentucky),
M.A. (St. Louis) - - - - - Lecturer J

E. S. Lucy, B.A. (Hobart College, Geneva, New York) - Lecturer

Sociology 100 or its equivalent is a prerequisite for all courses in the department beyond the 100 level. Courses at the 400 level are normally open only to Honours students but may be open to General students with the permission of the instructor.

General students majoring in Sociology must elect the following courses: Sociology 100, 201, 210, 320, 325 and either Sociology 300 and Sociology 301 or Sociology 339 and one other course in Sociology.

History, Mathematics and Science are desirable matriculation subjects for students proposing to major in Sociology.

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15. **Sociology.** A general introduction to the subject covering the main concepts, theories, and ideas and how they relate to the study of groups in society. 3 lectures, half course.

100. **Introductory Sociology.** The sociological approach to social phenomena emphasizing analytical concepts and tools of investigation. 3 lectures.

200.* **Physical Anthropology.** An introductory study with major emphasis on evolution as fact and theory; lectures and demonstrations on topics such as taxonomy, the place of primates, the preconditions of culture as related to the structure of behaviour of living primates, the nature of fossil evidence and the origin of Homo sapiens, anthropometry, race etc. 3 lectures, half course.

201.* **Cultural and Social Anthropology.** An introductory study of the nature of culture, its structural and dynamic aspects, variations; selected theories and case studies in cultural and social anthropology. 3 lectures, half course.

205G.* **Social Problems.** An analysis and interpretation of contemporary social problems and the dynamic forces creating them. 3 lectures, half course.

210.* **Introductory Social Psychology.** The place of interaction, language, and culture in the development of human identity. The analysis of interpersonal relationships in situational contexts. Determinants of definitions of situation, types of interpersonal strategies, representations and misrepresentations of self, empathy, role taking, and the imputation of motives. 3 lectures, half course.

211.* **Social Structure and Character.** The relationship between social organization and model as well as deviant personality types. Differential processes of socialization, and the effects of personality types on social organization. Social structures considered will include occupational, fraternal, and kinship groupings. 3 lectures, half course.

230G.* **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, half course.

240.* **Collective Behaviour.** The sociological analysis of the behavior of crowds, mobs, publics, and related phenomena and their relationships to social organization and social change. 3 lectures, half course.

241.* **Social Movements.** The sociological analysis of varieties of social movements and their relationships to social organization and social change. 3 lectures, half course.
250.* Crime and Society. Theories of criminal behaviour with emphasis on the relationship between the social structure and crime causation; patterns in criminal behaviour; review of significant research and statistics; prevention of crime and society's treatment of the criminal; the prison as a social institution. Although the orientation of the course is primarily theoretical some attention will be given to the field of applied criminology.
3 lectures, half course.

251.* Ethnic and Racial Relations. Relations between different racial and cultural groups; analysis of majority-minority group status.
3 lectures, half course.

260.* Population. The study of population as an area of sociological investigation; population size, composition, and distribution; population trends and problems. Special attention is given to the population of Canada.
3 lectures, half course.

261.* Human Ecology. Factors influencing the distribution and movement of populations with special emphasis on the community level.
3 lectures, half course.

270.* Communication. An analysis of the role of language and other symbol systems in social interaction; the interplay between communication and the social systems; the formation of attitudes through language; social and individual disorders as caused by, and reflected in, the breakdown in the communication process.
3 lectures, half course.

300.* Human Communities. A comparative analysis of different types of human communities from sociological and anthropological points of view mainly: primary emphasis on types of communities found in non-literate, folk and pre-industrial societies; major theories concerning communities of these types.
3 lectures, half course.

301.* Urban Sociology. The comparative study of urbanization as a process; the culture and social organization of cities, urban problems; special attention given to industrial cities of Western societies.
3 lectures, half course.

315. Social Stratification. Analysis of social classes in society including their basis for development, composition, and consequences for society.
3 lectures, half course.

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.
3 lectures.

335.* Sociology of Science. The study of science as an institution; its historical development and contemporary relationships with other institutions including government, education, and industry.
3 lectures, half course.

339.* Industrial Sociology. Sociological analysis of industry, including relationships between labor and management and industry and society. Separate sections will be arranged to meet the special demands of other departments and faculties.
3 lectures, half course.

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 function 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.
3 lectures, half course.

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, half course.

355.* Sociology of Religion. The analysis of religion as a social institution; its relationship to culture, personality and social change with considerations of theories of religious behaviour and contemporary research findings.
3 lectures, half course.

360.* Political Sociology. The sociological analysis of the institutionalization of power, political movements, parties, conflict and its accommodation.
3 lectures, half course.

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, half course.

380.* Sociology of Health and Welfare. The structure and processes of health and welfare services are examined as parts of the institutional network of North American society. Professionalization and bureaucratic organization as aids and obstacles toward institutionalized goals. The impact of scientific and technological changes on the structure of health and welfare services and career.
3 lectures, half course.

385.* Education and Society. The structure and processes of education are examined in relation to those of community and society. Schools as sources, recipients, and modifiers, of social and cultural changes. The selection, preparation, positions, and professionalization of personnel in relation to the institutionalized goals of education in North America Society.
3 lectures, half course.

430.* Sociology of Knowledge. An analysis of the social and cultural determinants of thought and its various forms of expression.
3 lectures half course.

1 - 3 hours.

465. Readings. Selected readings and essay assignments under the direction of a staff member.
3 - 4 hours.

470. Seminar. Seminar on selected topics conducted by one or more staff members.
1 - 3 hours.

499. Senior Honours Essay. Required of all honours students in Sociology or Psychology - Sociology in their fourth year.
Department of Spanish and Italian

J. C. McKegney, B.A. (Western), M.A. (Oregon), Ph.D. (Washington)
Associate Professor and Chairman of the Department

M. I. Kieffer, C.R., B.A., (St. Louis), M.A. (McGill), J.C.D. (Gregorian)
Professor J

J. C. Forster, B.A., M.A. (King's College, Cambridge)
Doctor en Filosofía y Letras (Granada)
Assistant Professor

D. Sardinha, M.A. (Toronto)
Lecturer

Rosario Hoefert (Mrs.), Bachillerato (Madrid)
Lecturer (part-time)

Spanish

General Arts students who wish to major in Spanish will take Spanish 100, 200, 300 and any two Honours Spanish courses chosen in consultation with the department chairman.

1-50. Introduction to Spanish. Intensive drill in the fundamentals of grammar and composition. The language laboratory will be used regularly.
No prerequisite, though the student should have Grade XIII French.
5 lectures.

100. Survey of Spanish Literature. Intensive review of grammar and composition. Survey of Spanish literature. The language laboratory will be used regularly.
Prerequisite: Spanish 1-50 or Grade XIII Spanish.
4 lectures.

200. Survey of the Spanish Novel. For students in General Arts only. Critical survey of representative Spanish novels, from Lazarillo de Tormes to the mid-twentieth century. Lectures, readings, reports.
Prerequisite: Spanish 100.
3 lectures.

210. Spanish Civilization. A study in English of the main historical and cultural currents in Spain and Spanish America. (Honours Spanish students may not take this course for credit.)
3 lectures.

Prerequisite: Spanish 100.
3 lectures.

260. Prose and Drama of the 18th and 19th Centuries. Critical reading of the principal authors and playwrights of the period. Lectures in Spanish, readings, reports.
Prerequisite: Spanish 100.
3 lectures.
Department of Spanish and Italian

300. Survey of the Spanish Drama. For students in General Arts only. Critical survey of representative Spanish plays, from Juan de Encina to the mid-twentieth century. Lectures, readings, reports.
Prerequisite: Spanish 200.
3 lectures.

350. Advanced Composition. Writing of essays based on critical examination of selected plays and novels; discussion, in Spanish, of these works; practice in the language laboratory.
Prerequisite: Spanish 250.
2 lectures.

360. Spanish Prose and Drama of the 16th and 17th Centuries. Critical study of the literature of the Spanish Golden Age.
Prerequisite: Spanish 260.
2 lectures.

2 hours.

370. Survey of Spanish American Literature. A critical study of Spanish American literature from the Cortés letters to the present.
Prerequisite: Spanish 100.
3 lectures.

375. Individual Playwrights of the Golden Age.
3 hours seminar.

450. Senior Spanish Composition and Oral Practice. The language laboratory will be used regularly.
Prerequisite: Spanish 350.
2 lectures.

455. Individual Writers of the Twentieth Century.
3 hours seminar.

460. Spanish Literature of the 20th Century. Critical examination of the works of the most significant writers of this Century.
Prerequisite: Spanish 360.
2 lectures.

465. Cervantes and His Age.
3 lectures.

470. Mediaeval Spanish. Study of the literature from the beginnings to 1500 A.D.; introduction to Old Spanish grammar; elementary Portuguese.
Prerequisite: Spanish 370.
2 lectures.

475. The Modernista Movement.
3 lectures.
476. The Novel in Mexico.
3 lectures.

480. Survey of Spanish Poetry. From the Poema del Cid to the present.
Lectures, reports.
Prerequisite: Spanish 300 or 360.
2 lectures.

Italian

12J. Beginning Italian. Grammar, composition, conversation. The Language Laboratory will be used.
4 lectures.

