University of Waterloo
Undergraduate Calendar
1972 1973
Enquiries and formal applications for admission should be directed to the:

Registrar,
University of Waterloo, Waterloo, Ontario, Canada
Telephone: 885-1211 (Area Code) 519)

The Registrar's Office is located on the second floor of the Student Services Building.
Office hours are from 9 a.m. to 5 p.m. Monday through Friday. The office is not open on Saturday.

Federated and Affiliated Church Colleges: Telephone
Conrad Grebel College 885-0220 (area code 519) Renison College 884-4400 (area code 519)
University of St. Jerome's College 884-8110 (area code 519) St. Paul's College 885-1460 (area code 519)

The Senate and the Board of Governors of the University of Waterloo reserve the right to invoke changes in this Calendar without prior notice.
General Information

1 University of Waterloo
2 Admission
3 Fees
4 Scholarships, Bursaries, Prizes, & Financial Aid
5 Student Services
6 Coordination and Placement
7 Libraries

Undergraduate Programmes

8 Faculty of Arts
9 Faculty of Engineering
10 Division of Environmental Studies
11 Integrated Studies Programme
12 Inter-Faculty Programme Board
13 Faculty of Mathematics
14 School of Physical Education and Recreation
15 Faculty of Science

Undergraduate Course Descriptions

16 Undergraduate Course Descriptions

Governing Bodies and Staff

17 Governing Bodies and Staff
Contents

General Information

1 The University of Waterloo
   17 The Undergraduate Calendar
   17 The University of Waterloo
   19 University of St. Jerome's College
   20 Renison College
   20 Conrad Grebel College
   20 St. Paul's College
   20 Degrees
   21 Systems of Study
   21 Part-time Studies
   22 Correspondence Courses
   22 Continuing Education
   22 Centre for Continuing Studies in Marketing
   23 The Computing Centre
   23 Office of Research Administration
   24 Waterloo Research Institute
   24 Office of Human Research

2 Admission Information and Requirements
   27 General Admission Information
   28 Applicants - Ontario Grade 13
   32 Applicants Other Than Ontario Grade 13
   35 Applications - Documents and Procedures

3 Fees and Registration
   41 Fees and Registration

4 Scholarships, Bursaries, Prizes & Financial Aid
   49 Scholarships, Bursaries, Prizes & Financial Aid

5 Student Services
   63 Federation of Students
   65 Cultural Programme Centre
   65 Bookstore
   66 Counselling Services
   67 Health Services
   67 Residence Information
   71 Office of the Dean of Women
   71 Office of the Registrar - Liaison Tours
   72 Student Awards

6 The Departments of Coordination and Career Planning and Placement
   76 The Cooperative Plan
   81 Department of Career Planning and Placement
   81 Post-Graduate Careers Information
7 The University Libraries

8 Undergraduate Programmes

8 Faculty of Arts

9 Faculty of Engineering

9 Division of Environmental Studies

10 Programme of Integrated Studies

11 The Inter-Faculty Programme Board
13 Faculty of Mathematics
187 Admission
189 Standings and Promotions
190 Degrees
192 Academic Programmes
198 Cooperative Mathematics Programme
203 Applied Analysis and Computer Science Department
203 The Applied Mathematics Department
204 The Department of Combinatorics and Optimization
205 The Department of Pure Mathematics
205 The Department of Statistics

14 School of Physical Education and Recreation
210 Degrees
210 Regular Programme
210 Cooperative Programme
210 Admission
211 Examinations and Standings
215 Academic Programmes
215 Kinesiology
217 Health Studies
219 Dance
219 Recreation

15 Faculty of Science
223 Degrees
224 Admission
225 Examinations and Standings
231 Academic Programmes
231 First Year Programmes (Regular and Cooperative)
234 Honours Programmes
250 Optometry Programme
253 The General Science Programme

261 Grading System
262 Cross-Registration-Waterloo Lutheran University

Undergraduate Course Descriptions

16 Undergraduate Course Descriptions
528 Anthropology
421 Applied Analysis & Computer Science
422 Applied Mathematics
267 Architecture
282 Arts
285 Biology
291 Canadian Studies
294 Chemical Engineering
300 Chemistry
311 Civil Engineering
Contents

319 Classics and Romance Languages
320 Classics
423 Combinatorics and Optimization
411 Dance
355 Drama and Theatre Arts
331 Earth Sciences
335 Economics
340 Electrical Engineering
347 English
357 Environmental Studies
356 Fine Arts
324 French
366 General Engineering
368 Geography
380 Germanic and Slavic Languages and Literatures
380 German
322 Greek
390 History
404 Human Relations and Counselling Studies
328 Italian
406 Kinesiology
322 Latin
413 Management Sciences
415 Man-Environment Studies
421 Mathematics
450 Mechanical Engineering
364 Music
460 Optometry
466 Philosophy
476 Physics
488 Political Science
496 Psychology
424 Pure Mathematics
504 Recreation
510 Religious Studies
385 Russian
520 Science
524 Social Science (Applied) Programme
527 Sociology and Anthropology
533 Sociology
329 Spanish
424 Statistics
544 Systems Design
389 Ukrainian
552 Urban and Regional Planning
558 Women’s Studies

Governing Bodies and Staff

17 Governing Bodies and Staff
563 The Board of Governors
563 The Senate
565 Administrative Offices
To reach UW campus from Hwy 401, take interchange 35 and follow Hwy 9 to Kitchener; enter Conestoga Pkwy by following Hwy 7 East sign and follow Pkwy to University Ave. Follow University Ave. West to campus.
Campus Guide

Information Kiosks (After hours, please call Security, Bldg. No. 15)

Faculty of Arts
9 Arts Lecture Hall
5 Modern languages and Theatre of the Arts
10 Isaiah Bowman Social Sciences
24 J.G. Hagey Hall of Humanities and Humanities Theatre
8 Dana Porter Arts Library
101 Psychology

Faculty of Engineering
1 Engineering 1
2 Engineering 2
3 Engineering 3
29 Engineering 4
11 Engineering Lecture Hall

Faculty of Science
4 Physics
6 Chemistry 1
28 Chemistry 2
7 Biology 1
13 Biology 2
Optometry Clinic, 35 King St. N., Waterloo

Faculty of Mathematics
17 Mathematics and Computer Building (includes Optometry offices and EMS Library)

School of Physical Education
18 Physical Education & Athletics
90 Seagram Stadium
91 Seagram Gymnasium

Environmental Studies Division
10 (Offices in Social Sciences Bldg.)
105 School of Architecture

Integrated Studies
202 Isafarm

Residences
104 Housing Office
20 Student Village 1
25 Student Village 2
21 Tutors Apartments
23 Minota Hagey Residence
26 Married Students Apartments
149 Hammarskjold House (Co-op)
150 Philip St. Residence (Co-op)

Services
16 South Campus Hall (Continuing Education, Food Services, Bookstore, Marketing Centre)
19 Campus Centre
22 Health Services
27 Faculty Club
12 Central Stores
14 Maintenance and Stores
15 Commissary and Security
201 Warehouse
31 Student Services (Registrar, Coordination)
32 Administrative Services (Financial Services)

Federated Colleges
81 St Jerome’s College
Residences
80 Notre Dame College
140 Resurrection College

Affiliated Colleges
82 Renison College
83 St. Paul’s College
84 Conrad Grebel College

Parking Lots
Free Parking (E)
Pay Parking (C,B-1,M,A)
Reserved Parking (A,B,H,L,N,F,I,K,V,S)
Academic Calendar

1972

July 1, Saturday  Last Day for Receipt of Fall Term 1972 Applications for admission
July 3, Monday   Registration—Summer Session—Summer Session Lectures Begin
July 17, Monday  Supplemental Examinations Begin
August 1, Tuesday Lectures End—Spring Term
August 4, Friday  Examinations Begin—Spring Term Co-operative Programmes
August 7, Monday  Civic Holiday—University Closed
August 11, Friday Examinations Begin—Summer Session
August 12, Saturday Examinations End—Spring Term—Co-operative Programmes
August 25, Friday  Spring Work Term Ends—Co-operative Programmes
August 28, Monday Fall Work Term Begins—Co-operative Programmes
September 4, Monday Labour Day—University Closed
September 5, Tuesday Registration Begins—Undergraduate, Regular and Co-operative Programmes
September 7, Thursday Meeting—Senate Executive Committee
September 8, Friday  Registration Ends—Undergraduate, Regular and Co-operative Programmes
September 8, Friday  Registration—Graduate Studies
September 11, Monday Lectures Begin
September 21, Thursday Meeting—University Senate
September 29, Friday  End of Course Change Period—Fall Term
October 5, Thursday Meeting—Senate Executive Committee
October 9, Monday  Thanksgiving Day—University Closed
October 10, Tuesday Meeting—Board of Governors
October 19, Thursday Meeting—University Senate
October 20, Friday  Fall Convocation
November 2, Thursday Meeting—Senate Executive Committee
November 6, Monday  Supplemental Examinations Begin—Co-operative Programmes
November 8, Wednesday Pre-registration Begins—On-Campus Co-operative Students for Spring Term 1973
November 10, Friday  Pre-registration Ends—On-Campus Co-operative Students for Spring Term 1973
November 16, Thursday Meeting—University Senate
December 6, Wednesday Lectures End—Fall Term
December 7, Thursday Meeting—Senate Executive Committee
December 9, Saturday Examinations Begin—Fall Term
December 21, Thursday Meeting—University Senate
December 22, Friday  Examinations End—Fall Term
December 22, Friday  Fall Work Term Ends—Co-operative Programmes
December 25, Monday Christmas Day—University Closed
December 26, Tuesday  University Closed
December 27, Wednesday Winter Work Term Begins—Co-operative Programmes
Academic Calendar

1973

January 1, Monday New Year's Day—University Closed
January 2, Tuesday University Closed
January 3, Wednesday Registration—Undergraduate Co-operative Programmes
January 3, Wednesday Registration—Winter Term—Graduate Studies
January 4, Thursday Meeting—Senate Executive Committee
January 4, Thursday Lectures Begin
January 9, Tuesday Meeting—Board of Governors
January 18, Thursday Meeting—University Senate
January 26, Friday End of Course Change Period—Winter Term
February 1, Thursday Meeting—Senate Executive Committee
February 15, Thursday Meeting—University Senate
March 1, Thursday Meeting—Senate Executive Committee
March 12, Monday Supplemental Examinations Begin—Co-operative Programmes
March 12, Monday Pre-registration Begins—Regular and Co-operative Students for Fall Term 1973
March 15, Thursday Meeting—University Senate
March 16, Friday Pre-registration Ends—Regular and Co-operative Students for Fall Term 1973
April 3, Tuesday Lectures End—Winter Term
April 5, Thursday Meeting—Senate Executive Committee
April 7, Saturday Examinations Begin—Winter Term
April 10, Tuesday Meeting—Board of Governors
April 19, Thursday Meeting—University Senate
April 20, Friday Good Friday—University Closed
April 27, Friday Examinations End—Winter Term Ends
April 27, Friday Winter Work Term Ends—Co-operative Programmes
April 30, Monday Spring Work Term Begins—Co-operative Programmes
May 1, Tuesday Registration—Undergraduate Co-operative Programmes
May 1, Tuesday Registration—Graduate Studies—Spring Term
May 2, Wednesday Lectures Begin—Spring Term
May 3, Thursday Meeting—Senate Executive Committee
May 17, Thursday Meeting—University Senate
May 21, Monday Victoria Day—University Closed
May 23, Wednesday End of Course Change Period—Spring Term
May 24, Thursday Spring Convocation
May 25, Friday Spring Convocation
May 26, Saturday Spring Convocation
May 28, Monday Pre-registration Begins—Co-operative Students for Winter Term 1974
May 30, Wednesday Pre-registration Ends—Co-operative Students for Winter Term 1974
June 7, Thursday Meeting—Senate Executive Committee
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 12, Tuesday</td>
<td>Meeting—Board of Governors</td>
</tr>
<tr>
<td>June 21, Thursday</td>
<td>Meeting—University Senate</td>
</tr>
<tr>
<td>July 2, Monday</td>
<td>University Closed—Dominion Day Observance</td>
</tr>
<tr>
<td>July 3, Tuesday</td>
<td>Registration—Summer Session</td>
</tr>
<tr>
<td>July 3, Tuesday</td>
<td>Lectures Begin—Summer Session</td>
</tr>
<tr>
<td>July 16, Monday</td>
<td>Supplemental Examinations Begin</td>
</tr>
<tr>
<td>August 1, Wednesday</td>
<td>Lectures End—Spring Term</td>
</tr>
<tr>
<td>August 4, Saturday</td>
<td>Examinations Begin—Spring Term</td>
</tr>
<tr>
<td>August 6, Monday</td>
<td>Civic Holiday—University Closed</td>
</tr>
<tr>
<td>August 10, Friday</td>
<td>Examinations Begin—Summer Session</td>
</tr>
<tr>
<td>August 11, Saturday</td>
<td>Examinations End—Spring Term Co-operative Programmes</td>
</tr>
<tr>
<td>August 24, Friday</td>
<td>Spring Work Term Ends—Co-operative Programmes</td>
</tr>
<tr>
<td>August 27, Monday</td>
<td>Fall Work Term Begins—Co-operative Programmes</td>
</tr>
<tr>
<td>September 3, Monday</td>
<td>Labour Day—University Closed</td>
</tr>
<tr>
<td>September 4, Tuesday</td>
<td>Registration Begins—Undergraduate, Regular and Co-operative Programmes</td>
</tr>
<tr>
<td>September 6, Thursday</td>
<td>Meeting—Senate Executive Committee</td>
</tr>
<tr>
<td>September 7, Friday</td>
<td>Registration Ends—Undergraduate, Regular and Co-operative Programmes</td>
</tr>
<tr>
<td>September 7, Friday</td>
<td>Registration—Graduate Studies</td>
</tr>
<tr>
<td>September 10, Monday</td>
<td>Lectures Begin</td>
</tr>
<tr>
<td>September 20, Thursday</td>
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</tr>
<tr>
<td>September 28, Friday</td>
<td>End of Course Change Period—Fall Term</td>
</tr>
<tr>
<td>October 4, Thursday</td>
<td>Meeting—Senate Executive Committee</td>
</tr>
<tr>
<td>October 8, Monday</td>
<td>Thanksgiving Day—University Closed</td>
</tr>
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</tr>
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</tr>
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</tr>
<tr>
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<tr>
<td>December 5, Wednesday</td>
<td>Lectures End—Fall Term</td>
</tr>
<tr>
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</tr>
<tr>
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<td>Examinations Begin—Fall Term</td>
</tr>
<tr>
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<td>Fall Work Term Ends—Co-operative Programmes</td>
</tr>
<tr>
<td>December 22, Saturday</td>
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</tr>
<tr>
<td>December 24, Monday</td>
<td>Winter Work Term Begins—Co-operative Programmes</td>
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<tr>
<td>December 25, Tuesday</td>
<td>Christmas Day—University Closed</td>
</tr>
<tr>
<td>December 26, Wednesday</td>
<td>University Closed</td>
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</tbody>
</table>
1

The University of Waterloo
The Undergraduate Calendar

The Undergraduate Calendar is published once a year by the Office of the Registrar, University of Waterloo. The Calendar serves to provide a current and official list of academic courses and programmes, policies, and regulations regarding admissions, examinations, and fees, as well as general information about the University. It also serves as an official and historical record of the University.

Candidates for admission and students currently enrolled in the University are encouraged to become familiar with the contents of the Calendar. If there is any doubt as to the interpretation of the contents of the Calendar, enquiries can be directed to the Registrar or to the person directly concerned with the area in question.

The Calendar is arranged in chapters which fall into four divisions. The first division contains general information about the University including services, systems of study, and library facilities. The second division outlines the undergraduate programmes offered at the University and the third division describes the courses offered in these programmes. All courses listed may not be offered in the current section; therefore, students are advised to consult the University course offerings list prior to arranging their programmes. The last division of the Calendar describes the general administrative structure of the University. A more detailed table of contents can be found at the beginning of the Calendar.

The information in this Calendar applies to the 1972-73 academic session which commences in September 1972. The Senate and the Board of Governors of the University of Waterloo reserve the right to make changes in the academic Calendar without prior notice.

The University also publishes:

a Graduate Studies Calendar
an Admissions Brochure
a Summer School Brochure
a Post-Degree Brochure
an Extramural Brochure

The University

Classes at the University of Waterloo commenced in July, 1957, with the introduction of the Cooperative 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 offering courses at both the undergraduate and the graduate level. The University is co-educational and non-denominational. Programmes are now offered in Architecture, Arts, Engineering, Environmental Studies, Integrated Studies, Mathematics, Optometry, Physical Education and Recreation, and Science. The University is a member of The Association of Universities and Colleges of Canada and of the Association of Commonwealth Universities.
The University of Waterloo

The Campus
The University is situated on a beautiful 1,000 acre campus in the northwest section of the City of Waterloo. Waterloo, and its twin city Kitchener, are steadily growing industrial centres in mid-western Ontario with a combined population of approximately 150,000 people.

Since the opening of the first permanent structure on campus in 1958, the University has expanded steadily. The twenty-eight teaching and service buildings presently on campus include a Computing Centre, a Physical Activities Complex, a stadium, extensive library facilities, two theatres, four residential Church Colleges, and a variety of modern residential accommodation.

University Colours and Coat of Arms

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

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

Motto
Concordia Cum Veritate – In Harmony with Truth

The University Mace

The symbolic theme may be described as follows:

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

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

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

University Jurisdiction

The University exercises its statutory jurisdiction and authority with respect to the operation, protection and control of its property and plant and the regulation of persons on campus insofar as is necessary to ensure the orderly performance of a university's functions.

In addition it should be recognized that all members of the University, as members of all society at large, must expect to be subject to the general public, civil and criminal jurisdiction whether on or off campus.
The University of Waterloo

Academic Organization

The University is organized under several academic units called Faculties, Divisions, or Schools as follows: The Faculty of Arts, The Faculty of Engineering, The Division of Environmental Studies, the Faculty of Mathematics, The Faculty of Science, and The School of Physical Education and Recreation. Within this framework are various departments and schools. Students who want to follow a more independent and unstructured course of study than the traditional one may wish to seek admission to the Integrated Studies Programme. Qualified students, registered in any Faculty, Division or School in the University may choose electives from among the multi-disciplinary courses offered by the Inter-Faculty Programme Board.

Enrollment for each Faculty/School/Division – 1971-72

<table>
<thead>
<tr>
<th>Faculty/Division</th>
<th>1971-72</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty of Arts</td>
<td>2,658</td>
</tr>
<tr>
<td>Faculty of Engineering</td>
<td>2,605</td>
</tr>
<tr>
<td>Division of Environmental Studies</td>
<td>997</td>
</tr>
<tr>
<td>Integrated Studies Programme</td>
<td>77</td>
</tr>
<tr>
<td>Faculty of Mathematics</td>
<td>2,437</td>
</tr>
<tr>
<td>School of Physical Education &amp; Recreation</td>
<td>808</td>
</tr>
<tr>
<td>Faculty of Science</td>
<td>1,645</td>
</tr>
</tbody>
</table>

Total Undergraduate Enrollment                | 11,226  |
Graduate Student Enrollment (Full-Time)       | 1,176   |

The Church Colleges

There are four church-related colleges associated with the University.

