University of Waterloo

Calendar 1964-65
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 232 of the Physics and Mathematics 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.
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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 40 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 building on the campus, the Chemistry-Chemical Engineering Building, was occupied in September, 1958. The second building, the Physics and Mathematics Building, was occupied in September, 1959. The Engineering Building was occupied in December, 1961. Construction of the Arts Building commenced during the Autumn of 1961 and was completed in August, 1962. All the University buildings are completely air-conditioned. The general administrative offices of the University are temporarily located in the Physics and Mathematics Building. The athletic facilities of the University are located at Seagram Stadium, and include a fully-equipped gymnasium, a quarter-mile track, and a football field. The University Cafeteria and the student offices are situated in Annex 2, a
temporary building east of the Engineering Building. The University greenhouse is situated to the south of the Chemistry-Chemical Engineering Building. A three floor Arts Library Building will be completed for the 1964-65 academic session. The Library will accommodate more than 900 readers and 200,000 volumes. Future expansion will provide up to ten floors.

Also ready for September 1964 will be a three floor, 144,000 square foot Chemistry and Biology Building.

Additional teaching buildings, University residences, an auditorium, and a student union building are to be completed within the next few years.

Students in all faculties are eligible to apply for residence in any of the Church Colleges. In addition, until such time as the University can provide additional residence facilities, suitable accommodation may be obtained, through the University Housing Service, in private homes.
II

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 study or group of studies. 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 participate in a variety of studies, especially in the First year. The programme of studies does demand also a measure of concentration of study 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 fifth 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
Degrees

Honours Courses (4 years)

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

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 at the University, ordinarily the applicant should have completed the requirements for the Ontario Secondary School Honour Graduation Diploma (Senior Matriculation) or its equivalent, showing an over-all average of 60% in nine Grade XIII papers, including:

- English (Composition and Literature)
- A language other than English (Authors and Composition)
- Five additional papers chosen wherever possible in accordance with the student's proposed major field of study.

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

Senior Matriculation (Grade XII)
Senior Matriculation (Grade XIII)
Senior Matriculation (Grade XII)
Senior Matriculation (Grade XIII)
Year I Memorial University
Senior Matriculation (Grade XII)
Third Year Certificate from Prince of Wales College
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.
The Scottish Leaving Certificate
High School Graduation plus an additional year of formal study in subjects comparable to Ontario Grade XIII.
Admission and Registration

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 21 Monday Year I
September 22 Tuesday Advanced Years

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 obtaining the necessary course card from 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.

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 Board of Governors reserves the right to make changes in the published schedule of fees without notice.

<table>
<thead>
<tr>
<th>Sessional Fees</th>
<th>$476.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuition</td>
<td>$435.00</td>
</tr>
<tr>
<td>Incidental*</td>
<td>41.50</td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

Part-Time Students

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

Miscellaneous Fees

- Examination — Supplemental, each paper $10.00
- Special, each paper 15.00
- Presiding fee (at an outside centre, each half day) 5.00

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.
Examinations and Promotions

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 department 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) 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 before the end of the examination period.

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</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>

Standing in an individual subject is determined by combining the marks assigned 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>
</tbody>
</table>
60 - 65%  C
50 - 59%  D
49 or less  F
Supplementals allowed  Conditional

(c) 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.

(d) 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.

(e) 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 of a regular programme at the final examination fails his year. He is not eligible for supplemental privileges.

(b) Any student granted permission to repeat his year must take a full complement of courses. The Dean may, at his discretion, grant the student credit for courses in which he has secured "A" standing.

(c) A student will ordinarily be granted the privilege of repeating one year only.

5. Supplemental Examinations

(a) To be eligible for supplemental examinations at the end of Year I, 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 I, 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 over-all 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 before July 1.

(e) A student may not write supplemental examinations to raise his standing in courses already passed.

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

**Academic Programmes**

1. Each student’s programme must be approved by the Dean and department chairman.

2. Year I is common to both the General and Honours Courses. Each student will 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;


**Year I (Common to both General and Honours Programmes)**

Two subjects from Group A
Two subjects from Group B
Two other subjects

**Notes:**

(i) 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,

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

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.
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 courses of study following this page for other departmental requirements.
Honours Economics

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

Year I (see page 17) Recommended Programme: Hours
Economics 100 3
Political Science 110 3
English 110 3
A language other than English or a Foreign Culture course 3
Mathematics 130 (see Note) 3
One Elective 3

Year II
Economics 250 3
Economics 260 3
Economics 251 or Mathematics 233 3
Two Electives 6

Year III
Economics 350 or 355 and two other third-year courses in Economics 9
Mathematics 236 2
One Elective 3

Year IV
Economics 450, 455, 460, 470 12
One Elective 3

Note: Students lacking three Grade XIII papers in Mathematics are required to make up their deficiency in Year I. All Honours students in Economics must complete Mathematics 130 and 236 by the end of Year III.
Honours English

Prerequisite: It is desirable, but not necessary, for a student planning to enter Honours English to offer, in addition to the compulsory English, Grade XIII papers in French, German, History and Latin.

Year I (see page 17) Recommended Programme: Hours
English 100 3
One of French 100, German 100, Latin 100 3-4
Philosophy 100 3
Psychology 100 3
History 100 3
Science 100 or a course in Religious Knowledge 4

Year II English 200, 250, 260, 270, 280 11½
Two supporting courses (see note) 6

Year III Examination on Summer Reading
English 350, 360, 370, 380 11
Classical Civilization 260 3
Philosophy 320 2
One or two supporting courses (see note) 3-6

Year IV Examination on Summer Reading
English 300, 451, 460, 470, 495 13
One or two supporting courses (see note) 3-6
Comprehensive Examination

Note: Supporting courses will be chosen in light of a student's vocational and academic interests and may be selected from the following: English 225, 310, 335, 390, 475; foreign language or literature courses; History 210, 250, 360, 450; Philosophy courses; Psychology 311, 352; Sociology courses; and courses in Religious Knowledge.

Honours English and French

Prerequisite: Students planning to enter the Honours programme in English and French are advised to offer Grade XIII German, History and Latin in addition to English and French.

Year I (see page 18) Recommended Programme: Hours
English 100 3
French 100A 4

21
History 100 or Philosophy 100
One of History 100, Philosophy 100, a course in German, Latin or Spanish
Psychology 100 or Political Science 100
Science 100 or a course in Religious Knowledge or a second Social Science

Year II
English 200, 250, 360
French 250, 260
Classical Civilization 260
One further course

Year III
Examination on Summer Reading
English 370, 380
French 350, 360, 370
History 360
One of English 260 (see note) or 270 or 280 or 300 or 350 or 470
further French course
History 260, 350
a further Philosophy course or a course in Religious Knowledge

Year IV
Examination on Summer Reading
English 451, 460
French 450, 460, 470, 480
Philosophy 320
Senior Honours Essay
Comprehensive Examination

Note: Students planning to enter the Ontario College of Education must choose English 260.

Honours English and German

Year I (see page 17) 
Recommended Programme:  
Hours
English 100
3
German 100
3
History 100 or Philosophy 100 (see note)
3
Psychology 100 or another social science
3
Two of French 100 or another language, German 250, History 100, Mathematics 130, Science 100, Philosophy 100, Religious Knowledge 100J or 110R, second social science course (see note) 5-7
Honours English and German

<table>
<thead>
<tr>
<th>Year</th>
<th>Courses</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year II</td>
<td>English 200, 250, 360</td>
<td>7½</td>
</tr>
<tr>
<td></td>
<td>German 250 (or, on approval, 270), 260</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Two other courses (see note)</td>
<td>4-6</td>
</tr>
<tr>
<td>Year III</td>
<td>English 370, 380</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>German 350, 360, 370, 380</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Philosophy 320</td>
<td>2</td>
</tr>
<tr>
<td>Year IV</td>
<td>English 451, 460</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>German 450, 460, 470</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>One other course (see note)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Senior Honours Essay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Comprehensive Examination</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Supporting courses will be chosen in light of a student's vocational goal and academic interests, and may be chosen from the following: Classical Civilization 250, 260, 350, 370; English 260; History 100, 350, 360; Science 100; Philosophy 100 and further courses in Philosophy; Religious Knowledge; other literary courses, in the original or in translation, or courses in the civilization of a country. (Students planning to enter the Ontario College of Education must include English 260 in their programme.)
### Honours English and History

**Year I** *(see page 17)*  
*Recommended Programme:*

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 100</td>
<td>3</td>
</tr>
<tr>
<td><em>One of French 100, German 100, Latin 100</em></td>
<td>3-4</td>
</tr>
<tr>
<td>History 110</td>
<td>3</td>
</tr>
<tr>
<td><em>Three of Economics 100, Geography 100, Science 100, Religious Knowledge</em></td>
<td>9-10</td>
</tr>
</tbody>
</table>

**Year II**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 200, 250, 360</td>
<td>7½</td>
</tr>
<tr>
<td>History 260, 360</td>
<td>6</td>
</tr>
<tr>
<td><em>One of Philosophy 100, Psychology 100</em></td>
<td>3</td>
</tr>
<tr>
<td><em>an advanced literature course</em></td>
<td></td>
</tr>
</tbody>
</table>

**Year III**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination on Summer Reading</td>
<td>5</td>
</tr>
<tr>
<td>English 370, 380</td>
<td></td>
</tr>
<tr>
<td><em>Three of History 250, 255, 350, 380</em></td>
<td>9</td>
</tr>
<tr>
<td>Geography 220, or Geography 321, or a course in Religious Knowledge</td>
<td>3</td>
</tr>
</tbody>
</table>

**Year IV**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination on Summer Reading</td>
<td>7</td>
</tr>
<tr>
<td>English 451, 460</td>
<td></td>
</tr>
<tr>
<td><em>One or two of English 260 (see note), 270, 280, 300, 350, 470</em></td>
<td>3-4</td>
</tr>
<tr>
<td><em>Three of History 450, 470-79, 480</em></td>
<td>7-8</td>
</tr>
<tr>
<td>Senior Honours Essay</td>
<td></td>
</tr>
<tr>
<td>Comprehensive Examination</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Students planning to enter the Ontario College of Education must choose English 260.

### Honours English and Latin

**Prerequisite:** Students planning to enter this course should offer Grade XIII papers in French, History, and either German or Greek, in addition to English and Latin.

**Year I** *(see page 17)*  
*Recommended Programme:*

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 100</td>
<td>3</td>
</tr>
<tr>
<td>Latin 100</td>
<td>3</td>
</tr>
<tr>
<td>Two courses in social sciences</td>
<td>6</td>
</tr>
<tr>
<td>History 100 or Philosophy 100</td>
<td>3</td>
</tr>
<tr>
<td>One elective <em>(see note)</em></td>
<td>3</td>
</tr>
</tbody>
</table>

**Year II**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 200, 250, 360</td>
<td>7½</td>
</tr>
<tr>
<td>Latin 250, 260</td>
<td>4</td>
</tr>
</tbody>
</table>
**Honours English and Latin**

<table>
<thead>
<tr>
<th>Year III</th>
<th>Year IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 370, 380</td>
<td>English 451, 460</td>
</tr>
<tr>
<td>Latin 350, 360, 370</td>
<td>Latin 450, 460, 470</td>
</tr>
<tr>
<td>Philosophy 320</td>
<td>One of Classical Civilization 350 or 360</td>
</tr>
<tr>
<td>One elective (see note)</td>
<td>English 260* or 270 or 280 or 300</td>
</tr>
<tr>
<td></td>
<td>or 470, further course in Philosophy</td>
</tr>
<tr>
<td></td>
<td>2-3</td>
</tr>
</tbody>
</table>

Senior Honours Essay

* Students planning to enter the Ontario College of Education must choose English 260.

**Note:** Before graduation a student will be expected to complete Science 100.

---

**Honours English and Philosophy**

**Year I (see page 17) Recommended Programme:**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>English 100</td>
<td>3</td>
</tr>
<tr>
<td>One of French 100, German 100, Latin 100, Greek 100</td>
<td>3-4</td>
</tr>
<tr>
<td>Philosophy 100</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 100 or Political Science 100</td>
<td>3</td>
</tr>
<tr>
<td>Science 100</td>
<td>4</td>
</tr>
<tr>
<td>One of History 100 or foreign language course</td>
<td>3-4</td>
</tr>
</tbody>
</table>

**Year II**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>English 200, 250, 360</td>
<td>7½</td>
</tr>
<tr>
<td>Philosophy 250, 260, 261</td>
<td>7</td>
</tr>
<tr>
<td>One of Classical Civilization 260, Psychology 100, Political Science 100, or a course in Religious Knowledge</td>
<td>3</td>
</tr>
</tbody>
</table>

**Year III**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination on Summer Reading</td>
<td></td>
</tr>
<tr>
<td>English 370, 380</td>
<td>6</td>
</tr>
<tr>
<td>Philosophy 300, 320, 340</td>
<td>7</td>
</tr>
<tr>
<td>One of English 260, 270, 280, 300, 350, 470 History 260, 350</td>
<td></td>
</tr>
<tr>
<td>Philosophy 330</td>
<td>2-3</td>
</tr>
</tbody>
</table>

**Year IV**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination on Summer Reading</td>
<td></td>
</tr>
<tr>
<td>English 451, 460</td>
<td>7</td>
</tr>
<tr>
<td>Three courses in Philosophy</td>
<td>6</td>
</tr>
</tbody>
</table>
**Honours English and Spanish**

**Prerequisite:**
Students planning to enter the honours programme in English and Spanish are advised to offer Grade XIII History and Latin in addition to English and French. 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 (see page 17)**

*Recommended Programme:*

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 100</td>
<td>3</td>
</tr>
<tr>
<td>French 100</td>
<td>4</td>
</tr>
<tr>
<td>Spanish 100</td>
<td>4</td>
</tr>
<tr>
<td>History 100 or Philosophy 100</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 100 or Political Science 100</td>
<td>3</td>
</tr>
<tr>
<td>Science 100 or a course in Religious Knowledge</td>
<td>4</td>
</tr>
</tbody>
</table>

**Year II**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 200, 250, 360</td>
<td>7½</td>
</tr>
<tr>
<td>Spanish 250, 260</td>
<td>6</td>
</tr>
<tr>
<td>Classical Civilization 260</td>
<td>3</td>
</tr>
<tr>
<td>Second course in the social sciences</td>
<td>3</td>
</tr>
</tbody>
</table>

**Year III**

*Examination on Summer Reading*

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 370, 380</td>
<td>6</td>
</tr>
<tr>
<td>Spanish 350, 360, 370</td>
<td>7</td>
</tr>
<tr>
<td>History 360</td>
<td>3</td>
</tr>
</tbody>
</table>

*One of English 260 (see note), 270, 280, 300, or 470*

*Further French course*

*History 260 or 350*

*Further Philosophy course*

*Further Spanish course* 2-3

**Year IV**

*Examination on Summer Reading*

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 451, 460</td>
<td>7</td>
</tr>
<tr>
<td>Spanish 450, 460, 470, 480</td>
<td>8</td>
</tr>
<tr>
<td>Philosophy 320</td>
<td>2</td>
</tr>
</tbody>
</table>

*Senior Honours Essay*

*Comprehensive Examination*

**Note:** Students planning to enter the Ontario College of Education must choose English 260.
### Honours French and German

#### Year I (see page 17)  
**Recommended Programme:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>French 100A</td>
<td>4</td>
</tr>
<tr>
<td>German 100</td>
<td>3</td>
</tr>
<tr>
<td><em>Two of History, English, Philosophy</em></td>
<td></td>
</tr>
<tr>
<td>One course in the social sciences</td>
<td>3</td>
</tr>
<tr>
<td>One elective (see note 1)</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Year II

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>French 250, 260</td>
<td>6</td>
</tr>
<tr>
<td>German 260, and one of 250, 270</td>
<td>6</td>
</tr>
<tr>
<td>Two electives</td>
<td>6</td>
</tr>
</tbody>
</table>

#### Year III

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>French 350, 360, 370</td>
<td>7</td>
</tr>
<tr>
<td>German 350, and two of 360, 370, 380</td>
<td>7</td>
</tr>
<tr>
<td>One elective</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Year IV

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>French 450, 460, 470, 480</td>
<td>8</td>
</tr>
<tr>
<td>German 450, 460, 470</td>
<td>7</td>
</tr>
<tr>
<td>One elective (see note 2)</td>
<td>3</td>
</tr>
</tbody>
</table>

**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 Latin

#### Year I (see page 18)  
**Recommended Programme:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latin 100</td>
<td>3</td>
</tr>
<tr>
<td>French 100A</td>
<td>4</td>
</tr>
<tr>
<td>Two courses in the social sciences</td>
<td>6</td>
</tr>
<tr>
<td>English 110 or History 200</td>
<td>3</td>
</tr>
<tr>
<td>One elective</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Year II

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latin 250, 251, 260</td>
<td>4</td>
</tr>
<tr>
<td>French 250, 260</td>
<td>6</td>
</tr>
<tr>
<td>Philosophy 100</td>
<td>3</td>
</tr>
<tr>
<td>One elective</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Year III

<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>French 350, 360, 370</td>
<td>7</td>
</tr>
<tr>
<td>One elective</td>
<td>3</td>
</tr>
</tbody>
</table>
### Year IV

<table>
<thead>
<tr>
<th>Language</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latin 450, 460, 470</td>
<td>7</td>
</tr>
<tr>
<td>French 450, 460, 470, 480</td>
<td>8</td>
</tr>
</tbody>
</table>

### 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.

<table>
<thead>
<tr>
<th>Year I (see page 17)</th>
<th>Recommended Programme:</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>French 100A</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Russian 1-50 or 100</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Two of History, English, Philosophy</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>One course in the social sciences</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>One elective (see note 1)</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year II</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>French 250, 260</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Russian 260 or 100 and one of 250, 370</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Two electives</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year III</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>French 350, 360, 370</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Russian 350, and two of 360, 370, 470</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>One elective</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year IV</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>French 450, 460, 470, 480</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Russian 450, 460, 480</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>One elective (see note 2)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Comprehensive Examination</td>
<td></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 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.

<table>
<thead>
<tr>
<th>Year I (see page 18)</th>
<th>Recommended Programme:</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>French 100A</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Spanish 100</td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>
### Honours French and Spanish

<table>
<thead>
<tr>
<th>Year</th>
<th>Courses</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>French 250, 260, Spanish 250, 260, History 260, Italian 50J (for those who took 12J) or one elective</td>
<td>6</td>
</tr>
<tr>
<td>III</td>
<td>French 350, 360, 370, Spanish 350, 360, 370, English 380</td>
<td>7</td>
</tr>
<tr>
<td>IV</td>
<td>French 450, 460, 470, 480, Spanish 450, 460, 470, 480</td>
<td>8</td>
</tr>
</tbody>
</table>

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>I (see page 18)</td>
<td><strong>Geography 100</strong>&lt;br&gt;One of French 100, German 100, Spanish 100, Russian 100 (French preferred)&lt;br&gt;Four courses chosen after consultation with Department of Geography</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>II</td>
<td>Geography 200*, 260*, 220, 275&lt;br&gt;Three courses other than Geography (Economics 100 if not previously taken)</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>III</td>
<td>Geography 300, 310, 375&lt;br&gt;Three additional courses (one must be other than Geography)</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>IV</td>
<td>Geography 420, 421-29, 480, 490&lt;br&gt;One course other than Geography</td>
<td>10-11</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 1964-65 Geography 200 will be given in the fall term, 260 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</th>
<th>Recommended Programme:</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Geography 100</td>
<td>Lectures Labs.</td>
</tr>
<tr>
<td></td>
<td>One of French 100, German 100, Spanish 100, Russian 100 (French preferred)</td>
<td>2 2</td>
</tr>
<tr>
<td></td>
<td>Four courses chosen after consultation with Department of Geography</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Geography 200*, 260*, 220, 275</td>
<td>7 4</td>
</tr>
<tr>
<td></td>
<td>Three courses other than Geography (Economics 100 if not previously taken)</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Geography 300, 310, 350, 355, 356</td>
<td>9 6</td>
</tr>
<tr>
<td></td>
<td>One course other than Geography</td>
<td>3</td>
</tr>
<tr>
<td>IV</td>
<td>Geography 456, 480, 490</td>
<td>7-8</td>
</tr>
<tr>
<td></td>
<td>One of Geography 345, 420, 421-29, 450</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One course other than Geography</td>
<td>3</td>
</tr>
</tbody>
</table>

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 1964-65 Geography 200 will be given in the fall term, 260 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 other work related to planning.
Honours German and Russian

Year I (see page 17) *Recommended Programme:*

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>German 100</td>
<td>3</td>
</tr>
<tr>
<td>Russian 1-50 or 100</td>
<td>5-3</td>
</tr>
<tr>
<td>Two of History, English, Philosophy</td>
<td>6</td>
</tr>
<tr>
<td>One course in the social sciences</td>
<td>3</td>
</tr>
<tr>
<td>One elective (see note 1)</td>
<td></td>
</tr>
</tbody>
</table>

Year II

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>German 260 and one of 250, 270</td>
<td>6</td>
</tr>
<tr>
<td>Russian 260 or 100 and one of 250, 270</td>
<td>6</td>
</tr>
<tr>
<td>Two electives</td>
<td>6</td>
</tr>
</tbody>
</table>

Year III

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>German 350, two of 360, 370, 380</td>
<td>8</td>
</tr>
<tr>
<td>Russian 350, 360 or 260 and one of 370, 470</td>
<td>8</td>
</tr>
<tr>
<td>One elective</td>
<td>3</td>
</tr>
</tbody>
</table>

Year IV

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>German 450, 460, 470</td>
<td>7</td>
</tr>
<tr>
<td>Russian 450, 460, 470, 480</td>
<td>9</td>
</tr>
<tr>
<td>One elective (see note 2)</td>
<td>3</td>
</tr>
<tr>
<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 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 (see page 18) *Recommended Programme:*

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>History 110</td>
<td>3</td>
</tr>
<tr>
<td>English 100</td>
<td>3</td>
</tr>
<tr>
<td>Philosophy 100</td>
<td>3</td>
</tr>
<tr>
<td>One of French 100, German 100, Latin 100</td>
<td>3</td>
</tr>
<tr>
<td>(or an acceptable alternative language)</td>
<td></td>
</tr>
<tr>
<td>Two of Economics 100, Geography 100,</td>
<td>6</td>
</tr>
<tr>
<td>Political Science 100</td>
<td></td>
</tr>
</tbody>
</table>
Year II

History 250, 255, 260, 299 7

One of History 220, 270, 275, 276, 277, 280, 285, 290 3

English 200 3

Two of Introduction to General Science, Economics, Geography, Philosophy, Political Science, Religious Knowledge, Sociology 6

Year III

Examination on Summer Reading

Three of History 350, (361 or 362), 370, 380 9

Three other courses (see note 1) 9

Year IV

Examination on Summer Reading

History 499 and two of History 470, 471, 472, 473, 474, 475 5

Three of History or approved alternative senior courses (see note 2) 6-9

Comprehensive Examination

Notes:

1. By the end of Year III a sequence of at least two courses should be completed in both the humanities and social sciences in addition to History.

2. Such alternative senior courses may be chosen from 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 Mathematics

Prerequisite: Students entering this programme should have an over-all 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 over-all average of 60% in each year.

Year I (see page 17) 

Recommended Programme:

Mathematics 130, 131 6

Four other courses, one of which may be Mathematics 132

Year II

Mathematics 230, 231, 232, 233 11

Three electives, one of which may be chosen from Mathematics 234, 235 8

32
<table>
<thead>
<tr>
<th>Year</th>
<th>Option</th>
<th>Courses</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>(Pure Mathematics Option)</td>
<td>Mathematics 330, 331, 332, 333</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two additional Mathematics courses</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two electives</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>(Statistics and Actuarial Mathematics Option)</td>
<td>Mathematics 331, 332, 334, 335</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two courses chosen from Mathematics 330, 333, 336, 338</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two electives</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>(Teaching Option)</td>
<td>Mathematics 330, 331, 332, 334</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One additional Mathematics course</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two electives</td>
<td>6</td>
</tr>
<tr>
<td>IV</td>
<td>(Pure Mathematics Option)</td>
<td>Mathematics 430, 431, 432, 433, 434</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One additional Mathematics course</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two electives</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>(Statistics and Actuarial Mathematics Option)</td>
<td>Mathematics 435, 438</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One of Mathematics 433, 437</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Three courses from Mathematics 430, 436, 439, 440, 444, 447</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two electives</td>
<td>6</td>
</tr>
</tbody>
</table>
(Teaching Option)
Mathematics 446
Four additional Mathematics courses numbered above 200
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.

As this Calendar was being printed, approval was given by the University Senate to a Co-operative Mathematics programme in the Faculty of Arts. The programme is the same as the four-year Honour Mathematics programme outlined here except it is offered on the work-study plan as explained in Section VIII. The regular Honours Mathematics programme will continue as before.

For a brochure outlining the Co-operative Mathematics programme in detail please write to The Registrar.