50J. Preliminary Year Italian. Intermediate grammar and composition. Translation of authors, conversation. The Language Laboratory will be used.
4 lectures.

100J. A Survey of Literature, with Grammar and Oral Practice.
3 lectures.

Ukrainian — See page 177.
VIII

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 industrial 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 industrial experience. Each co-ordinator is responsible for a designated area and is the liaison officer between the University and the employers of students in his territory. Each acts as a counsellor and advisor to these students.

Staff:

Director
A. S. Barber, P.Eng.

Assistant to the Director
D. V. Deverall, B.A. (Bishop's)

Engineering and Applied Physics

Assistant Director
G. L. White, B.A.Sc. (Toronto), P.Eng.

Staff Assistant
M. S. Stevens, B.Sc. (Queen's), P.Eng.

Co-ordinators
D. G. S. Anderson, B.A.Sc. (Toronto), P.Eng.
H. D. Ball, B.A. (Western), P.Eng.
L. B. Jones, B.A.Sc. (Toronto), P.Eng.
A. L. Lind, B.Sc. (Queen's), P.Eng.
A. M. Moon, B.A.Sc. (Toronto), P.Eng.
R. D. Mumford, B.Sc. (Queen's), P.Eng.
M. M. Smith, B.Sc. (Queen's), P.Eng.

Co-operative Mathematics

Senior Co-ordinator

Graduate Placement and Summer Employment
C. F. Burk, M.A.Sc. (Toronto), P.Eng.
The Co-operative (Work-Study) 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

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>1965</th>
<th>1966</th>
<th>1967</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Winter</td>
<td>Spring</td>
</tr>
<tr>
<td>Stream “A” 1st Term</td>
<td>Second Term</td>
<td>Work Period</td>
</tr>
<tr>
<td>Stream “B” 1st Term</td>
<td>Work Period</td>
<td>Second Term</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>1968</th>
<th>1969</th>
<th>1970</th>
</tr>
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<tbody>
<tr>
<td>Winter</td>
<td>Spring</td>
<td>Fall</td>
</tr>
<tr>
<td>Stream “A” 5th Term</td>
<td>Work Period</td>
<td>Sixth Term</td>
</tr>
<tr>
<td>Stream “B” Work Period</td>
<td>Fifth Term</td>
<td>Work Period</td>
</tr>
</tbody>
</table>
All Year I students enrol in September. These Year I 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 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. Precise dates for the beginning and end of various terms are shown in the Academic Calendar.

**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 implies that students will accept work assignments either through the regular interview procedure or where their best interests are served on an assignment that the Department may determine. All positions held by students must be approved by the Co-ordination Department in order to be considered as part of the required work assignments.

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 consultation does take place with the University's Co-ordination Department.

Although the Co-ordination Department does not guarantee placement of students in industry, every effort is made to ensure that appropriate employment is made available.

Job notices are posted on the bulletin boards and students are asked to examine the notices and indicate their interest by signing for an interview appointment. An interview schedule is prepared and the company representatives interview the students on campus. The experience obtained in dealing with industry 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 companies will not obtain the students they have selected. Consequently, the Department will make every effort to place these students and satisfy the companies 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.

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. Repetition of poor performance will
result in a required withdrawal from a co-operative course or suspension from the University. The Co-ordination Department maintains a close liaison with the faculties, with industry and with the students, so that a valid assessment of a student's progress can be made by members of the Department.

Remuneration during work assignments is in accordance with prevailing wage policies of the individual employers, and depends on the nature of the work being performed. Wages can be expected to increase when merited as the student progresses through the course and assumes more responsibility. However, the student should not ordinarily expect the income from his work periods to make him completely self-supporting.

The preparation of a "work report" by the student is required for each work assignment. The report must cover some phase of the student's current employment and it must be presented to, and be approved by, the employing company two weeks prior to the end of each term of employment. This report must then be submitted to the Co-ordination Department of the University.

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 chosen field as he progresses through the course.

It is emphasized that during the student's periods in industry he carries a responsibility to build and maintain his own good reputation as well as that of the University. Poor performance, unexcused absence from work, consistent lack of punctuality, inability to work with supervisors or fellow workers, lack of interest in the job, will be interpreted as an indication that he is not acceptable for professional training. A student who fails to honour an agreement to work with a company 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 breech 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 busi-
ness 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 industrial phases of his education.

**Industrial Advisory Council for the Co-operative Engineering Programme**

The Industrial Advisory Council is composed of delegates from companies interested in engineering education. The Council acts in an advisory capacity presenting industry's viewpoint to the University on the programming of the co-operative course at Waterloo as it affects the relations of the University and its students with industry.

<table>
<thead>
<tr>
<th>Dominion Textile Company Limited</th>
<th>Mr. K. C. F. Mills</th>
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<tr>
<td>Hydro-Electric Power Commission of Ontario</td>
<td>Mr. D. H. Cooke</td>
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<td>Noranda Mines Limited</td>
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Canadian General Electric Company Limited
Canadian Industries, Limited
Canadian Westinghouse Company Limited
Fiberglas Canada Limited
City of Hamilton
Cyanamid of Canada Limited
Dominion Tar and Chemical Company Limited
The Foundation Company of Canada, Limited
Hawker Siddeley Canada Limited
The International Nickel Co. of Canada Limited
John Inglis Company Limited
Kaufman Rubber (Ontario) Limited
Kimberly-Clark Pulp & Paper Co. Limited
Link-Belt Limited
Northern Electric Company Limited
C. C. Parker & Associates, Limited
Pigott Construction Company, Limited
Polymer Corporation Limited
The Steel Company of Canada, Limited
Trans Canada Pipe Lines Limited

Mr. W. F. McMullen
Dr. J. W. Tomecko
Mr. H. J. Simmons
Mr. A. J. Fisher
Mr. W. A. Wheten
Mr. H. B. Van Hartesveldt
Mr. G. F. Harrison
Mr. W. E. Hickey
Mr. W. D. Walker
Dr. S. H. Ward
Mr. H. B. Style
Mr. W. H. Bechtel
Mr. C. C. Wright
Mr. J. W. Lear
Mr. J. B. Hutchinson
Mr. C. C. Parker
Mr. D. H. Stevens
Mr. A. R. Powell
Mr. C. P. Layard
Mr. I. H. Fee

Companies Employing Co-operative
Honours Mathematics Students

The British American Oil Company Limited
The Bell Telephone Company of Canada

Canadian Canners Limited
Canadian Imperial Bank of Commerce
Canadian National Railways
Canadian Tire Corporation Limited
Canadian Westinghouse Company Limited
Chemcell (1963) Limited
Civil Service Commission of Canada
Confederation Life Association

Dominion Life Assurance Company
Dominion Textile Company Limited

Electric Reduction Company of Canada, Ltd.
The Empire Life Insurance Company
The Excelsior Life Insurance Company

Ford Motor Company of Canada, Limited

General Motors of Canada, Limited
Global Life Insurance Company
The Goodyear Tire & Rubber Company of Canada, Limited
The Hydro-Electric Power Commission of Ontario
International Business Machines Company Limited
International Harvester Company of Canada, Limited
KCS Limited
John Labatt Limited
The Manufacturers Life Insurance Company
Massey-Ferguson Limited
The Mutual Life Assurance Company of Canada
North American Life Assurance Company
Northern Electric Company Limited
The Northern Life Assurance Company
The Prudential Assurance Company Limited
Pulp & Paper Research Institute of Canada
Simpson-Sears Limited
The Steel Co. of Canada, Limited
Sun Life Assurance Company of Canada
Sun Oil Company Limited
Union Gas Co. of Canada, Limited
United Aircraft of Canada Limited
United Co-operatives of Ontario
Univac-Canada, Division of Remington-Rand Limited

Companies Employing Co-operative Engineering and Applied Physics Students

Aerovox Canada Limited
Air Canada
Alchem Limited
Algoma Ore Properties - Div. of The Algoma Steel Corporation, Limited
The Algoma Steel Corporation, Limited
Allen-Bradley Canada Limited
Aluminum Company of Canada, Limited
Aluminum Laboratories Limited
Anaconda American Brass Limited
R. V. Anderson & Associates Limited
Angelstone Limited
Atlas Steels Company Limited
Atomic Energy of Canada Limited
Aunor Gold Mines Limited
Automatic Electric (Canada) Limited
Automotive Hardware Limited
The Ault & Wiborg Co., of Canada Limited
Aviation Electric Limited