University of St. Jerome's College

The University of St. Jerome's College is a liberal arts college which had been affiliated with the University of Ottawa since 1947 and entered into federation with the University of Waterloo in July, 1960. It offers a complete range of undergraduate courses in the Faculty of Arts and registers students in regular Mathematics and the Division of Environmental Studies. Students registered at St. Jerome's College freely supplement their programmes with courses offered at the university and students registered at the university complement their programmes with course offered uniquely by St. Jerome's. Graduates of the college receive University of Waterloo degrees in accordance with the terms of the federation agreement. A continuous building programme since 1962 finds St. Jerome's presently with a teaching and administration building, a men's residence accommodating 120 and a women's residence, Notre Dame College, operated by the School Sisters of Notre Dame, which has room for 120 students. The University of St. Jerome's College is conducted by the Congregation of the Resurrection.
Renison College

Renison College was founded by a group of Anglicans committed to the principle of a small residence-teaching community which could emphasize the virtues of intimacy, creativity, and innovation with regard both to teaching and residential life.

Academic offerings at Renison include courses in two areas: (a) Applied Social Science Programme, and (b) General Arts. The former is an integrated programme of courses in the areas of Social Work, Psychology, and Sociology, with emphasis on both classroom study and community involvement. Within General Arts are courses in English, French, Geography, Psychology, Religious Studies, and Sociology.

The college has two residences accommodating 100 men and 80 women.

Conrad Grebel College

A Mennonite church supported college which affiliated with the University in 1961, Conrad Grebel College offers courses in Arts, History, Music, Religious Studies, and Sociology. The College residence accommodates 48 men and 58 women.

St. Paul's College

St. Paul's United College is a teaching and residential community of 150 men and women. It offers a limited number of courses in Religious Studies which are available for academic credit to any student enrolled in the University. Residence life in the College provides a valuable contribution to university experience beyond that which comes from courses taken for credit. Through a programme of athletics, community dinners, interest groups and a congregation engaged in various projects and issues relating to the University, the Church, personal life, and society, members of the College and associates participate in a vital and enriching community. Application for admission to residence and further enquiries should be made to the Principal, St. Paul's United College, Waterloo, Ontario.

Degrees Offered

The University of Waterloo offers the following undergraduate degrees:

- Bachelor of Architecture B.Arch.
- Bachelor of Arts B.A.
- Bachelor of Applied Science B.A.Sc.
- Bachelor of Environmental Studies B.E.S.
- Bachelor of Independent Studies B.I.S.
- Bachelor of Mathematics B.Math.
- Bachelor of Science B.Sc.
- Doctor of Optometry O.D.

Further information concerning these degrees and their related programmes is available in the faculty sections of this Calendar.
The University of Waterloo offers the following graduate degrees:

- Master of Arts M.A.
- Master of Applied Science M.A.Sc.
- Master of Science M.Sc.
- Master of Philosophy M.Phil.
- Doctor of Philosophy Ph.D.

Further information concerning these degrees and their related programmes is available in the Graduate Calendar.

Honorary Degrees

The following honorary degrees are conferred by the Senate of the University:

- Doctor of Laws L.L.D.
- Doctor of Science D.Sc.
- Doctor of Letters D.Litt.
- Doctor of Engineering D.Eng.
- Doctor of Environmental Studies D.E.S.

Systems of Study

The University offers its students two different systems of study, the Regular System and the Cooperative System. Some programmes are offered under one system only while others are offered under either system. Each of the Programme sections in this Calendar contains information concerning the System of Study that can be followed for the programme described.

Regular System

Under the Regular System of Study the student follows the conventional eight-month academic year from September to April.

Cooperative System

Students studying under the Cooperative System spend alternating terms of four months duration on the campus for academic studies, and with business, industry, or government for off-campus practical training. The standard Cooperative Programme consists of eight four-month terms of study and six four-month terms of employment. Some programmes vary from this standard arrangement. The necessary arrangements for the work terms are handled by the Coordination Department. Further information about the Cooperative System can be found in the section of this Calendar that deals with the Coordination Department.

Part-time Studies

Opportunities for part-time studies are available primarily through the Faculty of Arts, and to a limited extent through the other faculties. There is no distinction between part-time and full-time students as to admission requirements, grading practices, or promotion policies.

Courses of interest to part-time students are offered in the evenings, on Saturdays, and during a six-week Summer Session commencing in July of each year. Information regarding the availability of courses can be obtained from the Office of the Registrar.
Correspondence Courses

The University of Waterloo offers degree credit courses by correspondence in Chemistry, Physics, and Mathematics. Lectures are recorded on magnetic tape and are accompanied by supplementary material.

The Correspondence Programme is designed primarily to assist elementary and secondary school teachers in upgrading their teaching qualifications. However, the courses may be taken by anyone with a suitable academic background and can be used for credit towards a degree at the University of Waterloo. A maximum of two correspondence courses per year may be taken at the University of Waterloo, for credit towards a degree, for a total of six such courses in a three-year General Programme and eight in a four-year General Programme. Further information can be obtained from:

The Director,
University of Waterloo Correspondence Programme,
c/o Department of Physics,
University of Waterloo,
Waterloo, Ontario.

Continuing Education

Through a number of channels the University recognizes its responsibility for the continuing education of adults.

A brochure outlining the many credit courses offered by correspondence, or on the campus, at times convenient to members of the outside community, is available from the Office of the Registrar.

A number of academic departments sponsor special lecture series of interest to all persons in the community. Information regarding these series can be obtained from the department concerned or from the Information Services Department.

Through its Bookings Office the University makes its facilities available at reasonable cost to those organizations or groups who desire to conduct educational functions on the campus. Many such conferences, symposia, and workshops are held on the campus each year.

The activities of the Centre for Continuing Studies in Marketing are outlined below.

Centre for Continuing Studies in Marketing

The Centre for Continuing Studies in Marketing offers short courses, seminars, and workshops for the business community in both marketing and management. They are designed to help managers do a better job in their current assignments, to better prepare them for the job ahead and to give them new perspectives, through exposure to their peers, in a wide range of business and industry.

In addition, the Centre's staff assists in the preparation of management development programmes to meet the particular needs of an organization.

No degree courses are offered by the Centre and no courses involve degree credits.
The programme has grown from the original Advanced Course in Marketing and Sales Management in 1962 to almost fifty offerings in 1971-72 in the areas of Sales and Management Techniques. Further information can be obtained from the Centre for Continuing Studies in Marketing, University of Waterloo.

The Computing Centre

The Computing Centre, located on the first two floors of the Mathematics and Computer Building, provides programming facilities for faculty, staff, graduates and undergraduates. Such facilities include keypunch and programme preparation rooms, programme submission areas, and a variety of computer equipment chosen to meet the wide range of computing applications in a university community. Faculty and graduate students use the computer to aid them in their research. Undergraduates write programmes for their course assignments. Administration and staff use the computer for such tasks as student records, course timetables, exam results, library circulation control, and payroll processing.

Undergraduates who are interested in programming soon become familiar with what are known as the Debug Terminals. These consist of a high speed card reader and printer which are used by programmers to "debug" or find the errors in their programmes. These Debug Terminals are set up à la cafeteria-style lineup, a concept developed at the University of Waterloo to enable students to submit the maximum number of programmes with the least possible delay in receiving their programme output or results. This concept has been adopted by many other Universities, to quickly process the small programmes which are assigned in undergraduate computing courses.

As well as operating the computer equipment and maintaining the software of the computer systems, the Computing Centre provides many services to the computer users on campus to help make programming an easier and more efficient process. Programming consultation, non-credit courses, computer reference room facilities and a number of publications are provided by the Services personnel of the Computing Centre.

In short, the Computing Centre is a service department whose facilities are available to all members of the university community.

Office of Research Administration

The Office of Research Administration was set up in March, 1969, and is responsible for the administration of research grants and contracts for the University of Waterloo.

Among the functions of the ORA are the following: to provide interested members with application forms for the main granting agencies; to review and forward to the appropriate bodies all requests for money to be used for research and training grants in the university; to advise interested parties of the terms of each individual grant or contract and to act as a centre of communication between granting agencies and members of the university staff.

The ORA also administers the university's patent assistance programme.
Waterloo Research Institute

Established as the Industrial Research Institute in December, 1967, the Waterloo Research Institute is an organization within the University of Waterloo which provides research and development assistance to organizations wishing to obtain such help on a contract basis. The essential purpose of the WRI is to provide a working liaison between the university and all organizations in which contracted research and development offers potential assistance.

The WRI stimulates, arranges and manages the execution of research and development programmes sponsored by industry and other organizations. The Institute draws upon the resources of all faculties of the university to achieve this purpose.

The scope of research available through the WRI is as broad as the range of academic studies at the university. There are many special research strengths at the university and they are frequently brought together in interdisciplinary studies. The major faculties and their departments and the numbers of permanent faculty members indicate the scope of research carried out at the University of Waterloo. Competence in many disciplines abounds among the university faculty and students and the Waterloo Research Institute identifies those who are best able to assist with specific problems.

Office of Human Research

The Office of Human Research reviews university research programmes involving human subjects, as to ethical acceptability, legal liability and medical advisability. As the official liaison office between the university and local public and separate school boards, the OHR is responsible for obtaining school age children as subjects for suitable university research programmes.
2

Admissions
Campus Scene—Summertime
Admission Information and Requirements

General Admission Information

Applications seeking admission to undergraduate programmes are required to have suitable and adequate preparation to enable them to successfully undertake studies at the University. Before submitting an application, prospective students should read carefully the description of the programme they wish to study and then review the admission requirements to determine if their background qualifies them for consideration.

Candidates may apply for admission to the programmes listed in the various faculty sections of this Calendar. All applicants will be considered for admission to the University unless St. Jerome’s College or Renison College is specified.

All completed documents and correspondence should be directed to the Assistant Registrar for the Faculty to which the candidate is applying.

More detailed information regarding admission requirements is available from the Office of the Registrar, University of Waterloo.

Applicants are advised to outline thoroughly their educational background in order to facilitate the admission process. The admission information and requirements set forth in this Calendar are applicable for admission in September, 1973.

St. Jerome’s College

Applicants may apply for programmes in Arts and Mathematics (regular programme only) through St. Jerome’s College. St. Jerome’s College applicants who are currently enrolled in an Ontario Grade 13 programme should indicate “St. Jerome’s College” clearly on their application forms in the “Programme Applied To” section. The University will then forward the application form to St. Jerome’s College for processing.

St. Jerome’s College applicants not currently enrolled in Ontario Grade 13 should send their application forms and completed documents directly to:

The Registrar,
St. Jerome’s College,
University of Waterloo,
Waterloo, Ontario.

Renison College

Applicants may apply for programmes in Arts through Renison College as well as through the University. Renison College applicants should send their application forms and completed documents to the Assistant Registrar for the Faculty to which they are applying at the University and indicate “Renison College” clearly on the application form.

Part-time Studies

Students wishing to pursue degree studies on a part-time basis may enrol in regularly scheduled day courses as well as evening or Saturday classes. In addition, the University offers a six week summer programme under the Faculty of Arts as well as a correspondence programme with courses primarily in Chemistry, Mathematics, and Physics.
There are no distinctive admission requirements for part-time students. The admission requirements outlined in this chapter apply equally to applicants to full-time or part-time studies.

Applicants interested in part-time study should refer to the section in Chapter 1 which outlines the various part-time programmes.

Applicants applying under the Adult Student requirements should refer to page 32 of this chapter.

Application Dates

Application forms and supporting documents for full or part-time studies commencing in September, 1973, should be submitted by July 1st, 1973. Applicants currently enrolled in Ontario Grade 13 who wish to be considered for Early Admission must apply before December 1st, 1972. Applicants to Summer School must apply prior to June 1st, 1973. Applicants applying or sending in supporting documents after these dates cannot be guaranteed consideration of their applications.

Release of Academic Information

The University may, on request from a Secondary School in Ontario, release the following academic information of the student without written approval of the student; the student's name, the programme in which the student is registered, and one of the four academic decisions for the particular year - passed, failed, supplementals required, withdrawn. Students not wishing to have this information released should contact the Registrar's Office accordingly.

Limited Enrolment

In some programmes the number of qualified applicants may exceed the number of places available. The possession of the minimum requirements does not in itself guarantee admission to any of the programmes.

Authority to Admit

All applicants for admission to the University will be considered by the Admissions Committee for the Faculty to which admission is sought. No final decision regarding the acceptability of any applicant will be made by any individual or group other than the appropriate Admissions Committee.

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.

Applicants – Ontario Grade 13

In order to be considered for admission, applicants to all programmes will normally be required to achieve a 60% overall average in their Grade 13 standings. The University expects to fill the majority of places available to Grade 13 applicants using the following criteria:

Grade 13 interim standing
Grade 12 final standing
Principal's recommendation

The overall University requirement will be assurance from the applicant's Secondary School that the prerequisites for the Secondary School Honour Graduation Diploma have been satisfied.
Early Admission
All Ontario Grade 13 applicants will be notified on or after May 18th, 1973, of the status of their application for admission. Grade 13 applicants who do not receive an offer of admission at this time will have their applications deferred until their final Grade 13 marks are received by the University. When these marks have been received, qualified applicants will be admitted until the remaining places are filled.

Ontario Grade 13 applicants who receive an early offer of admission are encouraged to confirm as soon as possible but are not required to respond before June 8, 1973.

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

Applicants who have spent more than the normal length of time in Secondary School to complete their University preparation may be required to present a higher admission average than 60%. Applicants who completed their secondary school studies in less than the normal period of time will be considered providing that the Grade 13 admission prerequisites have been satisfied.

Preparation for University
Each Faculty, School, or Division at the University has specific requirements over and above the basic University requirements. It is recommended that applicants normally present a Grade 13 programme that has involved preparation in more than three subject areas. It is expected that applicants will present a balanced selection of Grade 13 courses.

A subject area for these purposes is an area of study, i.e., Mathematics, English, Biology, as opposed to individual courses such as Mathematics A, English Composition, History of Canada, etc.. The terms Science, Humanities, or Languages are not treated as subjects in the listing of admission requirements.

Please note that these recommendations are made in order to assist students in their preparation for study at University. Where recommendations are stated, the University will consider all applications regardless of the applicant's Grade 13 programme. Where a Faculty area states specific requirements, it is expected that applicants will include these requirements in their Grade 13 programme.

Recommendations and specific requirements for admission to the various Faculties are described on the following chart. As well, each Faculty Programme section of the Calendar will contain the recommendations or specific requirements for that particular Faculty area.

<table>
<thead>
<tr>
<th>Faculty of Arts</th>
<th>Specific Grade 13 Requirements</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Averages</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Recommendations and Notes</td>
<td>Applicants are advised to take courses in subject areas selected from English, a language other than English, and any Arts subject related to the proposed programme of study.</td>
<td></td>
</tr>
</tbody>
</table>
### Admissions

<table>
<thead>
<tr>
<th>Faculty of Engineering</th>
<th>Specific Grade 13 Requirements</th>
<th>Relations and Functions, Calculus, Algebra, Chemistry, Physics.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Special Averages</td>
<td>60% overall average in specific requirements.</td>
</tr>
<tr>
<td></td>
<td>Recommendations and Notes</td>
<td>Applicants who do not have the specific Grade 13 requirements but who have a high overall standing including at least Relations and Functions, and Calculus are also encouraged to apply for admission.</td>
</tr>
</tbody>
</table>

### Division of Environmental Studies

Because of the increasing use of statistics and quantitative methods in environmental research, it is recommended that applicants present at least one Grade 13 Mathematics course for admission to programmes in Environmental Studies.

**Architecture (Pre-Professional Programme)**

<table>
<thead>
<tr>
<th>Specific Grade 13 Requirements</th>
<th>Relations and Functions, Calculus and Physics.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Averages</td>
<td>60% overall average in specific requirements.</td>
</tr>
<tr>
<td>Recommendations and Notes</td>
<td>Selected applicants to the Architecture (Pre-Professional Programme) may be required to come to the University for an interview.</td>
</tr>
</tbody>
</table>

**Urban and Regional Planning**

<table>
<thead>
<tr>
<th>Specific Grade 13 Requirements</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Averages</td>
<td>None</td>
</tr>
<tr>
<td>Recommendations and Notes</td>
<td>Selected applicants to the Urban and Regional Planning Programme may be required to come to the University for an interview.</td>
</tr>
</tbody>
</table>

**Geography**

<table>
<thead>
<tr>
<th>Specific Grade 13 Requirements</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Averages</td>
<td>None</td>
</tr>
<tr>
<td>Recommendations and Notes</td>
<td>None</td>
</tr>
</tbody>
</table>

**Man-Environment Studies**

<table>
<thead>
<tr>
<th>Specific Grade 13 Requirements</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Averages</td>
<td>None</td>
</tr>
<tr>
<td>Recommendations and Notes</td>
<td>None</td>
</tr>
</tbody>
</table>
**Integrated Studies Programme**

Specific Grade 13 Requirements: None

Special Averages: None

Recommendations and Notes: Due to the nature of the Programme, each applicant to Integrated Studies is considered on the basis of a personal interview with a committee composed of Faculty and students. Those who show the strongest aptitude for self-direction and independent study and the ability to flourish in an unstructured academic setting will be given strongest consideration.

**Faculty of Mathematics**

Specific Grade 13 Requirements: Relations and Functions, Calculus, Algebra.

Special Averages: The Regular Programme requires a 60% overall average in specific requirements. The Cooperative Programme requires a 66% overall average in specific requirements.

Recommendations and Notes: None

**School of Physical Education and Recreation**

*Kinesiology*

Specific Grade 13 Requirements: None

Special Averages: None

Recommendations and Notes: Applicants are advised to select a Grade 13 programme that includes one or more of the following courses: Calculus, Biology, Chemistry, Physics.

*Recreation*

Specific Grade 13 Requirements: None

Special Averages: None

Recommendations and Notes: Applicants are advised to include both Biology and Geography in their Grade 13 programme.
Faculty of Science (Including Optometry)

Specific Grade 13 Requirements: Relations and Functions, Calculus, and two Science courses, one of which must be Physics or Chemistry.

Special Averages: 60% overall average in specific requirements. 70% in Mathematics and Physics for Co-operative Applied Physics.

Recommendations and Notes: Applicants are advised to include both Chemistry and Physics in their Grade 13 programme.

Applicants – Other Than Ontario Grade 13

Applicants who are not currently registered in Ontario Grade 13 are considered under the following broad categories. These categories serve to identify general areas of academic preparation. Applicants should pay particular attention to the section in this chapter on Application – Documents and Procedures.

Adult Students: Individuals of mature age who have been away from formal education for more than two years and who do not possess the minimum requirements for admission may apply as adult students. It is recommended that applicants who are applying to enter the University as adult students, attempt to obtain standing in at least one Ontario Grade 13 level subject or its equivalent. This preparation should relate to the programme the applicant wishes to study at University.

Mature students who cannot meet the requirements for degree candidacy, or who are uninterested in pursuing a degree at this time, may apply on a non-degree basis. Such students may take as many as two courses per session for University credit, up to a total of six. Courses taken under this provision will count toward a degree if the student is admitted later as a degree candidate.

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

Advanced Standing: Applicants to advanced years must specify the Faculty to which they are seeking admission, the programme they wish to study, and the level of admission sought. All faculties, with the exception of Engineering, operate on a course credit system where a student’s progress is measured by courses completed rather than by years completed. Applicants to faculties which operate under the course credit system will have previous work evaluated on an individual course basis.
Transfer Credit
Transer credit will depend upon the programme applied to, the relevancy of the previous programme studied, and approval from the appropriate department that such courses are to be credited to the student's programme.

Generally transfer credit is given for courses in which a grade of 60% or better was obtained. Students transferring from other institutions may have their transferred courses count toward the University of Waterloo degree, however, the marks obtained in these courses will not be included in the calculation of the student's average.