Honours Mathematics and Philosophy

Year I (see page 17)  Recommended Programme:  Hours
English 100  3
Philosophy 100  3
A foreign language  3
One course in the social sciences  3
Mathematics 130, 131  6

Year II
Mathematics 230, 231, 232  8
Philosophy 260, 261  6
Elective  3

Year III
Mathematics 330, 332, 233, 234  10
Philosophy 300, 220  6
One of Philosophy 301, 320, 330, 340  2

Year IV
Mathematics 331, 337, 433, 446  7
Philosophy 499  1
Two of Philosophy 450-489  4
Elective (may be another Math.)  2-3
Honours Mathematics and Psychology

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

<table>
<thead>
<tr>
<th>Year I (see page 18)</th>
<th>Recommended Programme:</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Lectures</strong></td>
<td><strong>Labs.</strong></td>
</tr>
<tr>
<td>Mathematics 130, 131, 132</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 110</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Philosophy 100</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>A language other than English</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Biology (see note 1)</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

| Year II | Mathematics 230, 231, 232 | 8 | - |
|         | Psychology 220 | 2 | 2 |
|         | One other course in Psychology at the 250-299 level | 2 | 2 |
|         | Philosophy 220 | 3 | - |
|         | Biology or Zoology (see note 1) | 2 | 2 |

| Year III | Mathematics 233, 331, 332 | 6 | 2 |
|          | Psychology 321, 322 | 2-3 | 2 |
|          | One other course in Psychology at the 350-399 level | 2-3 | 0-2 |
|          | Philosophy 340 | 2 | - |

| Year IV | Mathematics 439 or 449 | 2 | - |
|         | Two of Mathematics 333, 334, 335, 446 | 4 | 0-2 |
|         | Psychology 430, 499 | 2 | 5 |
|         | Elective (may be another Math. or Psych.) | 2-3 | - |

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

Honours Philosophy

<table>
<thead>
<tr>
<th>Year I (see page 17)</th>
<th>Recommended Programme:</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philosophy 100</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>One of French 100, German 100, Latin 100, or Greek 100</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>One of Psychology 100, Sociology 100</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Two of Mathematics 130, Mathematics 131, Political Science 100, or Economics 100 or Geography 100</td>
<td>6</td>
<td>35</td>
</tr>
</tbody>
</table>
History 100
A Natural Science
Another language

Year II
Philosophy 250, 260, 261
Three other courses, one of which should be in the general area of the humanities

Year III
Philosophy 300, 220
Two of Philosophy 301, 320, 330, 340
Two electives

Year IV
Philosophy 450 or 460
Philosophy 470, 499
Three of Philosophy 458, 480-9, 452, 453, 454, 455, 456, 457
One elective

Honours Philosophy and Literature

Year I (see page 17)  
Recommended Programme:  
Philosophy 100  
French 100A (or German 100)  
English*  
A Social Science  
Two of A Natural Science  
Mathematics  
History  
Another language**  
Another Social Science  

Year II
Philosophy 250, 260, 261  
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 300  
Two of Philosophy 310, 320, 330, 340  
French 350, 360, 370  
(or German 350, 360, 380)  
One elective

* 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.
Honours Philosophy and Literature

**Year IV**

Three courses in Philosophy, one of which may be from the 300 level
French 450, 460, 470, 480
(or German 450, 460, 470)
Senior Essay

Honours Philosophy and Psychology

**Year I (see page 17)**

<table>
<thead>
<tr>
<th>Recommended Programme:</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philosophy 100</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 110</td>
<td>3</td>
</tr>
<tr>
<td>A language other than English</td>
<td>3</td>
</tr>
<tr>
<td>English 110</td>
<td>3</td>
</tr>
<tr>
<td>A Social Science other than Psychology</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics or a Natural Science</td>
<td>2-3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year II</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Philosophy 220, 260, 261</td>
<td>9</td>
</tr>
<tr>
<td>Psychology 211, 212, 220</td>
<td>5</td>
</tr>
<tr>
<td>Psychology 270</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics, a Natural Science, or a Social Science other than Psychology</td>
<td>2-3</td>
</tr>
</tbody>
</table>

(see note 1)

<table>
<thead>
<tr>
<th>Year III</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Philosophy 250, 360</td>
<td>4</td>
</tr>
<tr>
<td>Two other courses in Philosophy</td>
<td>6</td>
</tr>
<tr>
<td>Psychology 311, 351, and 352 or 390</td>
<td>2-3</td>
</tr>
<tr>
<td>Mathematics, a Natural Science, or a Social Science other than Psychology</td>
<td>2-3</td>
</tr>
</tbody>
</table>

(see note 1)

<table>
<thead>
<tr>
<th>Year IV</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Philosophy 450</td>
<td>2</td>
</tr>
<tr>
<td>One other course in Philosophy</td>
<td>2-3</td>
</tr>
<tr>
<td>Psychology 410, 430</td>
<td>5</td>
</tr>
<tr>
<td>Senior Honours Essay</td>
<td></td>
</tr>
<tr>
<td>(Philosophy-Psychology 499)</td>
<td></td>
</tr>
<tr>
<td>An elective</td>
<td>2-3</td>
</tr>
</tbody>
</table>

**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.
Honours Political Science

Year I (see page 17)  
*Recommended Programme:*  
<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Political Science 110</td>
<td>3</td>
</tr>
<tr>
<td>One of Economics 100, Psychology 100,</td>
<td>3</td>
</tr>
<tr>
<td>Sociology 100, Geography 100</td>
<td>3</td>
</tr>
<tr>
<td>One of History 100, another approved History course, Philosophy 100</td>
<td>3</td>
</tr>
<tr>
<td>One of English 110, a Foreign Language, a Foreign Culture Course</td>
<td>3</td>
</tr>
<tr>
<td>Two other courses to be selected in consultation with the Department</td>
<td>6</td>
</tr>
</tbody>
</table>

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

Year III  
Four Political Science courses selected in consultation with the Department  
Two other approved courses  

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

Honours Psychology

Year I (see page 17)  
*Recommended Programme:*  
<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychology 110</td>
<td>3</td>
</tr>
<tr>
<td>Philosophy 100</td>
<td>3</td>
</tr>
<tr>
<td>Biology (see note 1)</td>
<td>2</td>
</tr>
<tr>
<td>A language other than English (see note 2)</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics (see note 3)</td>
<td>3</td>
</tr>
<tr>
<td>A Social Science other than Psychology or a Natural Science other than Biology</td>
<td>2-3</td>
</tr>
</tbody>
</table>

Year II  
Psychology 220  
Two other full-year courses in Psychology or the equivalent in half-year courses  
Philosophy 220 or Mathematics (see note 3)  

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4-5</td>
<td>2-4</td>
</tr>
<tr>
<td>2-3</td>
<td>-</td>
</tr>
</tbody>
</table>
### Honours Psychology

<table>
<thead>
<tr>
<th>Year</th>
<th>Courses</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Psychology 311, 321, 322</td>
<td>5</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>
</tr>
<tr>
<td></td>
<td>Philosophy or Mathematics (see note 3)</td>
<td>2-3</td>
</tr>
<tr>
<td></td>
<td>A Natural Science or a Social Science other than Psychology</td>
<td>2-3</td>
</tr>
</tbody>
</table>

### Year IV

<table>
<thead>
<tr>
<th>Courses</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychology 410 and 499</td>
<td>3</td>
</tr>
<tr>
<td>One full-year Psychology course, or two half-year courses at the honour level</td>
<td>2-3</td>
</tr>
<tr>
<td>Mathematics 449</td>
<td>2</td>
</tr>
<tr>
<td>A Natural Science or a Social Science other than Psychology</td>
<td>2-3</td>
</tr>
</tbody>
</table>

### 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.

### Honours Psychology and Sociology

#### Year I (see page 17)

<table>
<thead>
<tr>
<th>Recommended Programme</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychology 110</td>
<td>3</td>
</tr>
<tr>
<td>Sociology 100</td>
<td>3</td>
</tr>
<tr>
<td>Philosophy 100</td>
<td>3</td>
</tr>
<tr>
<td>Biology (see note 1)</td>
<td>2</td>
</tr>
<tr>
<td>A language other than English</td>
<td>3</td>
</tr>
<tr>
<td>Elective (see note 2)</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Year II

<table>
<thead>
<tr>
<th>Courses</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychology 211, 212, and 220</td>
<td>5</td>
</tr>
<tr>
<td>Sociology — two courses at the 200 level</td>
<td>6</td>
</tr>
<tr>
<td>Philosophy 220</td>
<td>3</td>
</tr>
<tr>
<td>Elective (see note 2)</td>
<td>2-3</td>
</tr>
</tbody>
</table>

#### Year III

<table>
<thead>
<tr>
<th>Courses</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychology 311, 351, 352</td>
<td>6</td>
</tr>
<tr>
<td>Sociology 320, and one other course in Sociology at the 300 level</td>
<td>6</td>
</tr>
<tr>
<td>Two electives (see note 2)</td>
<td>5-6</td>
</tr>
</tbody>
</table>

---

### Hours

- **Lectures**: 3
- **Labs**: –

---

### Math 130

- **Year III**: Mathematics 449
- **Year IV**: A Natural Science or a Social Science other than Psychology

### Russian

- **Year III**: Russian is strongly recommended.

### Philosophy and Mathematics

- **Years II, III, IV**: A student wishing to take both Philosophy and Mathematics in Years II, III, IV may omit one of the other recommended courses.

### Biology

- **Year I**: Biology (see note 1)

### Elective

- **Year III**: Elective (see note 2)

---

### 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.
Year IV

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychology 410 and 430</td>
<td>5</td>
</tr>
<tr>
<td>Sociology 450, 455</td>
<td>6</td>
</tr>
<tr>
<td>One elective</td>
<td>2-3</td>
</tr>
<tr>
<td>Senior Honours Essay</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<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.

Honours Sociology

Year I (see page 17)  Recommended Programme:  Hours

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sociology 100</td>
<td>3</td>
</tr>
<tr>
<td>History 100</td>
<td>3</td>
</tr>
<tr>
<td>Philosophy 100</td>
<td>3</td>
</tr>
<tr>
<td>English 100</td>
<td>3</td>
</tr>
<tr>
<td>Psychology 100</td>
<td>3</td>
</tr>
<tr>
<td>A language other than English</td>
<td>3</td>
</tr>
<tr>
<td>or a foreign culture course</td>
<td>3</td>
</tr>
</tbody>
</table>
Honours Sociology

Year II
Sociology 210 and two other courses in Sociology 9
Economics 100 3
Two electives 6

Year III
Examination on Summer Reading
Sociology 320, 325 and two other courses in Sociology 12
Two electives 6

Year IV
Examination on Summer Reading
Sociology 450, 455, 465 and 470 12
One elective 3

Note: Students proposing to do 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 Honour Courses

Students interested in taking Honours Courses or combination 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 Philosophy

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.
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.

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 for M.A.Sc. Degree</td>
<td>Two</td>
<td>Four</td>
</tr>
<tr>
<td>Time of Year Available</td>
<td>Fall, Winter or Spring Semesters</td>
<td>Fall, Winter or Spring Semesters</td>
</tr>
</tbody>
</table>

![Image of a man in uniform shaking hands]

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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 45, 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>1964</th>
<th>1965</th>
<th>1966</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>1967</th>
<th>1968</th>
<th>1969</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 Engineering Year I

In order to be considered for admission to Engineering Year I, 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 nine Grade XIII papers, with a minimum of 60% in the five papers required in Mathematics and Science. Standing is required in the following subjects:

- English (Composition and Literature)
- Mathematics (Algebra, Geometry, Trigonometry)
- Science (Chemistry, Physics)
- Two additional papers.

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.

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)
Admission

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 Indies, East and West Africa
The General Certificate of Education with passes in at least five subjects, two of which must be at Advanced Level. Advanced Level subjects must include Mathematics and either Physics or Chemistry.

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.

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

Registration
September 10    Thursday    Year I
September 11    Friday      Advanced Years
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 obtaining the necessary course card from 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 term 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 Board of Governors reserves the right to make changes in its 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>$255.00</td>
<td>$305.00</td>
</tr>
<tr>
<td>Incidental*</td>
<td>25.00</td>
<td>25.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$280.00</strong></td>
<td><strong>$330.00</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Miscellaneous Fees</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination — Supplemental, each paper</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>— Special, each paper</td>
<td>15.00</td>
<td>15.00</td>
</tr>
<tr>
<td>— Presiding fee (at an outside centre, each half day)</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Late Registration</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Transcript of Record</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Degree and Graduation — Final year only</td>
<td>10.00</td>
<td></td>
</tr>
</tbody>
</table>

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.

* 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.
Examinations and Promotions

The Faculty constitutes the examining body for all University examinations. The arrangement of the undergraduate engineering programme is shown on page 47. 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
   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 products, and primary attention is necessarily focused on the capacity to innovate design in process and product. Engineers are undoubtedly amongst the most important leaders in such a society, and the conditions noted lead to primary concern with fundamental education, versatility of mind, and the ability to maintain a position close to the frontiers of development.

Rigorous work in Mathematics and the Sciences is emphasized throughout the course, and the common work in these basic areas of Science in the first and second years is used in each departmental programme to support advanced
studies in engineering analysis and synthesis. It should be noted that the first year of the engineering course provides 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 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 empha-
sized 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 primary 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 48*)

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

**Note:** *signifies a course given on alternate weeks.

*Detailed course descriptions commence on page 56.*

*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.*

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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 Code</th>
<th>Course Title</th>
<th>Lect.</th>
<th>Lab. or Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 22</td>
<td>Calculus II</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Math. 23</td>
<td>Numerical Methods</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Math. 24</td>
<td>Mathematical Problems</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Math. 31</td>
<td>Differential Equations</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Math. 32</td>
<td>Numerical Analysis</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Math. 41</td>
<td>Applied Analysis I</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Math. 51</td>
<td>Probability and Statistics</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 22</td>
<td>Analytical Chemistry</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 26</td>
<td>Organic Chemistry I</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Chem. 31</td>
<td>Atomic and Molecular Structure</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Chem. 35</td>
<td>Electrochemistry</td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td>Chem. 36</td>
<td>Organic Chemistry II</td>
<td>3</td>
<td>3*</td>
</tr>
</tbody>
</table>

b. Engineering Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lect.</th>
<th>Lab. or Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>G. E. 12</td>
<td>Introduction to Engineering Systems</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>G. E. 41</td>
<td>Mechanics of Deformable Solids</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>G. E. 61</td>
<td>Philosophy of Science</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>E. E. 12</td>
<td>Electricity and Magnetism I</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>E. E. 13</td>
<td>Electricity and Magnetism II</td>
<td>2</td>
<td>3*</td>
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<td>Unit Operation Analysis</td>
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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>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lect.</th>
<th>Lab. or Prob.</th>
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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 students 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**

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Civil Engineering

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B. Elective Courses

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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.
<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lect.</th>
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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 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

a. Mathematics and Science Courses

<table>
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<th>Course</th>
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<td>Electrical Laboratory VI</td>
<td>-</td>
</tr>
<tr>
<td>E. E.</td>
<td>99</td>
<td>Seminar</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>c. Non-Technical Courses (two required)</strong></td>
<td></td>
</tr>
<tr>
<td>G. E.</td>
<td>61</td>
<td>History and Philosophy of Science,</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Arts Elective</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>B. Elective Courses (six to be chosen)</strong></td>
<td></td>
</tr>
<tr>
<td>E. E.</td>
<td>23</td>
<td>Analogue Computation</td>
<td>3</td>
</tr>
<tr>
<td>E. E.</td>
<td>24</td>
<td>Logic and Switching</td>
<td>3</td>
</tr>
<tr>
<td>E. E.</td>
<td>44</td>
<td>Pulse and Switching Circuits</td>
<td>3</td>
</tr>
<tr>
<td>E. E.</td>
<td>45</td>
<td>Network Synthesis</td>
<td>3</td>
</tr>
<tr>
<td>E. E.</td>
<td>55</td>
<td>Solid State Electronics</td>
<td>2</td>
</tr>
<tr>
<td>E. E.</td>
<td>64</td>
<td>Advanced Electromechanics</td>
<td>3</td>
</tr>
<tr>
<td>E. E.</td>
<td>65</td>
<td>Power Systems Analysis</td>
<td>3</td>
</tr>
<tr>
<td>E. E.</td>
<td>74</td>
<td>Microwave Circuit Theory</td>
<td>3</td>
</tr>
<tr>
<td>E. E.</td>
<td>75</td>
<td>Dielectrics and Magnetics</td>
<td>2</td>
</tr>
<tr>
<td>E. E.</td>
<td>83</td>
<td>Communication Theory</td>
<td>3</td>
</tr>
<tr>
<td>Math.</td>
<td>51</td>
<td>Probability and Statics</td>
<td>2</td>
</tr>
<tr>
<td>Math.</td>
<td>55</td>
<td>Digital Computer Programming</td>
<td>3</td>
</tr>
<tr>
<td>Math.</td>
<td>56</td>
<td>Matrix Algebra</td>
<td>3</td>
</tr>
<tr>
<td>G. E.</td>
<td>32</td>
<td>Fluid Mechanics</td>
<td>2</td>
</tr>
</tbody>
</table>
Mechanical Engineering

Traditionally, Mechanical Engineers have been engaged in all phases of Canadian industry ranging from power generation, transmission and utilization to the design and manufacture of a wide variety of machines and equipment. 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.

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

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

(b) 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 (mathematics, physics, and chemistry) and the engineering sciences (particularly with respect to the mechanics of solids) and to gain insight and skill in the application 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) Industrial Engineering 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 planning aspects of mechanical engineering.

(e) Engineering Materials Science—is for students who are interested in broadening their knowledge and qualifications into such fields as Metallurgy, Plastics or Ceramics. The course work will provide a fundamental understanding of the structure and behaviour of materials as used in industrial applications.
A. Core Programme

a. Mathematics and Science Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Lect.</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 22</td>
<td>Calculus II</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>Math. 23</td>
<td>Numerical Methods</td>
<td>–</td>
<td>2</td>
</tr>
<tr>
<td>Math. 31</td>
<td>Differential Equations</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>Math. 32</td>
<td>Numerical Analysis</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Math. 41</td>
<td>Applied Analysis</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>Phys. 15</td>
<td>Modern Physics</td>
<td>3</td>
<td>–</td>
</tr>
</tbody>
</table>

b. Engineering Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Lect.</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. E. 12</td>
<td>Electricity and Magnetism I</td>
<td>2</td>
<td>–</td>
</tr>
<tr>
<td>E. E. 13</td>
<td>Electricity and Magnetism II</td>
<td>2</td>
<td>3*</td>
</tr>
<tr>
<td>E. E. 32</td>
<td>Electronics</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>E. E. 81</td>
<td>Control Systems</td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td>C. E. 22</td>
<td>Mechanics of Deformable Solids II</td>
<td>2</td>
<td>–</td>
</tr>
<tr>
<td>M. E. 13</td>
<td>Kinematics</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>M. E. 21</td>
<td>Mechanics of Machinery</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>M. E. 22</td>
<td>Design of Machines</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>M. E. 53</td>
<td>Heat Transfer I</td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td>M. E. 81</td>
<td>Seminar</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>M. E. 82</td>
<td>Mechanical Engineering Projects</td>
<td>–</td>
<td>9</td>
</tr>
<tr>
<td>G. E. 12</td>
<td>Introduction to Engineering Systems</td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td>G. E. 31</td>
<td>Thermodynamics</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>G. E. 32</td>
<td>Fluid Mechanics</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>G. E. 41</td>
<td>Mechanics of Deformable Solids</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>G. E. 42</td>
<td>Dynamics</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>G. E. 51</td>
<td>Micro Structure of Materials</td>
<td>2</td>
<td>–</td>
</tr>
<tr>
<td>G. E. 52</td>
<td>Physical Properties of Materials</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

c. Non-Technical Courses

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

B. Elective Courses

Six elective courses are required in addition to the core courses listed above to fulfill the requirements of the Mechanical Engineering programme. Considerable latitude for individual choice is available depending upon the particular Mechanical Engineering option selected. Elective courses may be chosen from the list below or from other Engineering course lists, or from Mathematics, Arts, and Science, lists, as suggested by the Mechanical Engineering Department.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Lect.</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>M. E. 23</td>
<td>Analysis and Synthesis of Machines</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>M. E. 25</td>
<td>Mechanical Vibrations</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>Course</td>
<td>Title</td>
<td>Lect.</td>
<td>Lab. or Prob.</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------------</td>
<td>-------</td>
<td>---------------</td>
</tr>
<tr>
<td>M. E. 35</td>
<td>Nuclear Engineering</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M. E. 36</td>
<td>Physical Metallurgy</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M. E. 37</td>
<td>Ceramics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M. E. 41</td>
<td>Manufacturing Analysis</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M. E. 42</td>
<td>Industrial Organization</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M. E. 54</td>
<td>Thermodynamics II</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>M. E. 55</td>
<td>Statistical Thermodynamics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M. E. 56</td>
<td>Heat Transfer II</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M. E. 62</td>
<td>Fluid Dynamics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M. E. 63</td>
<td>Turbo Machines</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M. E. 64</td>
<td>Hydraulic Engineering</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M. E. 65</td>
<td>Gas Dynamics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M. E. 66</td>
<td>Turbulent Flow</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M. E. 73</td>
<td>Human Factors Engineering</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. 81</td>
<td>Law Contracts and Specifications</td>
<td>2</td>
<td></td>
</tr>
<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. 51</td>
<td>Probability and Statistics</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Math. 54</td>
<td>Differential Equations of Mathematical Physics</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Math. 55</td>
<td>Digital Computer Programming</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Chem. 25</td>
<td>Polymer Chemistry and Physics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M. E. 666</td>
<td>Wave Phenomena in Fluid Flow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Faculty of Science
The Faculty of Science

The rapid and successful growth of the University's Engineering Faculty brought together a considerable number of scientists and mathematicians to provide the basic instruction for Engineering students. Before long, it became possible to offer a programme in Science, and the University issued its first calendar for the Faculty of Science in the Spring of 1959. The programmes of the Faculty were organized under its first Dean, the late B. W. Kelley.

There are three teaching departments within the Faculty of Science: Physics, Chemistry and Biology. Extensive instruction is also given by members of the University's Mathematics Department. Instruction in Astronomy and in Geology is given by members of the Physics Department; Biochemistry is offered by the Chemistry Department; Botany, Zoology, and certain courses embracing these fields together, are taught in the Biology Department. All three departments offer post-graduate instruction for details of which see the section of the calendar dealing with Graduate studies. The majority of the graduates in Honours courses in Science undertake some post-graduate study. All courses in this Faculty except Applied Physics are offered in two terms throughout a conventional academic year. The Applied Physics course is given 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 216).

The Dean and departmental chairmen in this Faculty invite inquiries from or interviews with students contemplating a University course in fields leading to the B.Sc. degree.

Degrees

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

General Course (3 years)

General Science

Honours Courses (4 years)

Biology
Chemistry
Chemistry and Biology
Chemistry and Physics
Mathematics
Physics
Co-operative Applied Physics
Degrees

Graduation from the three-year course in General Science has been approved by the Department of Education as acceptable academic preparation admitting to the degree leading to the High School Assistant's Certificate, Type "B", at the Ontario College of Education.

Graduation with Honours from the four-year courses has been approved by the Department of Education of Ontario as acceptable academic preparation admitting to the appropriate course leading to the High School Assistant's Certificate, Type "A", at the Ontario College of Education.

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 Year I of the Science course, the applicant must have completed the requirements for the Ontario Secondary School Honour Graduate Diploma (Senior Matriculation), or its equivalent, showing an over-all average of 60% in nine Grade XIII papers, with a minimum of 60% in the five papers required in Mathematics and Science. Standing is required in the following subjects:

- English (Composition and Literature)
- Mathematics (Algebra, Geometry, Trigonometry)
- Science (Chemistry, Physics)
- Two additional papers.

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 terms 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:

<table>
<thead>
<tr>
<th>Province</th>
<th>Certificate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alberta</td>
<td>Senior Matriculation (Grade XII)</td>
</tr>
<tr>
<td>British Columbia</td>
<td>Senior Matriculation (Grade XIII)</td>
</tr>
<tr>
<td>Manitoba</td>
<td>Senior Matriculation (Grade XII)</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>Senior Matriculation (Grade XIII)</td>
</tr>
<tr>
<td>Newfoundland</td>
<td>Senior Matriculation (Grade XII)</td>
</tr>
<tr>
<td></td>
<td>Senior High School Leaving Certificate</td>
</tr>
<tr>
<td>Nova Scotia</td>
<td>Senior Matriculation (Grade XII)</td>
</tr>
<tr>
<td>Prince Edward Island</td>
<td>Third Year Certificate from Prince of Wales College</td>
</tr>
<tr>
<td>Quebec</td>
<td>McGill Senior Matriculation or Quebec</td>
</tr>
<tr>
<td></td>
<td>Senior High School Leaving Certificate</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>Senior Matriculation (Grade XII)</td>
</tr>
<tr>
<td>England and Wales, West Indies, East and West Africa</td>
<td>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.</td>
</tr>
<tr>
<td>Scotland</td>
<td>The Scottish Leaving Certificate</td>
</tr>
<tr>
<td>United States of America</td>
<td>High School Graduation plus an additional year of formal study in subjects comparable to Ontario Grade XIII.</td>
</tr>
</tbody>
</table>

**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
Admission and Registration

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

September 21 Monday Year I
September 22 Tuesday Advanced Years

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 obtaining the necessary course card from 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 Board of Governors reserves the right to make changes in the published schedule of fees without notice.

<table>
<thead>
<tr>
<th></th>
<th>Regular</th>
<th>Co-operative Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Per Session</td>
<td>Per Term Year One</td>
</tr>
<tr>
<td>Tuition</td>
<td>$435.00</td>
<td>$255.00</td>
</tr>
<tr>
<td>Incidental*</td>
<td>41.50</td>
<td>25.00</td>
</tr>
<tr>
<td>Total</td>
<td>$476.50</td>
<td>$280.00</td>
</tr>
</tbody>
</table>

Part-Time Students

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

Miscellaneous Fees

<table>
<thead>
<tr>
<th>Service</th>
<th>All Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination — Supplemental, each paper</td>
<td>$10.00</td>
</tr>
<tr>
<td>— Special, each paper</td>
<td>15.00</td>
</tr>
<tr>
<td>— Presiding fee (at an outside centre, each half day)</td>
<td>5.00</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>
Fees

* 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.

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 August. 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.

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.
Examinations and Promotions

14. Supplemental examinations will be held in August. Application for supplemental examinations must be filed before July 15, 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 First Year Applied Physics see page 88)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 130</td>
<td>Types of English Literature</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 131</td>
<td>Mechanics, Wave Motion, and Heat</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 131</td>
<td>General Chemistry</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 130</td>
<td>Calculus</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Biology 131</td>
<td>An Introduction to Biology</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

One of (See note 1)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics 131</td>
<td>Algebra and Solid Geometry</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Psychology 100</td>
<td>Introduction to Psychology</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 132</td>
<td>Numerical Procedures</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Geology 130</td>
<td>Introductory Geology</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

(see note 2)

Note 1: Mathematics 131 is required for admission to General or Honours courses in the Physical sciences. Biology 131 is required for admission to all subsequent courses in Biology. These two subjects may both be taken, but in this case no subject is to be selected from the second group of options.
Note 2: Geology 130 is a recommended subject for students in the second year of the General Course planning a major in Biology.