Babcock-Wilcox and Goldie-McCulloch Limited
Ball Brothers Limited
Barber-Colman of Canada Ltd.
Barnes Electric Company Limited
Bathurst Containers Limited
Beatty Bros. Limited
Beaver Construction Company
Bedard-Girard Limited
Beer Precast Concrete Limited
The Bell Telephone Company of Canada
Bendix-Eclipse of Canada Limited
Black Clawson-Kennedy Ltd.
Black & McDonald Limited
Blacktop Paving Company Limited
H. Boehmer & Company Limited
The Borden Chemical Company (Canada) Ltd.
Borg Fabrics Limited
Bowman, Black & Shoemaker, O.L.S.
Brant, County of
Brantford, The Corporation of the City of
Brantford Coach and Body Limited
Benco Machine & Tool Co. Ltd.
The British American Oil Company Limited
British Motor Corporation of Canada Limited
Brunner Mond Canada Limited
Building Products of Canada Limited
Burgess Battery Company - Div. of Servel (Canada) Limited
Burlington, Corporation of the Town of
Calvert Distillers Limited
Campbell Soup Company Ltd.
Canada Barrels & Kegs, Limited
Canada Cement Company, Limited
Canada and Dominion Sugar Company Limited
Canada Foundries & Forgings, Limited
Canada Iron Foundries, Limited - Tamper Division
Canada Machinery Corporation, Limited
The Canada Metal Co., Limited
Canada Packers Limited
Canada Sand Papers Limited
Canada Vitrified Products Limited
Canadair Limited
Canadian Admiral Corporation, Limited
Canadian Allis-Chalmers Limited
Canadian Aviation Electronics Ltd.
Canadian Bird Equipment Ltd.
The Canadian Blower & Forge Company Limited
Canadian Brass Limited
Canadian Broadcasting Corporation
The Canadian Coleman Company, Limited
Canadian Copper Refiners Limited
Canadian General Electric Company Limited
Canadian General-Tower Limited
Canadian Hanson & Van Winkle Company Ltd.
Canadian Industries Limited
Canadian Ingersoll-Rand Company Limited
Canadian Johns-Manville Co., Limited
Canadian Name Plate Co., Limited
Canadian National Railways
Canadian National Telecommunications
Canadian Pacific Railway
Canadian Pacific Telecommunications
Canadian Refractories Limited
Canadian Shipbuilding & Engineering Limited
Canadian SKF Company Limited
Canadian Standards Association
Canadian Steelcase Co., Ltd.
Canadian Thermos Products Limited
Canadian Underwriters' Association
Canadian Vickers Limited
Canadian Westinghouse Company Limited
Capital Wire Cloth Limited
Carter Bros. (Waterloo) Ltd.
Chatham, City of
Chicago Rawhide Products Canada Limited
Chrysler Canada Ltd.
Clare Brothers Limited
Cobalt Refinery Limited
Columbian Carbon (Canada) Ltd.
Columbus McKinnon Limited
Combustion Engineering-Superheater Ltd.
Concrete Pipe Limited
The Consolidated Mining and Smelting Company of Canada Limited
Consolidated Paper Corporation Limited
Consolidated Sand & Gravel Limited
The Consumers' Gas Company
Consumers Glass Company, Limited
Continental Can Company of Canada Limited
Controls Company Canada Limited
Cooper-Bessemer of Canada Ltd.
Corning Glass Works of Canada Ltd.
Coulter Copper & Brass Co., Limited
Crane Packing Company, Limited
Crowe Foundry Limited
CTS of Canada, Ltd.
Cutler-Hammer Canada Limited
Cyanamid of Canada Limited

Dahmer Steel Limited
Davis Controls Limited
Daystrom, Limited
Dayton Steel Foundry Canada Ltd.
Dearborn Chemical Company Ltd.
John Deere Welland Works
The De Havilland Aircraft of Canada, Limited
De Laval Company Limited
De Leuw, Cather & Company of Canada, Limited
Department of Highways, Ontario
Department of Mines, Ontario
Department of Transport, Ontario
Dickenson Mines Limited
Direct Winters Transport Limited
Dominion Bridge Company Limited
Dominion Chain Company Limited
Dominion Electrohome Industries Limited
Dominion Foundries and Steel, Limited
The Dominion Road Machinery Co., Limited
Dominion Rubber Company Limited
Dominion Tar & Chemical Company, Limited
Dominion Textile Company Limited
Domtar Chemicals Limited
Domtar Construction Materials Ltd.
Domtar Newsprint Limited
Domtar Pulp & Paper Limited
Dravo of Canada Limited
Dryden Chemicals Limited
Duncan-Reynolds Limited
Dunker Construction Limited
Dunlop Research Centre
Du Pont of Canada Limited

Eastern Construction Company Limited
Eastern Steel Products Company - Div. of Turnbull Elevator Limited
Eaton Automotive Canada Limited
The E. B. Eddy Company
Electric Reduction Company of Canada, Ltd.
Eldorado Mining and Refining Limited
Electrical Bureau of Canada
Emco Limited
Enelco Limited
E.S.A. (Canada) Limited
Ex-Cell-O Corporation of Canada, Limited
Fairgrieve & Son, Limited

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Falconbridge Nickel Mines Limited
Ferranti Electronics - Div. of Ferranti-Packard Electric Limited
Fiberglas Canada Limited
Firestone Tire & Rubber Company of Canada Limited
Fischer & Porter (Canada) Limited
Fisher Governor Company of Canada Limited
Flanagan & Black, Consulting Engineers
Ford Motor Company of Canada, Limited
The Foundation Company of Canada, Limited
Foxboro Company, Limited
Franklin Manufacturing Company (Canada) Limited
Fraser-Brace Engineering Company, Limited
The Frontier College
Fruehauf Trailer Company of Canada Limited

John Gaffney Construction Company Limited
Galt, City of
Galt Metal Industries Limited
Gamma Engineering Ltd., Consulting Engineers
Geco Mines Limited
General Concrete Ltd.
General Engineering Company Limited
General Motors of Canada, Limited
General Foods, Limited
General Steel Wares Limited
The General Tire and Rubber Company of Canada, Limited
Geocon Limited
G. M. Gest Contractors Ltd.
Giffels Associates Limited
The Glidden Company Limited
B. F. Goodrich Canada Limited
The Goodyear Tire & Rubber Company of Canada, Limited
Gore & Storrie Limited
W. R. Grace & Co. of Canada Ltd.
The Great Lakes Power Company, Limited
A. P. Green Fire Brick Co. Ltd.
Guelph Sand & Gravel Limited

Hallnor Mines, Limited
Hamilton, City of
Hamilton Gear and Machine Company - Div. of Turnbull Elevator Ltd.
Hayes Steel Products Limited
H. J. Heinz Company of Canada Ltd.
Hiroy Envelopes & Stationery Limited
H & O Centerless Grinding Limited
Holstead & Orendorff, O.L.S.
Honeywell Controls Limited
S. W. Hooper and Co. Ltd.
Horton Steel Works Limited
The Hydro-Electric Power Commission of Ontario

Imperial Oil Enterprises Ltd.
John Inglis Co. Limited
International Business Machines Company Limited
International Cellulose Research Limited
International Harvester Company of Canada, Limited
International Nickel Company of Canada, Limited
International Systcoms Limited
Interprovincial Pipe Line Company
Iron Ore Company of Canada
ITT Canada Limited

Jerrold Electronics (Canada) Limited
Johnson & Johnson Limited
S. C. Johnson & Son, Limited
Johnson Controls Limited
Joy Manufacturing Company (Canada) Limited

Henry J. Kaiser Company (Canada), Ltd.
Kam-Kotia Porcupine Mines Ltd.
Kaufman Rubber (Ontario) Limited
Kayson Plastics & Chemicals Limited
James R. Kearney Corporation of Canada, Limited
Keeprite Products Limited
Kellogg Company of Canada, Limited
Kerr-Addison Mines Limited
Kilborn Engineering Limited
Kimberly-Clark of Canada Limited
Kitchener, City of
Kitchener Electronic Industries Ltd.
Koehring-Waterous Ltd.
Konvey Construction Company Limited
Kralinator Filters Limited
The KVP Company Limited

Lackie Brothers Limited
Laughlin, Wyllie & Ufnal, Consulting Engineers
Lever Brothers Limited
Link-Belt Speeder (Canada) Limited
Litton Systems (Canada) Limited
Logan Contracting Limited
London, City of
Looby Construction Ltd.

McCormick & Rankin Limited
W. A. McDougall Limited
McIntyre Porcupine Mines, Limited
A. M. MacKay & Associates Limited
Arthur G. McKee & Company of Canada, Ltd.
MacLeod-Cockshutt Gold Mines Limited
McNamara Construction of Ontario Limited
Madsen Red Lake Gold Mines Limited
Marsland Engineering Limited
Massey-Ferguson Limited
Mattagami Lake Mines Limited
Measurement Engineering, Ltd.
Microwave Systems - Div. of Uni Tel Limited
Minnesota Mining & Manufacturing of Canada Limited
Molson's Brewery (Ontario) Limited
Montreal Engineering Company Limited
Moore Instrument Co. Ltd.
Morval Products Limited
Murray Printing & Gravure Limited

National Sewer Pipe Limited
National Silicates, Limited
National Sound Services Limited
National Starch and Chemical Co. (Canada) Ltd.
National Steel Car Corporation Limited
Naugatuck Chemicals - Div. of Dominion Rubber Company Limited
Niagara Falls, City of
R. H. Nichols Co. Limited
Noranda Copper Mills Ltd.
Noranda Mines, Limited
Northern Electric Company Limited
Northern Telephone Limited
North York, Township of

Oakville, Town of
Oakville, Public Utilities Commission of
Ontario Northland Communications
The Ontario Paper Company Limited
Otis Elevator Company Limited