Stidents transferring from Faculties within the University, or former University of Waterloo students returning after an absence, generally have an option of transferring previous University of Waterloo courses with 60% or better and not including these courses in the cumulative average or transferring all relevant courses passed (including D's) and including all courses passed or failed in the cumulative average.

Applicants from Ontario Colleges of Applied Arts and Technology
As a general policy, applicants who have achieved first class honours or high second class honours in each of the three years of a programme at an Ontario College of Applied Arts and Technology are considered for admission to Year Two of a relevant programme at the University of Waterloo.

Applicants who have completed two years with first class honours or high second class honours are considered for admission to Year One.

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

Applicants from Other Canadian Provinces
Applicants from a Canadian Secondary School system who are applying to Year One must have the equivalent of the Ontario Grade 13 programme in course requirements and averages.

Equivalent Certificates
The following certificates or their equivalents will be considered.

<table>
<thead>
<tr>
<th>Province</th>
<th>Equivalent Certificate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alberta</td>
<td>Senior Matriculation (Grade 12)</td>
</tr>
<tr>
<td>British Columbia</td>
<td>Senior Matriculation (Grade 12)</td>
</tr>
<tr>
<td>Manitoba</td>
<td>Senior Matriculation (Grade 12)</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>Senior Matriculation (Grade 12)</td>
</tr>
<tr>
<td>Newfoundland</td>
<td>Year 1 Memorial University</td>
</tr>
<tr>
<td>Nova Scotia</td>
<td>Senior Matriculation (Grade 12)</td>
</tr>
<tr>
<td>Prince Edward Island</td>
<td>Year 1 University of P.E.I.</td>
</tr>
<tr>
<td>Quebec</td>
<td>First Year CEGEP programme or Senior High School Leaving Certificate</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>Senior Matriculation (Grade 12)</td>
</tr>
</tbody>
</table>

Applicants from Other Countries
Applicants should submit certificates indicating subjects studied and grades received. Documents submitted in a language other than English must be accompanied by a notarized English translation.
Note

Applicants from other countries, who are applying to Co-operative programmes of study at the University, must obtain Landed Immigrant Status in Canada before their applications will be considered for a Co-operative programme. Until such proof is received, applicants will be considered for a comparable programme offered under the regular system of study.

Equivalent Certificates

The following is a list of certificates or degrees which are considered to be equivalent to completion of Ontario Grade 13.

**United Kingdom and Commonwealth**

General Certificate of Education with passes in at least 5 subjects, 2 of which must be at the Advanced level.

**United States of America**

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

**Hong Kong**

Hong Kong Certificates of Education (English) and University of Hong Kong Matriculation (Advanced Level) with passes in at least 5 subjects, 2 of which must be at the Advanced Level. (Applicants with 3 or more University of Hong Kong Advanced Level subjects will also be considered.)

Chinese University of Hong Kong – First Year standing with courses appropriate to programme.

**India**

B.A. or B.A.Sc. (first or second division)

**Europe**

Maturity or Matriculation Certificate

**Central and South America**

First year University with a standing of at least (B–)

**Countries Using French Educational System**

Baccalaureate Passable

Applicants from countries not mentioned in the list above can obtain detailed admission requirements from the Office of the Registrar.

Landed Immigrant Status

Because of the nature of the Co-operative programmes at the University, where a student alternates four months of study on campus with four months of practical work experience in business, industry, or government, applicants from other countries must obtain Landed Immigrant Status in Canada before applying for admission to the University. Exceptions can be made on an individual basis at the request of a government agency or other employer. Immigrants from other countries are expected to have one year's residency in Canada before applying for admission to a Co-operative programme.
English Proficiency Test

Applicants from non-English speaking countries may be required to take the "Test of English as a Foreign Language" (TOEFL). Other equivalent English proficiency tests will be accepted. The results of these TOEFL tests must satisfy the Admissions Committee that the applicant's knowledge of the English language is adequate to enable him to pursue his studies successfully. In addition, applicants to Co-operative programmes must satisfy the Admissions Committee that they can perform satisfactorily in their work terms. The expenses involved in administering the test must be borne by the applicant.

Applications – Documents and Procedures

The following points describe the various documents required by the University for admission and outline the procedures which are followed.

Ontario Universities Application Centre

A candidate planning to enrol in the first post-Grade 13 year at an Ontario university in the Spring or Fall of 1973 will submit his application through the new Ontario Universities' Application Centre. Established by the Council of Ontario Universities, the Centre will commence operation in October, 1972, for the 1972-1973 admission cycle.

Candidates presently enrolled in an Ontario secondary school who indicate on the Ontario Department of Education registration that they intend to apply to a university will receive a personalized preprinted application form direct from the Centre.

Candidates not presently enrolled in an Ontario secondary school will obtain an application form from the university of their choice. All applications received by the University through the Ontario Universities' Application Centre will be acknowledged by the University.

Ontario Grade 13 Applicants

All applicants currently registered in Ontario Grade 13 courses should apply on forms supplied by their Secondary School in conjunction with the Ontario Universities' Application Centre. In programmes which require an interview, additional letters of reference may be required.

Other Than Ontario Grade 13 Applicants

All applicants who are not currently enrolled in an Ontario Grade 13 programme should make application on the appropriate application form available from the Office of the Registrar. When completing this application form, candidates should keep the following points in mind:

No application will be considered until the necessary supporting documents have been received. It is the applicant's responsibility to ensure that all such documents are submitted.

All personal data requested on the application form must be filled in completely and correctly.

Advanced students should indicate their major field of study. Applicants must supply all the information requested. Incomplete application forms will be returned to the applicants.
Supporting Documents: Application for admission to the University of Waterloo should be made as early in the year as possible. Academic transcripts (not diplomas) and other supporting documents should be forwarded as soon as they become available. Admission cannot be granted until all the requirements have been met and all the required documents submitted.

Confidential Letter of Reference Applicants are required to submit two confidential letters of reference. The forms for these letters will be mailed with the application form to the applicant. These letters should be filled in by two different referees and returned directly to the University by the referees. A referee must be someone who can judge the applicant’s scholastic ability (preferably a teacher). If such a person is unavailable, the applicant may then ask a person of responsibility (who has reason to know him academically) to be his referee.

Secondary School Records Applicants must arrange to have their secondary school records sent directly to the University from the school. The records must be on the school’s forms. Records of any other educational achievements beyond the elementary level must be submitted directly from the academic institutions to the Assistant Registrar for the Faculty to which the candidate is applying at the University of Waterloo.

Ontario Grade 13 Results The University requires a record of every Grade 13 paper (passing or failing) ever written by the applicant. Applicants from Ontario who are not currently registered in a full-time Grade 13 programme but who have attended Ontario Grade 13 at some time must ensure that all of their Grade 13 results are included in the records submitted directly to the University by the secondary school. Photostat copies of these documents will be accepted if they are properly certified by an appropriate school official.

Academic Transcripts – Transfer Students Students from other universities or post-secondary institutions who wish to transfer to the University of Waterloo must arrange to have certified transcripts of their academic records sent directly from the institution they attended to the Assistant Registrar for the Faculty to which they are applying at the University of Waterloo. All such transcripts must be submitted regardless of the level of entry sought. Students who wish to transfer into studies at an advanced level will facilitate the processing of their applications if they include a letter outlining their background and providing official Calendar descriptions of each course they have studied and wish credit for. Applicants with transcripts from foreign institutions must arrange to have certified English translations of the documents submitted.

Supplement to the Application Any candidate for admission who has had his education interrupted for any reason must arrange to supplement his academic application with a resume of employment, etc., since leaving the last educational institution he attended. It is necessary to declare and verify by documentation any educational courses taken or institutions attended.
Admissions

Processing of an Application

In order to complete the processing of an application to the University of Waterloo, it is mandatory that all required documents (i.e. transcripts, letters of reference, etc.) plus an application for undergraduate admission are on file in the appropriate Faculty area in the Office of the Registrar. The application will then be presented to the Admissions Committee.

Applicants who are not currently enrolled in an Ontario Grade 13 programme can expect to wait several weeks before receiving a decision on their application. Some programmes require applicants to come to the University for an admission interview and a decision cannot be made in such programmes until after the interview has been accomplished and the Admissions Committee has had ample opportunity to consider all of the information that has been presented to them. Applicants who feel there has been an undue delay in the consideration of their application should check to ensure that all required documents have been sent to the appropriate Faculty area in the Registrar's Office.

Registration and Fees

All applicants applying to the University for the first time are encouraged to take advantage of pre-registering for courses and paying tuition fees by mail. For those students who do not register by mail, a registration period is held on campus during the week prior to the beginning of lectures each term.

A schedule of fees is outlined in Chapter 3, page 43 of this calendar.
3

Fees and Registration
Campus Scene—Wintertime
Fees and Registration

Academic fees are due and payable on or before the final date of registration. Students who receive their fee statement by mail are normally expected to make payment by mail. Detailed instructions outlining the payment procedures will be included with the fee statement.

All students are encouraged to take advantage of pre-registering for courses. For those students who do not register by mail, a registration period is held on campus during the week prior to the beginning of lectures of each term. The dates of pre-registration, registration and beginning of lectures are listed on page 10 of the calendar.

Students who have received notice of assistance under the Ontario Student Awards Programme and are relying upon this source of funds for the payment of their fees may make arrangements by mail to direct payment to the University up to the value of the award. Where notice of assistance has not been received, consideration will be extended toward arrangement of fees at the on-campus registration centre provided an Application for Award has been filed with the Awards Office on or before the following dates:


Credit for scholarships or bursaries may be given only on the authority of Financial Services after presentation of proof of such assistance.

Fees may be paid in two instalments, but an extra charge of $10.00 for regular students and $5.00 for co-operative students will then be added to the first instalment. The first instalment is to be paid at the time of registration and must be a minimum of 60% of the tuition fees plus 100% of the incidental fees. The balance is to be paid as follows:

Regular Students – On or before the first day of the second term.
Co-operative Students – On or before the first day of the eighth week of the current term.

Registered students who fail to fulfill fee payment arrangements will be assessed a 5% surcharge on the total fees outstanding plus a 1% per month service charge applied to the balance outstanding and calculated from the due date.

Students who register after the final date of registration will be assessed the following penalty:

<table>
<thead>
<tr>
<th>Day</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>First day</td>
<td>$10.00</td>
</tr>
<tr>
<td>Second day</td>
<td>$15.00</td>
</tr>
<tr>
<td>Third day</td>
<td>$20.00</td>
</tr>
<tr>
<td>Fourth day</td>
<td>$25.00</td>
</tr>
<tr>
<td>Thereafter</td>
<td>$25.00 plus a 1% per month service charge applied to the balance outstanding and calculated from the due date.</td>
</tr>
</tbody>
</table>
Fees and Registration

Under no circumstances will a student (including part-time, correspondence, or multi-media) be allowed to register after the following dates:

<table>
<thead>
<tr>
<th>Session Starting</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 1972</td>
<td>November 15, 1972</td>
</tr>
<tr>
<td>January 1973</td>
<td>February 1, 1973</td>
</tr>
<tr>
<td>May 1973</td>
<td>June 15, 1973</td>
</tr>
<tr>
<td>July 1973</td>
<td>July 15, 1973</td>
</tr>
</tbody>
</table>

Failure to register by the above dates will indicate that the student is not returning for the current session and will result in cancellation of registration documents for the current session.

Failure to pay all outstanding fees, accounts, or other assessments such as library fines before conclusion of lectures may bar a student from writing examinations and will result in withholding of credit for previous work.

Students must register on or before the final date of registration whether or not a final timetable has been received. See chapter 2 for appropriate dates. Students who subsequently change programmes must re-register with the new fee statement within 5 days of the change.

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, will entitle him to a refund of a portion of his fees on the following basis:

a) Total tuition fee, less registration charge of $50.00, on a diminishing basis, calculated weekly over a total of 23 weeks for regular students and 12 weeks for co-operative student terms.

b) Incidental fees for Federation of Students, Intercollegiate Athletics on a pro rata basis over 13 weeks for regular students and 6 weeks for co-operative student terms.

c) Refer to refund schedules page 44.

d) No fees will be refunded unless the above procedure is followed.

The fee schedule shown is the one proposed for the 1972-73 year, and at the time of printing is still subject to review and possible change. If a fee change is made, a notice will be issued with a new fee schedule; however, the University does not undertake or accept responsibility to so notify all recipients of this calendar. The Board of Governors reserves the right to make changes in the published schedule of fees without notice.
## Schedule of Fees - Undergraduate Programmes Tuition & Incidentals For All Years

<table>
<thead>
<tr>
<th>Faculty or School</th>
<th>Session/ Term</th>
<th>Session</th>
<th>Tuition Fees</th>
<th>Incidental Fees</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arts</td>
<td>Session</td>
<td></td>
<td>$624.80</td>
<td>$49.50</td>
<td>$674.30</td>
</tr>
<tr>
<td>Engineering</td>
<td>Term</td>
<td></td>
<td>$390.20</td>
<td>$26.50</td>
<td>$416.70</td>
</tr>
<tr>
<td>Environmental Studies</td>
<td>Session</td>
<td></td>
<td>$624.80</td>
<td>$51.50</td>
<td>$676.30</td>
</tr>
<tr>
<td>- Regular</td>
<td>Session</td>
<td></td>
<td>$659.80</td>
<td>$51.50</td>
<td>$711.30</td>
</tr>
<tr>
<td>- Architecture - Yr 1</td>
<td>Session</td>
<td></td>
<td>$390.20</td>
<td>$25.75</td>
<td>$415.95</td>
</tr>
<tr>
<td>- Architecture - Upper Yrs</td>
<td>Term</td>
<td></td>
<td>$624.80</td>
<td>$47.00</td>
<td>$671.80</td>
</tr>
<tr>
<td>Integrated Studies</td>
<td>Session</td>
<td></td>
<td>$624.80</td>
<td>$47.00</td>
<td>$671.80</td>
</tr>
<tr>
<td>Mathematics</td>
<td>Session</td>
<td></td>
<td>$624.80</td>
<td>$52.00</td>
<td>$676.80</td>
</tr>
<tr>
<td>- Regular</td>
<td>Term</td>
<td></td>
<td>$372.70</td>
<td>$26.00</td>
<td>$398.70</td>
</tr>
<tr>
<td>Science</td>
<td>Session</td>
<td></td>
<td>$624.80</td>
<td>$51.00</td>
<td>$675.80</td>
</tr>
<tr>
<td>- Regular</td>
<td>Term</td>
<td></td>
<td>$372.70</td>
<td>$25.50</td>
<td>$398.20</td>
</tr>
<tr>
<td>Optometry</td>
<td>Session</td>
<td></td>
<td>$624.80</td>
<td>$51.00</td>
<td>$675.80</td>
</tr>
<tr>
<td>Physical Education</td>
<td>Session</td>
<td></td>
<td>$624.80</td>
<td>$51.00</td>
<td>$675.80</td>
</tr>
<tr>
<td>- Regular</td>
<td>Term</td>
<td></td>
<td>$372.70</td>
<td>$25.50</td>
<td>$398.70</td>
</tr>
<tr>
<td>Part-Time Students</td>
<td>Per Course (limit 2 courses per session)</td>
<td>$120.00</td>
<td>NIL</td>
<td>$120.00</td>
<td></td>
</tr>
<tr>
<td>Summer School</td>
<td>1 course</td>
<td></td>
<td>$126.00</td>
<td>NIL</td>
<td>$126.00</td>
</tr>
<tr>
<td></td>
<td>2 courses (limit)</td>
<td>$246.00</td>
<td>NIL</td>
<td>$246.00</td>
<td></td>
</tr>
</tbody>
</table>

Summer School assessment includes a charge of $6.00 to cover University health and recreational services.

Session represents the traditional 8 month (September – April) period of study

Term represents the 4 month academic term for students registered in Co-operative programmes.
## Fees and Registration

### Representative Schedule of Tuition and Incidental Fee Refunds Available for the 1972-73 Academic Year

<table>
<thead>
<tr>
<th>Regular Undergraduate Students</th>
<th>Tuition Fees</th>
<th>Student Activities</th>
<th>Intercollegiate Athletics</th>
<th>Total Amount of Refund</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fees Paid:</td>
<td>$624.80</td>
<td>$22.00</td>
<td>$15.00</td>
<td>$661.80</td>
</tr>
</tbody>
</table>

### 1st Term

| Up to end of 1st week of lectures | 574.80 | 20.00 | 13.00 | 607.80 |
| Up to end of 2nd week of lectures | 550.00 | 19.00 | 12.00 | 581.00 |
| Up to end of 3rd week of lectures | 525.00 | 17.00 | 11.00 | 553.00 |
| Up to end of 4th week of lectures | 500.00 | 16.00 | 10.00 | 526.00 |
| Up to end of 5th week of lectures | 475.00 | 14.00 | 9.00  | 498.00 |
| Up to end of 6th week of lectures | 450.00 | 13.00 | 8.00  | 471.00 |
| Up to end of 7th week of lectures | 425.00 | 11.00 | 7.00  | 443.00 |
| Up to end of 8th week of lectures | 400.00 | 10.00 | 6.00  | 416.00 |
| Up to end of 9th week of lectures | 375.00 | 8.00  | 5.00  | 388.00 |
| Up to end of 10th week of lectures| 350.00 | 7.00  | 4.00  | 361.00 |
| Up to end of 11th week of lectures| 325.00 | 5.00  | 3.00  | 333.00 |
| Up to end of 12th week of lectures| 300.00 | 3.00  | 2.00  | 305.00 |
| Up to end of 13th week of lectures| 275.00 | 1.00  | 1.00  | 277.00 |
| Up to end of 14th week of lectures| 250.00 | –     | –     | 250.00 |
| Up to end of 15th week of lectures| –      | –     | –     | –       |

### 2nd Term

| Up to one week after the start of lectures | 250.00 | 250.00 |
| Up to 2nd week after the start of lectures | 225.00 | 225.00 |
| Up to 3rd week after the start of lectures | 200.00 | 200.00 |
| Up to 4th week after the start of lectures | 175.00 | 175.00 |
| Up to 5th week after the start of lectures | 150.00 | 150.00 |
| Up to 6th week after the start of lectures | 125.00 | 125.00 |
| Up to 7th week after the start of lectures | 100.00 | 100.00 |
| Up to 8th week after the start of lectures | 75.00  | 75.00  |
| Up to 9th week after the start of lectures | 50.00  | 50.00  |
| Up to 10th week after the start of lectures | 25.00  | 25.00  |
| Up to 11th week after the start of lectures | –      | –      |

### Co-operative Undergraduate Students

<table>
<thead>
<tr>
<th>Fees Paid</th>
<th>$390.20</th>
<th>$11.00</th>
<th>$7.50</th>
<th>$408.70</th>
</tr>
</thead>
</table>

### 1st Term

| Up to end of 1st week of lectures | 340.20 | 9.00  | 6.50  | 355.70 |
| Up to end of 2nd week of lectures | 310.00 | 8.00  | 5.50  | 323.50 |
| Up to end of 3rd week of lectures | 280.00 | 6.00  | 4.50  | 290.50 |
| Up to end of 4th week of lectures | 250.00 | 5.00  | 3.50  | 258.50 |
| Up to end of 5th week of lectures | 220.00 | 3.00  | 2.50  | 225.50 |
| Up to end of 6th week of lectures | 190.00 | 2.00  | 1.50  | 193.50 |
| Up to end of 7th week of lectures | 160.00 | –     | –     | 160.00 |
| Up to end of 8th week of lectures | 130.00 | –     | –     | 130.00 |
| Up to end of 9th week of lectures | 100.00 | –     | –     | 100.00 |
| Up to end of 10th week of lectures| 70.00  | –     | –     | 70.00  |
| Up to end of 11th week of lectures| 40.00  | –     | –     | 40.00  |
| Up to end of 12th week of lectures| 10.00  | –     | –     | 10.00  |
| Up to end of 13th week of lectures| –      | –     | –     | –      |
The following incidental fees are refunded directly by the Federation of Students:
- Society Fees
- Donation to Tenth Anniversary Fund

<table>
<thead>
<tr>
<th>Incidental Fees</th>
<th>Regular Session</th>
<th>Co-operative Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federation of Students</td>
<td>$22.00</td>
<td>11.00</td>
</tr>
<tr>
<td>Intercollegiate Athletics</td>
<td>$15.00</td>
<td>7.50</td>
</tr>
<tr>
<td>Tenth Anniversary fund— (See Note 1)</td>
<td>$10.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Society Fees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(See Note 2)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note 1 — Tenth Anniversary Fund
In January, 1968, the Students’ Council of the Federation of Students petitioned the Board of Governors to assess each student $5.00 per term as a donation to the Tenth Anniversary Fund.