**The General Course**

The three year General Course is designed for students wishing to teach, to qualify for positions as senior technicians in laboratories of various types, or for those who desire a general background of information in the Sciences.

Graduates of the General Course who have taken the required subjects are qualified to apply for admission to medical schools in Ontario. Students who have 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 third year, the student will select his major field of study from one of the following departments: Biology, Chemistry, Mathematics, or Physics. He must have attained C standing in this field in his first year, before he may choose the field for major study. He must attain C standing in this field in his second year for promotion to third year, and in his third year in order to graduate.

The curriculum is arranged as follows:

**Year I**—See page 75.

**Year II and Year III**  Two subjects from a major group  
One subject from a second group  
One subject from a third group  
One Arts subject

The selection of subjects in the second and third years will be restricted partly by the limitations on choice imposed by the timetable, and partly by the necessity in some subjects of having completed prerequisites. A student's programme must therefore be approved by the chairman of the department of his major field.

The subjects are grouped by departments as follows:

**Group A: Biology**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 231</td>
<td>Genetics and Evolution</td>
<td>2</td>
</tr>
<tr>
<td>Biology 232</td>
<td>The Vascular Plants</td>
<td>2</td>
</tr>
<tr>
<td>Biology 233</td>
<td>Vertebrate Zoology</td>
<td>2</td>
</tr>
<tr>
<td>Biology 331</td>
<td>Plant Physiology</td>
<td>2</td>
</tr>
<tr>
<td>Biology 332</td>
<td>Vertebrate Physiology</td>
<td>2</td>
</tr>
<tr>
<td>Biology 333</td>
<td>Invertebrate Zoology</td>
<td>2</td>
</tr>
<tr>
<td>Biology 334</td>
<td>The Non-Vascular Plants</td>
<td>2</td>
</tr>
</tbody>
</table>
The General Course

**Group B: Chemistry**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 231</td>
<td>Chemical Bonding and Structure</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 232</td>
<td>Analytical Chemistry</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry 236</td>
<td>Organic Chemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 325</td>
<td>Physical Chemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 331</td>
<td>Inorganic Chemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 337</td>
<td>Biochemistry</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Group C: Mathematics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics 132</td>
<td>Numerical Procedures</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics 230</td>
<td>Algebra I</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 233</td>
<td>Probability and Statistics</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics 235</td>
<td>Actuarial Mathematics</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 236</td>
<td>Elementary Differential Equations</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 330</td>
<td>Euclidean and Projective Geometry</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 334</td>
<td>Numerical Methods</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics 446</td>
<td>History of Mathematics</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

**Group D: Physics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<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>0</td>
</tr>
<tr>
<td>Physics 242</td>
<td>Electricity and Magnetism</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Physics 332</td>
<td>Electronics</td>
<td>2</td>
<td>3*</td>
</tr>
<tr>
<td>Physics 335</td>
<td>Thermodynamics</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 339</td>
<td>Atomic and Nuclear Physics</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

**Other Courses**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 131</td>
<td>An introduction to Biology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Geology 130</td>
<td>Introductory Geology</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

* Indicates a laboratory taken in alternate weeks.

**Recommended Programmes**

The following combinations of subjects have been recommended by the departments for major study in their fields. The timetable has been designed to ensure that these combinations are permitted. Other combinations of subjects may be taken if they fit the student's timetable and are approved by his department chairman.

**Biology Major**

**Year II**

Two of: Biology 231, 232, 233, 334  
Plus: Chemistry 236  
Geology 130  
Arts Elective

**Year III**

Two of: Biology 331, 332, 333, 334  
Plus: Chemistry 337  
Physics 237  
Arts Elective
Chemistry Major

Year II
Chemistry 232, 236
One of: Physics 242
Zoology 231
One of: Mathematics 236
Physics 237

Arts Elective

Mathematics Major

Year II
Two of: Mathematics 132, 230, 233, 235, 236, 330
One of: Physics 235, 237, 242
One of: Biology 131
Chemistry 231
Geology 130

Arts Elective

Physics Major

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

Arts Elective

Year III
Chemistry 325
One of: Chemistry 231, 337
One of: Physics 235
Biology 231
One of: Mathematics 233
Geology 130

Arts Elective

Honours Biology Programme

Year I see Page 75

Lectures Labs.

Year II
Biology 232 The Vascular Plants 2 3
Biology 233 Vertebrate Zoology 2 3
Biology 231 Genetics and Evolution 2 2
Chemistry 236 Organic Chemistry I 2 3
Mathematics 233 Probability and Statistics 1 2
an elective 3 0
## 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 334</td>
<td>The Non-Vascular Plants</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 331</td>
<td>Plant Physiology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 332</td>
<td>Vertebrate Physiology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 337</td>
<td>Biochemistry I</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>an elective</td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

### Year IV

To be arranged in consultation with the Chairman of the Department. It is intended that a number of areas of specialization can be pursued, for example Botany, Zoology, Microbiology, Entomology, Physiology. Normally six courses will be considered a full complement, and of these, five should be in Biology.

## Honours Chemistry

*(For Year I, see page 75)*

### Year II

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 231</td>
<td>Chemical Bonding and Structure</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 232</td>
<td>Analytical Chemistry</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry 235</td>
<td>Physical Chemistry I</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 236</td>
<td>Organic Chemistry I</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Physics 242</td>
<td>Electricity and Magnetism</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 236</td>
<td>Differential Equations</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Arts Elective</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

### Year III

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 331</td>
<td>Inorganic Chemistry I</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 335</td>
<td>Physical Chemistry II</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry 336</td>
<td>Organic Chemistry II</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 332</td>
<td>Electronics</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 233</td>
<td>Probability and Statistics</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Arts Elective</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

### Year IV

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 431</td>
<td>Inorganic Chemistry II</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry 435</td>
<td>Physical Chemistry III</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 436</td>
<td>Organic Chemistry III</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 439</td>
<td>Advanced Laboratory</td>
<td>0</td>
<td>6</td>
</tr>
</tbody>
</table>
Physics 339  Atomic and Nuclear Physics  3  0
Mathematics 450  Applied Analysis  2  0

*One of:
Chemistry 337  Biochemistry I  2  0
Chemistry 445  Polymer Chemistry  2  0
Physics 439  History and Philosophy of Science  2  0

13  13

*Indicates a laboratory taken in alternate weeks.

Honours Chemistry and Biology

(For Year I, see page 75)

<table>
<thead>
<tr>
<th>Year II</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
</table>
| Chemistry 231    | Chemical Bonding and Structure  2  0
| Chemistry 232    | Analytical Chemistry  2  6
| Chemistry 236    | Organic Chemistry I  2  3
|                  | Arts Elective  3  0
| Two of:          |          |       |
| Biology 233      | Vertebrate Zoology  2  3
| Biology 232      | The Vascular Plants  2  3
| Biology 334      | The Non-Vascular Plants  2  3
|                  |          |       |
|                  | 13  15  |       |

<table>
<thead>
<tr>
<th>Year III</th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| 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 332      | Vertebrate Physiology  2  3
| Biology 331      | Plant Physiology  2  3
| Biology 333      | Invertebrate Zoology  2  3
|                  |          |       |
|                  | 12  15  |       |

<table>
<thead>
<tr>
<th>Year IV</th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| Chemistry 331    | Inorganic Chemistry  2  3
| Chemistry 437    | Biochemistry  2  3
| Mathematics 233  | Probability and Statistics  1  2
| Three of:        |          |       |
| Biology 431      | Ecology  2  2
| Biology 432      | Microbiology  2  3

80
Honours Chemistry and Biology

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 433</td>
<td>Entomology</td>
</tr>
<tr>
<td>Biology 434</td>
<td>Genetics</td>
</tr>
<tr>
<td>A three-hundred course not previously taken</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11 16(17)

Honours Chemistry and Physics

(For Year I, see page 75)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year II</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry 231</td>
<td>Chemical Bonding and Structure</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 232</td>
<td>Analytical Chemistry</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry 235</td>
<td>Physical Chemistry I</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Mathematics 231</td>
<td>Differential Calculus</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 232</td>
<td>Integral Calculus</td>
<td>3</td>
<td>0</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>
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</table>
### Year III

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 236</td>
<td>Organic Chemistry I</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 335</td>
<td>Physical Chemistry II</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics 233</td>
<td>Probability and Statistics</td>
<td>2</td>
</tr>
<tr>
<td>Physics 331</td>
<td>Classical Mechanics I</td>
<td>3</td>
</tr>
<tr>
<td>Physics 334</td>
<td>Atomic and Nuclear Physics I</td>
<td>3</td>
</tr>
<tr>
<td>Physics 336</td>
<td>Physical Mathematics I</td>
<td>2</td>
</tr>
<tr>
<td>One Arts Elective</td>
<td></td>
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</tr>
</tbody>
</table>

### Year IV

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 331</td>
<td>Inorganic Chemistry I</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 336</td>
<td>Organic Chemistry II</td>
<td>2</td>
</tr>
<tr>
<td>Physics 332</td>
<td>Electronics</td>
<td>2</td>
</tr>
<tr>
<td>Physics 333</td>
<td>Intermediate Laboratory</td>
<td>0</td>
</tr>
<tr>
<td>Physics 434</td>
<td>Atomic and Nuclear Physics II</td>
<td>2</td>
</tr>
</tbody>
</table>

**Option A (Chemistry)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 435</td>
<td>Physical Chemistry III</td>
<td>2</td>
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<tr>
<td>Chemistry 439</td>
<td>Advanced Laboratory</td>
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<tr>
<td>Chemistry 337</td>
<td>Biochemistry I</td>
<td>2</td>
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<tr>
<td>Chemistry 445</td>
<td>Polymer Chemistry</td>
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</table>

**Option B (Physics)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs.</th>
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<tbody>
<tr>
<td>Physics 435</td>
<td>Solid State Physics</td>
<td>2</td>
</tr>
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<td>One Arts or Science Elective</td>
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</tbody>
</table>

* Indicates a laboratory taken in alternate weeks.

### Honours Mathematics

(Mathematics and Physics programme)

(For Year I, see page 75)

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics 230</td>
<td>Algebra I</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 231</td>
<td>Differential Calculus</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics 232</td>
<td>Integral Calculus</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 233</td>
<td>Probability and Statistics</td>
<td>1</td>
</tr>
<tr>
<td>Physics 232</td>
<td>Electricity and Magnetism</td>
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<td>Physics 235</td>
<td>Optics</td>
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<td></td>
</tr>
<tr>
<td>Mathematics 234</td>
<td>Mechanics</td>
<td>2</td>
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<td>Mathematics 235</td>
<td>Actuarial Mathematics</td>
<td>2</td>
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**Honours Mathematics**

### Year III (Pure Mathematics Option)

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<tbody>
<tr>
<td>Mathematics 330</td>
<td>Euclidean and Projective Geometry</td>
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<td>Algebra II</td>
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<tr>
<td>Mathematics 332</td>
<td>Theory of Functions</td>
<td>3</td>
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<tr>
<td>Mathematics 333</td>
<td>Differential Equations</td>
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<td></td>
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### Statistics Option

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<tr>
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<td>Mathematics 332</td>
<td>Theory of Functions</td>
<td>3</td>
<td>0</td>
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<td>Mathematics 334</td>
<td>Numerical Methods</td>
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<tr>
<td>Mathematics 335</td>
<td>Finite Differences</td>
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Two of:

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<th>Labs</th>
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<tr>
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<td>Differential Equations</td>
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<td>Mathematics 336</td>
<td>Life Contingencies</td>
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<td>Mathematics 339</td>
<td>Mathematical Statistics</td>
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<td>One Science Elective</td>
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### Applied Mathematics Option

<table>
<thead>
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<td>Theory of Functions</td>
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<tr>
<td>Mathematics 333</td>
<td>Differential Equations</td>
<td>2</td>
<td>0</td>
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<tr>
<td>Mathematics 334</td>
<td>Numerical Methods</td>
<td>2</td>
<td>2</td>
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<td>Mathematics 337</td>
<td>Advanced Mechanics</td>
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<tr>
<td>Mathematics 339</td>
<td>Electromagnetism I</td>
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### Teaching Option

<table>
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<tbody>
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<td>Mathematics 331</td>
<td>Algebra II</td>
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<td>Mathematics 334</td>
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<tr>
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<td>One Additional Mathematics Course</td>
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### Year IV (Pure Mathematics Option)

<table>
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<tbody>
<tr>
<td>Mathematics 430</td>
<td>Finite Projective Geometries</td>
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<tr>
<td>Mathematics 431</td>
<td>Algebra III</td>
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<tr>
<td>Mathematics 432</td>
<td>Functions of a Complex Variable</td>
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<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Required Credits</td>
<td>Elective Credits</td>
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<td>--------------------------------------------------</td>
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<tr>
<td>Mathematics 433</td>
<td>Theory of Integration</td>
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<tr>
<td>Mathematics 434</td>
<td>Differential Equations of Mathematical Physics</td>
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<tr>
<td>One Science Elective</td>
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(Statistics Option)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
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<td>Laboratory</td>
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<td>Mathematics 438</td>
<td>Estimation and Hypothesis Testing</td>
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<td>Theory of Integration</td>
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<tr>
<td>Mathematics 437</td>
<td>Graduation and Mortality</td>
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(Three Courses from:)

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<th>Course Title</th>
<th>Required Credits</th>
<th>Elective Credits</th>
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<tbody>
<tr>
<td>Mathematics 430</td>
<td>Finite Projective Geometries</td>
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<td>0</td>
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<tr>
<td>Mathematics 436</td>
<td>Life Contingencies II</td>
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<tr>
<td>Mathematics 439</td>
<td>Theory of Experimental Design</td>
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<td>Mathematics 440</td>
<td>Advanced Probability</td>
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<td>Mathematics 446</td>
<td>History of Mathematics</td>
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<td>Mathematics 447</td>
<td>Statistical Mechanics</td>
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<tr>
<td>One Science Elective</td>
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<td>–</td>
<td>–</td>
</tr>
<tr>
<td>One Non-Science Elective</td>
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</table>

(Applied Mathematics Option)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Required Credits</th>
<th>Elective Credits</th>
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</thead>
<tbody>
<tr>
<td>Mathematics 432</td>
<td>Functions of a Complex Variable</td>
<td>2</td>
<td>0</td>
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<tr>
<td>Mathematics 434</td>
<td>Differential Equations of Mathematical Physics</td>
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(Four Courses from:)

<table>
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<th>Elective Credits</th>
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<tbody>
<tr>
<td>Mathematics 441</td>
<td>Quantum Theory</td>
<td>2</td>
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<tr>
<td>Mathematics 442</td>
<td>Theory of Relativity</td>
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<td>0</td>
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<tr>
<td>Mathematics 443</td>
<td>Electromagnetism II</td>
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<td>0</td>
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<td>Elasticity</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 445</td>
<td>Hydrodynamics</td>
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<tr>
<td>Mathematics 446</td>
<td>History of Mathematics</td>
<td>2</td>
<td>0</td>
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<tr>
<td>Mathematics 447</td>
<td>Statistical Mathematics</td>
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(Teaching Option)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<th>Elective Credits</th>
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<tbody>
<tr>
<td>Mathematics 446</td>
<td>History of Mathematics</td>
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</table>

Four additional Mathematics courses numbered above 200 | – | – |
| One Science Elective |                                    | –                | –                |
| One Non-Science Elective |                                  | –                | –                |
Honours Mathematics

Elective course both in Mathematics 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 and fourth years:*

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Lectures</th>
<th>Labs.</th>
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</thead>
<tbody>
<tr>
<td>Physics 338</td>
<td>Geophysics</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 339</td>
<td>Atomic and Nuclear Physics</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Biology 231</td>
<td>Genetics and Evolution</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Mathematics</td>
<td>Any Mathematics course not previously taken</td>
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<tr>
<td>Geology 130</td>
<td>Introductory Geology</td>
<td>2</td>
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*Non-Science Electives for the third and fourth years:*

<table>
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<tr>
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<th>Title</th>
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<th>Labs.</th>
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<tbody>
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<td>19th Century Literature</td>
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<tr>
<td>History 200</td>
<td>The Expansion of Europe</td>
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<td>Russian I</td>
<td>Elementary Scientific Russian</td>
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<tr>
<td>German I</td>
<td>Elementary Scientific German</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 439</td>
<td>History and Philosophy of Science</td>
<td>2</td>
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<tr>
<td>Psychology 100</td>
<td>Introduction to Psychology</td>
<td>3</td>
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</tbody>
</table>
Note: (1) Any other course may be submitted as an elective if it fits the student's time-table and is approved by the Chairman of the Department of Mathematics.

(2) Students completing this course may qualify for the High School Assistant's Certificate, Type "A", in Mathematics.

(3) Students wishing to qualify for High School Assistant's Certificate, Type "A", in Mathematics and Physics must choose courses in Physics for their Science elective in Years III and IV.

Honours Physics

(Mathematics and Physics programme)

(For Year I, see page 75)

<table>
<thead>
<tr>
<th>Year II</th>
<th>Lectures</th>
<th>Labs.</th>
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<tbody>
<tr>
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<td>Differential Calculus</td>
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<tr>
<td>Mathematics 232</td>
<td>Integral Calculus</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 233</td>
<td>Probability and Statistics</td>
<td>2</td>
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<tr>
<td>Physics 232</td>
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<td>Physics 237</td>
<td>Astronomy I</td>
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Year III

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Physics 331</td>
<td>Classical Mechanics I</td>
<td>3</td>
</tr>
<tr>
<td>Physics 332</td>
<td>Electronics</td>
<td>2</td>
</tr>
<tr>
<td>Physics 333</td>
<td>Intermediate Laboratory</td>
<td>0</td>
</tr>
<tr>
<td>Physics 334</td>
<td>Atomic and Nuclear Physics I</td>
<td>3</td>
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<tr>
<td>Physics 335</td>
<td>Thermodynamics, Kinetic Theory of Gases, Statistical Mechanics</td>
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one Arts or Science Elective

*Option A

<table>
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<th>Lectures</th>
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<tbody>
<tr>
<td>Physics 336</td>
<td>Physical Mathematics I</td>
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*Option B

one Science Elective

Year IV

<table>
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<tbody>
<tr>
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<tr>
<td>Physics 434</td>
<td>Atomic and Nuclear Physics II</td>
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<tr>
<td>Physics 435</td>
<td>Solid State Physics</td>
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<tr>
<td>Physics 441</td>
<td>Electromagnetic Theory</td>
<td>2</td>
</tr>
<tr>
<td><strong>Option A</strong></td>
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<td><strong>Lectures</strong></td>
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<td>Physics 431</td>
<td>Classical Mechanics II</td>
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<tr>
<td>Physics 436</td>
<td>Physical Mathematics II</td>
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<tr>
<td>Physics 432</td>
<td>Physics of Solid State Devices</td>
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<td>Physics 437</td>
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<td>one Science Course</td>
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<table>
<thead>
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<th><strong>Labs.</strong></th>
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<tbody>
<tr>
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<td>Physical Mathematics I</td>
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<tr>
<td>Physics 439</td>
<td>History and Philosophy of Science</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>one Arts or Science Elective</td>
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* 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 for high school teaching.

**Recommended Science Electives:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<td>Physical Chemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Geology 130</td>
<td>Introductory Geology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 330</td>
<td>Euclidean and Projective Geometry</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 338</td>
<td>Mathematical Statistics</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 440</td>
<td>Advanced Probability</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 337</td>
<td>Astronomy II</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 338</td>
<td>Geophysics I</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 438</td>
<td>Geophysics II</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 439</td>
<td>History and Philosophy of Science</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 416</td>
<td>Biophysics</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

**Recommended Non-Science Electives:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 235</td>
<td>Selections from the Literature of Ideas</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>History 200</td>
<td>Expansion of Europe Since 1400 A.D.</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Philosophy 100</td>
<td>Introduction to Philosophy</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Russian 1-50</td>
<td>Beginner's Russian</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>German 1-50</td>
<td>Beginner's German</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Any other course may be substituted as an elective if it fits the student's timetable. In all cases, selection of an elective must be approved by the Chairman of the Department of Physics.
Honours Applied Physics

For information about the operation of the Co-operative Applied Physics programme see page 216.

<table>
<thead>
<tr>
<th>Year I — Term A</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 11</td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td>English 15</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 12</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics 21</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Physics 11</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>One Arts Elective</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year I — Term B</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 11</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>C. E. 11</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>English 15</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 12</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics 21</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Physics 11</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year II — Term A</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics 22</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 32</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>E. E. 12</td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td>Physics 14</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Arts or Engineering Elective</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year II — Term B</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics 33</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 34</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 51</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>E. E. 13</td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td>Physics 42</td>
<td>3</td>
<td>3*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year III — Term A</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. E. 41</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>E. E. 51</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>Physical Mathematics IA</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>
### Honours Applied Physics

#### Year III — Term B

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. E. 52</td>
<td>Electronics II</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 331</td>
<td>Classical Mechanics IB</td>
<td>3</td>
<td>0</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 IB</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 335</td>
<td>Thermodynamics, Kinetic Theory of Gases, Statistical</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Mechanics (B)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics 336</td>
<td>Physical Mathematics IB</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>One Arts or Engineering Elective</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Year IV — Terms A and B

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 433</td>
<td>Advanced Laboratory</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Physics 434</td>
<td>Atomic and Nuclear Physics II</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 435</td>
<td>Solid State Physics</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 436</td>
<td>Physical Mathematics II</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 441</td>
<td>Electromagnetic Theory</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.
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, and Russian.

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, and Mechanical Engineering.

Courses leading to the degree of Doctor of Philosophy (Ph.D.) are offered by the departments of Biology, Chemistry, Civil Engineering, Electrical Engineering, Mathematics, Mechanical Engineering, and Physics.

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 45.

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.

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 Ph.D. Degree

The candidate must have an adequate knowledge of at least one foreign language, 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, 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.

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 on 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.
(Special arrangements are available for graduate students employed by the University.)

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 Board of Governors reserves the right to make changes in its published schedule of fees without notice.

### Fees

**Fees**

(a) For the Master's Degree

<table>
<thead>
<tr>
<th>Description</th>
<th>Per Annum</th>
</tr>
</thead>
<tbody>
<tr>
<td>— Preliminary or Qualifying Years (includes first year from general degree or the first year of any two-year programme)</td>
<td>$435.00</td>
</tr>
<tr>
<td>— Each year from the honours degree or equivalent</td>
<td>350.00</td>
</tr>
</tbody>
</table>

(b) For the Ph.D. Degree

<table>
<thead>
<tr>
<th>Description</th>
<th>Per Annum</th>
</tr>
</thead>
<tbody>
<tr>
<td>— Each year from the honours degree or equivalent</td>
<td>350.00</td>
</tr>
</tbody>
</table>

(c) Single Courses or Part-Time

<table>
<thead>
<tr>
<th>Description</th>
<th>Per Annum</th>
</tr>
</thead>
<tbody>
<tr>
<td>— Per course, part-time per annum</td>
<td>150.00</td>
</tr>
<tr>
<td>— Per course, part-time per term</td>
<td>75.00</td>
</tr>
</tbody>
</table>

(d) Incidental Fees (Full Time only)

<table>
<thead>
<tr>
<th>Description</th>
<th>Per Annum</th>
</tr>
</thead>
<tbody>
<tr>
<td>— Health Services</td>
<td>3.00</td>
</tr>
<tr>
<td>— Health Insurance (optional, 8 months' coverage)</td>
<td>8.50</td>
</tr>
</tbody>
</table>

(e) Miscellaneous Fees

<table>
<thead>
<tr>
<th>Description</th>
<th>Per Annum</th>
</tr>
</thead>
<tbody>
<tr>
<td>— Late Registration</td>
<td>10.00</td>
</tr>
<tr>
<td>— Transcript of Record</td>
<td>1.00</td>
</tr>
<tr>
<td>— Degree</td>
<td>20.00</td>
</tr>
</tbody>
</table>

**Notes:**

1. Two or more courses: full time fee.
2. A thesis is considered equivalent to two courses: full time fee.
3. Fees will be determined by the Graduate Admissions Committee.
Examinations

Letter grades will be used to designate standing in individual subjects.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>75 - 100%</td>
</tr>
<tr>
<td>B</td>
<td>66 - 74%</td>
</tr>
<tr>
<td>C</td>
<td>60 - 65%</td>
</tr>
<tr>
<td>F</td>
<td>less than 60% (failure)</td>
</tr>
</tbody>
</table>

Students must obtain an average of at least 66% in the set of courses which they present in fulfillment of course requirements for any graduate degree.
VI

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

In September 1964 the University of Waterloo will inaugurate a one year post-degree programme leading to the degree of Bachelor of Physical Education (B.P.E.).

The new 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 in the Fall at Camp Tawingo in Huntsville. The skill school will include lectures and the beginning of skills training.

The programme is offered on 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 Board of Governors reserves the right to make changes in its 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>$435.00</td>
</tr>
<tr>
<td>Incidental*</td>
<td>91.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$526.50</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Examination —</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplemental, each paper</td>
<td>$10.00</td>
</tr>
<tr>
<td>Special, each paper</td>
<td>15.00</td>
</tr>
<tr>
<td>Presiding fee (at an outside centre, each half day)</td>
<td>5.00</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<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 Services Commission. Such coverage is the student's own responsibility.

Examinations

Final written examination 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 three 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 (men)
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 offered to students in the Faculty of Engineering numbered:
   - 1-9 are at the Ontario Grade XIII level
   - 10-99 are at the undergraduate level

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

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

31. Microbiology for Engineers. An introduction to the fundamental theories and principles of general microbiology including the role of microorganisms in both natural and special environments.
   2 lectures and 2 hours laboratory per week, one term.