Pamour Porcupine Mines, Limited
C. C. Parker and Associates Limited, Consulting Professional Engineers
Perkins Glue Company of Canada, Limited
Peterborough, City of
Philips & Roberts Limited, Consulting Engineers
Pigott Construction Company Limited
Pioneer Electric Eastern Limited
Pioneer Saws Ltd.
Polymer Corporation Limited
H. K. Porter Company (Canada) Limited
Potter & Brumfield - Div. of AMF Canada Limited
Powers Regulator Company of Canada, Limited
Pre-Con Murray Limited
Preston, Town of
Price Brothers & Company, Limited
Procor Limited
The Procter & Gamble Co. of Canada, Limited
Proctor & Redfern, Consulting Engineers
Provincial Gas Company Limited
Pulp and Paper Research Institute of Canada
Purolator Products (Canada) Limited
Pye Electronics Limited
Quemont Mining Corporation, Limited
Quist & Associates, Consulting Engineers

Raytheon Canada Limited
R.C.A. Victor Company, Ltd.
Renabie Mines Limited
Richards-Wilcox Company - Div. of General Products Mfg. Corp. Limited
Rio Algom Mines Limited
Wm. Roberts Electric Ltd.
P. L. Robertson Manufacturing Co., Limited
E. S. & A. Robinson (Canada) Limited
Roelofson Elevator Co., Limited
Ross of Canada - Div. of Midland-Ross of Canada Limited
Royal Metal Corp. Ltd.
Royal Military College of Canada

The St. Lawrence Seaway Authority
St. Mary's Cement Co., Limited
Sandwell and Company Limited
Sarnia Scaffolds Limited
J. M. Schneider Limited
Schwenger Construction Limited
Joseph E. Seagram & Sons, Limited
Sehl Engineering Limited
Shawinigan Chemicals Limited
Shell Canada Limited
Sherbrooke Machineries, Limited
Shore & Moffat and Partners, Architects & Engineers
Simplicity Products Ltd.
N. Slater Company - Div. of Slater Steel Industries Limited
Aden B. Snyder Electric Limited
Spruce Falls Power & Paper Co., Limited
Standard Prestressed Structures Limited
Standard Tube and T. I. Limited
The Steel Co. of Canada, Limited
Stephens-Adamson Mfg. Co. of Canada, Limited
Studebaker of Canada, Limited
Sudbury, City of
Summerhayes Industrial and Wood Products Limited
Sun Oil Company Limited
Sunshine Office Equipment Limited
Swift Canadian Co., Limited
Taylor Electric Mfg. Co., Limited
Texaco Canada Limited
Thermo Electric (Canada) Ltd.
Thompson Products Limited
Timberland-Ellicott Limited
Toronto, City of - Board of Education
Toronto, Municipality of Metropolitan - Dept. of Works
Toronto Transit Commission
The Torrington Manufacturing Co. of Canada Ltd.
Trans-Canada Pipe Lines Limited
Leo Tremblay, Electrical Contractors
W. A. Trow & Associates Ltd.
Turnbull Elevator of Canada Limited

Union Carbide Canada Limited
Union Gas Co. of Canada, Limited
United Aircraft of Canada Limited
United Steel Corp. Limited

James A. Vance Construction Limited
Varian Associates of Canada Ltd.
Vickers-Sperry of Canada Ltd.

Wakefield Lighting Limited
Wallaceburg Brass, Limited
The Warnock-Hersey Company Ltd.
Waterloo, City of
Waterloo, County of
Watts & Henderson Limited
Jervis B. Webb Company of Canada, Ltd.
Welding, Fittings & Flanges of Canada, Limited
Welland, County of
Wilcolator (Canada) Ltd.
Willroy Mines Ltd.
W. C. Wood Co., Limited
IX

General Information
General Information

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.

Residence

Students in all faculties are eligible to apply for residence in Conrad Grebel College, Renison College, St. Jerome's College, St. Paul's College or the University Residence Village.

Conrad Grebel College (Mennonite) offers residence accommodation for sixty-five men and forty women.

Renison College (Anglican) offers residence accommodation for one hundred and forty men and forty women.
St. Jerome's College (Roman Catholic) have available a men's residence with accommodation for one hundred students and a women's residence with accommodation for fifty-five students under the supervision of the School Sisters of Notre Dame.

St. Paul's United College offers accommodation for one hundred men and fifty women.

University of Waterloo Residence Village (non-denominational) offers accommodation for three hundred and sixty-six men and eighty-eight women.

Application forms for residence may be obtained from the Office of the Registrar or from the college or residence concerned.

Housing Service

The Housing Service provides assistance to students seeking residence accommodation off-campus in private homes. Inquiries should be made in person to the Secretary of the Housing Service, and freshmen students must bring with them proof of University admission. Off-campus housing is not supervised by the University. The Housing Service office is open Monday through Friday from nine to five.

Athletics

Facilities for athletics at the University centre around Seagram Stadium and Gymnasium located on the south-east border of the campus. Included in the athletic complex are a lighted football field seating 6,000, a quarter-mile track and related jumping and field event areas, a gymnasium for indoor activities as well as various practice and playing fields. The gymnasium is located adjacent to the football stands and contains facilities for basketball and other gym sports, weight-lifting and exercise rooms, training rooms with specialized equipment as well as complete locker and equipment rooms for both men and women. The athletic offices as well as the offices of the Department of Physical Education are located adjacent to the gymnasium.

Bookstore

University of Waterloo students may purchase textbooks, stationery and engineering supplies at the University's modern book store, located on the ground floor of the Engineering Building. The book store is open week days from 9:00 a.m. to 5:00 p.m. throughout the year. During the fall and winter when extension courses begin, the book store is also open from 7:00 p.m. to 9:00 p.m. In addition to textbooks, reference materials, paper supplies and drawing materials, the University of Waterloo book store also features the largest display of quality paperbacks in Kitchener-Waterloo.
Department of University Extension

"No man achieves his fullest potentiality without a challenge. One of the objectives of adult education is to supply the individual with a challenge, or a series of challenges, to grow intellectually until he achieves his ultimate potential development"

Robert E. Sharer

One of the responsibilities of a University is to provide opportunities for continuing education for adults. In the atmosphere of directed study, within the environment of academic disciplines, these opportunities can be fulfilled. Within this frame of reference the needs of our community, that can best be provided by a University, are the first concern.

To help undertake this expanding task many community leaders provide advice, counsel and guidance from their own experience. Interested groups co-sponsor both courses and programmes. We have been fortunate in finding dedicated citizens who, fully supporting the concept of continuing education, give freely of their time to help in the development of courses for the benefit of our citizens. Their many and varied interests are carefully considered before any programme reaches the calendar.

Conferences, Seminars and Workshops, many of which are enhanced by the availability of on-campus residences are designed to make the best use of the combined talents of scholars, business and community leaders. Many of the co-operative education programmes (courses co-sponsored by outside organizations and associations) for which the University is becoming widely known, are scheduled between 1 May and 1 September when the air-conditioned lecture and residences facilities are more generally available.
In the special area of business, in which most adults have little interest in attaining academic standing towards a degree, the "updating" and "refresher" approach recognizes and complements adult experience. Completely new and different programmes have been designed with this in mind. Our present programmes in Marketing reflect this philosophy in the imaginative development of several new courses, flexible in design, to meet the content needs and the format most suitable for management executives.

One of the exciting areas of interest to many adults is in the Liberal Arts. Non-vocational education is becoming a consuming interest in every community. No longer is it sufficient to be just professionally qualified, or to have been concerned with practical matters. Today's citizen, sharing his time between church, community and home activities, is turning increasingly towards the opportunities to greater understanding in social and humanistic subjects.

Administrative services are available to academic departments wishing to present special opportunities to secondary school teachers and students, professional associations or groups, and the general public through lectures, colloquia, seminars, conferences, workshops, intensive short courses and University orientation programmes in a particular discipline.

Courses not fully developed at the time of the publication of the Calendar will be advertised in sufficient time to acquaint the public.

Courses for which credits can be accumulated towards a degree are presented by the Department offering the subject. Any enquiries respecting eligibility, admission, fees, etc. should be made by telephone or in person to the Office of the Registrar, University of Waterloo, in the Arts Library.

Full details of all Extension courses, programmes and other offerings are listed in the University Extension Calendar. Further details or information is available by writing to the Director, Department of University Extension, University of Waterloo, Waterloo, Ontario.

There are two centres for library service and study on the campus. The beautiful new $2,525,000 Arts Library Building will be completed in 1965 and provides immediate accommodation on the second (main) floor and third floor for 140,000 volumes on the Humanities and Social Sciences, as well as seating space for 400 readers and quarters for the library administration and all technical services. University administrative and faculty offices are being housed temporarily on other floors of the library building. Future expansion of the building will provide ten floors with a total area of approximately 167,000 square feet.

The Engineering and Science Library has temporary quarters on the ground floor of the west wing of the Engineering Building. There you will find 40,000 volumes of books and bound periodicals in Science and Technology, 1,000 current journals, and a good selection of the important reference materials so
essential in a modern library of this kind. A permanent Engineering and Science Library is being planned.

Our total library holdings number more than 100,000 volumes of books and periodicals, 1800 current periodical subscriptions, and a growing collection of pamphlets, phonorecords, microfilms, and microcards. The collection is now increasing at the rate of 30,000 volumes per year.