It is anticipated that this assessment will continue until a total donation of $500,000 has been accumulated.

Payment of the assessment is required at registration but a student who does not wish to participate may obtain a refund by presenting a receipted copy of the Fee Statement to the Federation of Students’ Office in the Campus Centre Building within three (3) weeks after the close of registration.

Note 2 — Society Fees
The following schedule of fees applies:

<table>
<thead>
<tr>
<th></th>
<th>Regular Session</th>
<th>Co-operative Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arts</td>
<td>$2.50</td>
<td>—</td>
</tr>
<tr>
<td>Engineering</td>
<td>—</td>
<td>$3.00</td>
</tr>
<tr>
<td>Mathematics</td>
<td>$5.00</td>
<td>$2.50</td>
</tr>
<tr>
<td>Environmental Studies</td>
<td>$4.50</td>
<td>$2.25</td>
</tr>
<tr>
<td>Science (including Optometry)</td>
<td>$4.00</td>
<td>$2.00</td>
</tr>
<tr>
<td>Physical Education &amp; Recreation</td>
<td>$4.00</td>
<td>$2.00</td>
</tr>
<tr>
<td>St. Jerome’s Student Council</td>
<td>$4.00</td>
<td>—</td>
</tr>
</tbody>
</table>

Payment of the Society Fee is required at registration but a student who does not wish to participate may obtain a refund by applying to his Society within three (3) weeks after the close of registration.

Campus Health Services
The amount of tuition assessed includes:

a) for regular students—the operating cost of campus health facilities for the session and the premium for supplemental medical coverage for a 12 month period from date of registration.

b) for co-operative students—the operating cost of campus health facilities for the term and the premium for supplementary medical coverage for an 8-month period from date of registration. First year co operative students registering in January for a second term, have an adjusted assessment to ensure coverage until the date of next registration. Final year co-operative students registering in January have an adjusted assessment to complete coverage to the end of the final term.
Fees and Registration

The Health Insurance plan does not include the premium or benefits of the Ontario Health Insurance Plan. Such Coverage is the Student’s own Responsibility.

Details of supplementary medical coverage may be obtained by direct communication with the Campus Health Services office.

<table>
<thead>
<tr>
<th>Miscellaneous Fees</th>
<th>Examination—Supplemental each paper</th>
<th>$10.00</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>— Presiding fee (at outside centre each half day)</td>
<td>$7.00</td>
</tr>
</tbody>
</table>

Returned Cheques—Handling charge of $10.00 plus late registration penalty as below.

Late Registration—Students who register after the final date of registration, will be assessed the following penalty:

First Day $10.00
Second Day $15.00
Third Day $20.00
Fourth Day $25.00
Thereafter $25.00 plus a 1% per month service charge applied to the balance outstanding and calculated from the due date.

Duplicate fee receipt (per request) $ 1.00
Transcript of record (per request) $ 1.00

Residence Fees Residence fees are payable by term and are due in full on the day of residence registration. Students who have received notice of assistance under any awards programme may apply to residence fees only those funds which are to be received during the term in question.

Further information concerning residences may be found on page 68.

Enquiries Enquiries concerning payment of fees should be directed to “Student Accounts, Financial Services”.

Scholarships
Bursaries,
Prizes and
Financial Aid
Undergraduate Scholarships

Alberta Optometric Association Scholarships (Undergraduate) - The Alberta Optometric Association Scholarships are in the amount of $250 each. One scholarship will be provided for each of 2 students from the Province of Alberta entering the study of Year 1 of the Optometry Course at the School of Optometry, Faculty of Science, University of Waterloo.

One scholarship will be provided for each of 2 students from the Province of Alberta entering the study of Year 2 of the Optometry Course, at the School of Optometry, Faculty of Science, University of Waterloo. They are awarded on the basis of academic achievement. 

Application should be made to the Director, School of Optometry.

Allied Chemical Canada Scholarship - This scholarship is awarded annually to one student not otherwise holding a scholarship, entering final year of undergraduate studies in Chemical Engineering or majoring in Chemistry. Based on merit, the award is in the amount of $750 and made with the recommendations of both the Faculties of Engineering and Science.

Application is not necessary.

American Optical Company of Canada Ltd. Scholarship (Value $525.00) - The American Optical Co. of Canada Ltd. presents an annual scholarship to any Canadian student entering Year 2 in the School of Optometry.

Application for this Scholarship should be submitted to the Scholarship Committee before July 31st of each year.

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 Grade 13 examinations and who is entering an accredited engineering course at the University of Waterloo.

No application is necessary.

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.

No application is necessary.

British Columbia Optometric Association - The British Columbia Optometric Association offers an award of $250 to two British Columbia students enrolling in Year 2 of the School of Optometry.

Application should be made to the Director, School of Optometry.

Centennial Optical Scholarship - The Centennial Optical Company offers three scholarships in the amount of $150 each to students entering first year Optometry. $50 is awarded in first year and the remaining $100 automatically upon admission to Year 2. Recommendations for these awards are made by the School of Optometry.

No application is necessary.

CHEM 13 News Research Assistanceships - The Department of Chemistry offers CHEM 13 NEWS Research Assistanceships to recognize academic excellence in students proceeding to a degree in Chemistry. The awards are made for one year at a time and are valued at $500 for one year. Award holders are required to work with a professor or his research group within the Department.
Awards to students entering Year 1 are made on the basis of performance on an examination held in April. Students entering Upper Years in Honours Chemistry (Co-operative or Regular timetable) are automatically considered for the award.

Cominco Scholarships
To assist in ensuring a continuing supply of qualified graduates in fields vital to industry in Canada, Cominco Ltd. has established a programme of twenty-four scholarships at specified Universities in Canada. One of these scholarships will be awarded annually in the form of a two-year award of $800 per year, at the University of Waterloo. It is open to students who, in the fall, will enter the penultimate undergraduate year of a course leading to a degree in Chemical Engineering, Honours Geology, Geological Engineering, Mining, Mineral Engineering, Metallurgy, Metallurgical Engineering, Soil Science, Agronomy. Students must apply to the University of Waterloo by November 1st, on forms obtainable from the Awards Officer, University of Waterloo, Waterloo, Ontario. Renewals for the second year will be subject to attainment of academic standards satisfactory to the Scholarship Committee of the University.

Concordia Club Scholarship in 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.

Charles E. De Leuw Transportation Scholarship
The De Leuw Cather and Company of Canada Limited, in memory of the Company's founder, is making an annual award available to a 4th year Civil Engineering student with the transportation option. The award is in the amount of $500 and will be given to the student showing high academic achievement, good character, and financial need. The Senate Committee on Scholarships and Student Aid will work in conjunction with the Department of Civil Engineering in determining the winner.

Application forms should be requested from the Awards Office.

Rene Descartes Scholarships, Fellowships, and Bursaries
Awards in varying amounts are offered through the Faculty of Mathematics to first year students enrolled in that Faculty and showing the University of Waterloo as their first choice on the application for admission to the university. In order to be eligible, a student must write the Ontario Senior Mathematics Problems Competition.

Applications may be received through the Associate Dean, Faculty of Mathematics.

E.L. Ruddy Company Limited Scholarship
The E.L. Ruddy Company Limited is offering an annual scholarship of $250 to be awarded to a third or fourth year student registered in the Honours Urban and Regional Planning programme. The student must have attained high academic standing and indicate an interest in planning.

Application should be made to the Awards Officer.

Elgin County Council Award
One award in the amount of $100 is offered to the boy or girl attaining the highest academic standing in any university year. The student will normally be a resident of Elgin County. Residents of the city of St. Thomas are ineligible.

No application is necessary.
G. Elmore Reaman Scholarship (History) A scholarship in the value of $300 is offered each year to a 3rd or 4th year student of the University for study and research in the Social History of Upper Canada, from the earliest time to 1818. The award will be made by the Department of History, on the basis of a formal research paper prepared by the candidate.

Friedrich Lehner Scholarship This scholarship will be awarded to a third or fourth year undergraduate student of German Literature and Language. The value of this award is $100 and is provided annually by Mr. Friedrich Lehner of Lehner Travel Service, Toronto, Ontario, Canada.

Huron County Scholarship Huron County Council is offering two $100 Scholarships to be awarded to the boy and girl from Huron County who obtain the highest standing regardless of the year in which he or she is registered. 

*No formal application is necessary.*

Sir Isaac Newton Scholarships The Department of Physics awards Sir Isaac Newton (SIN) Scholarships annually to the top three students entering each of second, third and fourth years in Honours Physics, both Regular and Co-op. Values are $200., $150., $100. in each year. One freshman Isaac Newton Scholarship is awarded annually, based mainly on the results of the SIN Physics test written in Ontario Secondary Schools. Value is $1500. for one year, with an additional $1800. over three more years as an Assistantship.

Sir Isaac Newton Assistantships The Department of Physics offers Sir Isaac Newton (SIN) Assistantships to recognize and encourage academic excellence in students proceeding towards an Honours Physics degree. The awards are normally made to freshmen, and are valued at $2400., payable at $600. per year. Renewal is based on satisfactory academic standing. About ten new awards are given each year, based mainly on the results of the SIN test mentioned above. Recipients of this award are required to undertake a minor academic or research project within the Department.

J.P. Bickell Foundation Scholarships The Trustees of the J.P. Bickell Foundation provide a number of J.P. Bickell Foundation scholarships of $1500. each to be awarded to qualified students in the Chemical Engineering Department and the Earth Sciences Department in any of the second, third or fourth years of the course. To be eligible for one of these scholarships a student must obtain an average of 75% in the previous term's or year's examinations and maintain this standing throughout the course. The scholarship will be paid at the rate of $250. a term. 

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

The Percy Hermant Centennial These awards are the gift of Sydney Hermant. Bursary Scholarships are awarded on the basis of academic achievement in first year General Science at any Canadian University and financial need to a student who is proceeding into Year 2, School of Optometry. Six Scholarships are available, each of a total possible value of $1200., being $300. per year over the four professional years (years 2, 3, 4 and 5) provided a satisfactory standing is maintained. One scholarship is awarded to a
student who resided in the Maritimes immediately prior to his first University year; two scholarships are awarded to students who resided in Western Canada. The various Provincial Optometrical Associations are consulted in awarding these Bursary Scholarships.  
*Application for this Scholarship should be submitted to the Scholarship Committee before July 31st, of each year.*

St. Jerome's College Awards  
A limited number of Year 1 scholarships are offered by the College to students on the basis of their standing and need. Application must be made directly to the Dean, St. Jerome's College.

The Saskatchewan Optometric Association Scholarship (value $500.00)  
The Saskatchewan Optometric Association presents an annual scholarship of $500 to a Saskatchewan student enrolling in the School of Optometry.  
*Application for this Scholarship should be submitted to the Scholarship Committee for the School of Optometry before July 31st, of each year.*

Science Society Scholarship  
The Science Society, University of Waterloo, is offering two $50 scholarships to the undergraduate students attaining the highest mark in the Faculty of Science in any academic year. This award may not be held concurrently with other scholarships or merit awards.

Ukrainian Credit Union "Buduchnist" Scholarship in Ukrainian Studies  
The Scholarship of $100. will be awarded annually to an outstanding full-time student who attains the highest academic standing in a Ukrainian course.

University of Waterloo Undergraduate Research Assistantships  
These Assistantships are made available by the Faculty of Engineering to give the opportunity to outstanding students to become involved in non-classroom activities associated with research being done within the Faculty. The student must have an outstanding academic record and be interested in spending time during his academic term on activities not associated with the prescribed curriculum. The value of this award is $500. per term on campus.

Bursaries

Note  
*Second class standing is normally required of applicants for bursary assistance. Applications must be submitted by the end of the first month of first term unless otherwise indicated. Unless otherwise stipulated, all bursaries are applied for on a common University of Waterloo application form.*

ASHRAE, Ontario Chapter Bursaries (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Ontario Chapter)  
The American Society of Heating, Refrigeration & Air Conditioning Engineers, Ontario Chapter is making available, on an annual basis, a sum of money to be distributed in bursary form. Applicants must be normal residents of Metropolitan Toronto or adjacent municipalities, and be enrolling in 2nd or 3rd year Mechanical or Electrical Engineering. Recipients will be determined in conjunction with the related Departments and subject to verification by the Senate Committee on Scholarships and Student Aid.  
*Applications on regular University forms must be submitted to Awards Office.*
ATA Trucking Industry Education Foundation Bursaries

The Automotive Transport Association Trucking Industry Educational Foundation was established in 1958 by a group of transport companies who decided to divert monies formerly spent in customer gift-giving at Christmas to bursaries for deserving and needy students. The funds are to be distributed to students in all faculties, who, because of extenuating circumstances, are deserving of financial help, and would not be in a position to continue their studies without some assistance.

Awards will be made by the Scholarship Committee. Application for a bursary should be made through the Awards Office.

Atkinson Charitable Foundation Bursaries

The Atkinson Charitable Foundation has established a bursary programme which gives assistance to students of merit and proven financial need. Awards are made only to students who are bona fide residents of the Province of Ontario.

Further information and application forms may be obtained from the Awards Office.

Birks Family Foundation Bursary

Birks Family Foundation have made an amount available to the University of Waterloo to distribute in bursary form. The amount of the award varies depending upon proven need.

Applications should be forwarded to the Awards Office.

Canada Packers Award

Canada Packers Limited is making available two $100. awards to fourth year Chemical Engineering students having attained high academic achievement in third year. One award will be made in each of stream 'A' and stream 'B'. Other determining factors include personal characteristics, financial need and extra curricular activities. The recipients will be male and winners will be determined by the Senate Committee on Scholarships and Student Aid in conjunction with the Chemical Engineering Department. No application is necessary.

Huron County Bursaries

Huron County Council has established a bursary fund at the University of Waterloo for students who attended High School in Huron County and whose home is in that County. The bursaries, offered annually, will be for an amount of $100, and will be awarded to full-time undergraduate students in any faculty of the University who have good academic records and who are in need of financial assistance to enable them to continue their studies.

Students should make application through their high school or direct inquiries to the Awards Office.

The Hydro-Electric Power Commission of Ontario Bursary

A bursary, of the value of $500., is offered annually by the Hydro Electric Power Commission of Ontario to a student in second year in any of the following honours courses: Mathematics, Physics, Applied Science and Engineering. It is to be awarded to undergraduates with good academic standing who are in need of financial assistance. The bursary may be held concurrently with other awards where the need exists. Awards will be made by the Scholarship Committee.

Applications should be made through the Awards Office.
IBM-Thomas J. Watson Memorial Bursaries

The University of Waterloo has been invited to participate in the IBM-Thomas J. Watson Memorial Bursary Programme, established by the IBM Canada Limited. The objective of the program is to provide financial assistance to undergraduate students in need with good academic standing. This will apply to all years and faculties of the University. A bursary may be held concurrently with other awards provided that a definite need is established.

*Bursaries will be awarded by the Scholarships Committee. Application may be made through the Awards Office.*

Interprovincial Pipeline Company Bursary

The Interprovincial Pipeline Company Bursary Fund, of a total value of $2,500., has been established by Interprovincial Pipeline Company to benefit students beyond the first year in any faculty who are in need of financial assistance in order to continue their studies. The company has stipulated that at least 50% of the funds granted, go to students in the applied sciences. Preference will also be given to students whose normal residence is Canada or the U.S.A.

*Application for a bursary should be made through the Awards Office.*

J.P. Bickell Foundation Bursaries

The Foundation is making available a sum of money to be used in providing bursary assistance to Chemical Engineering and Earth Science students of good academic standing who need financial assistance.

*Awards will be made by the Scholarships Committee. Application for a bursary should be made to the Awards Office.*

Canadian Federation of University Women – Kitchener – Waterloo Bursaries

The Canadian Federation of University Women has established a bursary fund at the University of Waterloo to assist one or more girls in second, third or fourth year, who have attained Second Class Standing and are in need of financial assistance. Preference will be given to girls not holding tuition scholarships.

*Application should be made on the forms provided by the Awards Office.*

Lambton County Bursary

Lambton County Council offers a bursary valued at $100. to a student from the County but excluding residents of the city of Sarnia.

*Application should be made through the Awards Office.*

Litton Systems Bursary

A bursary, to the value of $500., is offered annually by Litton Systems (Canada) Limited. The bursary may be awarded to students in the Faculty of Engineering with preference being given to those in the electronic or electro-mechanical fields. It is intended to provide financial assistance to undergraduates in need and may be held concurrently with other awards where the need exists.

*Awards will be made by the Scholarships Committee and the amount available may be apportioned among two or more students. Applications for a bursary should be made to the Awards Office.*

Middlesex County Bursaries

Middlesex County Council offers two bursaries, each valued at $150. to students from Middlesex County who are of approved academic standing and in need of financial aid.

*Application should be made through the Awards Office. Selection will be made by the Senate Committee on Scholarships and Student Aid.*
Bursaries

Monsanto Canada Ltd. Bursaries
Two bursaries, each for $500.00, are being offered to 4th year Chemical and Mechanical Engineering students. A “B” standing in 3 B term is necessary in order to be considered eligible. Recipients will be determined in conjunction with the respective Engineering departments. Applications should be forwarded to the Awards Office.

Oxford County Bursaries
Oxford County Council has granted the University of Waterloo an amount of $1000. to be distributed to Oxford County students excluding those from the municipalities of Woodstock and Ingersoll. Students must be of good academic standing and in need of financial assistance. Application should be made through the Awards Office.

Perth County Bursary
Perth County Council offers two bursaries of $100. to deserving students beyond the freshman year. Candidates must have resided in Perth County for one year previous to admittance to the University of Waterloo. Application should be made through the Awards Office.

P.L. Robertson Manufacturing Co. Ltd. Bursary
A bursary, to the value of $100., is offered annually by the P.L. Robertson Manufacturing Co. Ltd. The bursary is to be awarded to students in the Faculty of Engineering who are in need of financial assistance and who have satisfactory academic standing. Where the need exists the bursary may be held in conjunction with other awards. The Scholarships Committee will award the bursary and application should be made to the Awards Office.

The Minnesota Mining and Manufacturing of Canada Limited Bursaries
Two bursaries, to the value of $500. each, are offered annually by the Minnesota Mining and Manufacturing of Canada Limited. The bursaries may be awarded to any full-time undergraduate student at the University, who has a good academic record and is in need of financial assistance for continued studies. Awards will be made by the Scholarships Committee. Application for a bursary should be made to the Awards Office.