131. An Introduction to Biology. Life, the nature of protoplasm, cells and cellular processes. The structure and functioning of the flowering plant. The variety of plants, plant phylogeny. The role of macroflora and microflora in organic circles. Animal characteristics, a survey of the animal kingdom. Human physiology. An introduction to genetics and evolutionary theory.
   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. 2 lectures, 2 hours laboratory.

232. The Vascular Plants. A survey of the higher plants, with emphasis on morphological change and evolutionary advance. Prerequisite: Biology 131. 2 lectures, 3 hours laboratory per week.

233. Vertebrate Zoology. The evolution of the vertebrate body as exemplified by both living and fossil members of the group. Laboratory dissections form an integral part of the course. Prerequisite: Biology 131. 2 lectures, 3 hours laboratory.

331. Plant Physiology. Study of respiration, photosynthesis, water relationships, nutrition, growth factors, etc., as fundamental physiological processes of the plant. Prerequisites: Chem. 236, Biol. 232. 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. Prerequisites: Chem. 236, Biol. 233. 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.

334. The 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 131. 2 lectures, 3 hours laboratory per week.

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, Biology 334. 2 lectures, 2 hours laboratory.

432. Microbiology. The study of microorganisms with special reference to the morphology, cytology, physiology and metabolism of bacteria. Prerequisites: Biology 131 or 31, Chemistry 236 or 26, Chemistry 337 or 37. 2 lectures, 3 hours laboratory per week.
433. **Entomology.** An introduction to the classification, functional anatomy and physiology of insects, together with a survey of the Arachnids.
Prerequisite: Biology 333.
2 lectures, 3 hours laboratory per week.

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 331 or Biology 332.
2 lectures, 3 hours laboratory per week.

601. **Water Pollution Biology.** A lecture seminar and practical course providing an introduction to the biological, chemical and engineering aspects of water pollution.

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 environment 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.

610. **Limnology for Engineers.** A study of the freshwater environment, physical chemical and biological cycles in pure and polluted waters. A survey of the fresh water flora and fauna.
3 hours per week. 1 term.

699. **Thesis.**

**Department of Chemical Engineering**

D. S. Scott, M.Sc. (Alberta), Ph.D. (Illinois)

*Professor and Chairman of Department*

T. L. Batke, M.A.Sc., Ph.D. (Toronto) - - - - - Professor

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

L. E. Bodnar, Ph.D. (McMaster) - - - - Associate Professor

P. L. Silveston, M.S. (Massachusetts Institute of Technology),
Dr. Ing. (Tech. Hochschule, Germany) - Associate Professor
Department of Chemical Engineering

G. A. Coulman, B.S. (Case Institute of Technology), M.S. (Michigan), Ph.D. (Case Institute of Technology) - Assistant Professor

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

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

Undergraduate Programmes. Details of the undergraduate programme in Chemical Engineering are to be found on Page 00.

11. Chemical Process Principles I. Practice in applied stoichiometry. Mass 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.
Prerequisites: 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 alternate weeks, 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 System Theory I. A co-ordinated approach to linear systems analysis is presented in an engineering format. The physical phenomena of the several fields are presented as analogs to establish a useful basis for system analysis in the process industries.
Prerequisites: Math 41, ChE 22.
3 lectures, one term.

52. Process System Theory II. The material of Process System Theory I is extended to more complex processes. Closed loop systems are examined for stability. Advanced concepts in control systems 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.

61. Industrial Economics. Market surveys, estimation of capital and operating costs of a new product or process. Economic feasibility studies and projected economic evaluation for processes in the various stages of research, development, and design. Appraisal of capital expenditures. Prerequisite: ChE 12. 
2 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 and Research Programs.

Graduate study and research may be pursued in the areas of Mass and Heat Transfer, Reaction Kinetics and Catalysis, Transport Phenomena, Thermodynamics, Process Dynamics and Control, and Computational Methods in Chemical Engineering.

Examples from the current research programme are Heat and Mass Transfer from spheres and other shapes under combined natural and forced convection; Turbulent heat transfer and studies on the transition of the boundary layer; Fluid mechanics and heat transfer studies in solid-gas systems; Heat transfer with chemical reactions; Thermal radiation to porous surfaces with thin liquid films; Unit operations with coupled heat and mass transport such as spray drying; Application of monomolecular films to evaporation reduction; Dye catalyzed photoxidation with the objective of application to photo-electrochemical cells; Mechanisms of catalyzed reactions in solution; Investigation of the rate determining steps in complex heterogeneous reactions; Studies of the contribution of surface diffusion in catalysis; Models for the pyrolysis of hydrocarbons and petroleum fractions; Effectiveness factors for complex reactions; Chemical process systems theory with particular emphasis on the identification and optimal prediction problem related to non-stationary systems.

Graduate Course Descriptions.

620. Advanced Topics in Heat Transfer. Analysis of unsteady state heat transfer in complex systems. Examination of high velocity and/or high temperature system. Coupled mass and heat transfer as in boiling, transpiration and ablation. One term.

632. Thermodynamics. A treatment from the engineering viewpoint of the volumetric and phase behaviour of pure substances and multicomponent systems at physical and chemical equilibrium. Estimation of thermodynamic properties from a knowledge of molecular structure. Emphasis will be on the application of these principles to the solution of problems in industrial practice. One term.

642. Advanced Reactor Design I. Design and scale up of fluidized and packed bed reactors. Simultaneous diffusion and reaction in porous materials.
Prerequisite: Chem. Eng. 42
Chem. Eng. 43
One term.

643. Advanced Reactor Design II. Design and scale up of homogeneous flow reactors allowing for non ideal mixing, various residence time distributions, back mixing.
Prerequisite: Chem. Eng. 42
2 lectures, 2 tutorials every other week.
One term.
644. Physical Processes in Catalysis. Examination of the role of diffusion, adsorption, physical structure of the catalyst on rate and selectivity. Prerequisite: Chem. Eng. 43
2 lectures
One term.

651. Process Optimization. The definition of the optimization problem in design and control. Introduction to applications of steepest ascent, calculus of variations and mathematical programming.

One term.

653. Random Signals and System Dynamics. A basic knowledge of the Laplace and Fourier transformations as well as some familiarity with the elements of probability theory are assumed. The theory of random processes will be examined. The methods of analysis and synthesis of systems subjected to stationary random inputs will be developed.

Department of Chemistry

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

Professor and Chairman of Department

W. F. Forbes, Ph.D. (London), D.I.C. - - - - - Professor
W. L. Elsdon, M.Sc. (Western), Ph.D. (McGill) - - Associate Professor
R. M. Guest, M.A. (Western), Ph.D. (McGill) - - - Associate Professor
J. R. Mills, M.A. (Toronto), Ph.D. (Illinois) - - - Associate Professor
H. G. McLeod, M.A., Ph.D. (Toronto) - - - 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, B.Sc. (Alberta), Ph.D. (Toronto) - - - Assistant Professor
J. B. Capindale, M.A., D.Phil. (Oxford) - - - Assistant Professor
D. E. Irish, B.Sc. (Western), M.Sc. (McMaster), Ph.D. (Chicago)

Assistant Professor

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


3 lectures, one term. 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.


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.

Covalent bond lengths and angles. Crystal chemistry of ionic substances. The stereochecmistry of various elements and their 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 on the chemistry of organic compounds of industrial interest.
Prerequisite: Chemistry 36.
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.
231. **Chemical Bonding and Structure.** Electronic structure of atoms; the periodic table; nature and classification of chemical bonding; bond energies and electronegativity scales; structure and shape of molecules; crystal structure of common inorganic substances.

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

232. **Analytical Chemistry.** Theory and practice of elementary quantitative inorganic analysis; experiments to illustrate gravimetric, titrimetric, and absorptiometric methods; introduction to various methods of separation.

2 lectures, 6 hours laboratory.

235. **Physical Chemistry I.** An introduction to chemical thermodynamics including the laws of thermodynamics applied to simple systems of fixed composition. Approximately ten hours of the course will be devoted to an 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.

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 stressing general forms of behaviour and periodic trends among the elements. Descriptive chemistry will be presented in part through reading assignments. The accompanying laboratory will illustrate methods of synthesis; analytical tests of products; and determination of composition, structure, and physical constants.

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.

335. **Physical Chemistry II.** The rate laws of elementary kinetics, complex reactions and catalysis. Electrochemistry and the thermodynamics of non-electrolytes.

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. Selected topics in inorganic chemistry including co-ordination chemistry, mechanism of inorganic reactions, nuclear and radiochemistry, non-aqueous solvent systems, high-temperature chemistry. The laboratory course includes preparation of typical inorganic compounds and physical measurements to establish structure and stability of these.
2 lectures, 6 hours laboratory.

435. Physical Chemistry III. The thermodynamics and kinetics of surface phenomena. An introduction to the fundamentals of quantum and statistical mechanics with applications to rate theories and small molecules.
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. Physical chemistry; or organic chemistry; or inorganic chemistry, for students in Honours Chemistry and Physics (cf. course 431). Three hours may be in Biochemistry (cf. course 437).
Chem. students, 6 hours laboratory.
Chem. & Phys. 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.

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.

645. Quantum Chemistry. The fundamentals of quantum chemistry with applications to the solution of the wave equation for simple molecules and the solution by approximate methods for large molecules.

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


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.


Department of Civil Engineering

A. N. Sherbourne, B.Sc. (London), M.S. (Lehigh), M.A., Ph.D. (Cambridge)  
Professor and Chairman of Department

N. C. Lind, M.Sc. (Royal Tech. Univ. of Denmark), Ph.D. (Illinois) - Professor
D. T. Wright, B.A.Sc. (Toronto), M.S. (Illinois), Ph.D. (Cambridge)  
Professor and Dean of Engineering

S. T. Ariaratnam, B.Sc.(Eng.) (Ceylon), M.Sc. (London), Ph.D. (Cambridge)  
Associate Professor

M. Z. Cohn, Candidate of Tech. Sc. (Bucharest) -  
Associate Professor
W. R. Drynan, B.A.Sc. (Toronto), M.Sc., Ph.D. (Texas) - Associate Professor
Undergraduate Programmes. Details of the undergraduate programme in Civil Engineering are to be found on page 58.

Prerequisite: GE 41.
2 lectures, one term.

Prerequisite: CE 22.
3 lectures, 3 hours laboratory, one term.

Prerequisite: CE 31.
2 lectures, 3 hours problems or laboratory alternate weeks, one term.

Prerequisites: CE 31, 32.
2 lectures, 2 hours problems or laboratory, one term.
34. Behaviour of Plain and Reinforced Concrete.
3 lectures, one term.

35. Advanced Design of Structures.
3 lectures, one term.

2 lectures, 4 hours field work, one term.

3 lectures, 3 hours laboratory alternate weeks, one term.

2 lectures, 3 hours laboratory alternate weeks, one term.


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.
2 lectures, one term.

2 lectures, one term.


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. 3 lectures, 2 hours laboratory, one term.

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. 3 lectures, one term.

81. Law, Contracts and Specifications. Engineering law. The design and composition of contracts and specifications. 2 lectures, one term.

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. 2 lectures, one term.

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. 3 lectures, one term.

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. 6 hours, one term.
85. Design Studies II. Advanced studies in civil engineering design related to optional courses offered and direction of special interest. 9 hours, one term.

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. 9 hours, one term.

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, Lind, Poorooshab, 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 courses 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 (Karrow, Poorooshab, 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) 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 (McLaughlin and Hutchinson) 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


Normally, this course would be studied for credit only by students intending to register for CE 615 in a subsequent term.
One term.

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.
One term.

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.
One term.

One term.

Prerequisite: CE 611 or CE 614.
One term.

One term.

One term.

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

One term.


One term.


One term.

642. Transportation Engineering (Urban Planning). Basic urban transportation studies including origin/destination, inventory, use, parking and transit studies. Land use planning, travel desires. Economics in urban transportation.

One term.


One term.


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.

One term.

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

One term.

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.

One term.


One term.
One term.

One term.

One term.

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.
One term.

698. Special Directed Studies.
One term.

Department of Classics

B. J. Graf, C.R., M.A. (Western) - - - - - - Professor J
F. G. Keleher, C.R., M.A. (St. Mary's, Kentucky) - - Associate Professor J
P. Keresztes, M.A. (Toronto), Ph.D. (Charles Francis University, Graz) - 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 Univ.) - Lecturer J
Phyllis H. Winkelman, A.B. (Holyoak), M.A. (Columbia) - Lecturer (Part-time)
A. G. Ziegler, B.A. (Akron) - - - - - - Lecturer

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. 3 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).

**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.

50J. **Advanced Latin.** The Ontario Grade 13 curriculum will be followed. 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, Latin 10, Latin 50J, or permission. 3 lectures.

250. **Prose Composition and Sight Translation.** 1 lecture.


350. **Prose Composition and Sight Translation.** 1 lecture.


370. **Lyric and Elegiac Poetry.** Horace, *Odes* and *Carmen Saeculare*, selections from Tibbulus, Propertius, and Orvid. 3 lectures.

450. **Prose Composition and Sight Translation.** 1 lecture.


**Classical Civilization (Courses in Translation)**

260. **Classical Literature in Translation.** Greek and Roman epic, drama, and verse.

3 lectures.

350. Classical Art and Archaeology. A survey of art and architecture from the Aegean age through the Roman Empire.
2 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.
2 lectures.

Department of Economics

W. G. Scott, B.A. (Western), M.A. (Toronto)

*Assistant Professor and Acting Chairman of the Department*

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

*Associate Professor J*

K. Pinola, B.A. (Minnesota), M.S. (Wisconsin), Ph.D. (Wisconsin)

*Associate Professor*

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

R. W. Hedden, B.Comm. (McMaster) - - - * (Sessional) Lecturer*

All the following courses are Honours courses but any of them may be taken by students in General Arts, with the exception of Economics 450, 460 and 470.

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.

251. Statistical Methods. Frequency distributions, measures of central tendency, and dispersion, simple probability, inference theory, tests of hypotheses, power of tests, analysis of variance, linear and curvilinear correlation and regression, Chi-square and other nonparametric methods, time series, index numbers, elements of quality control and sample size determination for efficiency of estimates.
Prerequisite: Grade XIII Algebra.
260R. Economic History. Economic and social problems in the historical
development of Europe from 1500 A.D.
3 lectures.

350. 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.

355. International Economics. The following topics are discussed in the first
term: balance of payments statistics; the economic basis of trade and invest-
ment; foreign exchange rates and their determination; commercial policy;
international investment and foreign aid.
The second half of the course studies the theory of international trade and
investment, with special reference to the problems of economic development.
3 lectures.

360. Labour Economics and Industrial Relations. History of trade unionism,
wage and employment theory, collective bargaining, labour law, social se-
curity system, unions and democracy, the wage price issue, labour and economic
development.
3 lectures.

365. Public Finance and Fiscal Policy. The place of public expenditures and
revenue in the national economy, taxation, debt management, and the role
of fiscal policy in economic stabilization.
3 lectures.

370. Industrial Organization and Public Policy. The problems of monopoly and
economic concentration with special reference to Canada. Government inter-
vention in agriculture, public utilities, transport, and foreign enterprise. Public
Ownership and State Planning.
3 lectures.

375. Economics of Development. Examines economics development and
growth as it is and has 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.

methods, growth, and development under socialistic and capitalistic systems,
and under bureaucratic and market mechanisms.
Prerequisite: Economics 100.
3 lectures.
440. Managerial Economics. The purpose of this course is to show how economic analysis can be used in formulating business policies and decisions. Concentration is given to those economic concepts - i.e. demand, cost, profit, competition, etc., that can be measured and applied to management problems, particularly in large scale industrial corporations.
Prerequisite: Economics 100, 250, and 251.
3 lectures.

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

3 lectures.

460. Introduction to Econometrics. Estimation, models of growth and decay, statistical estimation of supply and demand functions, forecasting, behaviour equations, and simulation techniques.
Prerequisite: Economics 100, 250 and 251.
3 lectures.

470. Senior Seminar. Topics in important and current economic problems.
3 lectures.

Department of Electrical Engineering

R. G. Anthes, M.A.Sc. (Toronto) - Professor and Acting Chairman of Department
H. K. Kesavan, B.E. (Mysore), M.S. (Illinois), Ph.D. (Michigan State)
Professor (on leave of absence)
L. Y. Wei, B.S. (National Northwestern College, China), M.S., Ph.D. (Illinois)
Professor
H. C. Ratz, B.A.Sc. (Toronto), S.M. (Massachusetts Institute of Technology),
Ph.D. (Saskatchewan) - Associate Professor
G. J. Dufault, B.A. (Ottawa), B.Sc. (Carleton) - Assistant Professor
J. V. Hanson, B.A.Sc. (Toronto), D.I.C. (Imperial College of Science
and Technology), M.Sc. (London) - Assistant Professor
J. S. Keeler, M.A.Sc. (Toronto) - Assistant Professor
W. N. Meikle, B.A.Sc. (Toronto) - Assistant Professor
R. H. MacPhie, B.A.Sc. (Toronto), M.S., Ph.D. (Illinois) - Assistant Professor
W. F. McGee, M.A. (Toronto), Ph.D. (Illinois) - Assistant Professor
P. H. Roe, B.A.Sc. (Toronto), M.Sc., Ph.D. (Waterloo) - Assistant Professor
L. Zafiriu, B.Sc. (American College, Istanbul), M.Sc. (Syracuse)
Assistant Professor
J. B. Ellis, B.A.Sc. (Toronto), M.Sc. (London) - Lecturer
A. H. Qureshi, B.E. (Peshawar), Dr. Ing. (Aachen) - Lecturer
R. G. Van Heeswijk, Dipl. Ing. (Technological University of Delft) - Lecturer
W. J. Vetter, B.A.Sc. (Toronto), M.A.Sc. (Waterloo) - Lecturer
Undergraduate Programmes. Details of the undergraduate programme in Electrical Engineering are to be found on page 61.

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


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

EE 13. Electricity and Magnetism II. A second course in electricity and magnetism containing an introduction to time-varying fields.


Prerequisite: Math 31, Math 45.
3 lectures, alternate laboratory, one term.

Prerequisite: EE 42, EE 52.
3 lectures, one term.

EE 25. Logic and Switching II. A course in engineering principles of stored programme digital computers. Design of arithmetic section, coding, control. Over-all logical organization and memory techniques.
Prerequisite: EE 24.
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. 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 52. **Electronics II.** Transistor models and circuits. Transistor voltage gain and current gain. Comparison of basic transistor circuits. Variation of transistor parameters. Introduction to the vacuum triode. Triode characteristic curves. Grounded cathode, cathode-follower and grounded-grid amplifiers. Tetrode and pentode control valves. Gas triodes. Prerequisite: EE 51. 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.
EE 61. Electromechanics I. Magnetic circuits, study of the commutating machine both in isolation and a component in a d.c. control system. Terminal characteristics of the three modes of operation - generator, motor, and rotating amplifier, transient and steady-state analysis. Matrix methods are used extensively.
3 lectures, one term.

EE 62. Electromechanics II. Two-winding and multi-winding transformers. Equivalent circuits are derived from transformation theory. Study of a.c. machines from their terminal characteristics. Symmetrical component sequence equations are derived from a linear transformation. Matrix methods are used extensively.
Prerequisite: EE 61.
3 lectures, one term.

Prerequisite: EE 62.
3 lectures, one term.

EE 65. Power Systems Analysis. Systematic mathematical formulation of systems of polyphase machines, 3-phase transformers, and transmission lines in terms of the sequence variables. Analytical and computer solutions.
Prerequisite: EE 62.
3 lectures, one term.

Prerequisite: Math 41, Phys. 13.
3 lectures, one term.

Prerequisite: EE 71.
3 lectures, one term.

Prerequisite: EE 72, Math 45.
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: EE 42.
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 non-linear systems analysis, phase plane and describing function techniques. Introduction to statistical systems analysis, optimum system criteria.
Prerequisite: EE 81.
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 Programmes

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.

A thesis is not required, but if submitted and accepted, will count either four or five units credit under EE 699. Thesis topics are worked out in discussions between students and faculty. No more than two units will be credited to a student taking EE 698. Furthermore, it is not possible to obtain credit under both EE 698 and EE 699.

Students transferring from other universities of recognized standing may be allowed a maximum of two units for graduate courses previously taken. No 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 student, the maximum load is reduced from five units per semester by one unit for each seven hours per week of employment or outside work.

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 cooperative graduate students from industry.

A complete programme consists of a total of ten units. Each student's programme must be approved by the Electrical Engineering Department, and is worked out 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 grade below 66%, or more than two courses in other fields than Electrical Engineering receives grade below 66%.
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A thesis student must be registered in EE 699 continuously without interruption, and the thesis must be done under the direct supervision of a professor of the Electrical Engineering Department, and is finally approved and accepted by that professor.

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 as 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.
4. Electric and magnetic materials.
5. Electric circuit theory.
7. Network synthesis.
8. Nonlinear control.
9. Solid state electronics.
10. System theory.

Well equipped are the solid state electronics lab and the semiconductor research lab, which provide adequate facilities for research in lasers, semiconductors, metallic thin films and infra-red absorption. The department has installed a Pace TR-48 ES-400 Analogue Computer and will establish a hybrid computer centre, including an IBM 1710 in the fall of 1964 for the engineering faculty.

Graduate Course Descriptions

One term.
One term.

One term.

One term.

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 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.

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, Larmor 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.

Department of English

W. K. Thomas, M.A., Ph.D. (Toronto) - Professor and Chairman of Department
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
H. T. Cox, M.A. (Akron), Ph.D. (Pennsylvania) - Associate Professor
L. A. Cummings, A.B. (Washington), M.A. (Missouri), Ph.D. (Washington) - Associate Professor
A. I. Dust, M.A., Ph.D. (Illinois) - Assistant Professor
W. R. Martin, M.A. (Natal) - Assistant Professor
J. S. Stone, M.A. (British Columbia) - - - - Assistant Professor
J. Carscallen, B.A. (Toronto), B.Litt. (Oxon.) - - - - Lecture
P. Morris, C.R., B.A. (Western), M.A. (St. Louis) - - - - Lecturer
A. M. MacQuarrie, B.A. (Acadia), M.A. (Toronto) - - - - Lecturer
Sister M. Leon, S.S.N.D., B.A. (Toronto), M.A. (Detroit) - - Lecturer
D. Keppel-Jones, B.A. (Natal), M.A. (Queen's) - - - - Instructor

English Major in General Arts

In Year I the prospective English major should select English 100, Philosophy 100, Science 100, at least one of French 100, German 100, and Latin 100, and other subjects in accord with the general regulations.

In Year II the English major shall complete English 200 and 250; in the course of Years II and III he shall complete one further Honours English course and at least two of English 210, 220, 225, 230, 300, 335, or any Honours English courses; in Year III he shall also complete English 345 and shall write a Comprehensive Examination in the general field of English Literature.

Subjects related to the study of English, and from which the English major is expected to choose his optional courses, are the following: Classics, French, German, History (especially English or American), Philosophy, Psychology, Religious Knowledge, Russian, Sociology and Spanish.

Note on numbering: English 100 and 200 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.

Note on prerequisites: Normally English 100 (or its equivalent at another University) will be prerequisite to all courses numbered 200 and above (except 225 and 235). In addition English 200 (or its equivalent) will normally be prerequisite to English 380, 450, 455, 460 and 470.

15. English Literature. Designed as an option for first-year Applied Physics students, 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.

Texts: First term: Scott. Topics and Opinions, First Series; Conrad, Lord Jim; Amis, Lucky Jim; Paton, Too Late the Phalorope; Golding, Lord of the Flies. Second term: Barnet, Berman & Burto, Eight Great Tragedies, Eight Great Comedies; Coffin, The Major Poets. 3 lectures.

50J. Preliminary Year English. General literature and composition; the Ontario Grade 13 curriculum will be followed. 4 lectures.
100. The Periods of English Literature, I: Mediaeval to Augustan. Beginning with a training in critical reading and an introduction to the conventions of various literary types, this course then examines the principal characteristics of English Literature in the Middle Ages, the Renaissance, and the Augustan Age. (For both General and Honours students who are likely to take a further English course.)


3 lectures.

110. Themes and Types of English Literature. An examination of the humanistic content of English literature and the various forms in which it is expressed. (For students who are likely not to take a further English course.)


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.

200. The Periods of English Literature, II: Romantic to Contemporary. Completing the survey begun in English 100, this course examines English literature in the Romantic movement, the early and later Victorian period, and our contemporary period. (For both General and Honours students)


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.

**Texts:** To be announced.

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.

**Texts:** To be arranged.

3 lectures.

230. **Nineteenth-Century Literature.** Designed to complement English 200, this course provides a more intensive study of Romantic and Victorian literature.

**Texts:** To be announced.

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 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.

250. **Practical Criticism.** A training in the application of critical principles to literary works. The course consists of a series of seminar meetings, for which the students prepare critical appraisals of literary works and in which these appraisals are examined and discussed in considerable detail.

1½ hour seminars.

260. **Old English.** An introduction to Anglo-Saxon language and literature in their historical context, with special attention to the development of the language.

**Texts:** Alston, *An Introduction to Old English*; Wyatt, *Anglo-Saxon Reader*.

2 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.
Department of English

Texts: Chaucer, Works, ed. Robinson; Dickens & Wilson, Early Middle English Texts; Sisam, Fourteenth Century Verse & Prose; The Lay of Havelok the Dane, ed. Skeat & Sisam; Langland (?), Piers Plowman, ed. Skeat; Sir Gawain and the Green Knight (in translation).
3 lectures.


2 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. Secondarily, 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.

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 19th and 20th 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.

345. Supervision of Senior Essay.
1 hour a week.


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-Shakespearean 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 260.

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).

460. Twentieth-Century Literature. A critical study of the principal works of Shaw, Yeats, Eliot, James, Corad, H. D. Lawrence, and others of the modern period.
Texts: To be announced.
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.
Texts: Bate, Criticism: The Major Texts; Goldberg & Goldberg, The Modern Critical Spectrum; Patrides, Milton’s “Lycidas”: The Tradition and the Poem.
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.
Texts: To be announced.
3 lectures.