A Library Handbook is issued to all students explaining the arrangement of library materials, the classification system, circulation procedures and general rules and regulations. Members of the library staff will be happy to assist students to make the best possible use of the library collections and facilities.

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.

Health Services

Health Centre - The Health Services offer a first-aid and medical care centre on campus with a Registered Nurse in attendance Monday through Friday from nine to five. The University Physician is available for consultation on campus at regular hours daily. A Counselling Psychologist is also available for consultation by appointment.

Health Insurance - Undergraduate students are covered from the date of registration by a University Health Insurance Plan. Graduate students who wish to participate in this insurance plan must make separate application to the secretary of the Health Services. Undergraduate students who do not wish this insurance and who can show proof of adequate coverage elsewhere may request a refund of the premium if application for premium refund is made within three weeks after registration.

Arts and Science students are insured from date of registration until completion of their last Spring examination or withdrawal from the course. Co-operative Engineering students are insured from date of registration for a period
of the eight months following, and therefore are covered while off campus in their work periods. Coverage ceases upon withdrawal from the course.

Further information about the University's Health Insurance Plan may be obtained from the secretary of the Health Services.

**Student Activities**

**Government** - Student Government at University of Waterloo is conducted by the Student Council. Officers and members are selected in an annual campus-wide election held each Spring.

All students are encouraged to participate in the activities and work of the Committees and Boards of Council.

These committees and boards are responsible to Student Council for all student extra-curricular clubs and organizations.

In addition to Student Council each faculty and college has a society which promotes activities of interest to its students.

**Clubs and Activities** - The Student Council sponsors a large number of clubs which encompass the social, cultural and athletic interests of students. The number and types of activity vary in proportion to student demand.

**Performing and Visual Arts** - The Theatre of the Arts provides University of Waterloo students with unique opportunities in music, art and drama. All students are able to receive professional assistance and guidance from University personnel in the use of the facilities and the development of skills and interests in these areas.

**Publications** - The Board of Publications is headed by a chairman responsible to Student Council and handles all student publications on campus. Student publications include the *Coryphaeus*, a weekly newspaper; *Compendium*, the student yearbook; *Volume 63*, a collection of national and international poetry; The Handbook Series which includes the Student-Faculty Directory and a number of small publications designed to guide and inform students in a wide variety of endeavours. All students interested in any aspect of writing, managing and publishing are encouraged to participate.

**Placement Service**

A Placement Service for graduates seeking permanent employment and undergraduates seeking summer employment is operated by the Department of Coordination and Placement, which is located in Room 234 in the Physics and Mathematics Building. This service is available to students of all faculties.

**The Canadian Officers' Training Corps (C.O.T.C.)**

1. The Canadian Officers' Training Corps offers undergraduates an opportunity to qualify for commissions in the Canadian Army, either Active or Reserve, through a training programme especially designed to meet their requirements.
2. Students are eligible who are:
(a) British subjects or Canadian citizens between the ages of seventeen and twenty-five.

(b) Of a physical standard suitable for the Canadian Army Active Force.

(c) Following a course of study leading to a recognized degree.

3. Training provided is in two parts:

(a) Two hours a week of theoretical training in military subjects during the academic year.

(b) Twelve to fifteen weeks of practical training during the summer.

4. Students accepted for C.O.T.C. training are granted the rank of Officer Cadet and at the end of two years training are commissioned as Second Lieutenants. They are eligible for pay according to their rank ($235.00 a month) for every full day of military duty. For this purpose, four hours of lectures during the academic year count as one day's duty; each day spent at summer camp, to a maximum of fifteen weeks, also counts.

Students wishing to apply for C.O.T.C. training should present themselves to:

D. V. Deverall
Department of Co-ordination and Placement

before November 1, after which no applications will be considered.

Regular Officers Training Plan (R.O.T.P.)

Under the R.O.T.P., undergraduates who are successful applicants are enrolled as Officer Cadets.

Applicants must be Canadian citizens or British subjects, single and under twenty-one at the commencement of their university or college training. If application is made prior to entry at university or college, it should be sent in writing to:

R.O.T.P. Selection Board.
National Defence Headquarters,
OTTAWA, Ontario.

If application is delayed until after admission to university, it should be sent to:

The District Recruiting Office,
KITCHENER, Ontario.

For successful applicants, the cost of tuition and other essential fees, will be borne by the Department of National Defence. The scale of pay and allowances under this plan is:

(a) During the academic year, pay of $73.00 a month and subsistence of $65.00 a month for a total of $138.00 a month. In addition to this an allowance of $75.00 a year will be provided for the purchase of books and instruments.
(b) During the period of practical summer training, pay of $73.00 a month with food and lodging provided.

Cadets will be issued with standard service uniforms and equipment. Free medical and dental care and annual leave with full pay will be received throughout the entire training period.

On successful completion of academic and military training, Cadets will be promoted to Commissioned Officer rank in the Regular Force. The privilege of release, if desired, will be honoured after three years' service as a commissioned officer.

*Note: Because of the requirement of three years' service in the Regular Force, students participating in the R.O.T.P. will not be able to undertake graduate work immediately.*
Financial Aid To Students
Undergraduate Scholarships

University of Waterloo National Scholarships

Four University of Waterloo National Scholarships are offered annually to students displaying exceptional academic ability. One award will be granted to a student from each of the following regions: the Maritime Provinces, Quebec, Ontario, the Western Provinces. Holders of these scholarships will receive the title of "University National Scholar" and will be so listed in University publications. Awards will be made by the Scholarships Committee under the following general conditions:

(a) Applicants must have attained a minimum average of 90% in the Ontario Grade XIII papers, or equivalent, required for admission to their particular faculty. A maximum of two Grade XIII papers, written in Grade XI and/or Grade XII in addition to taking the full Grade XI or Grade XII programme may be counted as part of the papers required for a Scholarship, provided that a full programme of papers is written and passed in Grade XIII year.

(b) The annual value of this award shall be the cost of tuition and incidental fees, as well as an additional $1,000 for the duration of the undergraduate course provided that, in the opinion of the awarding committee, the scholar maintains a sufficiently high academic standing.

(c) A University National Scholar is eligible to hold additional awards.

(d) Application must be made prior to June 1, on forms provided by the Office of the Registrar.

University of Waterloo Tuition Scholarships

University of Waterloo Tuition Scholarships are awarded annually to students of high academic achievement who are applying for entry to any faculty of the University, and to students proceeding to advanced years. Scholarship holders will receive the title of "University Scholar" and will be so listed in University publications.

Awards will be made by the Scholarships Committee under the following general conditions:

(a) Students entering the First Year must have attained a minimum average of 80% in the Ontario Grade XIII papers required for admission to their particular faculty.

A maximum of two Grade XIII papers, written in Grade XI and/or Grade XII in addition to taking the full Grade XI or Grade XII programme may be counted as part of the papers required for a Scholarship, provided that a full programme of papers is written and passed in the Grade XIII year.

(b) Students entering advanced years must have attained a minimum average of 80% in the final examinations of the preceding academic year.
Financial Aid — Undergraduate

(c) University of Waterloo Tuition Scholarships shall be renewable annually provided that, in the opinion of the awarding committee, the scholar maintains a sufficiently high academic standing.

(d) The value of the Scholarship shall be the value of the tuition fee and incidental fees of the holder. Residence fees are not included.

(e) A University Scholar is eligible to hold additional awards.

(f) Students entering the First Year must apply for the University of Waterloo Tuition Scholarships prior to June 1, on forms provided by the Office of the Registrar. No application is necessary for students in advanced years.

National and University Scholars

The following students have been named University National and University Scholars for the 1964-65 academic year.

University National Scholars

Bonnie Ann Barton
Richard Lawrence Ferch
James Keith Lindsey

University Scholars

James Edward Abel
David Ture Ahlberg
John Herman Ahrens
Linda Gail Allems
Diane Elaine Allen
Norman Evan Anderson
Wayne Hendry Anderson
William John Andres
Arni Neil Arnason
Janice Mary Arthur

James Robert Barney
Joan Elizabeth Bechler
Frank Peter Bilewicz
Dorothy Christine Black
Thomas David Bobier
Diane Margaret Boyle
Jorma Gunnar Braks
Laurie Ernest Bridger
Russell William Brown
John Wheelwright Browne
Esther May Brubacher
David John Busch
Lorne Daniel Byzyna