The Steel Company of Canada, Limited Bursary
The Steel Company of Canada is offering an admission bursary in the amount of $500. each year for four years to give financial assistance to students of superior ability who might not otherwise go to university because of lack of funds. Applicants must be permanent residents of Canada and must have completed the final year’s work for university entrance in one school year and have attained a minimum average mark of 66%. The Stelco Bursary is not tenable with scholarships totalling in excess of $200. but may be held with other bursaries at the discretion of the university. Application may be made by writing to the Awards Office, University of Waterloo.

Uniroyal (1966) Ltd. Student Aid Plan
Beginning with the academic year 1961-62 Uniroyal has included the University of Waterloo in its programme of aid to education. Awards will be made by the Scholarship Committee. A candidate must have completed at least one academic year, should establish a need for financial assistance and be willing to assume a moral obligation to repay the university over a reasonable period at least twenty-five per cent of any funds received. Further information and application forms may be obtained from the Awards Office.
Prizes

The Association of Professional Engineers of the Province of Ontario makes this award to the student in the fourth year of an accredited engineering course, who having received honours, has obtained the highest standing in the final examinations of the current academic year. Included with this award is a gift of technical books valued at approximately $50.

The Canadian Ophthalmic Laboratories' and Suppliers' provide funds to award the following prizes. Since the amount in the fund varies from year to year, they will be awarded in sequence until the fund is exhausted each year:

a) Four General Proficiency Prizes (value $200. each) awarded to the student in the School of Optometry standing highest in General Proficiency in each of the second, third, fourth and fifth years.

b) Four General Proficiency Prizes (value $100. each) awarded to the student in the School of Optometry standing second highest in General Proficiency in each of the second, third, fourth and fifth years.

All of the above prizes are made available through contributions of the following Canadian Suppliers and Laboratories:

- Bausch and Lomb Optical Company (Canada) Limited, Toronto, Ontario
- Canadian Optical Supply Co.
- Centennial Optical Limited
- Dominion Contact Lens Laboratory, New Toronto, Ontario
- Eastern Optical Laboratories Limited, Dartmouth, Nova Scotia
- Kahn Optical Company Limited, Toronto, Ontario
- K & W Optical Co. Ltd.
- Monarch Optical Company Limited, Toronto, Ontario
- Professional Optical Co.

The Classics Prize of $50. will be awarded annually to the student who attains the highest mark in either Latin 190 or Greek 190. To qualify for the prize the student must enroll in the second year of an honours programme offered by the Classics and Romance Languages Department.

The gifts of the Women's Auxiliary to the Optometrical Association of Ontario is awarded to students in second and third year in the School of Optometry standing highest in the subject of Physiological Optics.

The award of the Alumni Association in memory of the late Dean J.C. Thompson is made to a final year student in the School of Optometry who has ranked highest in Optometry.

The gifts of Sydney Hermant are awarded to the final year student in the School of Optometry ranking first and second in general proficiency.

The gift of the Board of Directors, College of Optometrists of Ontario, is awarded to the final year student in the School of Optometry ranking highest in General Proficiency.
The Arthur A. Johnson Medal: The gift of Arthur A. Johnson is awarded to the final year student in the School of Optometry ranking highest in Optometrical Optics.

The T.T. Beattie Medal: The bequest of T.T. Beattie is awarded to the final year student in the School of Optometry ranking highest in Orthoptics or Visual Training. The award is made once every three years, approximately, as funds permit.

The E.F. Attridge Medal: The gift of E.F. Attridge is awarded to the final year student in the School of Optometry ranking highest in Pathology.

& W Optical Company Limited Prizes: Two awards in the amount of $250 each are being made available to two final year students in the School of Optometry. The award winners are determined by the Awards Committee within the School of Optometry. No application is required.

The Canadian Contact Lens Society Prize (value approximately $75.00): The proceeds of a fund invested on behalf of the Canadian Contact Lens Society will be awarded to a final year student in the School of Optometry who shows the greatest proficiency in the theoretical and practical application of Contact Lenses.

Faculty and Staff Prize: The University of Waterloo Faculty Association has established a fund to award prizes, of the value of $50 each, to the students who rank first in the final examinations of any non-graduating year of each Faculty. This is provided that the student attains a minimum of 80% in the final examinations, is not repeating his year, has no supplemental examinations, and carries a full course load. An application is not required. The Faculty Association has the final decision in all cases.

The Jerome T. Miller Memorial Prize: This book prize was established in 1968 by relatives and friends in memory of the late Jerome Thomas Miller, B.Sc., M.Sc. (1966) - Honours Chemistry and Physics. The book is to be awarded each year, on the basis of marks, to the student in third year of a programme which combines studies in Chemistry and Physics.

Pennsylvania German Folklore Society of Ontario Prize in German: This prize of $50. will be awarded annually to the student in the Faculty of Arts, born in Canada, who has made the most progress in German during the year.

The Bobby Bauer Memorial Award: The Bobby Bauer Memorial Foundation will make one or more awards annually to students demonstrating outstanding proficiency in Hockey who qualify for admission to a full-time undergraduate course at a Canadian university.

Application should be made prior to August 31 on forms provided by the Foundation. A letter of reference from a person actively involved in Hockey must accompany each application.

Inquiries and applications should be sent directly to: Bobby Bauer Memorial Foundation, 60 Victoria Street North, Kitchener, Ontario.
The Bruce Wyler Kelly Memorial Prizes

These book prizes were established in 1960 by relatives and friends in memory of the late Bruce Wyler Kelly, the first Dean of Science at the University of Waterloo, 1958-1960. These prizes are awarded in the General Science Course at the end of the Second year to two students, one registered with Biology as his major subject and one registered with Chemistry as his major subject. Qualifications are (a) a clear pass standing and (b) highest standing in Biology with a minimum of B standing, in chemistry, or highest standing courses taken with a minimum of B standing in the average of these courses.

The Engineering Institute of Canada Student Prize

The E.I.C. Student Prize is awarded to a Student Member of the Institute in the year prior to the graduating year on the basis of the marks made in his academic year, and his activities in the student engineering organization or in the local branch of a recognized engineering society.

The Chemical Institute of Canada Prize

Two awards, one each to a Chemistry and a Chemical Engineering student, are made annually by the Institute. The awards, consisting of an inscribed medal and a $25 gift, are given to the student standing at the top of the penultimate year of either course. No application is necessary.

Government and Institution Loans

Canada Student Loans Plan

The purpose of the Canada Student Loans Plan is to make bank loans available to students who need financial help to enable them to engage in full-time studies directed towards a degree or diploma at universities or certain other educational institutions above the high school level.

The Canada Student Loans Plan is a Federal Government programme which is administered by the provincial agencies. The provisions of the plan are set out in a brochure issued by the Federal Authority. For more detailed information, reference should be made to that publication. Eligibility for a loan is based on need as determined by criteria established by the Federal Government in consultation with the provinces.

The Canada Student Loans Plan was set up to supplement family and other financial sources available to students, not to replace them. It follows that Certificates of Eligibility may be issued only if you can establish that the financial resources available to you, including those of your parents, are not enough to meet what the awarding authority considers to be reasonable costs for the academic year. To this end, you will be asked to give a signed statement which will include information concerning your financial resources. Since, in general, parents remain primarily responsible for the costs of post-secondary education, your parents will normally be asked to give information concerning their income. Under the plan, a ceiling is placed on the total loans that may be authorized by a province, and a Provincial Authority cannot be expected to use its part of the loan funds to approve loans to students who are really not in need of such assistance.

Copies of the application form are available at all post-secondary institutions. When completed in accordance with the instructions on the application form the required number of copies should be sent to:

Awards Office
Office of the Register
University of Waterloo
Waterloo, Ontario
When need has been determined in accordance with the established criteria, the student and the institution he proposes to attend will be informed of the loan assistance the student can expect to receive.

If the student feels that he or his family has had exceptional costs or that there have been substantial changes in the financial situation, he may request a review by the student awards officer of the institution he proposes to attend or is attending. The student awards officer of the institution may, if he considers the circumstances merit it, recommend an adjustment in the calculation of need.

The amount of loan finally authorized can be secured by the student after registration. Applications should be submitted prior to July 15. Applications submitted after this date may also be processed in time for registration but, to ensure this, the forms should be received by the date specified.

Grants Under Ontario Student Awards Programme
The Province of Ontario offers a grant to meet part of the need as determined by the criteria for the Canada Student Loans Plan as set out above.
*Further information may be obtained from the high school principal or Awards Office.*

Alumni Association Student Assistance Plan
This Loan Fund has been instituted by the Alumni Association, University of Waterloo.
Loans up to $100. with repayment periods of up to 4 months are available to students in all faculties.
*Further information may be obtained from the Awards Office.*

The Adelaide Detweiler Student Loan Fund
This loan fund has been established by Mr. J.R. Detweiler in memory of his mother, Adelaide Detweiler, to provide short-term loans, interest free, to students who may be confronted with unexpected expenses during their academic year.
*Further Information may be obtained and application may be made through the Awards Office.*

Engineering Society “A” Loan Fund
This fund was established by the Engineering Society “A” to assist students in need of short term loans.
*Further inquiries should be directed to the Awards Office.*

Ian Carr Loan Fund
This loan fund has been set up by the parents in memory of their son, a former student at the University of Waterloo. It is intended to provide short-term loans, interest free, to students who may be faced with unexpected expenses during their academic year.
*Further information may be obtained, and application may be made through the Awards Office.*

David Cook Memorial Fund
The University of Waterloo Mathematics Society has made an amount available to be used as an addition to the University's Emergency Loan Program. The Society's contribution is intended to provide short-term, interest free loans to Mathematics students who have been faced with unexpected expenses during their academic year.
*Further information may be obtained from the Awards Office.*
Environmental Studies Society Loan Fund

Short term non interest bearing loans are available to full time undergraduate students enrolled in the Division of Environmental Studies. The maximum loan is normally $100. These funds are made available by the Society and represent a part of the proceeds of functions sponsored by the Society.

Application should be made to the Awards Office.

Ginny Lee Memorial Fund

Students' Council has set aside a sum of money to be used in assisting students by providing interest free, short term loans. It is intended that this fund be used only when other avenues of obtaining assistance have been tried unsuccessfully.

Further information may be obtained from the Awards Office.

Graham, Myall, Thompson Memorial Fund

A memorial fund has been instituted by the classmates of the late J. Graham, M. Myall and J. Thompson, who lost their lives in an auto accident in 1969. The fund represents contributions received from their classmates and other interested donors. Loans are made available to students enrolled in the Engineering faculty and to those who have completed at least one full year of academic study. Maximum loans are $200. with repayment terms extending up to 90 days.

Further information may be obtained from the Awards Office.

John Faber Memorial Fund

This fund was established by the Circle K Club at the University of Waterloo in memory of John Faber, former club member. Short term loans are offered to full time students at the University of Waterloo. For further information, inquiries should be directed to the Awards Office.

Co-operative Lecture Emergency Loan Fund

This fund was established by Canadian politician T.C. Douglas in 1970. It is intended to provide short term, interest free loans to needy students who have been faced with unexpected expenses during their academic year.
5

Student Services
Student Services

Introduction  The following brief descriptions will introduce readers to the departments, organizations and services with which students are likely to have the most contact during their years at the University. Further and more detailed information concerning these services can be obtained by contacting the group concerned.

Federation of Students

"The philosophers have only interpreted the world, in various ways; the point, however, is to change it." Marx

The complementary education received from participation in extracurricular activities, in many cases, has a significant, beneficial and lasting effect on students as formal curricular education. At the University of Waterloo the opportunity to participate in such activities is provided, for those who wish to take advantage of it, by the Federation of Students and its various agencies. All students of the University of Waterloo are members of the Federation of Students. The Charter of the Federation of Students which guarantees certain rights and privileges to students was approved by the Board of Governors of the University and then by the Provincial Secretary on April 27, 1967. It supercedes the Constitution of the Federation which was approved in a campus-wide referendum in 1964.

Objects  The principal "Objects" of the Federation are:
- To promote the welfare and interests of the students of the University of Waterloo in all matters respecting their common interests.
- To act as the representative of the students.
- To promote and maintain responsible student government.
- To promote and co-ordinate student participation in athletics, cultural and social activities.
- To promote and maintain communication between the student body and the duly elected and appointed authorities of the University of Waterloo.

The Students' Council  Twenty-five elected members plus officers make up the Students' Council which is the governing body of the Federation. Members representing all faculties, societies and colleges are included.

The function of the Students' Council, the governing body of the Federation, include upholding the objects of the Federation, administration and control of finances, and operation and control of all Boards and Committees of the Council. Almost all of the social and cultural activities of the student body are managed by the Students' Council as well as off-campus representation of the student body.

Organization  The activities of the Students' Council are carried out by its various boards and committees which are directed by a student chairman.
The Executive Board

The Executive Board is composed of the principal officers of the Students' Council including the President, Vice-President, Treasurer, and all Board Chairmen. The Board controls day-to-day administration, finance, and recommends policy to the Students' Council. It also co-ordinates the activities and programmes of all other Boards and provides liaison between them.

The Creative Arts Board

The Creative Arts Board, whose membership includes students, faculty and staff, provides participating activities in music, drama and dance. Groups in each area are assisted by professional directors to prepare for evening and noonhour presentations. Included are: Music – Concert Choir, Chamber Choir, Concert Band, Little Symphony Orchestra, Stage Band, Warriors Band and Folk Song Club. Drama – University Players. Dance – Ballet Club, Modern Dance Club, and U of W Repertory Company.

The Board of External Relations

The Board of External Relations represents the Federation of Students, and handles its activities, programmes and organizations in all areas that are outer-directed in relation to the campus; activities which connect and relate the student to the local, national, and international communities. Board functions are roughly divided into three commissions: Domestic Affairs, International Affairs and Information and Services, and a Hosting Committee which welcomes official student groups from other Canadian campuses and other countries. In the past the Board, through its Commissions, has provided or worked for: a high school tutorial service, overseas travel service, C.U.S. Life Insurance, seminars on the Canadian Indian, speakers from foreign countries, a court of revision on campus for provincial elections, a Waterloo drop-in centre, a study of Red China, and many other activities within its broad area of concern. Through the International Affairs Commission the Board also provides support for the Student United Nations Association of Canada (S.U.N.A.C.), Canadian University Services Overseas (C.U.S.O.), Conference on Inter-American Student Projects (C.I.A.S.P.), and others.

The Board of Education

The Board of Education sponsors programmes to examine and improve the quality of education. These activities include anti-calendars, course critiques, speakers, seminars, films, research, and attempts to organize and co-ordinate student activities to promote social change.

The Board of Publications

The Board of Publications major publications include: The Chevron which is the weekly student newspaper; the Compendium, the University yearbook; the Student directory, the tri-annual campus telephone directory; the Handbook Series involving a set of informative guidebooks; Liontayles, a bi-annual literary magazine. In addition the Board provides financial assistance to the Faculty Societies for the production of faculty anti-calendars.
The Board of Student Activities

The Board of Student Activities co-ordinates and supervises all campus-wide programmes, including, Freshman Orientation, Homecoming, Winter Weekend, Grad Ball and Summer Weekend. The Board also maintains a classical record collection for the use of all students, supports the House of Debates, the Flying Club (which operates three aircraft and a flying school), and assists the operation of over thirty clubs whose membership is open to all members of the Federation.

Persons wishing more information on any aspect of Federation activities are advised to write:

The Federation of Students
University of Waterloo
Waterloo, Ontario, Canada

Cultural Programme Centre

The Cultural Programme Centre, room 254 in the Modern Languages Building, is the home of cultural programming and activities on the university campus.

A Creative Arts Board, under the jurisdiction of the Federation of Students, provides participating activities in music, drama and dance. Professional directors assist these groups to prepare for evening and noon hour presentations.

A number of professional attractions are presented throughout the year. Brochures and calendars are available upon request.

The Central Box Office handles all the Cultural Programme Centre’s tickets for professional and participating programmes. As a service to the university community, tickets are also sold on behalf of other organizations sponsoring events of general interest.

The Theatre of the Arts, a 504-seat theatre with thrust stage, is available as an educational and cultural resource. Contact the Reservations office in the Centre for booking information.

The Art Gallery arranges a series of 10 - 12 exhibitions each year. Its permanent collection, now in excess of one hundred works, is distributed throughout the university to enrich campus life.

Book Store

University of Waterloo students may purchase text books, stationery and engineering supplies at the University’s modern Book Store located on the main floor of the South Campus Hall. The Book Store is open weekdays from 8:30 a.m. to 5:00 p.m. throughout the year. Book Store hours are extended in the months of September and October. Students are advised to watch the bulletin board for further notices. In addition to text books, reference material, paper supplies, crested gift and souvenir items, and drawing materials, the University of Waterloo Book Store also features the largest display of quality paperbacks in Kitchener and Waterloo.
Counselling Services

**Director**  
W. W. Dick  B.A., B.D. (Toronto), M.A., Ph.D. (Ottawa)  
A. L. Evans,  B.A., B.D. (Toronto), S.T.M., Ph.D. (Boston)  
J. G. Gilmore,  (Ms)  B.A. (Oberlin), M.S.W. (Waterloo Lutheran)  
J. C. Hawkins,  B.A. (Western Ontario)  
J. L. Hayashi,  (Ms)  B.A., M.A. (Manitoba)  
R. L. Knight,  B.A. (Antioch)  
R. P. Kunkle,  B.A. (Oregon College of Education), M.S. (Oregon)  
S. Minas,  (Ms)  B.A. (Wayne State), M.A. (Ohio)  
I. J. H. Smart,  B.A. (R.C.M.), B.A. (Queen’s)  
J. A. Van Evra,  (Ms)  B.A. (Valparaiso), M.A. (Bowling Green State), Ph.D. (Michigan State)  
R. J. Walsh,  B.A. (Queen’s), M.A.Sc. (Waterloo)  
J. L. Williams,  B.A., M.A. (Alberta), Ph.D. (Missouri)  
J. J. Wine,  B.A. (Bridgewater), M.S. (Iowa State), Ph.D. (Alberta)

The goal of the University Counselling Services is to provide effective assistance to individual students. More specifically, professionally trained counsellors wish to help the student with his vocational, personal, marital and/or emotional development during his university years. Our aim, first and foremost, is to help the student develop his own resources and is based on the philosophy that the resources and responsibility for change lie within the student. Successful counselling should result in a student being able to generalize methods he learns to a variety of other situations and relationships.

Counselling Services offer a wide variety of programs and techniques (including individual and/or group counselling, psychological and vocational testing, and a self-serve reference and loan library of occupational, educational and sex information etc.) which aim to help the student to better understand himself and his relationship to the world around him. In every case, all information is held in strictest confidence.

The Counselling Service Centre is located on the 2nd floor of the Student Services' Building. There is also a counsellor in the Engineering Building, Room 2359. Appointments can be made with the secretary for any time from 9:00 – 5:00, Monday through Friday, either in person or by calling extension 2655.

Counselling Services takes advantage of the students' own awareness of the effects of a university's strengths and stresses to set up programmes that apply the concept of "peer-counselling". These programmes include:

1) **The Rap Room.** A drop-in centre that operates around the clock seven days a week.

2) **Hi-Line.** A telephone "help" service that handles calls concerning many types of problems from 7:00 p.m. to 7:00 a.m. any night of the week.

3) **Countryman Counselling.** This service was begun to fulfill a need of international students who know little about Counselling Services.
Health Services provides health care on a broadly defined basis to fulltime, registered students.