495. Supervision of Senior Honours Essay.
1 hour 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, M.A. (Western), Doctorat de l'universite de Paris
Professor and Chairman of Department

J. R. Finn, C.R., B.A. (Western), M.A. (Toronto), Ph.D. (Illinois)
Associate Professor

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 University of America) - Associate Professor

Dorothea Walter, (Mrs.) M.A. (Queen's) - Associate Professor
A. Ages, B.A., M.A. (Carleton), Ph.D. (Ohio State) - Assistant Professor

French

A General Arts student majoring in French will complete French 100A, 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.

100A. 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.

Prerequisite: French 100.
3 lectures.

220. French Literature from the Pléiade to the Encyclopédistes.
Prerequisite: French 100.
3 lectures.

250. Prose Composition and Grammar; Phonetics and Oral Practice.
Prerequisite: French 100 or French 100A.
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 100A.
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.

330. French Literature since the Encyclopédistes.
Not offered in 1964-65.
Prerequisite: French 220.
3 lectures.
350. Prose Composition, Grammar and Oral Practice. The language laboratory will be used.  
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 World War I. Lectures, readings, reports in French.  
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 Prose and Drama Since World War I. 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

699. Thesis

Note: All courses above 599 with the exception of the Thesis are considered half-courses.
Department of Geography

R. R. Krueger, M.A. (Western), Ph.D. (Indiana)  
Professor and Chairman of Department

A. Diem, B.A. (Wayne State), M.A. (Clarke), Ph.D. (Michigan)  
Associate Professor

D. K. Erb, B.Sc. (Western), M.A. (Toronto), Ph.D. (McGill) - Assistant Professor

J. T. Horton, B.A. (Wheaton), M.A. (Northwestern) - Assistant Professor

E. R. Officer, B.A. (British Columbia), M.A. (Wisconsin) - Assistant Professor

N. Pearson, B.A. (Dunelm) - Assistant Professor

15. 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, with an emphasis on world resources and the geographic bases of economic development, international trade, and political relationships. 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 fall term).

220. World Regional Geography. A survey of the major natural and political regions of the world with attention to areas of current interest in world affairs; the interrelationships of physical, economic, and cultural factors, and their implications for problems of economic growth.

2 lectures, 2 hours seminar.
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 spring 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.** An 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.

341. **Historical and Regional Geography of North America.** The economic and political geography of North America at different periods of time. The geographical influences of changing patterns of human occupation. The historical-geographical approach to current economic and political problems.

3 lectures.

345. **Political Geography.** An examination of the geographic aspects of the world's political patterns; politico-territorial problems of states; contemporary international problems and their geographic backgrounds; 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 **Geographic Approach to Land-Use Problems.** Urban and rural land-use problems; regional approach to land-use planning and resource management; pre-planning studies and resource inventory; conservation of renewable resources.

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 1964-65)

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.

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.
Department of Geography

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.

Geology

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

General Engineering

11. Engineering Synthesis. Principles of problem statement, analysis and concept creation. Discussions 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 for 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.

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.

Prerequisite: GE 21.
4 hours, one term.

3 hours lectures.
Department of German and Russian

Prerequisite: ME 12, Math 31.
3 hours lecture, 3 hours laboratory.

2 lectures, 2 hours tutorials, one term.

2 lectures, 1 hour tutorial, one term.


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.

3 lectures.

Department of German and Russian

J. D. Dyck, A.B. (Bethel), M.A. (Missouri), Ph.D. (Michigan)
Professor and Chairman of 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.)
I. Levitsky, A.B. (Rochester), M.A. (Buffalo), Ph.D. (Duke)  
*Assistant Professor (Germ./Russ.)*

S. P. Hoefert, A.B., 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.
2. Particular consideration has been given to critical analysis of literary texts and their contribution to European thought and to the whole of civilization.
3. The programmes for German major and Honours students are intended to give a coherent and complete picture of German literature.

(1) All courses above 100 are honours courses. Those marked with an asterisk are particularly recommended for general students.

(2) German 270 meets the requirement otherwise referred to in the calendar as cultural or civilization course.

1. **Beginner's German.** For Engineering students with no previous knowledge of German. The elements of German grammar, reading and translation.  
   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.

260.* The Age of Goethe. Storm and Stress, The Classical Period, Romanticism. Reading, interpretation and critical analysis of representative work of Lenz, Klinger, Goethe, Schiller, Kleist, Novalis, Brentano, Eichendorff, etc.
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.

350.* Intermediate Conversation and Composition. Written reports on prescribed themes and topics. Oral drill.
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, Hoffmannsthal, 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. (Saaz, Luther, Sachs, Grimmelshausen, Gryphius, Opitz, etc.) Prerequisite: German 100 or equivalent. 3 lectures.

495. Reading Course in Approved Topics.

600. German Literary Criticism. Research technique, 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 600 courses with the exception of the Thesis are 1 term courses.
Russian

Notes: (1) All courses above 100 are honours courses. Those marked with an asterisk 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.

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. **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.

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, Gorki, etc.) Reading, interpretation and critical analysis of prescribed prose, drama and poetry.

Prerequisite: Russian 100.

3 lectures.

370. **Russian Literature from its Beginning to the 18th Century.** An introduction to the History of the Language. Study of the Epics and Byliny. Reading and interpretations of representative works of Lomonosov, Derzhavin, Fonvizin, Radishchev.

Prerequisite: Russian 100.

3 lectures.

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.

460. Soviet Literature. (Essenin, Mayakovsky, Babel, Fedin, Pasternak, Sholokhov etc.) Reading, interpretation and critical analysis of prescribed prose, drama, and poetry.
Prerequisite: Russian 100.
3 lectures.

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, Mayakovsky, Pasternak, etc.)
Prerequisite: Russian 100.
2 lectures.

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.

Note: All 600 courses are one term courses.

Department of History

P. G. Cornell, E.D., M.A., Ph.D. (Toronto)  Professor and Chairman of Department
K. A. MacKirdy, M.A. (British Columbia), Ph.D. (Toronto) - Professor
A. W. Rees, B.A. (Aberystwyth U. College), M.A. (Wales) - Professor R
H. MacKinnon, B.A. (Montreal), Ph.L. S.T.L. (Gregorian), M.A. (Toronto), D.Phil. (Oxford) - Associate Professor
E. P. Patterson, B.A. (Baylor), M.A. (Kansas), Ph.D. (Washington)
Assistant Professor
R. E. Wynne, C.D., D.Jur (Vienna), B.Ed., M.A. (Alberta) - Assistant Professor
1. **General Course.** Students majoring in History will normally choose their courses from History 100, 200, 210, 300, 310. They will fulfill the requirement History 349.

2. **Honours Course.** The programme recommended at page 31 is the standard prescription. Some adjustments may be authorized.

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.

**501. Preliminary Year History.** The Ontario Grade 13 curriculum will be followed.

3 lectures.

**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.

**200. The Expansion of Europe Since 1400 A.D.** Surveys the course of Portuguese, Spanish, Dutch, and French colonial expansion, as compared to the historical development of British overseas institutions (1400—to 20th Century).

3 lectures.

**210. British History, 800 A.D. to the Present.**

3 lectures.

**250. History of Medieval Europe.**

3 hours, lectures and seminars.

**255. Ancient Civilization.** A survey of the social, political and economic history of Greece and Rome with an introduction to the civilizations of the Ancient Near East.

3 lectures.
260. Early Modern European History. From the Renaissance to the Enlightenment.
3 hours, lectures and seminars.

270. Asian History.
3 hours, lectures and seminars.

275. Russian History.
3 hours, lectures and seminars.

276. German History. The social, economic and political problems of Central Europe from the Thirty Years War to the First World War.
3 hours, lectures and seminars.

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.

299. Supervised Reading in Non-English Texts and Periodicals. The foreign language will be chosen in consultation with the Department.
1 hour consultation.

300. Canadian and American History Since 1760. A general survey of Canadian history with the introduction of several themes from American history that have a bearing on Canadian development.
3 lectures.

3 lectures.

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.

370. Comparative Studies in Imperialism and Colonization. The development of British colonial policy and the adjustment of British settlers to their new environment, compared with the policies and experiences of other European
peoples. Different themes will be developed each year. In 1964-65: Canada and Siberia; India and Indonesia.
3 hours, lectures and seminars.

380. Canadian History.
3 hours, lectures and seminars.

450. History of the United States. The growth of a new nation; the territorial and economic expansion of the United States from the Revolution to the Second World War; interrelationship of economic, social, political, and intellectual development.
3 hours, lectures and seminars.

460. History of the Far East in the Nineteenth and Twentieth Centuries.
3 hours, lectures and seminars.

462. Modern International History, Mainly since 1900.
3 hours, lectures and seminars.

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.

480. Interdisciplinary Seminars. (To be made available to selected senior students, by the co-operation of several Arts Departments.
2 hours.

499. Senior Honours Essay. (Required of all History honours students in their fourth year.

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 European History.

621. German History.

622. Medieval History.

Department of Mathematics

R. G. Stanton, B.A. (Western), M.A., Ph.D. (Toronto), F.S.S.
Professor and Chairman of Department
Dean of the Faculty of Graduate Studies

K. D. Fryer, B.A. (Western), M.A., Ph.D. (Toronto)
Professor and Associate Chairman of Department

G. Berman, M.A., Ph.D. (Toronto) - - - - - - Professor
W. B. Pennington, M.A., Ph.D. (Cambridge) - - - Visiting Professor
D. A. Sprott, M.A., Ph.D. (Toronto), F.S.S. - - - - - Professor
W. T. Tutte, M.Sc., M.A., Ph.D. (Cambridge), F.R.S.C. - - - Professor
G. E. Cross, M.A. (Dalhousie), Ph.D. (British Columbia) - Associate Professor
H. F. Davis, S.M., Ph.D. (Massachusetts Institute of Technology)

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
M. Behara, M.Sc. (Utkal), Dr. rer. oec. (Saarland), F.S.S. - Assistant Professor
A. Kerr-Lawson, B.A. (Toronto), S.M. (Chicago), Ph.D. (McMaster)

R. C. Mullin, B.A. (Western), M.A. (Waterloo) - - - - - Lecturer
R. B. Reed, B.A.Sc. (Toronto), M.Sc. (Waterloo) - - - - - Lecturer
G. N. Robertson, M.Sc. (Manitoba) - - - - - 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

D. D. Cowen, B.A.Sc. (Toronto), M.Sc. (Waterloo) - - - Lecturer
J. D. Lawson, B.A.Sc. (Toronto), M.Sc. (Waterloo) - - - Lecturer
Mathematics

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.

42. **Vector Methods.** Scalar and vector products; curl, divergence, and gradient. Use of vectors and matrices in discussion of physical problems in mechanics, fluid flow, and electromagnetism. Introduction to tensors.
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.
Prerequisites: Math 33, 34.
2 lectures, 1 hour problems, one term.

45. **Applied Analysis II** A continuance of some topics listed in Math 41, complex variables, calculus of variations.
2 lectures, one term.

Prerequisite: Math 22.
2 lectures, 3 hours problems, one term.

53. **Operational Methods.** The Heaviside Calculus and the Laplace Transform. Admittance, impedance, and other operators. Applications of operator techniques to problems in electricity, mechanics, and heat.
Prerequisites: Math 22, 31, and consent of instructor.
2 lectures, 1 hour problems, one term.

Prerequisites: Math 22, 31, and consent of instructor.
2 lectures, one hour problems, one term.
Prerequisite: Math 32.
3 lectures, one term.

Prerequisite: Math 21.
3 lectures, one term.

60J. Preliminary Year Algebra. The Ontario Grade 13 curriculum will be followed.
3 lectures.

62J. Preliminary Year Geometry. The Ontario Grade 13 curriculum will be followed.
3 lectures.

68J. Preliminary Year Trigonometry. The Ontario Grade 13 curriculum will be followed, omitting the study of statics.
3 lectures.

3 lectures.

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.
**Department of Mathematics**

3 lectures.

2 lectures, one hour problems.

1 lecture, 2 hours problems.

230. **Algebra.** Introduction to the theory of sets and groups. Introduction to rings and fields. Vector spaces and matrices.
3 lectures.

2 lectures.

3 lectures.

1 lecture, 2 hours problems.

2 lectures.

2 lectures.
2 lectures.

3 lectures.

331. Algebra II. A continuation of course 230.
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.

336. Life Contingencies. An advanced course on problems of single lives and on the death and survival of multiple lives.
3 lectures.

2 lectures.

2 lectures.

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425. Introduction to the Theory of Numbers. 2 hours per week.


431. Algebra II. 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. 1 hour per week.


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.

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.

441. **Quantum Theory**. The classical mechanics of Lagrange and Hamilton. Introduction to quantum theory. 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.

447. **Statistical Mechanics**. Applications of probability theory to theoretical Physics. 2 lectures.


2 lectures.


605. Groups and Matrices.

611. Advanced Probability. Review of classical probability theory, including occupancy problems, the binomial, Poisson, and normal distributions, applications in physics. Recurrent events. Markov chains, stochastic processes, including the ruin problem and diffusion processes; application to information theory, radar, queuing problems, etc.

614. Integral Equations.

615. Group Characteristics and Representation Theory.


624. Advanced Statistics.

625. Galois Theory.


634. Topics in Ordinary Differential Equations.

635. Algebraic Numbers.

639. Functional Equations.

641. Mathematical Methods for Operations Research. Construction and analysis of mathematical models of systems and processes connected with Science and Engineering. Related topics in numerical methods, probability, statistics, and linear graph theory. Special methods such as simulation, queuing theory and renewal theory. Methods of optimization including linear and non-linear programming, steepest descent, dynamic programming, and game theory.

645. Rings and Ideals.

649. Functional Analysis


655. Combinatorial Analysis.

659. Linear Operators.

663. Mathematical Logic.


665. Topics in Number Theory.

674. Statistical Decision Theory.

675. Linear Graphs. Definitions and basic theorems. Planar graphs and Kuratowski's theorem. Selected topics from advanced graph theory.

688. Special Topics in Algebra.

698. Special Topics in Analysis.

Department of Mechanical Engineering

W. B. Fallis, M.A.Sc., Ph.D. (Toronto) - Professor and Chairman of Department
S. Alpay, Dipl. Ing., Dr. Ing. (Berlin) - - - - - Professor
G. T. Csanady, Dipl. Ing. (Munich), Ph.D. (New South Wales) - - Professor
G. F. Pearce, B.A.Sc. (British Columbia), M.A.Sc. (Toronto) Associate Professor
Undergraduate Programmes.

Details of the undergraduate programme in Mechanical Engineering are to be found on page 63.

3 lectures, 3 hours laboratory, one term.

Introduction to mechanical vibrations. Transient forces. Static force analysis, dynamic force analysis, balancing, cam dynamics, dynamics of feedback systems.
Prerequisite: ME 13.
2 lectures, 3 hours laboratory, one term.

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: ME 21.
2 lectures, 2 hours laboratory, one term.

23. Analysis and Synthesis of Machines. Principle 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, one term.
Prerequisite: ME 21.  
3 lectures, one term.

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.  
Prerequisites: Math 31, Phys 15.  
3 lectures, one term.

Prerequisites: Chem 11, Phys 15.  
3 lectures, one term.

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.  
Prerequisites: Chem 11, Phys 15.  
3 lectures, one term.

42. **Industrial Economic Organization.** The economics and decision processes utilized in choosing between engineering alternatives and in choosing optimum operating levels. The topics discussed are costs, methods for tangible evaluation of alternatives, capital management, determination of minimum cost and maximum profit, risk, uncertainty and intangibles, elements of industrial measurement, analysis and forecasting.  
3 lectures, one term.

3 lectures, 3 hours laboratory, alternate weeks, one term.

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.  
3 lectures, 3 hours laboratory, one term.
Prerequisite: GE 31.
3 lectures, one term.

Prerequisite: ME 53.
3 lectures, one term.

Prerequisite: GE 32, Math 44.
3 lectures, one term.

Prerequisite: GE 32.
3 lectures, 3 hours laboratory, one term.

Prerequisite: GE 32.
3 lectures, one term.

Prerequisites: ME 53, GE 32.
3 lectures, one term.
Prerequisites: GE 32, Math 51.
3 lectures, one term.

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, one term.

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, one term.

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, one term.

**Graduate and Research Programmes**

In a field of applied science such as Mechanical Engineering the heart of any graduate work 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 following section. 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 super-
visor. 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.

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.

Another research project is aimed at investigating the influence of dislocation interactions on apparent work hardening rates in single crystalline solids. A number of experimental techniques are employed to produce slip in predetermined orientations thereby permitting an analysis of the dislocation intersections and interactions which occur upon deformation.

Design Studies.
The Design Studies Group is supported by the University, the National Design Council and interested industries. It has the purpose of investigating the various aspects of industrial design and the problems of the individual industrial designer. The area of primary concern to the group at the present time is the organizational structure surrounding the industrial designer and how it affects his level of performance.

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 a fluid jet control valve and of a submerged jet impinging normally on an eccentric orifice.

Aero-Space Propulsion.
Three projects are under way in the general area of aero-space propulsion. One is a study of the formation of oxide smokes in the combustion of metals. Another is an investigation of the combustion of liquid fuels at pressures near the critical. The third project is the design and construction of a simulator to reproduce some of the phenomena associated with flow in solid-propellant rocket motors.
In the first project flame spectroscopy is used in an attempt to discover the vapour-phase reactions taking place when metals burn. Transient effects become important in the combustion of liquid fuels at high pressures when the density of vapourized fuel is of the same order as that of the liquid. Time-resolved spectroscopy and high-speed motion pictures are used to study the unsteady effects in these flames.

The solid-propellant simulator is being designed for the study of flow phenomena in rocket motors. In particular, it is of interest to examine the relationship between the stability of the gas flow and the boundary conditions imposed on the flow field by the burning charge.

**Ground Effect Machines.**

The purpose of this research program is to investigate the influence of ground effects on the aerodynamic characteristics of very low aspect ratio lifting surfaces. The lifting surface envisaged is a ram wing type Ground Effect Machine in which pneumatic side jets and a trailing edge jet are used to contain the pressure field generated on the lower surface. This concept fits into the general category of vehicles known as hovercraft or Ground Effect Machines (GEMS).

**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.

**Graduate Course Descriptions**


One term.


One term.


One term.


One term.
One term.

One term.

One term.

One term.

One term.

One term.

One term.


664. **Turbulent Flow II.** Stochastic averages, methods of measurement of fluctuating quantities. Homogeneous turbulence models, velocity correlations and spectra, energy dissipation. Kolmogoroff’s theory of local isotropy. The structure of turbulence in shear flow, intermittency. Transport phenomena in
turbulent flow, "absolute" and "relative" diffusion, effects of scale. Applications to pipe and boundary layer flow, jets, wakes, atmospheric and oceanic turbulence. The generation of aerodynamic noise in shear layers and boundary layers.

Prerequisite: ME 66.

One term.


Prerequisite: ME 62

GE 31

One term.
Department of Philosophy

R. J. C. Burgener, M.A., Ph.D. (Toronto)

*Associate Professor and Chairman of Department*

C. A. Hergott, C.R., M.A. (St. Louis), S.T.D. (Gregorian) - - *Professor J*


*Associate Professor*

P. B. Sheridan, C.R., M.A. (Western), J.C.D. (Gregorian), Ph.D. (Fribourg)

*Associate Professor J*

L. Armour, B.A. (British Columbia), Ph.D. (London) - *Assistant Professor J*

J. R. Horne, M.A. (Western), B.Th. (Huron), Ph.D. (Columbia)

*Assistant Professor R*

B. J. Murphy, C.R., B.A. (Western), M.A., Ph.D. (Ottawa)

*Assistant Professor I*

J. F. Narveson, B.A. (Chicago), M.A., Ph.D. (Harvard) - *Assistant Professor*

P. Seligman, B.A., Ph.D. (London) - - - - *Assistant Professor*

C. C. Brodeur, B.A. (Fordham), M.A. (Toronto) - - - - *Lecturer*

Philosophy

100. Introduction to Philosophy. The normal first course in Philosophy both for those intending to proceed further and for those desiring a single terminal course. The student will attempt to come to grips with some of the fundamental problems of human life, for example, those associated with the nature of matter, mind, reality, knowledge, religion, virtue and beauty. Philosophies both ancient and modern will be discussed and some time devoted to the consideration of the structure of inference (logic) as it occurs in science and other instances of reasoning, argument, proof, and persuasion. 3 hours.

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 qualitative characteristics; motion; time, space; hylomorphic theory. Nature of science; abstraction; necessity; foundation and object of science; scientific method; hypothesis and theory. 3 hours.
201. Ethics and Value Theory. The philosophical approach to the fundamental questions about human values as they affect contemporary problems. Important ethical and political positions of past and present will be examined. Emphasis will be placed on the relevance of ethics to the study of human behaviour within the framework of the social sciences. Recommended as the normal Philosophy course following on from Philosophy 100 for those students who do not intend to pursue the 260-261-360 sequence. The first half of this course (designated as 201a) may be taken by students from other faculties who require a one-semester course.
Prerequisite: Philosophy 100 is recommended.
3 hours.

220. Logic. Rigorous and systematic treatment of truth-functional and quantificational theory, with some treatment also devoted to semantical and metalinguistic theory, proof theory, the foundations of mathematics, inductive logic, and non-extensional systems.
Philosophy 220 gives the student ample preparation for further work in mathematical logic, philosophical analysis, and the philosophy of science. It should also prove very useful for those doing work in linguistics.
Prerequisite: None.
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.

250. Tutorial for Honours.
1 hour.

260a. History of Philosophy I. A preliminary examination of the philosophy of Plato. Mention will be made of the historical Socrates and some of the Presocratics.
Prerequisite: Philosophy 100.
3 hours, half course.

Prerequisite: Philosophy 100.
3 hours, half course.

261a. Moral Philosophy. The various alternative ways of dealing theoretically with questions about human moral value. Views of some of the following positions will be discussed: the Epicureans, the Stoics, Socrates, Plato, Aristotle, Christianity, Spinoza, the Utilitarians, Nietzsche, Schopenhauer, Shaftesbury. Emphasis will be placed on relating these various views to the ethical pronouncements of the modern social sciences particularly cultural anthropology, behaviourism and Freud.
Prerequisite: Philosophy 100.
3 hours, half course.
261b. History of Philosophy II. A preliminary examination of the philosophy of Aristotle, particularly with reference to his metaphysics, physics and psychology, a preliminary examination of Mediaeval philosophy. Prerequisite: Philosophy 100. 3 hours, half course.

260-261 Note: This series of four half-courses will be offered each year. In 261 the order of the a and b half course is reversible. These courses are intended primarily for second year honours students, and for others willing and able to go rather thoroughly into the matters concerned.

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.

301a. Modern Ethics I. Discussion of the moral philosophies of some recent philosophers. Samples of the work of British, American, and Continental philosophers will be analysed. Some attempt will be made to acquaint students with the work of philosophers of a number of schools. Prerequisite: Philosophy 100. 3 hours, half course.

301b. Modern Ethics II. Contemporary ethical problems. Exploration of the epistemological and logical foundations of current ethical issues and discussion of specific problems such as the analysis of moral concepts, the significance and nature of the problem of free will, the data of ethics, the nature of moral rules and the bearing upon ethics of such problems as immortality and the existence of God. Prerequisite: Philosophy 100. 3 hours, half course.

315. Political Philosophy. Philosophical analysis of central concepts in political theory. The effect of the central issues of moral philosophy, epistemology, and metaphysics on the formation of political theories. Examples will be drawn from the work of philosophers of a number of periods and schools — for example, Plato, Aristotle, St. Thomas Aquinas, Hobbes, Locke, Hegel, Marx and contemporary thinkers. Prerequisite: Philosophy 100. 2 hours.

320. Aesthetics. The philosophical consideration of art and beauty. A study of the basic problems with examples from historical and contemporary writers. Various theories of art criticism and literary criticism. Art related to society, morality, the sciences and religion. Prerequisite: Philosophy 100. 2 hours.
330a. Oriental Philosophy. A survey of non-western philosophy, particularly that of China, Japan, and India. The views of such philosophers as Confucius, Lao-Tze and Mencius will be discussed and the philosophical content of the early Hindu and Buddhist writings examined. Zen Buddhism and other modern views.
Prerequisite: Philosophy 100.
3 hours, half course.

330b. Philosophy of History. Consideration of the various possible views about the ultimate nature and significance of history and historical knowledge. The views of such as the following are examined: St. Augustine, Vico, Hegel, Marx, Spengler, Croce, Collingwood and Toynbee.
Prerequisite: Philosophy 100.
3 hours, half course.

330c. Philosophy of Religion. A philosophical approach to the basic ideas of great world religions. The phenomenology of religious experience and mysticism and the nature of religious symbolism and language will be discussed. Enquiry will also be made into such characteristically religious notions as faith and revelation, sin and redemption.
Prerequisite: Philosophy 100.
3 hours, half course.

330d. Special Subject in Philosophy. The instructor presents a theme of special interest to himself well within the grasp of general students who have taken an introductory philosophy course.
Prerequisite: Philosophy 100 or 15.
3 hours, half course.

330 Note: This series of four half-courses will normally be arranged so that two are given in any year constituting a whole course for the purpose of assessing credits. Engineering students may take a half course by itself where appropriate. Although one may enter these courses with Philosophy 100, it is desirable in most cases to have had one other Philosophy course also.

340. Interdisciplinary Seminar. Specific problems regarding the philosophical underpinnings of various sciences and disciplines, including Physics, Biology, Mathematics, Psychology, History, Political Science and Economics, English and other literatures. Conducted by one philosophy instructor in conjunction with one other “visiting” instructor from the discipline concerned. Normal period for each discipline will be two weeks.
Prerequisite: Two full courses in Philosophy.
2 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.
349. Senior Essay. For Philosophy majors in the pass course.
1 hour.

360. History of Philosophy IV-V. The Philosophy of Kant, his predecessors and successors. Considerations of Rationalism and Empiricism not dealt with in Philosophy 260b, particularly those which are specially relevant to the Critical Philosophy. The Critique of Pure Reason. A survey of post-Kantian idealism with emphasis on Hegel.
Prerequisite: Philosophy 260.
3 hours.