Keith Lester Carr
Robert Bruce Cavanagh

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<td>Melville Donald Patterson</td>
<td>Toronto, Ontario</td>
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<td>Philip Michael Pearson</td>
<td>Chatham, Ontario</td>
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<td>Robert James Poulton</td>
<td>Rexdale, Ontario</td>
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<td>Ross Laverne Prentice</td>
<td>Uxbridge, Ontario</td>
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<td>Aira Maire Pussinen</td>
<td>Port Arthur, Ontario</td>
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<tr>
<td>Sheila Ann Randall</td>
<td>North Bay, Ontario</td>
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<td>Robert Morton Raphael</td>
<td>Downsview, Ontario</td>
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<td>Irene Redekopp</td>
<td>St. Catharines, Ontario</td>
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<td>Philip Owen Redfern</td>
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<td>Robert Laurence Redman</td>
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<td>William Lynn Renwick</td>
<td>Fort Frances, Ontario</td>
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<td>William Simon Rickert</td>
<td>Waterloo, Ontario</td>
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<td>Carol Jean Robbins</td>
<td>Camp Borden, Ontario</td>
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<td>Carolyn Elizabeth Roberts</td>
<td>Burlington, Ontario</td>
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<td>David Robins</td>
<td>Thorold, Ontario</td>
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<td>Jane Elizabeth Robinson</td>
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<td>John Paul Robinson</td>
<td>St. Catharines, Ontario</td>
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<td>Robert Rosehart</td>
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<td>John William Rothwell</td>
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<td>David MacElrov Rupar</td>
<td>Sarnia, Ontario</td>
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<td>James Robert Ruppel</td>
<td>Elmira, Ontario</td>
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<td>Barbara Anne Samson</td>
<td>Waterloo, Ontario</td>
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<td>Gordon James Savage</td>
<td>Beamsville, Ontario</td>
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<tr>
<td>Brian Morris Schaefer</td>
<td>Teeswater, Ontario</td>
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<tr>
<td>Paul Jacob Schellenberg</td>
<td>Leamington, Ontario</td>
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<td>Jane Elizabeth Scherer</td>
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<td>Nancy Gertrude Schmidt</td>
<td>Elmira, Ontario</td>
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<td>Donna Marie Schnarr</td>
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<td>Heidi Schnegelsberg</td>
<td>Kitchener, Ontario</td>
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<td>David Allen Sheppard</td>
<td>Sarnia, Ontario</td>
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<td>Wayne Thomas Shier</td>
<td>Hanover, Ontario</td>
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<td>Carl Albert Silke</td>
<td>Pembroke, Ontario</td>
<td>Science I</td>
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<tr>
<td>Kathleen Jean Skelton</td>
<td>Kitchener, Ontario</td>
<td>Arts III</td>
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Financial Aid — Undergraduate

Edward Laurence Skiba  Brantford, Ontario  Engineering I
Lawrence Raymand Staszkowski  St. Catharines, Ontario  Science II
Hans Stelzer  Westhill, Ontario  Engineering I
Cornelius Daniel Stoffer  Owen Sound, Ontario  Engineering III
Mary Ann Stribel  Kitchener, Ontario  Arts I
David Allan Swayne  Smiths Falls, Ontario  Science II
Norman Fredrik Taylor  Concord, Ontario  Science I
Douglas Bruce Tennant  Rexdale, Ontario  Arts I
Melvin Sutherland Ternan  Arthur, Ontario  Engineering II
John Raymond Trebish  Meaford, Ontario  Engineering IV
Frederick Walter Tricker  Dresden, Ontario  Engineering II
Donald Wayne Trim  Preston, Ontario  Arts IV
David Bruce Trowbridge  Sarnia, Ontario  Engineering I
Harry VanderVelde  Newmarket, Ontario  Arts I
John Kenneth Vranch  Fort William, Ontario  Science IV
Marilyn Vranch  Fort William, Ontario  Science I
Ronald Kenneth Walker  Downsview, Ontario  Engineering II
Thomas Wayne Watts  Downsview, Ontario  Science I
Matthew Alexander Weatherbie  Toronto, Ontario  Arts I
Siegmund Paul Weigel  Kitchener, Ontario  Engineering II
Klaus Wensauer  Toronto, Ontario  Engineering I
Lawrence Alexander White  Kitchener, Ontario  Engineering IV
Beverley Jean Wilkinson  Port Arthur, Ontario  Science III
Kelly Blake Wilson  Ice Lake, Ontario  Engineering I
Vernon Eric Wilson  Humber Summit, Ontario  Engineering II
Diane Elizabeth Winkler  Kitchener, Ontario  Arts IV
Mark Stanley Wolynetz  Kitchener, Ontario  Arts I
Charles Robert Zarnke  Waterloo, Ontario  Science III

University of Waterloo Special Proficiency Scholarships

Any student who stands among the top one percent of Ontario students writing the annual Mathematical Association of America contest, the Canadian Association of Physicists contest, or other competitions of equivalent status conducted on a provincial or national scale will be invited to apply for University of Waterloo Special Proficiency Scholarships.

Awards will be made by the Scholarships Committee under the following general conditions:

(a) The amount of the scholarship shall be $3,000 ($600 in Year I, $800 in each of the three succeeding years), provided that, in the opinion of the awarding committee, the scholar maintains a sufficiently high academic standing.

(b) Selection from among the applicants shall be made by the committee in the light of achievement on the Ontario Grade XIII examinations. It is rec-
ommended that each applicant write the Ontario Grade XIII Problems paper, where applicable.

(c) Applicants must apply prior to June 1, on forms provided by the Office of the Registrar.

University of Waterloo First Year Scholarships

University of Waterloo First Year Scholarships are awarded annually to students entering the first year in any faculty, who have obtained an average of 75% in the Ontario Grade XIII papers required for admission to their particular faculty.

A maximum of two Grade XIII papers, written in Grade XI and/or Grade XII in addition to taking the full Grade XI or Grade XII programme may be counted as part of the papers required for a Scholarship, provided that a full programme of papers is written and passed in the Grade XIII year.

The value of the First Year Scholarships will be the cost of tuition and incidental fees for one year.

Applicants who attain an average of 80% will automatically be considered for University Tuition Scholarships.

Application must be made prior to June 1, on forms provided by the Office of the Registrar.

C. N. Weber Ltd. Scholarship

Undergraduates in Mechanical Engineering who have completed at least two academic years are eligible to apply for the C. N. Weber Ltd. Scholarship,
Financial Aid — Undergraduate

of the value of one thousand dollars ($1,000), offered by C. N. Weber Ltd., Kitchener. Selection by the Scholarships Committee will be guided by the candidate's high academic achievement as well as an interest in and contributions to undergraduate activities. Financial need will be taken into consideration. Normally, the candidate will receive the sum of five hundred dollars in each of the third and fourth academic years.

Application to the Registrar is required at entry to Third Year.

The R. G. Stanton Scholarship in Mathematics and Physics

The R. G. Stanton Scholarship will be of an amount of $3,600 ($600 in the first year of the course, and $1,000 in each succeeding year), it is tenable so long as the student remains registered in the Mathematics option of the Mathematics and Physics course at the University of Waterloo, and maintains first-class honour standing in that course. The scholarship will be awarded to the candidate who, receiving an average of 75% on the Ontario Grade XIII papers required for admission, obtains the highest average on the four Mathematics papers (Algebra, Geometry, Trigonometry, Problems). The candidate must have an average of 90% or better on these four papers to qualify.

In case the successful candidate qualifies for another University of Waterloo Scholarship, the amount of the R. G. Stanton Scholarship will be decreased by the amount of the other Scholarship.

If no award is made in any one year, the amount may, at the discretion of the donor, be used to offer four scholarships of $900 ($300 in each of the second, third and fourth years) to deserving students who have shown high ability in Mathematics.

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 XIII 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.

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 Scholarships Committee and no application is necessary.

The basis on which the awards are made includes the following:
(a) excellence in academic achievement;
(b) indications that the scholar will achieve distinction in the intellectual, cultural, or social life of our society.

J. P. Bickell Foundation Scholarships

For the academic year 1965-66, the Trustees of the J. P. Bickell Foundation will provide twelve J. P. Bickell Foundation scholarships of $250 each to be awarded to qualified students in the Chemical Engineering Department in any of the second, third, or fourth years of the course.

To be eligible for one of these scholarships a student must obtain an average of 75% in the previous term's examinations and maintain this standing throughout the course. The scholarship will be paid at the rate of $250 a term for up to six terms.

Awards will be made by the Scholarships Committee. No application is necessary.

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 Planning option of the Honours Geography programme. The student must have attained high academic standing and indicate an interest in planning. Application should be made to University Registrar.

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.

Canadian German Society Scholarship in German

A scholarship of $100 will be awarded annually in the Faculty of Arts by the Canadian German Society to an outstanding student majoring in German.

Canadian German Business Association Scholarship in German

A $300 annual scholarship will be awarded in the Faculty of Arts by the Canadian German Business Association of Toronto for students showing high proficiency and scholastic ability in German language and literature.
Financial Aid — Undergraduate

Undergraduate Bursaries

Note: Second Class standing is normally required of applicants for bursary assistance.

Atkinson Charitable Foundation Bursaries

With the consent and approval of the Minister of Education for the Province of Ontario, a university bursary programme, sponsored by the Atkinson Charitable Foundation, became effective in June, 1953. Students with an average of at least 66% on eight papers (or equivalent) of the Grade XIII examinations will be eligible for bursaries, provided they meet the admission requirements of the university concerned. Candidates must be residents of Ontario and be sponsored by their Secondary School principals. Final decision as to awards will be made by the university after investigation and assessment of applications. Bursaries will be granted to students of merit on the basis of $400.00 for students living away from home (in residence, or boarding while attending university), and $200.00 yearly for students residing within easy access to the university (where normal transportation costs do not exceed 75 cents daily). Applicants are free to select any course at one of the participating universities, provided such courses lead to a degree.

Atkinson Charitable Foundation “In Course” Bursaries

The Atkinson Charitable Foundation has established an “In Course” bursary programme in addition to the “Admission” bursary programme which the Foundation has supported since the 1953-54 academic year. The “In Course” programme gives assistance to students of merit and proven financial need beyond the first year. 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.