Health Services operates an out-patient clinic, a vision clinic, and an infirmary. During most of the school term the building is staffed on a 24 hour basis by nurses. In addition there is always a doctor on call. A member of Counselling Services works closely with Health Services and has an office in the Health Services' building.

The medical staff consists of a full-time medical director and several family physicians from the Kitchener-Waterloo area who attend on a part-time basis. There is close co-operation between Health Services and the local medical community.

Health Services has an active programme in the field of medical education for the students. Several lectures and panel discussions on current health topics are sponsored yearly by Health Services, such as sex education, abortion, and drug abuse.

Health Services is also concerned about the field of preventative medicine as shown by an active programme on birth control.

The financing of Health Services is primarily from a fee that students pay at registration. This does not include the physician's fee. Therefore students are advised to carry medical insurance such as OHIP. The doctors at Health Services accept the 90% OHIP payment as full payment. Students not carrying health insurance are responsible for paying their doctor's fees.

Students should make every effort to be aware of the complexities of medical and hospital insurance to be certain that they are insured and that they are taking full advantage of the premium assistance.

A booklet containing more details of Health Services functions and outlining the medical insurance plans is available at the Health Services.

Residence Information

Three autonomous housing operations exist at the University which together accommodate approximately 4,000 students annually in Residence. These are:

1) University Operated Residences and Off-Campus Housing
2) Federated and Affiliated Colleges
3) Student Cooperative Residences

Students who wish to apply for residence in the University operated residences – Village 1, Village 2, and Minota Hagey, must have been academically accepted by the University and have received a "Permit to Register" before a residence application form will be sent to them.

Apartments for married students and their families are available on campus in the Married Students' Apartment Complex. The Complex is operated by the University through the office of the Director of Housing and Residence Operations.
Those wishing to secure off-campus accommodation should attempt to do so as soon as possible after they have been academically accepted by the University. Off-campus housing must be negotiated on a personal basis between landlord and student (tenant). Current lists are available from the Housing and Residence Operations Office on campus, however, the University neither inspects nor approves off-campus housing.

The Housing Office, located in Annex 5, “the Farmhouse”, is open between the hours of 9:00 a.m. and 4:00 p.m., Monday to Friday.

**Residences – University Operated**

**University of Waterloo Residences**
The University of Waterloo Residences (non-denominational) known as “Student Village 1”, “Student Village 2” and “Minota Hagey” are adjacent to the teaching facilities of the campus and are under the jurisdiction of the Warden.

**Village 1**
The residence portion consists of 26 houses with a total of 1263 rooms of which 875 are single rooms, 372 interconnecting rooms and 8 are double rooms. Each House is under supervision of a Don. Accommodation is available for 908 men and 355 women.

**Village 2**
Consists of 480 double rooms which will accommodate 960 residents. In addition, 20 Don’s suites are available as well as accommodation for 2 tutors.

<table>
<thead>
<tr>
<th>Fees</th>
<th>Per Academic Year</th>
<th>Per Academic Term</th>
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<tbody>
<tr>
<td>Single</td>
<td>$1120</td>
<td>$560</td>
</tr>
<tr>
<td>Interconnecting</td>
<td>$1070</td>
<td>$535</td>
</tr>
<tr>
<td>Double</td>
<td>$1020</td>
<td>$510</td>
</tr>
</tbody>
</table>

**Minota Hagey Residence**
The Minota Hagey Residence can accommodate 72 women graduate students. There are no major dining facilities included, and residents can use the facilities available in the nearby Food Services Building.

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<thead>
<tr>
<th>Fees</th>
<th>Per 4 month Academic Term</th>
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<tbody>
<tr>
<td>Single</td>
<td>$330</td>
</tr>
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**Residences – Federated and Affiliated Colleges**

Students applying for residence to the Federated and Affiliated College residences should correspond with the residence of their choice as early in the year as possible; however, they should be aware that final processing of their applications will not be done until they have been academically accepted by the University.

**Conrad Grebel College**
Conrad Grebel College, a Mennonite Residential college and student centre, became affiliated with the University in 1961. The College provides accommodation on campus for 48 men and 58 women. All rooms are double rooms. Preference will be given to students who give evidence of wanting to develop an intelligent understanding and practice of the Christian faith as an integral part of their University life and studies.

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<tr>
<th>Fees</th>
<th>Per Academic Year</th>
<th>Per Academic Term</th>
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</thead>
<tbody>
<tr>
<td>Double</td>
<td>$990</td>
<td>$495</td>
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</table>
Renison College
Renison College is an Anglican undergraduate arts college affiliated with the University of Waterloo since 1960. The College provides accommodation on campus for 97 men and 80 women.
Admission to residence is open to students enrolled in Renison College General Arts Courses and Social Science (Applied) Programme, and others registered in any faculty of the University.

Fees:
- **Per Academic Year**
  - Single: $1080
  - Double: $1010
- **Spring Term Only**: 7 day occupancy, 5 days meals.
  - Single: $400
  - Double: $350

St. Jerome's College
St. Jerome's College is a Roman Catholic liberal arts college federated with the University of Waterloo. Its residence is on campus and is open to men enrolled in its own General Arts Course, or registered in any faculty of the University. Both single and double accommodation is available.
(Single accommodation is not available to first year residents.)

Fees:
- **Per Academic Year**
  - Single: $1090
  - Double: $990
- **Per Academic Term**
  - Single: $545
  - Double: $495

Notre Dame College
Notre Dame College is the women's residence of St. Jerome's College and is conducted by the School Sisters of Notre Dame. It is open to women registered in St. Jerome's or in any faculty of the University of Waterloo. Twenty single and fifty-one double rooms accommodate one hundred and twenty-two students.

Fees:
- **Per Academic Year**
  - Single: $1090
  - Double: $990
- **Per Academic Term**
  - Single: $545
  - Double: $495

St. Paul's College
St. Paul's is a residential and teaching affiliate of the University, sponsored by the United Church. A deliberate attempt is made to have a student body representing many religious traditions and all faculties, and to include undergraduate students from abroad and those seriously questioning their religious heritage.
The residence provides accommodation in seventy-five semi-private rooms for 100 men and 50 women. The number of vacancies differs each year, the average being 50.
St. Paul's offers elective courses in Religious Studies for academic credit towards a degrees in Arts, Engineering, Mathematics and Science.

Fees:
- **Per Academic Year**
  - Semi-Private: $1020
  - Spring Term Only: 7 day occupancy, 5 days meals — $330.00
- **Per Academic Term**
  - $510

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**Student Services**
Student Services

Student Cooperative Residence

Waterloo Cooperative Residence is a student built, owned and operated residence community offering residence accommodation to both single and married students.

Hammarskjold House
accommodating 105 students:
15 singles, 90 men in doubles

Philip Street Residence
accommodating 288 students:
192 men in doubles
96 women in single rooms

Philip Street Apartments with 63 units:
15 single bedroom
48 two bedroom

6 Detached Houses
accommodating 79 students:
18 singles, 28 doubles for
42 men and 37 women

Married Student Apartments

Location The Married Student Apartments at the University of Waterloo are located on the South East corner of the Main Campus between University Avenue West and Seagram Drive. The Complex consists of two 14 storey high rise towers each containing 120 one-bedroom apartments and 4 three storey courts each containing 90 two-bedroom walk-up apartments.

How to Apply Applications Forms are available from the Manager to whom the completed application form should be returned.

Lease Subject to further evaluation the rental rates are:

<table>
<thead>
<tr>
<th></th>
<th>1 Bedroom</th>
<th>2 Bedroom</th>
</tr>
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<tbody>
<tr>
<td>4 Month lease</td>
<td>$140.</td>
<td>$160.</td>
</tr>
<tr>
<td>8 Month lease</td>
<td>$135.</td>
<td>$155.</td>
</tr>
<tr>
<td>12 Month lease</td>
<td>$130.</td>
<td>$150.</td>
</tr>
</tbody>
</table>

Enquiries: The Manager's Office is located on the first floor of the West Tower in the Married Students' Apartment complex and is open from 8:00 a.m. to 5:00 p.m. Monday to Friday.
Telephone: 884-0310
or write.
The Manager, Married Students' Apartments,
Room 0104
159 University Avenue West
Waterloo, Ontario, Canada.
Office of the Dean of Women

The Office of the Dean of Women serves as a general information and advisory centre for all students.

Initial contact with women students is made through pre-arranged informal interviews. Often these interviews result in referral to another Student Service which specializes in a particular area concerning the non-academic life of a student. Most frequently, however, the office acts as a liaison between faculty and students regarding such things as course changes, programme changes, meeting deadlines, study habits, or effects of personal problems on academic performance. Conversely, faculty members may on occasion suggest that students see the Dean of Women in those situations where the student may need temporary support.

Office of the Registrar

The Office of the Registrar is basically responsible for the administration of academic policies and procedures as they relate to undergraduate students in the university. These responsibilities include admissions, registration, student records, transcripts, scheduling of courses and examinations, convocation, student awards, secondary school liaison, and publications such as the academic calendar and admission brochures.

The office is organized primarily according to the faculty structure of the University. There are five Assistant Registrars, each with a clerical staff, who are responsible for the duties that relate to a particular faculty area.

The primary contact that a student will have with this office will be with the Assistant Registrar who is responsible for the faculty area in which the student is registered.

A listing of the organization of the office is found at the back of this calendar.

The Office of the Registrar also serves as the primary contact of the University for general inquiries regarding undergraduate programmes. Prospective applicants and students currently enrolled in the University are encouraged to contact the office for assistance regarding any aspect of student admission/academic records.

Secondary School Liaison

Secondary School Liaison at the University of Waterloo is regarded as having two major areas of involvement: those activities taking place essentially on campus, and those efforts designed to reach students in their own geographical areas across the Province.

In the first instance, there are thousands of visitors annually attending two major on-going Faculty-initiated programmes: Computer Science Days, and Science Waterloo Days. Also, of prime importance, are the large number of visitors who request either a tour of the campus, or an interview within a specific interest area. These latter contacts are handled by the Secondary School Liaison Office, which is ably assisted by student tour guides from the Circle “K” Club on campus.

The University’s primary off-campus involvement is that of attending a large number of University Information Programmes and Dialogues, which take place from early fall to mid-winter in every country area of Ontario. Further, many Departmental, Faculty or individual presentations are made annually at functions such as, Conferences, Commencements, or Professional Development Days.
Student Services

Information may be obtained by writing:

Secondary School Liaison Officer
Office of the Registrar
University of Waterloo
Waterloo, Ontario

or by calling 885-1211 ext. 2582

Student Awards

The Student Awards office is responsible for the administration of undergraduate awards to full-time students. This includes the Ontario Student Awards Program as well as bursaries. Scholarships are very limited and under the direct jurisdiction of the individual faculties. Students should contact the Associate Dean of the faculty in which they plan to enroll concerning information on scholarships.

Any student interested in types of financial assistance available at the University of Waterloo should not hesitate to contact the Student Awards Office either in person or by correspondence. Detailed information concerning scholarships and bursaries may be found in Chapter 4 of this Calendar.
The Department of Co-ordination and Career Planning and Placement
Work Term Assignment—Co-operative Engineering Student
Departments of Co-ordination, and Career Planning and Placement

Director, Co-ordination
R.J. Wieser, B.E. (Saskatchewan), P. Eng.

Director, Career Planning and Placement

Executive Assistant
J.R. Culley, B. Comm. (McGill)

Department of Co-ordination

The Department of Co-ordination is responsible for the work terms in the Co-operative Programmes.

The staff of the department is comprised of professional personnel having extensive experience related to their fields of service.

Engineering

Assistant Director, Engineering

Faculty Liaison
Assistant Director, Operations
J.C. Wilson, B.Sc. (U.N.B.), P.Eng.

Executive Assistant
R. Mateyk, B.A.Sc. (Toronto), P.Eng.

Co-ordinators
D.G.S. Anderson, B.A.Sc. (Toronto), P.Eng.
D.F. Arnoldi, B.A.Sc. (Toronto), P.Eng.
G.P. Berthin, B.Sc. (Manitoba), Eng.
G.W. Ellis, B.Sc. (Alberta), P.Eng.
A.T. Girard, B.A.Sc. (Toronto), P.Eng.
R.A. Grant, B.Sc. (Queen's), P.Eng.
R. Grant, B.A.Sc. (Toronto), P.Eng.
L.B. Jones, B.A.Sc. (Toronto), P.Eng.
A.L. Lind, B.Sc. (Queen's), Eng.
R. McDowell, B.Sc. (Saskatchewan), P.Eng.
W.A. Runge, B.Sc. (Queen's), P.Eng.
M.M. Smith, B.Sc. (Queen's), P.Eng.
F.A. Subosits, B.Sc. (Mich. Technological Univ.)

Applied Science

Program Director
R.A. Pullin, B.S.A. (Toronto)

Co-ordinator
L.R. Bricker, B.Sc., M.Sc. (Waterloo)
Co-operative Mathematics
Options in Actuarial Science, Computer Science, Optimization, Business, Teaching and Statistics

Assistant Director
B.A. McCallum, B.A. (Western)

Executive Assistant
A.R. Dunnet, B.B.A. (U.N.B.)

Co-ordinators
N.A. Cusitar, B.A. (Manitoba)
R.W. Hancox, B.A.Sc. (Waterloo)
E.M. Johnson, B.A. (Queen's)
R.D. MacLean, B.Comm. (Dahousie)
S.R. Stankus, B.Sc. (R.M.C.)

Co-operative Kinesiology, and Recreation

Co-ordinators
A.D.F. Burnett, B.A. (Carleton), B.P.E. (Waterloo)
W.B. Fuller, B.A. (Western)
M.A. McMartin, B.A. (Western)

Environmental Studies - Architecture

Program Director
J.W. Hoag, B.Arch. (Toronto)

Co-ordinator
E.A. Macdonald, B.Arch. (McGill)

The Co-operative Plan

Co-operative education is based on the principle that during the undergraduate years an academic programme combined with integrated work experience in alternating terms, is relevant to, and desirable for, effective professional preparation. The work terms allow the student to acquire experience in the area of his career interest, while the academic terms can more properly be devoted to fundamental and theoretical studies. At Waterloo, most programmes consist of eight four-month academic terms. Thus the practical experience is in no sense a substitute for, but is rather a complement to, the academic studies.

The motivation, responsibility and opportunity for insight gained through co-operative education can be of inestimable value to the student's future. The co-operative principle is important precisely because it enables those with a career orientation to become full-time students of their subject - not only during the academic terms on campus but during the related work terms, and not in a random and uncertain manner, but within a structure of organized purpose and serious study.

Operation of the Plan

The necessary arrangements for the integration of the work terms, the securing of potential employers of the students, the arranging of interviews, the professional guidance involved, and generally the whole management of the co-operative employment scheme is the responsibility of the Department of Co-ordination. The co-ordinators counsel the students, visit them on the job, and assist them to adjust to work situations and professional development.
The Work-Study Sequence

In most of the co-operative programmes at Waterloo, all year 1 students enroll in September and spend the first term together at the University. As indicated on the diagram, they rejoin as a class for the last term to complete their course, and graduate together. Between the first and last terms, the diagram shows that each class is split into two approximately equal groups for continuity of employment opportunity in the co-operative programme. Both groups, of course, have the same total time on campus and in industry; one group having a double academic term at the start of the course and the other having a double academic term at the end of the course. The final choice of group is made by students during interviews with co-ordinators shortly after registration. As far as possible students' choices will be honoured, but in the case of a major imbalance, students may be requested to enter the deficient group. Precise dates for the beginning and end of various terms are shown in the Academic Calendar.

The eight terms of study and six terms of employment provided in the co-operative programmes are arranged as shown in the diagram.

<table>
<thead>
<tr>
<th>1972</th>
<th>1973</th>
<th>1974</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Winter</td>
<td>Fall</td>
</tr>
<tr>
<td>First Term</td>
<td>Second Term</td>
<td>Work Term</td>
</tr>
<tr>
<td>1A</td>
<td>1B</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1975</th>
<th>1976</th>
<th>1977</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter</td>
<td>Spring</td>
<td>Fall</td>
</tr>
<tr>
<td>Fifth Term</td>
<td>Work Term</td>
<td>Sixth Term</td>
</tr>
<tr>
<td>3A</td>
<td>4</td>
<td>3B</td>
</tr>
</tbody>
</table>

| Work Term | Fifth Term | Work Term | Sixth Term | Work Term | Seventh Term | Eighth Term |
| 4 | 3A | 5 | 3B | 6 | 4A | 4B |

Exceptions occur in the co-op pattern for some programs. In Kinesiology and Recreation, all first year students remain on campus for eight months and proceed on their first work term in the Spring. In Systems Design (Engineering) and Chartered Accounting (Mathematics), first year students are at the University for four months and have their first work term in the Winter. Variations of the standard program are used in Applied Physics, Environmental Studies - Architecture and the option in Co-operative Mathematics for Prospective High School Teachers.
Work Terms  A basic requirement of the Co-operative Programmes at the University of Waterloo is satisfactory performance during co-operative work terms.

Registration in a co-operative course commits students to the acceptance of work assignments either through the regular interview procedure or, where their best interests are served, on an assignment that the Department may determine. All positions held by students must be approved by the Co-ordination Department.

By registering in a co-operative course, students give permission for the release of their grades to employers.

Students and employers choose each other through the following process. Job notices are posted on Co-ordination Department bulletin boards and students are asked to examine the notices and indicate their interest by applying for interviews. Students make these applications by completing and returning to the Department specially designed computer cards which are made available to them.

Following receipt of these applications, each employer is mailed the record of all students who have applied for interviews with his organization. These student records consist of the academic grades and the work term performance grades, and a resume if provided by the student. For first year students, Grade 13 marks are the only academic grades sent. For new students in upper years, marks from previous institutions are not included. A list of the students whom the employer wishes to interview is returned and, from these, a schedule of interviews is drawn up.

Interviews arranged through this procedure are conducted on campus in the offices of the Department.

When a student has completed all his interviews he ranks (on cards provided by the Department and given him by the interviewers) in order of preference, the companies by whom he was interviewed. These cards are then submitted to the Department. In the same manner students are ranked by employers and a computer is used at this point to match the interests of both parties. Under this procedure, there will be companies and students who do not obtain students and/or jobs. In such cases the Department will make every effort to place these students and satisfy the employers where the best interests of each can be served. If in the course of the interviews or while making his preference selection, it becomes apparent that the student is unable to accept a particular job (or two maximum) he must discuss this with the Department of Co-ordination before refusing the job(s). Failure to do so may result in the student being removed from the placement procedures.

It should be noted that a student is obligated to accept the employment obtained by him through the above procedures unless extenuating circumstances prevail, in which case he must consult with and obtain the permission of the Department before the job is refused.

Salaries paid co-operative students are determined within the employer's own wage structure, although employers may consult with the Co-ordination Department. Wages can be expected to increase when merited as the student progresses through the course and assumes more responsibility. However, the student should not expect the income from his work terms to make him completely self-supporting.

Students in co-operative courses are required to return for a second
work term when acceptable to employers. First work terms with employers include learning periods varying in length with the complexity of the jobs. Second work terms provide the students with an opportunity for better assessment of the jobs and provide the employers with the benefits of increased productivity. In many instances the second term also offers students some new duties and responsibilities. Valid reasons for exceptions to this rule will be considered by the Co-ordination Department. Additional work terms with co-operative organizations are a matter of mutual agreement between employers and students.