375. Philosophy of Science. Thorough introduction to the philosophical issues bearing specifically upon, or arising out of, science. Logical analysis of scientific methods and concepts, study of the role of mathematics in empirical science, consideration of the relations among the various sciences and between the "theoretical" and "applied" branches of particular sciences, and comparison of science as an activity with art, religion, philosophy and everyday life. Some attention will also be devoted to special problems arising from the social sciences, especially psychology.
Prerequisite: Philosophy 220. Very moderate acquaintance with the sciences is assumed. Well-qualified students in the sciences, however, may be admitted without Philosophy 220. May be taken concurrently with 220.
3 hours.

375a. The first semester of the Philosophy of Science course may be taken separately by students in Engineering and others requiring a half-course. Effort will be made to ensure that this portion of the course does not explicitly presuppose Philosophy 220.

450. Epistemology. The basic problems in the theory of knowledge, the nature of logical inference, concepts, causal and rational necessity, determinism, freedom, meaning, language, the fundamental nature of communication.
Prerequisite: Philosophy 360.
2 hours.

Prerequisite: Philosophy 260, 261.
2 hours.

453. Mediaeval Philosophy. Detailed consideration of selected portions of the works of St. Thomas and other Mediaeval philosophers such as Occam, St. Anselm, Albertus Magnus, St. Bernard, Duns Scotus.
Prerequisite: Philosophy 260, 261.
2 hours.

Prerequisite: Philosophy 360.
2 hours.
456. Existential Philosophy and Phenomenology. A study of selected readings. Prerequisite: Philosophy 360. With the consent of the instructor, this course is also open to general students with two full courses in Philosophy. 2 hours.

457. Metaphysics. Theories of reality including study of such fundamental concepts as being, form, substance, causality, process, universal and particular. Prerequisite: Philosophy 360. 2 hours.

458. Analytic Philosophy. Introduction to the rigorous and detailed philosophizing of the contemporary era. Readings from such figures as Frege, Russell, Moore, Lewis, Ayer, Carnap, Quine, Ryle, Austin, and especially Ludwig Wittgenstein. Prerequisite: Two courses in Philosophy. Philosophy 220 is specially recommended. 2 hours.

460. Problems. Seminar projects not readily classifiable into the above categories. Prerequisite: Philosophy 360. 2 hours.

470. Tutorials for Honour Students in Special Subjects. 1 hour.

480-9. Selected Study of One Philosopher. The intensive study of one significant figure in the History of Philosophy. 2 hours, half or full course.

499. Senior Honours Essay. 1 hour.

601. Seminar in Epistemology. 2 hours.

602. Seminar in Metaphysics. 2 hours.

603. Seminar in Ethics. 2 hours.

604. Seminar in Logic. 2 hours.

605. Seminar in Aesthetics. 2 hours.

606. Seminar in Political Philosophy. 2 hours.

607. Seminar in the Foundations of the Natural Sciences. 2 hours.

608. Seminar in the Foundations of the Social Sciences. 2 hours.
609. Seminar in the Philosophy of Religion.
2 hours.

610-19. Seminar in the Study of a Recent Philosopher. Names at present contemplated from which a choice may be made should the demand be sufficient: Bradley, Heidegger, McTaggart, Price, Russell, Ryle, Sartre, Wittgenstein.
2 hours.

620. Seminar in Presocratic Philosophy. The key ideas of Greek philosophy from Anaximander to the Atomists, their logical implications as well as their influence on later ages will be discussed. The foundation of philosophical thinking will be elucidated against the background of the mythological attitude that preceded it. Attention will also be given to early cosmological and anthropological speculation.
2 hours.

621. Seminar in the Philosophy of Kant.
2 hours.

622. Seminar in the Philosophy of Hegel and Post-Kantian Idealism.
2 hours.

670. Specially Directed Studies.
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. Such half-courses will for purposes of records be designated with the suffix "a", e.g. 620a.

Department of Physical and Health Education

D. J. Pugliese, B.A., B.P.E. (McMaster), Ed.M. (Buffalo)
Assistant Professor and Chairman of 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

D. Hayes, B.Sc., B.P.E. (Springfield) - - - - - Lecturer

(Miss) R. Hodgkinson, B.P.H.E. (Toronto) - - - - Lecturer

D. W. Geiger, B.Sc., M.D. (McGill) - - - - Special Lecturer

G. E. Wilson, M.D. (Toronto), Dip.P.H. (Toronto) - - Special Lecturer

Physical Education

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 lectures 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 illnesses 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 2 hours laboratory 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.

460. **Measurement and Evaluation.** The use of statistics with particular emphasis on general descriptive statistics useful in physical education. Examination and application of tests used in health and physical education. Organization of measurement and evaluation programmes and grading practices.
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 concerning 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 (women), track and field, rugger (men), softball (women), 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, football, softball, basketball, tennis, badminton, golf, archery, volleyball, track and field, rugger, field hockey and dance.
50 hours first week — Camp Tawingo.

Department of Physics

J. A. Cowan, B.Sc. (Manitoba), M.A., Ph.D. (Toronto)

Professor and Chairman of Department

F. W. C. Boswell, M.A., Ph.D. (Toronto) - - - - - Professor
R. R. Haering, M.A. (British Columbia), Ph.D. (McGill) - - - Professor
G. E. Reesor, M.A. (McMaster), Ph.D. (Toronto) - - - Professor
R. A. Aziz, M.A., Ph.D. (Toronto) - - - Associate Professor
I. R. Dagg, B.Sc. (Manitoba), M.S. (Penn State), Ph.D. (Toronto) - - Associate Professor
R. A. Snyder, Ph.D. (Western) - - - Associate Professor
D. E. Brodie, M.Sc., Ph.D. (McMaster) - - - Assistant Professor
P. C. Eastman, M.Sc. (McMaster), Ph.D. (British Columbia) - - - Assistant Professor
H. K. Ellenton, B.Sc. (Western), M.A. (Toronto) - - - Assistant Professor
D. J. Henderson, B.A. (British Columbia), Ph.D. (Utah) - - - Assistant Professor
N. R. Isenor, B.Sc. (Acadia), M.Sc., Ph.D. (McMaster) - - - Assistant Professor
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
M. G. Rochester, M.A. (Toronto), Ph.D. (Utah) - - - Assistant Professor
K. A. Woolner, B.Sc. (London) - - - - - Assistant Professor
J. M. Corbett, B.A.Sc. (Toronto), M.Sc. (Waterloo) - - - - - Lecturer
J. R. Richardson, B.Sc. (Queen's), M.Sc. (McGill) - - - - - Lecturer

Physics

3 lectures, 3 hours laboratory.

188
14. **Optics.** Geometrical optics, interference, diffraction and polarization.
3 lectures, 3 hours laboratory, one term.

15. **Modern Physics.** The fundamental particles of matter, assemblies of particles, nuclei and atoms, the wave-particle experiments, introductory quantum mechanics and atomic structure.
3 lectures, one term.

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.

43. **Nuclear Physics.** The atom and its nucleus, radioactive decay, nuclear masses and nuclear stability, nuclear spin and moments, structure of nuclei, gamma radiation processes, alpha decay, beta decay, nuclear reactions, fission, interaction of radiation with matter, counters, particle accelerators and reactors.
3 lectures, one term.

3 lectures, one term.

45. **Introductory Statistical Mechanics.** Review of essential classical and quantum mechanics; ensembles, microcanonical, canonical and grand canonical; quantum statistical mechanics, theory of the density matrix; applications.
3 lectures, one term.

3 lectures, one term.

131. **Mechanics, Wave Motion and Heat.** Vectors, rectilinear motion, plane motion, dynamics of particles, work and energy, linear momentum, rotational motion, statics, angular momentum, harmonic motion, gravitation, wave motion, sound waves, temperature, heat, first and second laws of thermodynamics, kinetic theory of gases.
3 lectures, 3 hours laboratory.

232. **Electricity and Magnetism.** Electrostatics, magnetic fields, electromagnetic induction, alternating current theory, the development of Maxwell's equations.
3 lectures, 3 hours laboratory (experiments and problems). Chemistry and Physics students take laboratory on alternate weeks.
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.

3 lectures, 3 hours laboratory and 2 hours problems on alternate weeks.

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 lectures, 3 hours laboratory alternate weeks for students not taking Physics 333.

333. Intermediate Laboratory. Selected experiments in mechanics, heat, sound, optics, spectroscopy, X-rays, atomic physics, electricity, magnetism, and electronics.
6 hours laboratory.

3 lectures.

3 lectures.

2 lectures.

337. **Astronomy II.** Selected topics in astrophysics, cosmogony, and radio-astronomy.

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; geographical 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.

2 lectures.

433. Advanced Laboratory. Selected experiments in atomic and nuclear physics, solid state physics, and 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.
2 lectures, 3 hours laboratory, alternate weeks, for students not taking Physics 433.

3 lectures.

437. Topics in Theoretical Physics. Selected subjects for advanced study.
2 lectures.

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.

439. 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; Archi-

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.


2 lectures.


2 lectures.


2 lectures, 3 hours laboratory.

505. Seminar and Problem. Each student will prepare and present at least one paper on a technical subject related to his studies. Specific problems may be assigned for investigation and report.

4 hours.


602. Electromagnetic Theory. A brief treatment of electrostatics, steady currents, magnetics and the laws of electrodynamics for stationary media; Maxwell’s equations for moving media; the momentum density and the radiation pressure of the electromagnetic field; magnetohydrodynamics; solution of the homogeneous wave equation and plane-wave scattering; solution of the inhomogeneous wave equation and multi-pole radiation; special relativity and the covariant formulation of electrodynamics; Lienard-Weichert potentials and radiation from an accelerated charge.

603. Solid State Physics. Crystal symmetry and bulk properties; binding energy; defects and their effect on diffusion, deformation, and optical properties; one-electron theory of solids; phonons and specific heat; transport processes and the electron-phonon interaction.


605. Atomic and Molecular Spectra. One or other of these courses may be offered each year. (a) The spectra emitted by atoms are treated on the basis of the vector model of the atom, as constructed from classical quantum theory and wave mechanics. Topics include: the Bohr-Sommerfeld model and wave mechanics of the hydrogen atom, the Schrödinger model of the alkali-like atoms with penetrating orbits, fine structure, hyperfine structure, the many electron model and exchange energy, Zeeman effect, selection rules and intensities of emitted radiation. (b) Emission and absorption of radiation by molecules. Topics include: rotational, vibrational and electronic spectra of diatomic molecules, the interaction of vibration and rotation and the finer details of infra-red and Raman spectra, electronic bands, dissociation, polyatomic molecules, intensities and selection rules of transitions.

608. 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.

609. Topics in Advanced Quantum Mechanics. One or more of the following courses may be offered, but not all will be available in any given year. Course 601 is a prerequisite.

(a) The Principles of Quantum Mechanics. The nature of quantum physics is demonstrated more directly by Dirac's symbolic method than by the usual historical method of presentation based on Schroedinger and Heisenberg mechanics. This course is an examination of the fundamental theoretical principles of the quantum theory, from the symbolic viewpoint.

(b) 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.

(c) 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.


611. Electron Optics and Electron Microscopy. Electrons in electrostatic fields, the electrostatic lens, the magnetic lens, aberrations, the electron microscope, electron specimen interactions, Fresnel diffraction and image contour phenomena, electron diffraction and dark-field microscopy, experimental methods in electron microscopy.


613. Selected Topics in Solid State Physics. One or two of the following topics may be offered each year.

(a) Imperfections in Crystals. Perfect and imperfect crystals, general properties of point defects and dislocations, interactions of imperfections, solid state
phase transformation, plastic deformation and work-hardening of metals, grain boundaries, influence of lattice imperfections on physical properties, internal friction in metals, diffusion, physical observation of lattice defects, generation and annealing of point defects, radiation damage.


(c) Inert Gas Solids. Theory of crystal lattices: quantum mechanical basis, inter-atomic potentials, stability, dynamics of cubic close-packed lattices, thermodynamics of ideal crystals, anharmonicity. Experimental properties.

(d) Advanced Quantum Theory of Solids. Theoretical and experimental techniques for determination of the band structure of metals and semiconductors; electrical and thermal conduction processes and electron-lattice interactions.

614. Physics of the Earth's Interior. Selected topics in theoretical geophysics; seismology, rheology of the Earth, geomagnetism, the Earth's rotation.

615. General Relativity and Cosmology. Tensor analysis: covariant and contravariant tensors, covariant differentiation, Riemannian space, geodesics, Ricci tensor, Christoffel symbols. General relativity: gravitation and special relativity, equivalence principle, field equations of general relativity, Schwarzschild metric, observational evidence for the general theory. Cosmology: Newtonian, Einstein and de Sitter universes, the expanding universe, cosmological principle and steady-state universe, observational clues.

616. Biophysics. The behaviour of some physical systems encountered in living organisms. Simple cell models: the cell membrane, diffusion problems, respiration, motion, instability and cell division, radiation damage. 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.

Department of Political Science

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

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

A. D. Nelson, A.B., A.M., Ph.D. (Chicago)  
Assistant Professor

T. H. Qualter, B.A. (New Zealand), Ph.D. (London)  
Assistant Professor

L. G. E. Edmondson, B.A. (Birmingham)  
Lecturer
Students electing either a single or double Honours Programme or a Major in Political Science 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 Politics. Political Science 100a and 100b will also be offered, on a semester basis, as a social science elective for Engineering students, i.e., as Political Science 15.

15a. See 100a.

15b. See 100b.

Political Science 15a and 15b are offered alternately in succeeding terms. Either course will fulfill the social science requirement in Engineering Year II. Other Political Science courses may be elected by Engineering students in senior years in consultation with the department.

100a. Contemporary Ideologies. A study of the origin, nature and impact of contemporary political doctrines including Communism, Fascism, Democratic Socialism and Democratic Capitalism.
3 lectures, half course.

100b. Government and Politics. A study of the theory and practice of modern government, with particular reference to the governments of Canada, the United States and Great Britain.
3 lectures, half course.

110. Democratic Government. A study of the theory and practices of the modern constitutional democracy. The relationship between basic political objectives and general features of organization, procedure and practice will be emphasized, with primary reference to Britain, Canada, and the U.S.
3 lectures.

201a. American Government and Politics. The theory and practice of American government and politics at the federal and state levels.
3 lectures, half course.

201b. British Government and Politics. The theory and practice of government and politics in Great Britain.
3 lectures, half course.

3 lectures.

3 lectures.
220. The History of Political Theory. A survey of the history of western political theory from the time of Socrates to the present day. (This course is designed specifically for Honours students in other disciplines. Political Science Majors may be admitted by consent of the instructor.) 3 lectures.

251. Political Theory from Socrates to Hobbes. 3 lectures.

252. Political Theory from Hobbes to the Present Day. 3 lectures.

Note: Political Science 251 and 252 make a more detailed study of the material outlined in Political Science 220. These courses are designed specifically for Honours students in Political Science, although others may be admitted by consent of the instructor.

260. International Politics. The politics of peace and conflict; a study of the causes of inter-state conflict and its adjustment through diplomacy, law and war. 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.

351. 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.

360. 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. Prerequisite: Political Science 201a & b or 210. 3 lectures.

362. The Electoral Process. An analytical and comparative treatment of electoral machinery and law, election strategy and tactics and voting behaviour. Prerequisite: Political Science 201a & b or 210. 3 lectures.

370a. Comparative Institutions - Legislatures. A comparative study of the legislative process in selected countries. 3 lectures, half course.

370b. Comparative Institutions - The Executive. A comparative study of the organization and role of the executive in selected countries. 3 lectures, half course.
375. **Federalism - Classical and Co-operative.** A study of the evolution, structure, and functions of modern federalism. 
Prerequisite: Political Science 201a & b or 210. 
3 lectures.

380. **The Developing Commonwealth.** A study of the Commonwealth as a whole and of the changing pattern of government of the member nations, particularly the recently independent Afro-Asian states. 
3 lectures.

Prerequisite: Political Science 260. 
3 lectures.

401. **Political Theory.** A detailed study of the political theory of one fairly limited period or school. (1964-65). English political theory of the nineteenth century. 
3 lectures.

405. **Local and Provincial Government.** A study of the development, structure, functions, machinery and finances of Canadian local and provincial governments. 
Prerequisite: Political Science 210. 
3 lectures.
410. Propaganda and Public Opinion. A detailed study of the nature of public opinion and the attempt to control it through propaganda.
Prerequisite: Political Science 360 or 362.
3 lectures.

415. Political Behaviour. An examination of the objectives, characteristics, problems and results of contemporary research on political behaviour, with emphasis on democratic electoral behaviour.
Prerequisite: Any one of the following: Political Science 360, 362, Sociology 320, Psychology 240, or consent of the instructor.
3 lectures.

498. Senior Research Seminar.
2 hours.

Department of Psychology

R. H. Walters, B.A., Dip.Ed., M.A. (Bristol), B.Phil. (Oxford), Ph.D. (Stanford), F.B.Ps.S. - Professor and Chairman of Department
E. Llewellyn Thomas, B.Sc. (London), M.D., M.C. (McGill) - Professor (Part-time)

R. K. Banks, M.A., Ph.D. (Toronto) - - - - Assistant Professor
M. P. Bryden, S.B. (Massachusetts Institute of Technology), M.Sc., Ph.D. (McGill) - Assistant Professor
G. V. Goddard, M.A. (Saskatchewan), Ph.D. (McGill) - Assistant Professor
H. M. Lefcourt, B.A. (Antioch), M.A., Ph.D. (Ohio State) - Assistant Professor
G. E. MacKinnon, M.A. (Queen's), Ph.D. (Johns Hopkins) - Assistant Professor
P. M. Rowe, B.A. (Toronto), M.A. (Dalhousie), Ph.D. (McGill) - Assistant Professor (Part-time)
I. W. Silverman, B.A. (Brooklyn), M.S., Ph.D. (Purdue) - Assistant Professor
R. A. Steffy, B.A. (Albright), M.D., Ph.D. (Illinois) - Assistant Professor (Part-time)

R. V. Thysell, B.A. (Montana), M.A., Ph.D. (Iowa State) - Assistant Professor
M. D. Vogel-Sprott, B.A. (McMaster), M.A., Ph.D. (Toronto) - Assistant Professor

A first-year student intending to major in Psychology must select Psychology 110 and Philosophy 100. 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 311 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 course in their programme: Biology 231; Mathematics 130, 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 200-250 and 300-350 courses, but Honours standing will be required.

All courses numbered 600-649 are offered on a half-year basis. Courses numbered 650 and above are full-year courses. Four Psychology courses at the 600-649 level and a thesis are required for a master's degree; two of these courses must be selected from the group numbered 601-610. An additional approved full-year course, or two half-year courses, at the graduate or undergraduate level must be taken in a Department other than Psychology. Candidates for the Ph.D. are required to take four full-year Psychology courses, or their equivalent in half-year course, at the 600 level; and one full-year graduate or undergraduate course, or two half-year courses, in a Department other than Psychology. Candidates for the Ph.D. degree with a master's degree from another university may be required to select two courses from the group numbered 601-610. In addition to these requirements, students offering Clinical Psychology as an area of specialization are required to take Psychology 670 and 680 and to complete internship training under conditions approved in advance by the Department.

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 behavior, learning, motivation, emotion, sensation and perception, and individual differences will be studied with reference to the physiological correlates and to environmental factors.
3 lectures.

211. Developmental Psychology. The genesis and development of behavior 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 behavior 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.

2 lectures, 2 hours laboratory, half-year course.
260. **Physiological Psychology.** The relationship between patterns of behavior and physiological processes.
2 lectures, 2 hours lab., 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 communication process.
3 lectures.

321. **Psychological Measurement.** 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.
3 lectures, two hours laboratory, half-year course.

322. **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.

351. **Personality Theory.** An examination and evaluation of some of the outstanding 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: 311, 351.
3 lectures, half-year course.

370. **Animal Learning.** More advanced of learning principles, together with a presentation of, and practice in, the techniques of experiments with animals.
Prerequisite: 220.
2 hours lectures, 2 hours laboratory.

380. **Advanced Physiological Psychology.** More advanced study of the physiological basis of behavior, 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.

601. Sensory Processes. A seminar dealing with current methodological and experimental problems in psychophysics, sensory physiology and sensory psychology.


603. Theories of Learning. Contemporary problems in motivation and learning; a critical review of theory and relevant research.

604. Human Learning. The adequacy of contemporary learning and motivational theory in accounting for human behaviour. Human research in such areas as emotional conditioning, transfer, and drug effects will be critically evaluated.

605. Physiological Psychology. Presentation and discussion of implications of recent experimental advances in physiological psychology.

606. Comparative Psychology. Presentation and discussion of principles relating to, and current research developments in the area of, comparative psychology.

607. Verbal Learning and Behaviour. Basic laws, theoretical issues, and experimental techniques in the area of verbal learning. Emphasis will be on critical evaluation and integration of the literature.

608. Thought and Language. An extension of psychology 607 to more complex topics such as conceptual behaviour, problem solving, psycholinguistics.

609. Social Learning. The acquisition and maintenance of social behaviour; research and theory.

610. Social-Interaction Processes. Detailed study of some major theoretical contributions, e.g., social-comparison and dissonance theory, and a review of related research.
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.

613. Clinical Psychology I. A critical evaluation of concepts and principles of particular concern to the clinical psychologist. The course will include discussions of important historical developments, ethical problems, and role definition. Relevant practicum training will be provided.

614. Clinical Psychology II. Specialized techniques; their rationale, development, and validity. The review of theory and research will be accompanied by practicum training.

615. Theories of Personality. Coverage of personality theories, including orthodox psychoanalytic theory, social-learning theories, and phenomenological contributions.

616. Theories of Psychotherapy. A detailed coverage of psychotherapeutic systems and theories of personality change, and of research relating to the theory and practice of psychotherapy.
Prerequisite: Psychology 614.

617. Experimental-Child Psychology. A detailed consideration of the laboratory-experimental approach to problems in the area of child development and behaviour, with special reference to selected topics of investigation.


620. Educational Psychology. An application of psychological principles to educational problems, together with a survey of relevant research findings concerning child and adolescent behaviour.

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.

650. Individual Research Project. A supervised experimental study, together with a review of the relevant literature.

655. Advanced Experimental Psychology. Detailed study of selected problems in the students' major area of specialization, e.g., cognition, learning, motivation, perception.


665. Seminar in Developmental Psychology. An advanced course in child development and behaviour. This course will concentrate on research findings and methodology. Students primarily interested in the clinical-child area are advised to take Psychology 670.
670. Psychopathology. A detailed study of the etiology and treatment of various deviant behaviour patterns within the context of psychological theory and research.

680. Seminar in Clinical Psychology. Recent developments in theory and research will be considered in relationship to specific cases and histories.


Religious Knowledge

J. W. Fretz, A.B. (Bluffton), Ph.D. (Chicago), B.D. (Chicago Theol. Seminary) - Professor G
W. Klassen, B.A. (McMaster), B.D. (McMaster Divinity School), Ph.D. (Oxford) - Associate Professor G
J. R. Horne, M.A. (Western), B.Th. (Huron), Ph.D. (Columbia) - Assistant Professor R
W. B. Mayer, C.R., Ph.D., S.T.D. (Gregorian) - Assistant Professor I
D. J. Hall, B.A. (Western), B.D., S.T.M., Ph.D. (Union Theol. Seminary)
D. A. Kirwan, C.R., B.A. (Western) - (Part-time) Lecturer P

Religious Knowledge

50J. Grace and the Sacraments. Grace; concepts pertaining to all the sacraments; the meaning of sacramental life to the individual and to society. 3 lectures.

100G. Christian Foundations. 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 to the founding and early development of the Christian Church. 3 lectures.

100J. Christian Apologetics. 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.

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.

300J. Catholic Social Doctrines. The Church and society; the pronouncements of the Church on civil, domestic, professional and international societies. 3 lectures.
100R. Western Philosophies of Religion. A historical consideration of the significant philosophies of religion which may be found in the record of Western civilization. Readings will be selected from the most important writings of religious thinkers from the patristic period to the present. 
Prerequisite: Philosophy 100 or the permission of the Instructor.

3 lectures.

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.

Department of Sociology

W. G. Scott, B.A. (Western), M.A. (Toronto)  
Assistant 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, M.S., Ph.D. (Cornell) - Professor and Dean of the Faculty of Arts

W. L. Sauer, B.A. (Wayne State), M.A., Ph.D. (Michigan State)  
Associate Professor

G. Campbell, B.A. (British Columbia), M.A. (Toronto) - Assistant Professor

T. E. Traynor, B.A. (Ottawa), M.A. (Washington) - Lecturer J

Sociology

Sociology 100, or its equivalent, is a prerequisite for all courses in the department beyond the 100 level. Courses at the 400 level are open only to Honours students. History, Mathematics and Science are desirable matriculation subjects for students proposing to major in Sociology.

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.
3 lectures.

200. Cultural Anthropology. A study of the nature of culture; theories of culture, elements of culture and culture types.
3 lectures.

205. Social Problems. An analysis and interpretation of contemporary social problems, focusing on Western civilization in general and Canadian society in particular.
3 lectures.

3 lectures.

230. Sociology of the Family. An evaluation of the origin and growth of the family as a social institution; its structures and functions in primitive and modern societies; the effect of modern technology on the family; trends and contemporary problems.
3 lectures.

240. Collective Behavior. The behavior of crowds, mobs, publics, and social movements and their relationships to social organization and social change.
3 lectures.

3 lectures.

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 formation of attitudes through language; the problem of 'expectancy set'; social and individual disorders as caused by, and reflected, in, the breakdown of the communication process; the transmission of culture; the contributions of 'General Semantics' to Communications.
3 lectures.

300. Urban Sociology. The study of urbanization, the culture and social organization of cities, urban problems. Special attention given to Western societies.
3 lectures.
Department of Sociology

305. Comparative Social Systems. Comparison of different types of societies in the present and past; literate and non-literate societies, industrialized and non-industrialized societies.
3 lectures.

310. Intergroup Relations. Relations between different racial and cultural groups; analysis of majority-minority group status.
3 lectures, one term.