ATA Trucking Industry Educational Foundation Bursaries

The Automotive Transport Association Trucking Industry Educational Foundation was established in 1958 by a group of transport companies who decided to divert monies formerly spent in Christmas customer gift-giving to bursaries for deserving 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.

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 programme 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.

**Dominion-Provincial Student-Aid Bursaries, Type A**

Given by the Dominion and Provincial Governments, these bursaries have a maximum value of $250 to students attending university in the community in which they reside, and a maximum value of $500 to out-of-town students. They are intended "for students of good character, whose health and physical fitness are satisfactory to the Committee of Award, who meet the required academic standing, and who, without financial assistance, could not continue their studies." To apply, the student should consult his Secondary School principal not later than June 30th.

**Dominion-Provincial Student-Aid Bursaries, Type B**

These bursaries are given by the Dominion and Provincial Governments for students in any course who have attained at least 66% standings in their previous year's work, and who would find it impossible to continue their formal education without assistance. An applicant responsible for his own support shall have been a resident of Ontario for at least one year immediately prior to date of application. The parent or guardian of an applicant, other than an applicant responsible for his own support, shall have been a resident of Ontario for at least one year before the date of application. Application is to be made through the Office of the Registrar not later than October 8 for students beginning a new academic year in the Fall and by January 8 for students commencing in January.

**The Minnesota Mining and Manufacturing of Canada Limited Bursaries**

Two bursaries, to the value of $500 each, are offered annually by the Minnesota Mining and Manufacturing of Canada Limited. The bursaries 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.

**University of Waterloo Student-Aid Fund**

Beginning with the academic year 1961-62, students requiring financial assistance may apply for bursary aid through the University of Waterloo Student-
Financial Aid — Undergraduate

Aid Fund. Awards will be made by the Scholarships Committee. Second Class standing is normally required of applicants for bursary assistance.

Application may be made at any time during the academic year on the forms provided by the Office of the Registrar.

Dominion Rubber Student Aid Plan

Beginning with the academic year 1961-62 the Dominion Rubber Co. Limited 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 two academic years, 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.

Litton Systems Bursary

A bursary, to the value of $500, is offered annually by Litton Systems (Canada) Limited. The bursary may be awarded to students in the Faculty of Engineering with preference being given to those in the electronic or electro-mechanical fields. It is intended to provide financial assistance to undergraduates in need and may be held concurrently with other awards where the need exists.

Awards will be made by the Scholarships Committee and the amount available may be apportioned among two or more students. Applications for a bursary should be made to the 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 the son or daughter of a veteran.

Application should be made through the Office of the Registrar by October 15.

Ontario Culvert Bursary

One bursary, valued at $500 (i.e. $250 per academic term), is 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.

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.

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.

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.

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.

Huron County Bursary

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.

Undergraduate Prizes

Association of Professional Engineers Gold Medal for Academic Achievement Award

The Association of Professional Engineers of the Province of Ontario makes
Financial Aid — Undergraduate

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.

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.

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, novellette, 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 1966 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.

“Great Books of the Western World” Achievement Award
Two sets of “The Great Books of the Western World” will be offered annually
by Encyclopedia Britannica of Canada Ltd., as prizes to one student graduating in each of the Faculties of Science and Engineering.

The award will be based on scholastic achievement in subjects dealing with the humanities and social sciences and also in regard to participation in the intellectual and cultural life of the academic community.

No application is required. Selection will be made by the Scholarship Committee.

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 Botany as major subject and one registered with Chemistry as major subject. Qualifications are (a) a clear pass standing and (b) highest standing in Botany 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.

Senior Physics Prizes

One or two Senior Physics prizes of $100 each will be awarded annually to the highest First Class Honour students registered in the Fourth Year Honours Physics or Applied Physics course.

On occasion, a Second Year prize may be awarded in lieu of one of the Senior Prizes.

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.

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 enrol in the second year of an honours programme offered by the French Department.

Undergraduate Loans

Canada Student Loans Plan

This Plan, instituted by the Federal Government in 1964, was introduced to provide loans to supplement the resources of a student and/or the parents where, in the absence of such aid, a student would be unable to pursue a post-secondary education. A student should apply for a loan under this Plan.
for only the funds needed, over and above those from his own resources and/or those of his family, to enable him to continue his studies. The institution to which application is made will determine the amount of loan required in each case.

Borrowers under this Plan are required to repay principal and to pay interest, but no payments are required so long as the student is in full-time attendance at an eligible institution and for six months thereafter. Interest charges during this period are paid by the Federal Government who also guarantees the loan principal. After the interest-free period, repayment of principal and simple interest charges at 5 3/4% on the outstanding balance are required in regular monthly payments to the bank from the borrower. The maximum amount which may be advanced under this Plan to one student is $1,000 in one year. The maximum total indebtedness under this plan is $5,000.

Application should be made in the first instance to the Office of the Registrar. When a loan is approved, the institution will issue a Certificate of Eligibility which authorizes the student to make arrangements for the loan with any branch of any chartered bank in Canada.

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.

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.

Student Emergency Loan 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 Registrar's Office.

The Canadian Scholarship Trust Mid-Term Emergency Student Loan Fund
This loan fund is intended to assist students who, because of some unforeseen emergency in mid-term, might be unable to complete the year because of lack of money.
Applicants must have good academic standing and have reasonable prospects of successfully completing the year.

Loans will be interest-free during the time the student is attending, and for two years subsequent to leaving university or college. Thereafter, interest will be charged at 5 per cent per annum.

Further information may be obtained from the Registrar’s Office.

Transportation Assistance

The Provincial Government makes grants to students residing in territorial districts towards the cost of transportation between the university and the applicant’s home. The assistance is payable only towards the cost of one round trip in any school year.

Applications should be made through the Office of the Registrar not later than November 1, for students commencing a new academic year in the Fall and by February 1, for students commencing in January.

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. These fellowships carry a stipend of $275 per month. 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. Application for these must be filed by March 1.

National Research Council Postgraduate Scholarships and Postdoctorate Overseas Fellowships

The National Research Council awards each year, in open competition, a number of postgraduate 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.

Applications made on the approved form must be filed not later than January 15.

The Queen Elizabeth II Ontario Scholarships

In honour of the visit of Her Majesty Queen Elizabeth II to Ontario in July, 1959, the Government of the Province established a fund to provide annually
Financial Aid — Graduate

a number of postgraduate awards to be known as “The Queen Elizabeth II Ontario Scholarships.” In 1965 six such Scholarships, each of the value of $4,000 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.

Applications should be made prior to December 1, 1965.
Woodrow Wilson National Fellowship Foundation

The Woodrow Wilson National Fellowship Foundation offers 1,000 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 $1,500 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, 1965.

Imperial Oil Graduate Research Fellowships

Imperial Oil Limited in 1946 established for annual competition Graduate Research Fellowships, now five in number and having a value of $2,500 a year for a maximum of three years. A fellow may not hold concurrently other awards which annually total more than $1,500.

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 (3 fellowships), and Social Sciences and Humanities (2 fellowships).

Nominations of students for the fellowships shall be made by the University not later than March 1 of each year.

Consolidated Mining and Smelting Company Graduate Research Fellowships

The Consolidated Mining and Smelting Company Limited offers ten Graduate Research Fellowships annually for the academic years 1962-1966 for award at Canadian universities. At least five of these awards will be made to graduates undertaking study and research leading to an advanced degree at Western Canadian Universities (West of Ontario).

The Fellowships will be of the value of $2,200 and open to any Canadian citizen who is a graduate in Pure Science, Applied Science, or Agriculture. A Fellowship will normally be tenable for one year, however, application for a renewal of the award may be made in succeeding years.

The subject of research investigation to be carried out under the Fellowship programme shall be in the field of Pure or Applied Science bearing some relationship to the technical interests of the Company, viz., Mining, Geology, Metallurgy, Chemistry, Chemical Engineering, Physics, Agriculture, and Electrical, Civil, and Mechanical Engineering.

Applications should be forwarded to the Secretary, Canadian Universities Foundation, not later than February 1 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 $2,000 each.

The competition for these fellowships is open to permanent residents of Canada who are graduates of a Canadian university. A fellowship will normally be tenable for one year, but in special circumstances may be renewed for a second year.

Applications should be forwarded to the Secretary, Canadian Universities Foundation, not later than February 28, 1965.

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 Canadian Commonwealth Scholarship Committee, 75 Albert 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 $2,000 for an academic year and the period between academic years (12 months), are offered by the Province of Ontario. The minimum prerequisite is an Ontario Honours B.A. or its equivalent. A Fellow
pledges to give serious thought to a career in university teaching and during tenure he will undertake a full-time programme of graduate study. Fellowships are tenable only at Ontario universities and most awards will be made to candidates who are residents of Ontario.

Application is to be made on the prescribed form which may be obtained from the Office of the Registrar. Deadline date is February 15.

Frank H. Kortright, President, Canadian National Sportsmen's Show Fellowship

The Canadian National Sportsmen's Show offers a post-graduate fellowship to a student with a good academic background who wishes to do research in resources development and conservation within the framework of the graduate programme in Geography and Regional Planning. Application should be submitted to the Chairman of the Department of Geography.