The student is required to prepare written reports which normally cover some phase of his employment during the work terms. Such 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 for analysis. The work report is designed to help train the student to think, to organize and to express himself on paper in a clear, logical and concise form. When possible it should be a project of benefit to the employer as well as the student.

**Evaluation** At the end of each work term, it is recommended that each student have an exit interview with his supervisor. During this interview, they should discuss together the student's work term performance using the "Employer's Evaluation of Co-operative Student" as a guide. For students in some programmes, this discussion will also include the evaluation of the student's work report. In other programmes, the evaluation of the work report will be given by the Department of Co-ordination on campus. Both these evaluations (performance and work report) subsequently will be maintained in the student's record.

**Conduct and Responsibilities** The satisfactory completion of co-operative work terms is a requisite of graduation. It is emphasized that during the student's work terms he carries a responsibility to build and maintain his own good reputation as well as that of the University.

No student may continue in a co-operative course at the University of Waterloo if he is not achieving acceptable progress during his work assignments. A student who fails to honour an agreement to work with an employer or who leaves his co-operative employment without prior approval from the Co-ordination Department, or who conducts himself while on the job so as to purposely cause his discharge, may be suspended immediately from the Co-operative programme.

Unsatisfactory performance by a student in two work terms will result in a thorough investigation of his suitability for professional training and he may be required to withdraw from the course.

The above discussion of Co-ordination has been written with the assistance of the Student Advisory Council to the Department of Co-ordination. The Council strongly recommends that students interested in co-operative education read a brochure designed to supplement the Calendar, entitled "Where it's at with Co-op Education" before deciding whether such a programme is designed to best further their academic interests. The brochure presents more details about Co-op in areas solely relevant to students, and should be available in most High School Guidance Departments or upon request from the Department of Co-ordination.
Departments of Co-ordination, and Career Planning and Placement

Student Advisory Council to the Department of Co-ordination

The Student Advisory Council advises the Department of Co-ordination on matters of interest and policy from the students' points of view. Members of Council also act as liaison between the student body and the Department. Council membership is by Society appointment as follows:
- 4 students Faculty of Engineering
- 2 students Faculty of Mathematics
- 2 students School of Physical Education and Recreation
- 1 student Department of Physics
- 1 student Department of Chemistry
- 1 student School of Architecture

Industrial Advisory Council for Co-operative Engineering and Applied Science

The Industrial Advisory Council of the University of Waterloo was established in 1958 to bring guidance from industry to the University of Waterloo. The Council meets twice each year to discuss problems and make recommendations relative to the University's co-operative programmes in Engineering, Applied Chemistry and Applied Physics.

Dr. D.H. Laughland
Chairman
Public Service Commission

Mr. W.L.W. Taylor
Secretary
Falconbridge Nickel Mines Limited

Mr. H.W. Adcock
Ontario Department of Highways

Mr. Wm. Bobbie
B.F. Goodrich Canada Limited

Mr. W.C. Bradbury
Canadian Westinghouse Company Limited

Mr. G.H. Crase, Jr.
Horton Steel Works Limited

Mr. A.W. Downe
Joseph E. Seagram & Sons Limited

Dr. F.S. Eadie
Bell-Northern Research

Mr. N.E. Field
Canadian National Railways

Mr. T. Larson
Borden Chemical Company (Canada) Ltd.

Mr. J.M. Lawrence
B.P. Refinery Canada Limited

Dr. H.B. Marshall
Domtar Limited

Mr. W.L. McDonald
Black & McDonald Limited

Mr. H.G. Peets
National Sewer Pipe Limited

Mr. G. Roelofson
Montgomery Elevator Company Limited

Mr. R.W. Sclater
Giffels Associates Limited

Mr. V. Scof
Frankel Structural Steel

Mr. R.D. Sloane
Bell Canada

Mr. D.H. Wilson
McIntyre Porcupine Mines Limited
Students requiring assistance in determining their career goals are encouraged to use the facilities of Career Planning and Placement. Types of current organizations and agencies compatible with the individual student's needs and abilities are explored during personal interviews. Career information is made known, such as the availability of opportunities, salaries, and trends. A broad selection of active company or agency files containing background information and employment histories is available for perusal. The Careers Information Centre contains descriptive material on most occupations. Through these the student is assisted in finding a meaningful career and ultimately his right employment choice.

In the Placement function, several hundred companies are invited to conduct on-campus interviews for graduating students at all levels. It is customary for employers interested primarily in students graduating from the faculty of Arts to participate in interviews during a three week period in November/December. Some of these employers also have requirements for students in non co-operative programs graduating from the faculties of Mathematics and Science. A second three week interview period in January is provided for students graduating from all faculties. Employers will interview postgraduate students during both interview periods.

The Career Planning and Placement Offices are located on the 6th Floor of the Mathematics and Computer Building.

Post-Graduate Careers Information

The Post-Graduate Careers Information section of the Department of Career Planning and Placement provides assistance to students graduating with advanced degrees who are seeking employment. The section discusses career plans with students, assembles information on job opportunities, and advises employers on the availability of people with advanced degrees to fill their requirements. It is concerned with any activities designed to improve channels of communication between employers and post-graduate students.
7

The University Libraries
The University Libraries

University Librarian
William J. Watson, B.J. (Carleton), M.A., B.L.S. (McGill)

Associate Librarian
Murray C. Shepherd, B.Ed. (Saskatchewan), M.A.(L.S.) (Denver)

Assistant Librarian, Arts
Helen McKinnon (Miss), B.A. (Saskatchewan), B.L.S. (Toronto), M.L.S. (McGill)

Assistant Librarian, E.M.S.
Ada Berti (Miss), B.A. (Windsor), B.L.S. (Toronto)

Collections Development Librarian
Doris E. Lewis (Mrs.), B.A., B.L.S. (Toronto), L.L.D. (Trent)

Systems Librarian
Robert G. Bean, B.A. (Western), B.L.S., M.L.S. (Toronto)

Assistant for Administration
Paul Wiens, B.A., B.L.S. (U.B.C.)

Assistant for Research & Development
Jorn Jorgensen, B.A. (Toronto)

Technical Services

Associate Librarian
Murray C. Shepherd, B.Ed. (Saskatchewan), M.A.(L.S.) (Denver)

Acquisitions Department
Head
Enid Waterman (Mrs.), B.A. (McMaster), B.L.S. (Toronto)

Bibliographic Searching Department
Head
Ramma Kamra (Mrs.), B.A. (Panjab), M.L.S. (Western)

Cataloguing Department
Head
Joan Scanlon (Miss), B.A., M.A., B.L.S. (Toronto)

Cataloguers
Samuel Alexander, B.A., M.A. (Delhi), M.L.S. (Western)
Amy Chan (Mrs.), B.A. (Hong Kong), M.L.S. (Western)
Yulerette Gordon (Mrs.), B.A. (Manitoba), B.L.S. (Toronto)
Carol Halperin (Miss), B.A., M.L.S. (Toronto)
George Louden, B.A. (Temple), M.L.S. (Toronto)
Pamela Stoksik (Miss), B.A., B.L.S. (Toronto)
Marina Wan (Mrs.), B.SSc. (Hong Kong), M.A., M.L.S. (Western)

Serials Department
Head
Cynthia Pugsley (Mrs.), B.A. (Toronto), M.L.S. (McGill)

Public Services, Arts Library

Assistant Librarian, Arts
Helen McKinnon (Miss), B.A. (Saskatchewan), B.L.S. (Toronto), M.L.S. (McGill)

Circulation Department
Head
Elaine Reaman (Miss), B.A. (McMaster), B.L.S. (Toronto)

Reference Department
Head
Madeline Grant (Miss), B.A., B.L.S. (Toronto)

Reference Librarians
Brenda Bailey (Miss), B.A. (London), Dip.Ed. (Oxford), M.L.S. (Western)
Lois Black (Miss), B.A. (Waterloo College), B.L.S., M.L.S. (Toronto)
Marsha Blok (Mrs.), B.A. (Waterloo), M.L.S. (Western)
Rienzi Crusz, B.A. (Ceylon), B.L.S. (Toronto), M.A. (Waterloo)
Alison Fitzgerald (Miss), B.A. (Queen's), B.L.S. (Toronto)
Alexander Slade, B.A. (Victoria), B.L.S. (U.B.C.)
Diane Wilkins (Miss), B.A. (Waterloo), M.L.S. (McGill)
The University Libraries

Government Publications

Department

Head, Carolynne Presser (Miss), A.B. (Hunter), M.L.S. (Pratt)
Librarian, Judith Boettger (Miss), B.A. (Waterloo), B.L.S. (U.B.C.)

Public Services, Engineering, Mathematics and Science Library

Assistant Librarian, E.M.S., Ada Berti (Miss), B.A. (Windsor), B.L.S. (Toronto)

Circulation Department

Supervisor, Virginia Mixer (Mrs.), A.B. (Hanover)

Reference Department

Head, Emily Chang (Miss), B.Sc. (Loyola), M.L.S. (McGill)
Reference Librarians
Shirley Beuttenmiller (Miss), B.Sc. (Waterloo), B.L.S. (Toronto)
John Kilbury, B.A., M.L.S. (Pittsburgh)
Eleanor MacLean (Miss), B.Sc., M.L.S. (McGill)
Wendy Macpherson (Mrs.), B.Sc., M.L.S. (Dalhousie)
James Parrott, B.Sc. (Queen's), M.Sc., B.L.S. (Toronto)
Benjamin Toth, B.A. (Queen's), M.L.S. (McGill)

Environmental Studies Library

Head, Carlotta Harvey (Miss), B.Sc., B.L.S. (Alberta)

The University Libraries are central to the academic programmes going on throughout the University. Their function is to provide books, journals, and other library materials to support those programmes. The library staff, aided by the university community in many important ways, works to make the library system an excellent base for teaching, study and research.

The Dana Porter Arts Library, situated in the centre of the campus and rising to a height of ten storeys, is the focal point of the University. The lower floors house the main public service departments and the behind-the-scenes technical services. From just inside the main entrance on the second floor the public catalogue, the circulation counter and the reference desk are all immediately visible and close at hand. The periodical and journal collections, government publications, microforms, and sound recordings are located on the third floor. The reserve book area, including both the reserve collection and a reading room, are on the fourth floor. The upper floors house the main circulating collections and seats for readers. In all there are more than one thousand places for readers.

The Arts Library collections number 375,000 volumes of books and periodicals in the Humanities and Social Sciences, plus pamphlets, theses, microforms, documents, reports, sound recordings, and other materials. The library grows by 5,000 volumes each month. An important element is the collection of journals and periodicals, back files and current issues. The library has 2,800 subscriptions to current titles.

The Engineering, Mathematics and Science Library occupies the fourth floor of the Mathematics and Computer Science Building. Again, the three principal public services—the catalogue, the circulation counter, and the reference desk—are just inside the entrance to the library. Space is provided for seven hundred readers.

The E.M.S. Library collections number 150,000 volumes of books and journals, plus many kinds of special materials, including technical reports, microforms, documents and maps. The library has 2,500 volumes.
The Environmental Studies Library is housed on the main floor of the Social Sciences Building. The core of the library collection consists of 35,000 maps, supported by 2,000 books and reports, together with atlases, periodicals, aerial photographs and films. Like the Arts and E.M.S. libraries, its resources are available to all members of the University.

The staff of the library system, 200 persons, both professional and supporting, is engaged in obtaining material, in processing it for the collections, and in bringing it to the attention of users. During the day and evening hours reference and circulation staff are on duty to assist in making use of the collections and facilities. Week nights the Arts and E.M.S. libraries are open for use, under the custodianship of library attendants.

Handbooks are available to explain the use of the libraries: the classification system, the card catalogues, the serial lists, and in general the rules and procedures. Also available are other publications, such as bibliographies and lists of reference materials.

Towards the end of 1972-73 academic year, the conversion of the library catalogues to machine-readable form should be completed. The machine-readable records will serve as the basis for a variety of projects, all of them aimed at offering better library services. In the summer of 1971 the library introduced an automated circulation system, designed to facilitate the borrowing of materials.

For a more detailed and up-to-date description of the University Libraries, see the current Library Handbook.
Faculty of Arts
The Faculty of Arts

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

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

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

Degrees

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

Pass Programme

The General Programme in Arts (page 99).

Honours Programmes

The Faculty of Arts offers Honours degrees in the following major disciplines: Anthropology, Economics, English, English (Drama), Fine Arts (Art), French, Geography, German, History, Latin, Philosophy, Political Science, Psychology, Religious Studies, Russian, Sociology, Spanish. Joint honours programmes combining any two of the above noted Arts disciplines or combining an Arts discipline with a programme in another faculty are available. Students should cater to their individual interests in selecting a particular programme.

Descriptions of the single honours programmes and each discipline's requirements in joint honours programmes are outlined on pages 100 through 117. Students interested in programmes and courses emphasizing Canadian material should examine the Canadian Studies programme on page 101 and the Canadian Studies section of the Calendar, pages 291 through 293.
Examinations and Standings

Type A Teaching Certification

Admission to the Type A Certification programme at the Ontario Colleges of Education requires the completion of a programme of at least twenty full-year University courses, including one or two specialist fields in which the student has obtained at least second class (honours) or equivalent standing. A programme of twenty courses and one specialist field must include at least nine full courses in the field. A programme of twenty courses and two specialist fields must include fourteen full-year courses in the two fields, with at least six in each field. The Ontario Department of Education approved specialist fields are as follows: Agriculture, Anglais, Art, Biology, Chemistry, Computer Science, Drama or Theatre Arts, Economics, English, Francais, French, Geography, Geology, German, Greek, History, Home Economics, Italian, Latin, Mathematics, Music, Physical and Health Education, Physics, Political Science, Psychology, Russian, Sociology, Spanish.

Admission

The admission requirements and procedures for all programmes are outlined in detail in Chapter 2 of this Calendar.

Registration

September 5, 6, 7, 8, 1972.
September 4, 5, 6, 7, 1973.

Fees

Refer to Section 3 page 43.

Examinations and Standings

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

Students should note that the Faculty of Arts operates under a course system in which student progress is measured by courses successfully completed rather than by years. Students who have passed fewer than five courses will be considered Year 1 students; those who have passed at least five courses but fewer than ten will be considered Year 2 students; those with at least ten but fewer than fifteen, Year 3, and those with 15 or more, Year 4.

1 Final Examinations

a) The Faculty constitutes the examining body for all examinations. Final written examinations are normally held at the end of a course in December or April; oral examinations may be required at the discretion of individual departments. The normal time for written examinations is three hours.

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

2 Standing

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

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Excellent</td>
</tr>
<tr>
<td>B</td>
<td>Very Good</td>
</tr>
<tr>
<td>C</td>
<td>Good</td>
</tr>
<tr>
<td>D</td>
<td>Passing</td>
</tr>
<tr>
<td>F</td>
<td>Failure</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Grade</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>95</td>
</tr>
<tr>
<td>B+</td>
<td>78</td>
</tr>
<tr>
<td>C+</td>
<td>68</td>
</tr>
<tr>
<td>D+</td>
<td>58</td>
</tr>
<tr>
<td>F+</td>
<td>46</td>
</tr>
<tr>
<td>A</td>
<td>89</td>
</tr>
<tr>
<td>B</td>
<td>75</td>
</tr>
<tr>
<td>C</td>
<td>65</td>
</tr>
<tr>
<td>D</td>
<td>55</td>
</tr>
<tr>
<td>F</td>
<td>38</td>
</tr>
<tr>
<td>A-</td>
<td>83</td>
</tr>
<tr>
<td>B-</td>
<td>72</td>
</tr>
<tr>
<td>C-</td>
<td>62</td>
</tr>
<tr>
<td>D-</td>
<td>52</td>
</tr>
<tr>
<td>F-</td>
<td>32</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Cumulative Average</th>
<th>Honours Programme</th>
<th>General Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>80-100</td>
<td>First Class Honours</td>
<td>Excellent</td>
</tr>
<tr>
<td>70-79.99</td>
<td>Second Class Honours</td>
<td>Very Good</td>
</tr>
<tr>
<td>60-69.99</td>
<td>Third Class Honours</td>
<td>Good</td>
</tr>
<tr>
<td>50-59.99</td>
<td></td>
<td>Conditional</td>
</tr>
<tr>
<td>0-49</td>
<td></td>
<td>Failure</td>
</tr>
</tbody>
</table>

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

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

e) Students may be enrolled for reduced programmes and may take less than five courses. Such programmes must be elected at pre-registration or during the official drop-add periods and must be consistent with the drop-add regulations outlined on Page 98. After these times reduced programmes require the approval of the Dean of Arts or of the Chairman of one of the Departments (depending upon the status of the
Examinations and Standings

student), and of the Examinations and Standings Committee and must be consistent with the drop-add regulations. Students should note, however, no Honours Degree shall be granted to a student who has not completed at least one year (other than year one) of his academic work as a full-time student in the Honours Arts programme.

f) To be considered in good standing in the General Arts programme, a student must maintain a cumulative overall average of at least 60 as well as an average of at least 65 in his field of specialization. If at any time a student's overall average falls between 50 and 60 or his average in his field of specialization below 65, he will be granted conditional status for one year, during which period he must make reasonable progress toward obtaining good standing or he will be asked to withdraw. A student whose cumulative overall average falls below 55 may continue only with the permission of the Examinations and Standings Committee. (See Note below)

g) To be considered in good standing in the Honours Arts programme, a student must maintain a cumulative overall average of at least 60% as well as an average of at least 75% in his field of specialization (unless otherwise specified in a departmental Honours programme). If an Honours degree candidate's major average falls below the prescribed minimum, he will be considered for the General degree and the regulations in (f) above will apply. If, subsequently, he raises his average to the required level, he may, through his Department Chairman, petition the Examinations and Standings Committee to review his case. (See Note below)

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

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

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

3 Make-up Examinations A student will be eligible to apply for make-up examinations only when failure to pass is attributable to extraordinary circumstances. In addition, he

a) must have attended a reasonable number of lectures in the course in which he proposes to write, and must have satisfied all term work requirements;

b) must have secured the permission of the professor concerned.

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

Group A and Group B Requirements

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

Group A (i)  English, History, Philosophy
Group A (ii)  French, German, Greek, Italian, Latin, Russian, Spanish, Ukrainian (see Note)
Group A (iii)  Drama, Fine Arts, Religious Studies
Group B  Anthropology, Economics, Geography, Political Science, Psychology, Sociology

Before being admitted to the degree an Arts student must complete with passing marks a minimum of three full course equivalents from Group A and a minimum of two full course equivalents, not both in the same subject in Group B. The student should note that Group A is further subdivided into Group A (i), Group A (ii) and Group A (iii). Of the three full course equivalents required of each student in Group A, a student must complete with passing marks:
- a minimum of one full course equivalent from Group A (i)
- a minimum of one full course equivalent from Group A (ii)

Special Note  Arts students should note that they may elect to meet the Group A (ii) requirement in their second or subsequent year by completing with passing marks one of the following courses:
French 291*/292*; German 271*/272*; Russian 271*/272*; Spanish 210; Classical Civilization 201*/202* or Italian 230. These courses are not open to first year Arts Students. These courses are the only approved alternatives to the A (ii) requirements.

Selection of Year 1 Programmes

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

Students thinking of the Honours Programme should generally follow the recommended first year programmes outlined in the Calendar beginning on page 100. These are recommendations only (which general students may also follow if they wish), but various substitutions and adjustments may be made to suit a student’s special needs or interests.