315. Stratification. Analysis of social classes in society including their bases for development, composition, and consequences for society.
3 lectures, one term.

320. Sociological Research. Review of stages in the research process including data collection and analysis. A survey of the principal methods and techniques utilized in sociological research. Each student will participate in a research project. The course is open only to third-year majors in the general course or Honours students.
3 lectures.

3 lectures.

3 lectures, half course.

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.

340. Formal Organizations. The structure and function of large scale organizations in various institutional settings including organization, bureaucratic pathology.
3 lectures, half course.

341. Sociology of Occupations. The study of occupations in the social structure; recruitment and socialization, career patterns, organizational setting, culture, status of occupations.
3 lectures, half course.

345. Small Groups. Analysis of interaction in small groups; review of experimental research.
3 lectures, half course.

350. Industrial Sociology. Sociological analysis of industry, including relationships between labor and management and industry and society.
3 lectures.
355. Sociology of Religion. An examination of religion as a social institution and its place in human societies. The course seeks to develop an understanding of the universality of religion and its effect on man's social relations and behavior.
3 lectures.

365. Social Structure of the Soviet Union. A sociological analysis of contemporary Soviet society focusing on the patterns and functions of its basic institutions including the family, government, education, and industry; consideration of class formation and distribution of power.
3 lectures, one term.

450. Contemporary Sociological Theory. A survey of sociological theory from 1920 to the present.
3 lectures.

455. Theory and Research. Relationships between theory and research in sociology; review of current developments in the field through survey of journal articles.
3 lectures.

365. 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 those students taking the Psychology-Sociology combined Honours Programmes.

Department of Spanish and Italian

J. C. McKegney, B.A. (Western), M.A. (Oregon), Ph.D. (Washington)
Associate Professor and Chairman of Department

M. I. Kieffer, C.R., B.A. (St. Louis), M.A. (McGill), J.C.D. (Gregorian)
Professor

D. Sardinha, M.A. (Toronto) - - - - - - Lecturer
Rosario Hoefert (Mrs.), Bachillerato (Madrid) - - (Part-time) Lecturer

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.

250. 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.

300. Survey of the Spanish Drama. For students in General Arts only. Critical survey of representative Spanish plays, from Juan del 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. Lectures in Spanish.
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.
VIII

Department of Co-ordination and Placement
Department of Co-ordination and Placement

The Department of Co-ordination and Placement is responsible for the successful operation 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 men, having extensive industrial experience. Each is responsible for a designated area and is the liaison officer between the University and the employers of students in his territory and acts as a counsellor and advisor to these students.

Staff:

Director
A. S. Barber, P.Eng.

Assistant Director
M. S. Stevens, B.Sc. (Queen’s), P.Eng.

Engineering and Applied Physics

Senior Co-ordinator
R. D. Mumford, 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. M. Moon, B.A.Sc. (Toronto), P.Eng.
M. M. Smith, B.Sc. (Queen’s), P.Eng.
G. L. White, B.A.Sc. (Toronto), P.Eng.

Co-operative Mathematics

Co-ordinator
To be appointed.

Graduate Placement and Summer Employment

Co-ordinator
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 or organized purpose and serious study.

Co-operative education is thus a synthesis of two educational themes—the academic theme and the theme of organized practical training in the area of career interest. These two themes, when carried on concurrently, give depth and meaning to the formative years of learning. The numerous industrial and business firms, as well as many other institutions and organizations that now 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 generation 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 program 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.

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.
Students and employers' representatives are quite free to choose each other and no compulsion is involved. Salaries paid co-operative students are determined within the employer's own wage structure, although a good deal of consultation takes place with the University's Co-ordination Department. The University normally expects to appoint one co-ordinator per 100 - 150 co-operative students. The co-ordinators, themselves professionally qualified, undertake to 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>1964</th>
<th>1965</th>
<th>1966</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter Term</td>
<td>Winter Period</td>
<td>Third Term</td>
</tr>
<tr>
<td>Stream “A”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First Term</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stream “B”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1967</th>
<th>1968</th>
<th>1969</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter Term</td>
<td>Winter Period</td>
<td>Work Period</td>
</tr>
<tr>
<td>Stream “A”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fifth Term</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stream “B”</td>
<td></td>
<td></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 for continuity of employment opportunity on the co-operative programme. Both groups, of course, have the same total time on campus and in industry; one group having a double academic term at the start of the course and the other having a double academic term at the end of the course. The division at the end of the first term of study is based upon student preferences, financial considerations of students, etc. Precise dates for the beginning and end of the various terms are shown in the Academic Calendar.

Co-operative Work Assignments:

A basic requirement of the Co-operative Programs at the University of Waterloo is satisfactory performance during co-operative work assignments. Each work assignment includes the preparation of a “work report” by the student. The report must cover some phase of the student's current employment and it must be presented to, and approved by, the employing company.
two weeks prior to the end of each term of employment. This report must then be submitted to 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. Satisfactory co-operative work assignments are a requisite to graduation and poor performance is thoroughly investigated. No student may continue on 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 is in 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.

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 select. 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.

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. Representatives of industry interview interested candidates on the campus, but in all instances, the responsibility for completing any employment arrangement rests with the student. The experience obtained in dealing with industry is a fundamental part of the student's education. 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.

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.

During his early years in the course, the student's work assignments teach him 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.

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 the student 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 breach of discipline.

From the foregoing paragraph it may be seen that the Department of Co-ordination and Placement 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 Program

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.

Canadian Industries Limited
Hydro-Electric Power Commission of Ontario
Dominion Textile Company Limited
The Anthes-Imperial Company Limited
Babcock-Wilcox and Goldie-McCulloch Limited
Beatty Bros. Limited
Canadian General Electric Company Limited
Canadian Westinghouse Company Limited
City of Hamilton
Cyanamid of Canada Limited
Dominion Tar and Chemical Company Limited
The Foundation Company of Canada Limited
Hawker Siddeley Canada Limited
International Harvester of Canada, Limited
The International Nickel Co. of Canada Limited
John Inglis Company Limited
Kaufman Rubber (Ontario) Limited
Kimberley-Clark Pulp & Paper Co. Limited

Dr. J. W. Tomecko
Past Chairman
Mr. D. H. Cooke
Chairman
Mr. K. C. F. Mills
Vice-Chairman
Mr. C. H. Watson
Secretary
Mr. V. A. Johnson
Mr. K. Noxon
Mr. W. F. McMullen
Mr. H. J. Simmons
Mr. W. A. Wheten
Mr. H. B. Van Hартесвeldt
Mr. G. F. Harrison
Mr. R. F. Shaw
Mr. W. D. Walker
Mr. W. B. P. Brown
Dr. S. H. Ward
Mr. H. B. Style
Mr. W. H. Bechtel
Mr. C. C. Wright
Link-Belt Limited
Minnesota Mining & Manufacturing of Canada Limited
Noranda Mines Limited
Northern Electric Company Limited
C. C. Parker & Associates Limited
Pigott Construction Company Limited
Trans Canada Air-Lines
Trans Canada Pipe Lines Limited
Union Carbide Canada Limited

Mr. J. W. Lear
Mr. J. S. Hawken
Mr. R. P. Riggin
Mr. J. B. Hutchinson
Mr. C. C. Parker
Mr. D. H. Stevens
Mr. J. T. Dyment
Mr. P. M. Allen
Mr. G. O. Loach

Companies Employing Co-operative Engineering and Applied Physics Students

Aerovox Canada Limited
The Algoma Steel Corporation, Limited
Allen-Bradley Canada Limited
Allied Chemical Canadian, Ltd.
Aluminum Company of Canada, Limited
American Electrical Contracting Company Limited
R. V. Anderson & Associates Limited
Andrew Antenna Corporation Limited
The Anthes-Imperial Company Limited
Atlas Steels Company Limited
Atomic Energy of Canada Limited
Aunor Gold Mines Limited
Automatic Electric (Canada) Limited
Automatic Screw Machine Products Limited
Aviation Electric Limited
Babcock-Wilcox & Goldie-McCulloch Limited
Ball Brothers Limited
Barringer Research Limited
Bathurst Containers Limited
Beamer Lathrop Limited
Beaver Construction Company
The Beaver Wood Fibre Company, Limited
Beckett Elevator Ltd.
The Bell Telephone Company of Canada
Bendix-Eclipse of Canada Limited
The Best Foods (Canadian), Ltd.
Black Clawson-Kennedy Ltd.
Black & McDonald Limited
Blacktop Paving Co. Ltd.
Brant, County of
Brantford, City of — Engineering Department
Brantford Coach and Body Limited
Bristol Cadmium Plating Co. Limited
The British American Oil Company Limited
British Titan Products (Canada) Limited
Brockville Chemicals Limited
Broulan Reef Mines Limited
Building Products Limited
Burlington, Town of — Engineering Department

Cabot Carbon of Canada, Ltd.
Calvert Distillers Limited
Campbell Red Lake Mines Limited
Campbell Soup Company Limited
Canada Barrels & Kegs Ltd.
Canada and Dominion Sugar Company Limited
Canada Iron Foundries, Limited
Canada Machinery Corporation, Limited
Canada Vitrified Products Limited
Canada Wire and Cable Company Limited
Canadair Limited
Canadian Admiral Corporation Ltd.
Canadian Allis-Chalmers Limited
Canadian Aviation Electronics Ltd.
Canadian Blower & Forge Company Limited
Canadian Brass Limited
Canadian Broadcasting Corporation
The Canadian Coleman Company, Limited
Canadian Comstock Company Limited
Canadian Copper Refiners Limited
Canadian Engineering and Contracting Co. Limited
Canadian General Electric Company Limited
Canadian General-Tower Limited
Canadian Industries Limited
Canadian Ingersoll-Rand Company Limited
Canadian Johns-Manville Co., Limited
Canadian Kodak Co., Limited
Canadian Motorola Electronics Company
Canadian National Railways
Canadian Pacific
Canadian National Telecommunications
Canadian Refractories Limited
Canadian Standards Association
Canadian Steelcase Co., Ltd.
Canadian Thermos Products Limited
Canadian Westinghouse Company Limited
Capital Wire Cloth Limited
Carter Bros. (Waterloo) Limited
L. Cazaly Associates  
Chatham, City of — Engineering Department  
Chicago Rawhide Products Canada Limited  
Chrysler Canada Ltd.  
Clare Brothers Limited  
Adam Clark Company Limited  
Clevite Limited  
Cobalt Refinery Limited  
Collins Radio Company of Canada Ltd.  
Columbian Carbon (Canada) Ltd.  
Combustion Engineering-Superheater Ltd.  
Consolidated Sand & Gravel Limited  
The Consumers' Gas Company  
Consumers Glass Company Limited  
Continental Can Company of Canada Limited  
Cool-Air Systems Limited  
Cooper-Bessemer of Canada Ltd.  
Corning Glass Works of Canada Ltd.  
Coulter Copper & Brass Co., Limited  
Crysler, Davis & Jorgensen, Limited  
CTS of Canada, Ltd.  
Cyanamid of Canada Limited  
Dahmer Steel Limited  
Davis Automatic Controls  
Daystrom, Limited  
Dearborn Chemical Company Limited  

John Deere Welland Works  

The De Havilland Aircraft of Canada, Limited  
De Leuw, Cather & Company of Canada Limited  
Delta Chemicals Limited  
Department of Highways, Ontario  
Department of Mines, Ontario  
Dickenson Mines Limited  
Direct Winters Transport Limited  
Frank Docner & Sons Limited  
Dominion Electrohome Industries Limited  
Dominion Foundries and Steel, Limited  
Dominion Magnesium 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 Packaging Limited
Domtar Pulp & Paper Limited
Dravo of Canada Limited
Dunker Construction Limited
Dunlop Research Centre
Du Pont of Canada Limited

Eastern Construction Company Limited
Eastern Steel Products Limited
The E. B. Eddy Company
Eldorado Mining and Refining Limited
The Electric Storage Battery Company (Canada) Limited
Electrical Bureau of Canada
Emery Industries (Canada) Limited
English Electric Canada
Erie Resistor of Canada, Ltd.
E. S. A. (Canada) Limited
Ex-Cell-O Corporation
The Exolon Company

Fairgrieve & Son Limited
Faraday Uranium Mines Limited
Federal Pacific Electric of Canada
Walter, Fedy & Associates Ltd.
Ferranti Electronics
Fiberglas Canada Limited
Firestone Tire & Rubber Company of Canada Limited
Fischer & Porter (Canada) Limited
Fisher Governor Company of Canada Limited
Ford Motor Company of Canada Limited
The Foundation Company of Canada Limited
The Foxboro Company, Limited
Franklin Manufacturing Company (Canada) Ltd.
The Frontier College

John Gaffney Construction Company Limited
Galt, City of — Engineering Department
Galt Metal Industries Limited
Gecko Mines Limited
General Concrete Ltd.
General Engineering Company
General Motors of Canada, Limited
The General Tire and Rubber Company of Canada, Limited
Giffels & Vallet of Canada, Ltd.
H. Q. Golder and Associates 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 Paper Company, Limited
Greening Wire & Perforated Metal Company
Guelph Stove Company Limited

Halnor Mines, Limited
Hamilton, The Corporation of the City of — Engineering Department
Hamilton Gear and Machine Company
Hammond Manufacturing Company Limited
Harding Carpets Limited
Hayes Steel Products Limited
H. J. Heinz Company of Canada Ltd.
John T. Hepburn, Limited
Hilton Mines
H & O Centreless Grinding Limited
The Hobart Manufacturing Company
Honeywell Controls Limited
S. W. Hooper & Co. Ltd.
Horton Steel Works Limited
Huron, County of — Engineering Department
The Hydro-Electric Power Commission of Ontario

John Inglis Co. Limited
International Business Machines Company Limited
International Harvester Company of Canada, Limited
Interprovincial Pipe Line Company
Iron Ore Company of Canada
ITT Canada Limited
Johnson Controls Ltd.

Kam-Kotia Porcupine Mines Ltd.
Kaufman Rubber (Ontario) Limited
Kayson Rubber & Plastics Limited
Kawartha Broadcasting Limited
James R. Kearney Corporation of Canada, Limited
Keeprite Products Limited
Kellogg Company of Canada, Limited
Kerr-Addison Gold Mines Limited
Kilborn Engineering Limited
Kimberly-Clark Pulp and Paper Company Ltd.
Kitchener, City of — Engineering Department
Kitchener, The Public Utilities Commission of
G. V. Kleinfeldt & Associates Ltd.
Koehring-Waterous Ltd.
Konvey Construction Company Limited
Kralinator Filters Limited
The KVP Company Limited

Lackie Bros. Limited
Lever Brothers Limited
Link-Belt Limited
Link-Belt Speeder (Canada) Ltd.
Litton Systems (Canada) Limited
London, City of — Engineering Department
London TV Cable Service Ltd.

Madsen Red Lake Gold Mines Limited
Markham, Township of — Engineering Department
Marsland Engineering Limited
Massey-Ferguson Limited
Measurement Engineering Ltd.
Microwave Systems
Minnesota Mining & Manufacturing of Canada Limited
Molson's Brewery (Ontario) Limited
Montreal Engineering Company, Limited
M & T Products of Canada, Ltd.
McCormick & Rankin Limited
W. A. McDougall Ltd.
McIntyre Porcupine Mines, Limited
Arthur G. McKee & Company of Canada, Ltd.
McKee Brothers Limited
MacLeod-Cockshutt Gold Mines, Limited
McNamara Construction of Ontario Limited

National Sewer Pipe Limited
National Silicates Limited
National Starch and Chemical Co. (Canada) Ltd.
National Steel Car Corporation Limited
Naugatuck Chemicals
R. H. Nichols Co. Ltd.

Noranda Copper and Brass
Noranda Mines, Limited
Noranda Research Centre
Northern Electric Company Limited
North York, Township of — Planning Department

The Office Specialty Manufacturing Company Limited
The Ontario Hospital
Ontario Northland Communications
The Ontario Paper Company Limited
Otis Elevator Company Limited

Page-Hersey Tubes, Limited
Pamour Porcupine Mines, Limited
C. C. Parker and Associates Limited
John B. Parkin Associates
Perkins Glue Company of Canada, Limited
Peterborough, City of — Engineering Department
E. M. Peto Associates Ltd.
Pigott Construction Company Limited
Pioneer Electric Eastern Limited
Pioneer Saws Limited
C. A. Pitts Limited
Polymer Corporation Limited
Potter & Brumfield
Pre-Con Limited
Preston, Town of — Engineering Department
Price Brothers & Company, Limited
Procor Limited
The Procter & Gamble Company of Canada, Limited
Provincial Gas Company Limited
Pulp and Paper Research Institute of Canada
Purolator Products (Canada) Limited

Albert Quait Co. Ltd.
The Quaker Oats Company of Canada Limited
Quemont Mining Corporation, Limited
Quist & Associates, Consulting Engineers

Ralston Purina Company, Limited
Raytheon Canada Limited
RCA Victor Company, Ltd.
Red-D-Mix Concrete Limited
Retor Developments Limited
Rio Algom Mines Limited — Milliken Division
Wm. Roberts Electric Limited
Robertson-Irwin Limited
E. S. & A. Robinson (Canada) Limited
Roelofson Elevator Company Limited
Ross of Canada
B. M. Ross, O.L.S., P.Eng.
Royalmetal Corporation Limited
Royal Military College of Canada

St. Catharines, City of — Engineering Department
St. Mary's Cement Co., Limited
Sarco (Canada) Limited
Sarnia Scaffolds Limited
H. Schlegel Construction
J. M. Schneider Limited
Schwenger Construction Limited
Joseph E. Seagram & Sons, Limited
Shawinigan Chemicals Limited
Shell Canada Limited
Sherbrooke Machineries Limited
Shore & Moffat and Partners, Architects and Engineers
Simplicity Products Limited
Sinclair Radio Laboratories Ltd.
N. Slater Company
Aden B. Snyder Electric Limited
Snyder's of Canada Ltd.
Sperry Gyroscope Company of Canada Limited
Spruce Falls Power and Paper Company, Limited
Standard Prestressed Structures Limited
Standard Tube and T. I. Limited
The Steel Company of Canada, Limited
Stephens-Adamson Mfg. Co. of Canada Limited
Sudbury, City of — Engineering Department
Sun Oil Company Limited
Sunshine Office Equipment Limited Limited
Texaco Canada Limited
Thermo Electric (Canada) Limited
Thompson Products, Limited
Thurso Pulp and Paper Company
Toronto, The Municipality of Metropolitan
Toronto Transit Commission
The Torrington Manufacturing Company of Canada, Limited
Trans-Canada Airlines
Trans-Canada Pipe Lines Limited
William A. Trow and Associates Ltd.
Turnbull Elevator of Canada Limited
Union Carbide Canada Limited
Union Gas Company Limited
United Aircraft of Canada Limited
United Steel Corporation Limited
Universal Electric
Douglas G. Ure and Sons, Ontario Land Surveyors
Van-Wilson Limited
Varian Associates of Canada Ltd.
Wegner-Leland
Wallaceburg Brass Limited
Warnock Hersey Soil Investigations Ltd.
Waterloo, City of — Engineering Department
Waterloo, County of — Engineering Department
Waterloo, University of
Jervis B. Webb Company of Canada, Ltd.
Welland, County of — Engineering Department
Harold White Construction Limited
White Mossop Associates Limited
Wiltonator (Canada) Limited
Wilson Science Equipment Limited
The W. C. Wood Company Limited
York Gears Limited

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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, are:

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 or St. Paul's College.

Conrad Grebel College offers residence accommodation for sixty-five men and forty women.

Renison College offers residence accommodation for forty men and forty women.

St. Jerome's College 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 College offers accommodation for one hundred men and fifty women. The residence fee per academic year is $630.00 for a double room. Application for residence should be made directly to the College concerned on the appropriate form. Until such time as the University can provide additional residence facilities, suitable accommodation may be obtained in private homes. Prospective students may obtain a list of these homes by applying in person to the Office of the Registrar after they have been accepted by the University.

Athletics

Facilities for athletics at the University centre around Seagram Stadium and Gymnasium located on the north-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.
Department of University Extension

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 weekdays 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

An educated person is one who continues throughout life to develop his intellect. Robert Redfield has said that a person is not educated unless he assumes command of his own growth. In this respect, a university cannot be dedicated solely to the service of the youthful elite. One of the unusual features of our society is the need for continuing education at all levels in all age groups. Educational opportunities for part time adult studies occupy a significant position in a university.

The activities available to adult students at the University of Waterloo vary from the formal to informal, from residential seminars to weekly meetings, from practical - vocational, technical or professional - courses to classes dealing with questions of meaning and value.

Programmes are available to broaden the preparation and skills of high school teachers. There are programmes designed in co-operation with such groups as business, labour and government. To assist groups to determine their own educational goals and carry them out in the atmosphere of a university, the Department of University Extension has established a Conference Division. In order to create a climate for the further development of the cultural arts in the University and community, the Department of University Extension has assumed responsibility for the administration of the Theatre of the Arts. An Institute of Marketing was established to help mobilize the resources of the University in the service of industry. In a word, the purpose of the Department of University Extension is to expand the opportunities for all men and women to continue their education throughout life.

Courses are generally arranged in co-operation with sponsoring organizations. The Course programme consists of two terms a year, thirteen weeks each, with classes held once a week two hours in length. There are four categories of instruction:

(1) Academic courses and courses in the performing and cultural arts.
(2) Four year courses set up by such chartered organizations as Canadian Industrial Management and The Society of Industrial and Cost Accountants of Ontario which give designations C.I.M. and R.I.A.
(3) Two or three year courses for which an Adult Education Certificate is given.
(4) One term business courses of thirteen weeks.
Adult Education classes have been held in Guelph, Galt, Ayr, Brantford, Woodstock and Stratford as well as the University of Waterloo. Registrations during the University year of 1963-1964 totalled two thousand in sixty courses. For detailed information concerning any Extension activity write Director of University Extension, University of Waterloo.

Library Facilities

At present there are two main centres of library service and study on the campus. The Arts Library is situated on the third floor of the Physics and Mathematics Building, and contains all books and periodicals in the Humanities and the Social Sciences. A special reading room is also provided on the first floor off the main lobby. Library materials in Science and Engineering occupy a spacious area on the ground floor, west wing of the Engineering Building. A $1,500,000 Arts Library Building is under construction and will be completed early in October, 1964. This building will accommodate more than 900 readers and 200,000 volumes on three floors, in a total area of 67,000 square feet. Future expansion will provide up to ten floors.

The Library regularly receives more than 1,500 current periodicals. Its present holdings of almost 75,000 volumes are now being increased at the rate of 25,000 volumes per year. In addition to materials in book and pamphlet form, it possesses a growing collection of phonorecords, microfilms and microcards. Microfilm and microcard readers are provided in each library.

A Library Handbook is issued to all students explaining the arrangement of Library materials, the classification system, circulation procedures, and general rules and regulations. The Library staff will be happy to assist students to make the best possible use of the Library collection and facilities.

Student Activities

Government—Student Government at the University of Waterloo is centred in the Students' Council. This organization and its executive is elected by the students in the spring of each year. The aims of Council are:

(a) To set high standards of student leadership in the University community,
(b) To represent the legitimate interest of students on campus,
(c) To be an official means of communication between students and other members of the University.

All students are welcome to participate in the activities and work of the committees of Council. In addition to Students' Council, each faculty and college has societies to promote the interests of the students in that particular faculty or college.

Responsibility for Student Clubs and activities at the University of Waterloo belongs in general to Students' Council or one of the faculty or college societies.

Clubs and Activities—Among the many campus organizations for students are clubs for Art, Astronomy, Bridge, Chess, Curling, Debating, Drama, Folksinging, International Folk Dancing, Judo, Music, Radio Amateurs; clubs
also for French, Geography, German, Mathematics and Physics, Philosophy, Psychology, Spanish. Among religious and political groups are the Canterbury Club, I.V.C.F., Newman Club, Student Christian Movement; the Liberal Club and Progressive Conservative Club. Professional and service organizations include the Chemical Engineering Club, Engineering Institute of Canada (Student Chapter), Institute of Electrical and Electronic Engineers (Student Chapter), Mechanical Engineering Club, Board of Publications, Canadian Union of Students, Circle K Club, International Students Association, Laureate Society (Women's Undergraduate Association), Students' Council and Student Wives' Club.

Music—University facilities in the Theatre of the Arts include individual practice studios equipped with pianos, a large rehearsal room for the use of students and a theatre with a semi-round stage and seating capacity for 500 people. Students can make arrangements for use of these facilities through Students' Council. Performing groups in Music include a University Chorus, Jazz Workshop, Orchestra and other instrumental groups.

Drama—Student interests in drama are served by a Drama Council under the auspices of Students' Council. Students may participate in all phases of Theatre performances: acting, directing, writing, producing, staging.

Publications—The Board of Publications is entirely responsible for student publications now including the Coryphaeus, the University's student newspaper; the Student Directory; the Undergraduates' Handbook; the Compendium, the University's yearbook; and Expression, an undergraduate literary magazine.

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, these requirements may be varied to allow a higher age of entry for men who were on active service during the war of 1939-45, and those entering special Corps.
   (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 twenty-two weeks of practical training during the summer, depending upon the length of the vacation period and the candidate's choice.

   Training will be as follows:
   (i) First and second years—at Corps Schools of the Canadian Army Active Force.
(ii) Third year—practical leadership in charge of a troop, section, or detachment at an Active Force Unit or camp in Canada or Europe.

4. Students accepted for C.O.T.C. training are granted the rank of Officer Cadet during the first two years and in the third year are appointed as Second Lieutenants. They are eligible for pay according to their rank ($210 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 a summer camp, to a maximum of twenty-two weeks, also counts.

Students wishing to apply for C.O.T.C. training should present themselves to the Officer Commanding before November 1, after which date no applications will be considered.

University Naval Training Division (U.N.T.D.)

The purpose of the University Naval Training Divisions is to select and train university students for commissioned rank in the Royal Canadian Navy (Reserve).