The Shore Fellowship in Environmental Design

This Fellowship in the amount of $500 has just been established this year, and will be awarded to a full-time student registered as a candidate for the M.A.Sc. degree in the Department of Design.

Application should be made on the prescribed form which may be obtained from the Office of the Registrar.

The British American Oil Company Limited Graduate Fellowships

The British American Oil Company Limited offers five graduate fellowships to be awarded annually beginning in 1965-66, 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 National Conference of Canadian Universities and Colleges.

Graduate students in any field of study at member institutions of the National Conference of Canadian Universities and Colleges may apply for the awards.

Applications are to be sent directly to the Director of Awards, Canadian Universities Foundation. to arrive not later than March 1 each year.
XI

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and Staff
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A. K. Adlington—Secretary

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W. A. E. McBryde, M.A., Ph.D. (Dean of Science)
R. G. Stanton, M.A., Ph.D., F.S.S. (Dean of Graduate Studies)

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To 1966

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H. R. N. Eydt, M.Sc., Ph.D. (Science)

To 1967

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A. N. Sherbourne, B.Sc., B.S., M.S., M.A., Ph.D. (Engineering)
G. N. Soulis, B.A.Sc. (Engineering)
W. F. Forbes, D.I.C., Ph.D., D.Sc. (Science)
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To 1967

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I. Kruuv, M.Sc.
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To 1966

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(North Park Collegiate Institute, Brantford)

To 1967

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(Owen Sound Collegiate & Vocational Institute)
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Secondary School Liaison Officer
S. G. B. Robinson, B.A., B.Paed., LL.D.

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Director of Technical Services - (Mrs.) Margaret Beckman, B.A., B.L.S.
Head, Cataloguing Department - - - Robert Bean, B.A., B.L.S.
Head, Reference Department - (Miss) I. M. Belle Grant, B.Sc.,
B.L.S., M.A.L.S.
Head, Circulation Department - (Miss) Elaine Rcaman, A.T.C.M.
B.A., B.L.S.

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M.A.Sc., P.Eng.

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Purchasing Agent - - - - - - W. G. Deeks

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Assistant Director (Physical Plant) - - R. G. Titze, B.E.
Assistant Director (Planning) - - A. E. Lappin, P.Eng.

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University Physician - - (Mrs.) Helen Reesor, M.D.
University Counsellor - - K. S. Bowers, A.B., Ph.D.
University Nurse - - (Mrs.) Phyllis Livingston, Reg.N.

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Provost - - - - - - - to be appointed
Warden of Residence - - - - - to be appointed
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Dean of Women - - - - (Mrs.) D. Walter, B.A., M.A.
Assistant Dean of Women - - (Mrs.) H. Marsden, B.A.

Athletics
Director - - - - - - - - - C. A. W. Totzke, B.A.
Director of Women's Athletics - - (Miss) Ruth Hodgkinson,
B.P.H.E.
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Parkinson, D. - - - - Biology
Pathak, P. K. - - - - Mathematics
Patterson, E. P. - - - - History
Pearce, G. F. - - - - Mechanical Engineering
Pearson, N. - - - - Geography
Pei, D. C. T. - - - - Chemical Engineering
Penney, R. K. - - - - Psychology
Piekarski, K. R. - - - - Mechanical Engineering
Ponzo, P. J. - - - - Mathematics
Pooonoshab, H. B. - - - - Civil Engineering
Porter, R. L. - - - - Classics
Power, G. - - - - Biology
Pugliese, D. J. - - - - Physical Education
Qualter, T. H. - - - - Political Science
Ralston, Z. T., C.R. - - - - French
Ratz, H. C. - - - - Electrical Engineering
Reed, R. B. - - - - Mathematics
Rees, A. W. - - - - History
Reesor, G. G. - - - - Physics
Rhodes, E. - - - - Chemical Engineering
Rich, G., C.R. - - - - Classics
Richardson, J. R. - - - - Physics
Richter, M. - - - - German and Russian
Rigelhof, R. - - - - Mathematics
Roberts, D. - - - - Philosophy
Robertson, G. N. - - - - Mathematics
Rochester, M. G. - - - - Physics
Roe, P. H. - - - - Electrical Engineering
Ross, R. R. - - - - Psychology
Rowe, P. M. - - - - Psychology
Rund, Hanno - - - - Mathematics
Ryall, P. L. J. - - - - Mathematics
Salkauskas, K. - - - - Mathematics
Salzen, E. A. - - - - Psychology
Sardinha, D. - - - - Spanish and Italian
Sauer, W. L. - - - - Sociology
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Scott, J. D. - - - - Civil Engineering
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Scott, W. G. - - - - Sociology and Anthropology
Seiss, L. J. - - - - Religious Knowledge
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Shelest, W. - - - - German and Russian
Sherbourne, A. N. - - - - Civil Engineering
Sheridan, P. B., C.R. - - - - Philosophy
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<td>Zoltvany, Y. F.</td>
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XIII

Academic Calendar
Academic Calendar

The University of Waterloo reserves the right to change its academic calendar at any time.

1965-66

July 1, 1965 Thursday Lectures Begin—Post-Degree Programme
July 19 Monday Supplemental Examinations Begin—Arts, Engineering and Science
August 6 Friday Examinations End—Co-operative Programmes
August 11 Wednesday Lectures End—Post-Degree Programme
August 12 Thursday Examinations—Post-Degree Programme
August 13 Friday Spring Work Term Ends—Engineering and Applied Physics
August 16 Monday Fall Work Term Begins—Engineering and Applied Physics
August 27 Friday Spring Work Term Ends—Co-operative Mathematics
August 30 Monday Fall Work Term Begins—Co-operative Mathematics
September 6 Monday Labour Day—University Buildings Closed
September 9 Thursday Registration—Engineering and Applied Physics Year I
September 10 Friday Registration—Engineering and Applied Physics Advanced Years
September 13 Monday Lectures Begin—Engineering and Applied Physics
September 15 Wednesday Registration—Science, All Years
September 16 Thursday Registration—Arts - Year I (including Co-operative Mathematics)
September 17 Friday Registration—Arts - Advanced Years (including Co-operative Mathematics)
September 20 Monday Lectures Begin—Arts (including Co-operative Mathematics) and Science
September 25 Saturday Registration—Part-Time Undergraduates
September 27 Monday Registration—Graduate Studies
October 11 Monday Thanksgiving Day—University Buildings Closed
October 21 Thursday Meeting—Board of Governors
October 28 Thursday Meeting—University Senate
October 29 Friday Fall Convocation
November 8 Monday Supplemental Examinations Begin—Co-operative Programmes
November 11 Thursday Meeting—Board of Governors
December 16 Thursday Meeting—University Senate
### Academic Calendar

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<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Event</th>
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<tr>
<td>December 23</td>
<td>Thursday</td>
<td>Examinations End—Co-operative Programmes</td>
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<tr>
<td>December 23</td>
<td>Thursday</td>
<td>Lectures End—Regular Programmes</td>
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<tr>
<td>December 24</td>
<td>Friday</td>
<td>Fall Work Term Ends—Co-operative Programmes</td>
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<tr>
<td>December 25</td>
<td>Saturday</td>
<td>Christmas Day—University Buildings Closed</td>
</tr>
<tr>
<td>December 27</td>
<td>Monday</td>
<td>Winter Work Term Begins—Co-operative Programmes</td>
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<tr>
<td>December 29</td>
<td>Wednesday</td>
<td>Supplemental Examinations—Post Degree Programme</td>
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<tr>
<td>January 1, 1966</td>
<td>Saturday</td>
<td>New Year's Day—University Buildings Closed</td>
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<tr>
<td>January 3</td>
<td>Monday</td>
<td>Registration—Undergraduate Co-operative Programmes</td>
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<td>January 3</td>
<td>Monday</td>
<td>Lectures Begin—Regular Programmes</td>
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<tr>
<td>January 4</td>
<td>Tuesday</td>
<td>Lectures Begin—Co-operative Programmes</td>
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<td>January 6</td>
<td>Thursday</td>
<td>Registration—Winter Term—Graduate Students in Engineering</td>
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<td>January 20</td>
<td>Thursday</td>
<td>Meeting—Board of Governors</td>
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<tr>
<td>February 24</td>
<td>Thursday</td>
<td>Meeting—University Senate</td>
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<tr>
<td>March 14</td>
<td>Monday</td>
<td>Supplemental Examinations Begin—Co-operative Programmes</td>
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<tr>
<td>April 8</td>
<td>Friday</td>
<td>Good Friday—University Buildings Closed</td>
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<td>Friday</td>
<td>Examinations End—Engineering and Applied Physics</td>
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<td>Winter Work Term Ends—Engineering and Applied Physics</td>
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<td>April 18</td>
<td>Monday</td>
<td>Spring Work Term Begins—Engineering and Applied Physics</td>
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<td>April 21</td>
<td>Thursday</td>
<td>Meeting—Board of Governors</td>
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<td>April 25</td>
<td>Monday</td>
<td>Registration—Engineering and Applied Physics</td>
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<td>Lectures Begin—Engineering and Applied Physics</td>
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<td>Examinations End—Arts and Science (Except Applied Physics)</td>
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