1. Admission Requirements
   (a) The candidate must be a Canadian citizen, or British subject resident in Canada with the status of a landed immigrant.
   (b) He must be medically fit, possess the required officer-like qualifications and have a sound academic record.
   (c) He must be over seventeen but not over twenty-two years of age prior to December 31 in the year of his enrolment in the U.N.T.D.
   (d) He must be registered in the first or second year of university work.

2. Method of Enrolment
   Students should apply for enrolment in the U.N.T.D. during the first two weeks of registration. An information centre is located on the campus during certain days of the week of registration. An officer is in attendance to assist all interested students. In addition, students interested in a career as either a Permanent Force Naval Officer or an officer in the Royal Canadian Navy (Reserve) may apply to the Department of Co-ordination and Placement for further information.

3. Selection Boards
   Students who join the U.N.T.D. are entered as probationary cadets on the Active list of the Royal Canadian Navy (Reserve) and during January of their first year appear before a Selection Board to determine their suitability for commissioned rank. Successful candidates are promoted to the rank of Cadet in the Royal Canadian Navy (Reserve).

4. Training Programme
   (a) During the academic year the U.N.T.D. training programme consists of one training night a week commencing in late September. The training is carried out through the media of lectures and instructional films and requires three winters to complete. Cadets from the University of Waterloo will train
Regular Officer Training Plan

with cadets of the Ontario Agricultural College at Guelph during the winter. Transportation to and from the College is arranged.

(b) During the summer, Cadets must train a minimum of seventeen weeks during their first two summers in ships and establishments of the Atlantic Command. The third summer training period is optional. Cadets may avail themselves of the opportunity to serve longer than seventeen weeks each summer if they so desire.

5. Rates of Pay

(a) During winter training, Cadets may receive up to sixteen days' pay for attendance on training nights or a maximum of one hundred and twenty dollars ($120.00).

(b) During the summer training, Cadets receive pay at the rate of $225.00 per month plus transportation and travelling expenses. In addition, rations, quarters, and medical services are supplied.

6. General

(a) Cadets are issued with all required uniforms.

(b) When a Cadet has successfully completed three winters and two summers he will appear before a promotion board for his final assessment for commissioned rank. If he passes this board he will be promoted to Sub-Lieutenant at the commencement of the next academic year.

7. Regular Officer Training Plan (R.O.T.P.)

Naval cadets enrolled at the University under the Regular Officers Training Plan are students who have selected the Navy as a permanent career. These cadets take their winter training with U.N.T.D. Cadets and their summer training in ships of the Pacific Command. More detailed information on this plan can be obtained from:

Director, Department of Co-ordination and Placement,
or by writing to:

Area Recruiting Officer,
Room 436,
National Revenue Building,
150 Main Street West,
Hamilton, Ontario.

Regular Officer Training Plan (R.O.T.P.)

Under the R.O.T.P., undergraduates who are successful applicants are enrolled as Officer Cadets in the Canadian Army.

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 the 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 books, instruments, 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 $63.00 a month and subsistence of $65.00 a month, for a total of $128.00 a month.

(b) During the period of practical summer training, pay of $63.00 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
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 nine Ontario Grade XIII papers required for admission, or the equivalent. Commencing with the year 1963-64 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 nine required for a Scholarship, provided that at least nine additional papers are written and passed in the 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 nine Ontario Grade XIII papers required for admission to their particular faculty.

Commencing with the year 1963-64 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 nine required for a Scholarship, provided that at least nine additional papers are 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.

(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 1963-64 academic year.

University National Scholars

Leonard Gottselig  Balgonie, Saskatchewan  Arts II
Patsie Lorraine Hutton  Glentworth, Saskatchewan  Arts III

University Scholars

James Edward Abel  Bridgeport, Ontario  Arts III
David Turc Ahlberg  St. Catharines, Ontario  Engineering III
William John Andres  Waterloo, Ontario  Engineering II
Arni Neil Arnason  Ottawa, Ontario  Science II
Gary Arnold Babbs  Peterborough, Ontario  Engineering II
William Gilbert Babichuk  Fort William, Ontario  Science II
Edward Malcolm Baker  Peterborough, Ontario  Science I
Joan Elizabeth Bechler  Kitchener, Ontario  Arts I
Gary Edmund Blau  Kitchener, Ontario  Engineering IV
Richard Carl Boettger  Waterloo, Ontario  Arts I
Larry Ralph Bricker  Kitchener, Ontario  Science II
Donald Stewart Brooks  Brantford, Ontario  Engineering II
Esther May Brubacher  Elmira, Ontario  Science I
Forbes John Burkowski  Port Arthur, Ontario  Science II
David John Busch  Guelph, Ontario  Engineering I
Carman Dennis Cann  Exeter, Ontario  Science IV
James Edward Chase  Guelph, Ontario  Science I
John Christensen  Guelph, Ontario  Science I
Alvin James Clark  Uxbridge, Ontario  Engineering III
Angelo Colavecchia  Thorold, Ontario  Engineering I
William Hamilton Colborne  Terrace Bay, Ontario  Science II
Michael Stuart Corlett  Toronto, Ontario  Engineering III
Gail Patricia Cuthbert  Ingersoll, Ontario  Arts I
<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Programme</th>
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<tr>
<td>Ronald George Dahms</td>
<td>Waterloo, Ontario</td>
<td>Arts III</td>
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<td>Ian Gordon Dennett</td>
<td>King, Ontario</td>
<td>Engineering I</td>
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<td>Wayne Morris Doran</td>
<td>Southampton, Ontario</td>
<td>Engineering II</td>
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<td>Martha Christine Gisela Dorrance</td>
<td>Seaford, Ontario</td>
<td>Arts I</td>
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<td>Kenneth Arthur Dunn</td>
<td>St. Catharines, Ontario</td>
<td>Science I</td>
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<tr>
<td>Michael Saylor Doyle</td>
<td>Toronto, Ontario</td>
<td>Engineering III</td>
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<td>Marguerite Victoria Dyck</td>
<td>Toronto, Ontario</td>
<td>Arts I</td>
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<tr>
<td>Victor Arnold Dyck</td>
<td>Niagara-on-the-Lake, Ontario</td>
<td>Arts I</td>
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<td>John Frederick Eix</td>
<td>Waterloo, Ontario</td>
<td>Science IV</td>
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<td>Walter Erich Elstner</td>
<td>Waterloo, Ontario</td>
<td>Engineering III</td>
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<tr>
<td>John Richard English</td>
<td>Platts ville, Ontario</td>
<td>Arts I</td>
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<td>Jeffrey Taylor Evans</td>
<td>Guelph, Ontario</td>
<td>Science II</td>
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<tr>
<td>Robert Alexander Fisher</td>
<td>Milton, Ontario</td>
<td>Science I</td>
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<tr>
<td>Graham John Farquhar</td>
<td>Kitchener, Ontario</td>
<td>Engineering IV</td>
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<tr>
<td>Walter Fred Finden</td>
<td>Burlington, Ontario</td>
<td>Science II</td>
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<tr>
<td>Harry Roland Fischer</td>
<td>North Bay, Ontario</td>
<td>Engineering III</td>
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<td>Bryan Earl Fletcher</td>
<td>New Westminster, B.C.</td>
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<td>John Arnold Frost</td>
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<td>Sandra Diane Funk</td>
<td>Vineland, Ontario</td>
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<td>Marilyn Anne Gear</td>
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<td>Helmut Giese</td>
<td>Beamsville, Ontario</td>
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<td>Joanne Maureen Gilbert</td>
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<td>Michael Howard Girdwood</td>
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<td>Karl Joseph Gmach</td>
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<td>Donald Hugh Gordon</td>
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<td>Melville Arthur Graham</td>
<td>Owen Sound, Ontario</td>
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<td>Eleanor Isabel Grant</td>
<td>Fergus, Ontario</td>
<td>Engineering I</td>
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<td>John Edward Hanna</td>
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<tr>
<td>Ekkehard Heidebrecht</td>
<td>St. Catharines, Ontario</td>
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<td>William James Hillier</td>
<td>Camlachie, Ontario</td>
<td>Engineering IV</td>
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<td>Roy Hoffman</td>
<td>Waterloo, Ontario</td>
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<tr>
<td>Mauno Sakari Immonen</td>
<td>Fonthill, Ontario</td>
<td>Engineering III</td>
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<td>Donald Elkin Ingham</td>
<td>Toronto, Ontario</td>
<td>Engineering I</td>
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<tr>
<td>Paul John Isaacs</td>
<td>Burlington, Ontario</td>
<td>Engineering III</td>
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<tr>
<td>Michael David Johnson</td>
<td>Kirkland Lake, Ontario</td>
<td>Science II</td>
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<tr>
<td>Elizabeth Sheila Jones</td>
<td>Markham, Ontario</td>
<td>Arts I</td>
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<td>John David Kalbfleisch</td>
<td>Goderich, Ontario</td>
<td>Science II</td>
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<td>Gordon Keir</td>
<td>St. Catharines, Ontario</td>
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<tr>
<td>David Stanley Kelly</td>
<td>Goderich, Ontario</td>
<td>Arts I</td>
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<tr>
<td>Roger Alfred Kingsley</td>
<td>Kitchener, Ontario</td>
<td>Arts II</td>
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<td>Walter Wladislas Kozlak</td>
<td>Hamilton, Ontario</td>
<td>Engineering III</td>
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<td>William Oliver Kummer</td>
<td>Preston, Ontario</td>
<td>Arts I</td>
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<tr>
<td>Philip John Kuntz</td>
<td>Waterloo, Ontario</td>
<td>Science IV</td>
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<tr>
<td>Mary Carolyn Lavigne</td>
<td>Waterloo, Ontario</td>
<td>Arts I</td>
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<tr>
<td>Jerald Franklin Lawless</td>
<td>Kirkland Lake, Ontario</td>
<td>Science II</td>
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</tbody>
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Financial Aid — Undergraduate

Sharon Frances Lee  Fort William, Ontario  Science III
David John Leffen  Scarborough, Ontario  Engineering II
Larry Clifford Lipskie  Kitchener, Ontario  Arts II
Allan Robert Loader  Montreal, Quebec  Engineering II
Joseph Patrick Lyons  Valleyfield, Quebec  Engineering I
Keith Bruce Macrae  Lachine, Quebec  Engineering III
Wayne Ross MacCallum  Pembroke, Ontario  Science III
Ritchie Jack MacKay  Scarborough, Ontario  Science I
Robert Lorne MacKinnon  Dobbinton, Ontario  Arts II
Franklin George Marcinkow  Fort William, Ontario  Engineering I
Edward Lincoln Martin  Baden, Ontario  Engineering II
Bryan Ernest Monkhouse  Downsview, Ontario  Science I
John Peter McClure  Owen Sound, Ontario  Science III
William David McCready  Guelph, Ontario  Arts II
Ross John McKenzie  Windsor, Ontario  Engineering I
David John McNaughton  New Hamburg, Ontario  Science III
Gregory McNeice  Sudbury, Ontario  Engineering IV
James George Mitchell  Galt, Ontario  Science II
David William Muir  Toronto, Ontario  Engineering III
Sharon Anne Murphy  Preston, Ontario  Arts IV
William David Ness  Toronto, Ontario  Science I
Philip David Neufeld  Waterloo, Ontario  Science IV
Catherine Anne Neumann  Matachewan, Ontario  Arts III
Susan Jane Nichols  Waterloo, Ontario  Arts III
Guenther Odlozinski  Galt, Ontario  Engineering III
Olutokunbok Oshinowo  Ibadan, Nigeria  Engineering II
David Wishart Parker  Port Credit, Ontario  Engineering I
Richard Stuart Phillion  Kitchener, Ontario  Engineering I
John Michael Philp  Bay Ridges, Ontario  Engineering IV
Gertraud Poppelreiter  Tavistock, Ontario  Arts I
Ross Laverne Prentice  Uxbridge, Ontario  Science I
David Redekop  Virgil, Ontario  Engineering I
Robert Laurence Redman  Toronto, Ontario  Engineering I
William Lynn Renwick  Fort Frances, Ontario  Engineering II
Susan Richardson  St. Thomas, Ontario  Arts I
Roy Edward Robertson  Toronto, Ontario  Science I
Robert Rosehart  Tillsonburg, Ontario  Engineering II
Margaret Ann Rosser  Fort William, Ontario  Science III
James Robert Ruppel  Elmira, Ontario  Arts I
David Robins  Thorold, Ontario  Engineering II
Voitto Saari  Mattawa, Ontario  Engineering IV
Barbara Anne Samson  Waterloo, Ontario  Arts I
Paul Jacob Schellenberg  Leamington, Ontario  Science III
Jane Elizabeth Scherer  Galt, Ontario  Arts I
Donna Marie Schnarr  Waterloo, Ontario  Arts I
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 recommended 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 nine Ontario Grade XIII papers required for admission to their particular faculty.

Commencing with the year 1963-64 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 nine required for a Scholarship, provided that at least nine additional papers are 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, 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 nine Ontario Grade XIII papers, 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 1964-1965, the Trustees of the J. P. Bickell Foundation will provide two J. P. Bickell Foundation scholarships of $1,500.00 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 year's examinations and maintain this standing throughout the course. The scholarship will be paid at the rate of $500.00 a year for three years. If the award is made in one of the later years, the sum of $1,500.00 will be divided and an equal amount paid in each year until the student finishes the course.

Awards will be made by the Scholarships Committee. No application is necessary.

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.

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 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 bona fide residence 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 $250.00 to students attending university in the community in which they reside, and a maximum value of $500.00 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% standing 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-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. Application 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 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.

**Undergraduate Prizes**

**Association of Professional Engineers Gold Medal for Academic Achievement Award**

The Association of Professional Engineers of the Province of Ontario makes this award to the student in the fourth year of an accredited engineering course, who having received honours, has obtained the highest standing in the final examinations of the current academic year. Included with this award is a gift of technical books valued at approximately $50.00.

**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.
Financial Aid — Undergraduate

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 1965 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.

R. A. Azly Prize in Physics

This prize of $100 will be awarded annually to the student registered as a Physics major in the third year of the Honours Mathematics and Physics
Course of the Faculty of Science who has obtained the highest First Class Honour Standing in the Second Year of that course.

The Bruce Wyler Kelley Memorial Prizes

These book prizes were established in 1960 by relatives and friends in memory of the late Bruce Wyler Kelley, 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.

The Edgar W. McKegney Prize in Spanish

This prize of $100.00 will be awarded annually to a student proposing to enter an Honours Spanish course. The applicant must have attained a 75% average on nine Grade XIII papers required for admission as well as 75% in French and in Spanish. The prize may be renewed in subsequent years upon application.

Undergraduate Loans

Provincial Student-Aid Loans

An applicant for a loan shall be in good health and of good character and shall establish in his application by his own declaration and, if he is under 21 years of age, that of his parent or guardian, his need for financial assistance to complete his course of study for the academic year 1964-65. An applicant who is responsible for his own support shall have been a resident of Ontario for at least one year before the date of his 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 the application. The maximum loan granted to any applicant for any one year shall ordinarily be $500.00. In general, the maximum loan outstanding to any
Financial Aid — Undergraduate

student at any one time shall be $2,000.00, but additional amounts may be lent at the discretion of the Minister to students taking an undergraduate course of more than four years duration or to postgraduate students.

A successful applicant will be required to sign an undertaking to repay the loan with simple interest at four per cent per annum calculated from the first day of April in the year following his graduation or withdrawal from the eligible institution, the payments to be $25.00 a month beginning with the said first day of April, with the privilege of paying any additional amount at any time. Payments made on the account of a loan shall be applied first to any interest due on the loan.

Any student interested in obtaining such a loan is urged to contact the Office of the Registrar.

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.

Application 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 or to the Dean of the Faculty of Graduate Studies.

Note: Some departments offer research assistantships which provide an opportunity for professional experience, and which may involve light instructional duties in addition to research. Applications 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 a number of postgraduate awards to be known as "The Queen Elizabeth II Ontario Scholarships". In 1964 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 15, 1964.
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, 1964.

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, 1964.

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.
XI

Governing Bodies
and Staff
The Board of Governors

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A. K. Adlington—Secretary

Ex-Officio Members:

The Chancellor
The President
The Mayor of the City of Kitchener
The Mayor of the City of Waterloo
The Warden of Waterloo County

Members Appointed by the Lieutenant-Governor in Council:

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Kenneth J. Shea, London

Elective Members:

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Brantford
J. D. Barrington
Toronto
Gordon Chaplin
Galt
A. A. Cumming
Toronto
George H. Dobbie
Galt
Karl Gruetzner
Hespeler
Lewis Hahn
New Hamburg
Colonel H. J. Heasley
Waterloo
G. R. Henderson
Sarnia
P. R. Hilborn
Preston
A. R. Kaufman
Kitchener
H. C. Krug
Kitchener
Dr. Harry Lackner
Kitchener
R. Bruce Marr
Kitchener
John E. Motz
Kitchener
Ira G. Needles
Waterloo
C. A. Pollock
Kitchener
W. M. Rankin
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A. I. Rosenberg
Kitchener
J. W. Scott
Kitchener
E. J. Shoemaker
Kitchener
J. Kenneth Sims
Kitchener
A. M. Snider
Waterloo
Dr. Hugh Templin
Fergus
O. W. Titus
Toronto
J. P. R. Wadsworth
Toronto
C. N. Weber
Kitchener
Leo J. Whitney
Waterloo
Senate

Officers

Chairman — The President and Vice-Chancellor
Vice-Chairman — The Academic Vice-President
Secretary — The Registrar

Ex-Officio Members

The Chancellor — The Hon. Dana H. Porter, Q.C., B.A., M.A.
Chief Justice of Ontario
The Vice-Chancellor — J. G. Hagey, B.A., LL.D.
The Academic Vice-President — T. L. Batke, B.A.Sc., M.A.Sc., Ph.D.

The Principal of each Federated or Affiliated College
C. L. Siegfried, C.R., B.A., M.Sc. (President, St. Jerome's College)
J. W. Fretz, M.A., Ph.D., B.D. (Principal, Conrad Grebel College)
A. W. Rees, M.A. (Principal, Renison College)

The Dean of each Faculty of the University
N. H. High, B.S.A., M.S., Ph.D. (Dean of Arts)
D. T. Wright, B.A.Sc., M.S., Ph.D. (Dean of Engineering)
W. A. E. McBryde, M.A., Ph.D. (Dean of Science)
R. G. Stanton, M.A., Ph.D. (Dean of Graduate Studies)

The Academic Dean of each Federated College
J. R. Finn, C.R., M.A., Ph.D. (St. Jerome’s College)

The Librarian — (Mrs.) D. E. Lewis, B.A., B.L.S.
The Chairman of the Board of Governors — I. G. Needles, B.A.
The Registrar — A. P. Gordon, B.A.
The Director of Extension — G. Campbell, M.A.

Elective Members

Faculty Representatives

To 1964
K. D. Fryer, M.A., Ph.D. (Arts)
G. N. Soulis, B.A.Sc. (Engineering)
W. R. Drynan, B.A.Sc., M.Sc., Ph.D. (Engineering)
W. F. Forbes, B.Sc., Ph.D. (Graduate Studies)
F. W. Boswell, M.A., Ph.D. (Science)
Z. T. Ralston, C.R., M.A., Ph.D. (St. Jerome’s)

To 1965
T. H. Qualter, B.A., Ph.D. (Arts)
J. W. Dyck, M.A., Ph.D. (Arts)
J. S. Keeler, M.Sc. (Engineering)
D. A. Sprott, M.A., Ph.D. (Graduate Studies)
R. G. Woolford, M.Sc., Ph.D. (Science)
B. J. Murphy, C.R., M.A., Ph.D. (St. Jerome's)
J. A. Cowan, B.Sc., M.A., Ph.D. (Science)

To 1966
Z. Adamczewski, A.M., Ph.D. (Arts)
G. A. Coulman, M.S., Ph.D. (Engineering)
I. R. Dagg, M.S., Ph.D. (Graduate Studies)
H. R. N. Eydt, M.Sc., Ph.D. (Science)

Alumni Representatives
To 1964
B. L. Hayes, C.R., B.A. (St. Jerome's College)

To 1965
W. Klos, B.A. (St. Jerome's College)

To 1966
N. Krasniuk, B.A. (St. Jerome's College)

High School Representatives
To 1964
A. I. Hunsberger, B.A., B.Paed. (Waterloo Collegiate Institute)
W. M. Prudham, B.A., B.Sc.
( Owen Sound Collegiate & Vocational Institute)

To 1965
F. M. Dobson, B.A. (Lakeport Secondary School, St. Catharines)
J. C. Herbert, B.A. (Ingersoll District Collegiate Institute)

To 1966
R. J. Hodd, B.A. (Kitcheiner-Waterloo Collegiate & Vocational Institute)
D. G. Kilmer, B.A., B.Comm.
(North Park Collegiate Institute, Brantford)

Officers of Administration

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Vice-President, Academic ............................. T. L. Batke, B.A.Sc., M.A.Sc., Ph.D.
Vice-President, Finance ................................. A. K. Adlington, B.A.
Assistant to the President ............................. J. R. Scott, B.A., A.M.
Dean of Arts ............................................... N. H. High, B.S.A., M.S., Ph.D.
Dean of Engineering ...................................... D. T. Wright, B.A.Sc., M.S., Ph.D.
Dean of Science ............................................ W. A. E. McBryde, B.A., M.A., Ph.D.
Dean of Graduate Studies .............................. R. G. Stanton, B.A., M.A., Ph.D.
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Assistant Registrar, Records . . . . B. Ingram, B.A.
Business Manager . . . . A. B. Gellatly, B.A.
Librarian . . . . (Mrs.) D. E. Lewis, B.A.
Director of Athletics . . . . C. A. W. Totzke, B.A.
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Assistant Director of Co-ordination and Placement . . M. S. Stevens, B.Sc.
Director of Development . . . . J. O. Hemphill
Director of Extension and Adult Education . . G. Campbell, M.A.
Director of Information Services . . . . J. D. Adams, B.A.
Director of Music . . . . E. M. Brookes, B.Sc., A.M.I.C.E.
Director of Planning . . . . R. G. Titze, B.E.
Superintendent of Buildings and Grounds . . . .
XII

Faculty
Faculty

Adamczewski, Z. . . . . Philosophy
Ages, A. . . . . French
Alpay, S. . . . . Mechanical Engineering
Anthes, R. G. . . . . Electrical Engineering
Ariaratnam, S. T. . . . . Civil Engineering
Armour, L. . . . . Philosophy
Atkinson, G. F. . . . . Chemistry
Aziz, R. A. . . . . Physics
Banks, R. K. . . . . Psychology
Batke, T. L. . . . . Chemical Engineering
Rehara, M. . . . . Mathematics
Berman, G. . . . . Mathematics
Bodnar, L. E. . . . . Chemical Engineering
Boswell, F. W. C. . . . . Physics
Brisbin, D. (Mrs.) . . . . Chemistry
Brodeur, C. C. . . . . Philosophy
Brodie, D. E. . . . . Physics
Bruneau, A. A. . . . . Mechanical Engineering
Bryden, M. P. . . . . Psychology
Brzustowski, T. A. . . . . Mechanical Engineering
Burgener, R. J. C. . . . . Philosophy
Cairncross, A. T. . . . . Civil Engineering
Campbell, G. . . . . Sociology
Capindale, J. S. . . . . Chemistry
Carscallen, J. . . . . English
Church, J. W. . . . . Mechanical Engineering
Cohn, M. Z. . . . . Civil Engineering
Corbett, J. M. . . . . Physics
Cornell, P. G. . . . . History
Coulman, G. A. . . . . Chemical Engineering
Cowan, D. D. . . . . Mathematics
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Cross, G. E. . . . . Mathematics
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Cummings, L. A. . . . . English
Dagg, I. R. . . . . Physics
Davies, R. M. . . . . Mechanical Engineering
Davis, H. F. . . . . Mathematics
Diem, A . . . . Geography
Drynan, W. R. . . . . Civil Engineering
Dufault, G. J. . . . . Electrical Engineering
Dust, A. I. . . . . English
Faculty

Duthie, H. C. ..... Biology
Dyck, J. W. ..... Germany and Russian
Eastman, P. C. ..... Physics
Edmondson, L. G. E. ..... Political Science
Ellenton, H. K. ..... Physics
Ellis, J. B. ..... Electrical Engineering
Elson, W. L. ..... Chemistry
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XIII

Academic Calendar
## Academic Calendar

### 1964 - 1965

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<th>Date</th>
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<tr>
<td>July 1</td>
<td>Wednesday</td>
<td>Registration — Post Degree Programme</td>
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<tr>
<td>July 1</td>
<td>Wednesday</td>
<td>Last Day for Supplemental Examination Applications — Arts, Engineering and Science</td>
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<tr>
<td>July 2</td>
<td>Thursday</td>
<td>Lectures Begin — Post Degree Programme</td>
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<tr>
<td>July 20</td>
<td>Monday</td>
<td>Supplemental Examinations Begin — Arts, Engineering and Science</td>
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<td>August 7</td>
<td>Friday</td>
<td>Examinations End — Engineering</td>
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<tr>
<td>August 12</td>
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<td>August 13</td>
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<td>August 14</td>
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<td>Spring Work Term Ends</td>
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<tr>
<td>August 17</td>
<td>Monday</td>
<td>Fall Work Term Begins</td>
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<tr>
<td>September 7</td>
<td>Monday</td>
<td>Labour Day — University Buildings Closed</td>
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<tr>
<td>September 10</td>
<td>Thursday</td>
<td>Registration — Engineering Year I</td>
</tr>
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<td>September 11</td>
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<td>Registration — Engineering Advanced Years</td>
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<td>September 14</td>
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<td>September 21</td>
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<td>Registration — Arts and Science Year I</td>
</tr>
<tr>
<td>September 22</td>
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<td>Registration — Arts and Science Advanced Years</td>
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<td>September 23</td>
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<td>October 12</td>
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<td>Thanksgiving Day — University Buildings Closed</td>
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<td>October 15</td>
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<td>October 30</td>
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<td>Fall Convocation</td>
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<td>Thursday</td>
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<td>December 23</td>
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<td>December 28</td>
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## 1964

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