A full time student will normally sign up for five courses. He should be careful to select introductory courses in subjects in which he thinks he might major or do an honours programme. A student is free to choose any course in the university for which he has the prerequisites. Students may choose courses from Group A and B; courses in Mathematics, in Science, in Physical Education or in Environmental Studies.
Academic Programmes

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

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

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

Note 2 Each student's programme must be approved on or before registration day by a faculty adviser from the Faculty of Arts.

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

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

Course and Programme Changes

a) Courses may be added or dropped during the first three weeks of the term in which they begin only with the signature of the instructor of the course and the Undergraduate Officer of the student's major department.

b) After these times, courses may be added or dropped only with the permission of the Examinations and Standings Committee acting on the recommendation of the instructor of the course and the Undergraduate Officer of the student's major department, and only if the student can support his case with reasons showing that such a change in his programme will serve his academic interests.

c) Courses offered during the Summer Session may be added or dropped during the first week in which the course begins only with the signature of the instructor of the course and the Undergraduate Officer of the student's major department, and thereafter only with the permission of the Examinations and Standings Committee.

d) Students in the Arts Faculty at the University of Waterloo may enroll in reduced programmes and may take less than five courses. Such programmes must be elected at pre-registration or during the official drop-add periods and must be consistent with the drop-add regulations outlined in (a) and (c) above. After these times reduced programmes require the approval of the Dean of Arts or of the Chairman of one of the departments (depending upon the status of the student), and of the Examinations and Standings Committee and must be consistent with the drop-add regulations.
e) A course that has not been dropped officially (i.e. recorded in the Registrar's Office) will receive a grade and be counted in the student's average.

The General Programme

Year 1 Each student in Year 1 chooses at least five courses, usually two from Group A and two from Group B, with one or two more as electives. See Year One Programme, page 97. At the end of Year 1, each student in the General major Programme must choose one of the following subjects as his major field of study:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Subject</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthropology</td>
<td>Geography</td>
<td>Political Science</td>
</tr>
<tr>
<td>Economics</td>
<td>German</td>
<td>Psychology</td>
</tr>
<tr>
<td>English</td>
<td>Greek</td>
<td>Religious Studies</td>
</tr>
<tr>
<td>English (Drama)</td>
<td>History</td>
<td>Russian</td>
</tr>
<tr>
<td>Fine Arts (Art)</td>
<td>Latin</td>
<td>Sociology</td>
</tr>
<tr>
<td>French</td>
<td>Philosophy</td>
<td>Spanish</td>
</tr>
</tbody>
</table>

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

Year 2 Each student in Year 2 of the General Programme chooses at least five courses in consultation with his departmental adviser:

a) a minimum of two further courses in his major subject (See notes);

b) three other courses (see notes).

Year 3 Each student in Year 3 must choose five courses in consultation with his departmental adviser:

a) a minimum of two further courses in his major subject;

b) three other courses.

Note 1 The Programme of every student in the General Programme must include either

a) a minimum of eight courses beyond the 100 level, or

b) courses from no more than seven subject fields.

Note 2 Before graduation each student in the General Programme must have completed a minimum of fifteen courses with passing mark in each and an overall cumulative average of at least 60%, and a cumulative average in his major of 65%.

Non-Major General Arts Programme

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

a minimum of 7.5 courses above the first year level;

a minimum of 7.5 courses in the Faculty of Arts;

a minimum of two courses, not both in the same subject, from among English, History, Philosophy, Fine Arts, Religious Studies, and languages other than English;

a minimum of two courses, not both in the same subject, from among Anthropology, Economics, Geography, Political Science, Psychology, and Sociology.
Honours Programmes

b) A cumulative average of 65% is required for graduation.

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

Minor Programmes Students in other faculties may elect a minor in an Arts discipline. Minor requirements are specified in the respective Departmental listings beginning page 267.

Honours Programmes

In Year 1 a student must normally complete the introductory course in the subject in which he will major in later years. Before graduation each student must have completed twenty to twenty-four courses, (as specified in a Departmental Honours Programme) with a passing mark in each.

Students are requested to refer to the detailed programmes following this page for other departmental requirements. Joint Honours Programmes not found in this section may be arranged by consultation between the student and the departments concerned.

Honours Anthropology

\textit{Year 1} \textit{Recommended Programme}

- Anthropology 101*/102*
- Four electives

\textit{Year 2} Three full courses (or half course equivalents) in Anthropology. Two electives.

\textit{Year 3} Three full courses (or half course equivalents) in Anthropology
- Two electives

\textit{Year 4} A theory-oriented full course (or two half courses) in Anthropology at the 400 level
- Two additional full courses (or half course equivalents) in Anthropology
- Two electives

Anthropology Joint Honours Programmes

The recommended Anthropology programme for joint honours is generally as follows.

\textit{Year 1} Anthropology 101*/102*

\textit{Year 2} Two full courses (or half course equivalents) in Anthropology

\textit{Year 3} Two full courses (or half course equivalents) in Anthropology

\textit{Year 4} Two full courses (or half course equivalents) in Anthropology, one of which must be a theory-oriented course at the 400 level

Consult the recommended programmes of other departments to determine their requirements.

Joint Honours Programmes have been approved with Anthropology and English, French, Geography, German, History, Man-Environment Studies, Political Science, and Sociology.

Note 1 Joint Honours students with Anthropology and Geography or Anthropology and Man-Environment Studies must fulfill the requirements of the Faculty of Arts for the B.A. degree or of the Division of Environmental Studies for the B.E.S.
Note 2 Students intending to qualify for the Type A Certificate for teaching high school must elect a minimum of nine courses in Geography.

Honours Programmes in Canadian Studies

Recommended Programme

Year 1 French 190 or French 101*/102* if students have not passed the equivalent of grade XIII French
The specified introductory course in the student's proposed major subject (see note 1)
The equivalent of three other full courses chosen from among those specifically recommended for freshmen planning a Canadian Studies programme (see note 2)

Year 2 Canadian Studies 201*/202*
The equivalent of three full courses in the student’s major subject, one of which should specifically deal with Canada (see note 3)
The equivalent of two other full courses chosen from among those specifically recommended for students concentrating their programme in Canadian Studies (see note 4)

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

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

Note 1 Students who wish to follow a programme in Canadian Studies do so by selecting a major department in the usual fashion and fitting the above recommendations to its requirements. Students proposing a double honours programme with a concentration in Canadian Studies should complete both the required introductory courses for their programme. (See page 93 for a further discussion of joint honours programmes).

Note 2 For descriptions of freshmen courses specifically recommended for students planning a programme in Canadian Studies see p. 291 of the Calendar.

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

Note 4 Each of the participating departments has designated its principal Canadian course at the 200, 300, and 400 levels but students may choose from among any of the Canadian content courses listed on pages 291-293 of the Calendar. Many 300 and 400 level courses have specific prerequisites and it is often desirable to use the electives to pursue work in a particular discipline. Students following double honours programmes should reduce the number of electives at each level by one.
Honours Economics

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

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

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

Year 3 Economics 300
Two of Economics 330, 340, 368*/369*, 380
Two electives

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

Economics Joint Honours Programmes
The core courses in economics for joint honours programmes normally are:

Economics 101*/102* (year one)
Economics 201*/202* or 203*/204* (year two)
Economics 231*/232* or 205*/206* (year two)
Economics 300 (year three)
Economics 400 (year four)
At least two other economics courses

In addition, students must meet the requirements of the other department, as well as the Faculty of Arts Group A and Group B requirements. Selection of courses will be made with the assistance of the appropriate undergraduate officers. For joint honours programmes, 22 courses are required.
Joint Honours Programmes have been approved with Geography, Political Science and Mathematics. The following notes pertain:

Note 1 Economics and Geography
The degree requirements of the Faculty of Arts must be met for the B.A. Degree and those of the Division of Environmental Studies for the B.E.S. Degree. Students must take one of Economics 300 or Geography 375 and the above core courses.
Note 2 Economics and Political Science
Economics 241*/242* must be taken and the above core courses.

Note 3 Economics and Mathematics
Economics 460, in addition to the above core courses. Students in Years 1 and 2 may take this programme in either faculty, but at the end of the second year, they will decide whether to continue toward a degree in Arts or a degree in Mathematics. The programme must then be approved by the Economics Department or by an appropriate department of the Faculty of Mathematics. Requirements will depend on which degree is taken: the student will have to add to these to meet the requirements of his faculty.

Economics Requirements for the Honours Minor
Economics 101*/102*, 201*/202*, 231*/232* and only two further courses in economics.

Honours English

English Requirements
Although English 101 is recommended, first year students may take any other approved English course.

English 251
One full course equivalent in each of the following categories:
1) Language and Early Literature (261, 373, 375)
2) Historical Periods of British Literature (281*, 282*, 370, 380, 451)
3) Major figures in British Literature prior to the Twentieth Century (270, 350, 362*, 363*)
Three approved English full course equivalents.

Other Requirements
One full course equivalent in either a language other than English or in a foreign culture.
Two full course equivalents from Group B.
Seven other full course equivalents.

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

Note 1 An English Honours Student will take a minimum of 20 courses before graduation, including a minimum of 10 approved English courses. These latter normally will be divided 1-3-3-3 among the four years. The student will also pass the Honours Examination before graduating. (Each student is strongly urged to write this Examination at the end of his third year.)

Note 2 The heart of this curriculum will reside in the conferences between the student and his advisor. The department will expect each student to have a rational programme designed to fit his needs and plans. Sample programmes with particular ends in mind will be drafted and made available.
Honours English (Drama)  

**English and Drama Requirements**

- English 101
- English 251
- English 361*, 362*, 363*, 364*
- Drama 223*, 224*, 225*, 325, 329
- Two full course equivalents to be chosen from Drama 228*, 330, 425, 429*, 430*, 442
- One full course equivalent from English 261, 270, 373, 375, 281*/282*, 350, 370
- One full course equivalent from English 380, 451, 456, 290*, 291*, 345*, 346*, 347*, 314*, 315*
- Two approved English full course equivalents
- Other requirements:
  - Nine other courses including the Faculty of Arts Requirements

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**English Joint Honours Programmes**

Although English 101 is recommended, first year students may take any other approved English course.

- English 251
- One full course equivalent from each of three of the following categories:
  1) Language and Early Literature (261, 373, 375)
  2) Historical Periods of British Literature (281*, 282*, 370, 380, 451)
  3) Major figures in British Literature prior to the Twentieth Century (270, 350, 362*, 363*)

- Three other approved English full course equivalents

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**English Requirements for the Honours Minor**

- 101 or equivalent
- Either 140*/141* or 251
- One full course equivalent from 261, 270, 281*, 282*, 350, 361*, 362*, 363*
- Two other English full course equivalents.

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**Honours Fine Arts**  

**Recommended Programme**

**Year 1**
- Fine 120*/121* (see note 1)
- The equivalent of eight additional half courses

**Year 2**
- Fine 224* and Fine 226* (see note 1)
- The equivalent of four half courses in Fine Arts (see note 2)
- The equivalent of four additional half courses

**Year 3**
- The equivalent of six half courses in Fine Arts (see note 1)
- The equivalent of four additional half courses.

**Year 4**
- Fine 490*/491* (Senior Honours Presentation) (See note 1)
- The equivalent of four additional half courses in Fine Arts (see note 2)
- The equivalent of four additional half courses
Note 1 Of the twenty required Fine Arts courses, all Honours Fine Arts students will take the following courses:

- Fine 110*/111*
- Fine 120*/121*
- Fine 224*/226*
- Fine 490/491*

All of these must be taken in the years indicated except for 110*/111* which must be completed before students are admitted to the 4th year.

Note 2 Additional Fine Arts half courses will be selected to include the following:

Group 1 two half courses in art history
two half courses in film

Group 2 two half courses selected from this group:
- Fine 227*, 324*, 325*, 326*, 327*, 328*, 329*
two senior seminars

The remaining four required Fine Arts half courses may not include music or dance.

Fine Arts Joint Honours Programmes Students choosing a Joint Honours programme involving Fine Arts must complete the equivalent of fourteen half courses in Fine Arts and the Senior Honours Seminar (two half courses). Unless other arrangements are approved by the Department, all students in joint honours programme must complete, before entering the fourth year, Fine 110*/111*, 120*/121*, 224*/226* plus two from each of Group 1 and 2. (See note 2 above) Other Joint Honours programmes may be arranged upon consultation with Fine Arts.

Honours French Recommended Programme

Year 1 French 190 Group B
Four more courses

Year 2 A minimum of three full courses or equivalent in French
Three more courses

Year 3 A minimum of three full courses or equivalent in French
Three more courses

Year 4 A minimum of three full courses or equivalent in French
Two more courses

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

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

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

Note 4 A total of 22 courses must be successfully completed before graduation.

Note 5 The degree requirements of the Faculty of Arts (see page 97) must be met for the B.A. degree.
Honours Programmes

French In Joint Honours Programmes

The Department of Classics and Romance Languages recognizes combined honours programmes in French and the following disciplines:

- English
- German
- Latin
- Philosophy
- Political Science
- Russian
- Sociology
- Spanish

Other combinations must be approved on an individual basis with the departments concerned.

Recommended Programme (French)

**Year 1**

French 190 Group B

**Year 2**

Three full courses in French or equivalent. (1)

**Year 3**

Two full courses in French or equivalent.

**Year 4**

Two full courses in French or equivalent.

(1) Two full courses in French when in combination with Political Science.

**Note 1** Before graduation, students in combined honours programmes must complete a minimum of eight full courses (or equivalent) in French. (Seven when combined with Political Science).

**Note 2** Those planning to enter the teaching profession should complete French 250, 350, 455*/456*.

**Note 3** A total of 23 courses must be successfully completed before graduation. (22 in the case of French and Political Science).

**Note 4** The degree requirements of the Faculty of Arts (see page 97) must be met for the B.A. degree.

Honours Geography

**Year 1**

Geography 102* Introduction to Physical Geography

and one of but no more than three of

- Geog. 101* Introduction to Human Geography
- Geog. 195* Geography and Environmental Problems
- Geog. 110* Tutorial in Human Geography
- Geog. 125R* Introduction to the Developing World
- Geog. 126R* The Emerging “Third World”
- Geog. 127* Regional Problems of Eastern Europe and the Soviet Union

Plus additional credits chosen after consultation with the department so that the student has 6 full credits. (Note that all of these courses (except Geog. 110*) are available to any student in the University. Geography students, however, cannot take more than four first year geography half credits, and these must be taken in first year).
Honours Programmes

Year 2  Env. 200* Field Ecology  
Geog. 201* Climatology and Geomorphology  
Geog. 202* Economic and Urban Geography  
Geog. 260* Cartography  
Geog. 275* Air Photo Interpretation  
Geog. 271* Introduction to Quantitative Research Methods  

*and one of*  
Geog. 203* Cultural and Regional Geography  
Geog. 232* Geography of Population  
Geog. 320* World Regional Geography  

and additional credits so that a student should have completed by the end of second year, 11 full credits.

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

Year 4  Geog 481* Frontiers of Geography  
Geog. 490 Seniors Honours Essay  

and additional credits so that a student should have a minimum of 21 full credits.

Geography Joint Honours Programmes: The following geography courses are required from students in a joint honours programme:

Geog. 102* and one of, but not more than three of, 101*, 110*, 125R*, 126*, 127*, 195*.  
Geog. 391*, 481*, 490 and additional geography electives so that the student has a minimum of seven full credits in geography.

Note 1  All students in joint honours programmes should consult with appropriate faculty member in respective departments the design of their programme.

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

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

Honours History

Year 1  Any first year programme that fulfills the general Faculty of Arts requirements, normally including an introductory course in History, is acceptable. History 110 and 120 are recommended.

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

Year 3  Two Honours History courses (see note 1).  
Three other courses, preferably including History 350 (see note 2).

Year 4  Two Senior Seminars  
One other Honours History course
Honours Programmes

Note 1  *In addition to an introductory History Course, the Honours candidate must complete at least eight and preferably nine Honours History courses with at least a B average. The Honours History courses must be selected to ensure development and breadth. To ensure development, they must include at least four courses in the 300 and 400 ranges, two of which must be Senior Seminars. To ensure breadth, they must include at least one full course from each of the following columns.*

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>255 (or 251*/252*)</td>
<td>261*/262*</td>
<td>265*/266*</td>
<td>277</td>
</tr>
<tr>
<td>Classics</td>
<td>263*/264*</td>
<td>267G*/268G*</td>
<td>281</td>
</tr>
<tr>
<td>295*/296*</td>
<td>296*/298*</td>
<td>282</td>
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<tr>
<td>258</td>
<td>357*/358*</td>
<td>380*/381*</td>
<td>284*/285*</td>
</tr>
<tr>
<td>260</td>
<td>359*/360*</td>
<td>382</td>
<td>291*/292*</td>
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<td>345*/346*</td>
<td>362</td>
<td>383*/384*</td>
<td>370</td>
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<tr>
<td>347G*/348G*</td>
<td>364</td>
<td>386*/387*</td>
<td>372</td>
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<td>388</td>
<td>374G*</td>
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<td>368</td>
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<td>363</td>
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<td>397</td>
<td>393</td>
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<td></td>
</tr>
<tr>
<td>Classics</td>
<td>365*/366*</td>
<td>394</td>
<td></td>
</tr>
</tbody>
</table>

Note 2  *In addition to the requirements for History courses, candidates must have completed, preferably by the end of the Third Year, one course beyond the First Year level in both the humanities and the social sciences. The humanities course may be in language or literature, but cannot be a "culture" equivalent to a language course. Students who plan to enter graduate school are strongly advised to develop some facility in a language other than English.*

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

Note 4  *It is possible for Honours students to take a minor in History. Details should be sought from the Undergraduate Officer.*

History Joint Honours Programmes

1) An Introductory History Course (preferably History 110 or History 120).

2) *Four Honours History courses selected from the 200 or 300 range in consultation with a department advisor. At least one of these courses must be in the 300 range (a Depth course).*

3) *Two Senior Seminars (History 400-455).*

Combined programmes presently exist with Philosophy, Geography, German, Russian, English, Political Science, Sociology and Anthropology. The History Department is prepared to work out others for keenly interested students who otherwise meet Honours standards.

Students enrolled in combined or double Honours programmes do not have to fulfill the column (ABCD) requirements in History outlined in Note 1 above. They must however fulfill the A & B requirements of the Faculty of Arts.

Not all double Honours programmes fulfill the Department of Education's requirements for a Type A certificate. Students should consult about this with the departmental advisor.
Honours Programmes

Honours German

Year 1  German 101*/102* or 121*/122*
Four additional full courses

Year 2  Three full courses in German
Three additional full courses

Year 3  Three full courses in German
Three additional full courses

Year 4  Three full courses in German
Two additional full courses

Note 1  Before graduation students must complete the Group A (i) and B requirements listed on page 97.

Note 2  With the permission of the department the student may spend one of his senior years at a university of a German-speaking country.

German Joint Honours Programmes

English and German
French and German
German and History
German and Political Science
German and Russian
Philosophy and Literature (German)

Other joint honours programmes may be arranged by consultation between the student and the departments concerned.

Note 1  A student in a Joint Honours Programme will take a minimum of 20 full courses before graduation, including seven in German.

Note 2  Before graduation students must complete the Group A (i) and B requirements listed on page 97.

Note 3  With the permission of the departments concerned, the student of German may spend one of his senior years at a university of a German-speaking country.

Honours Latin

Recommended Programme

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

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

Year 3  A minimum of three full courses or equivalent in Latin
Classical Civilization, one additional course
Two more courses

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

Note 1  Before graduation, students must complete a minimum of ten courses in Latin among which must be Latin 251*/252*.
Honours Programmes

Note 2 Students intending to obtain a Type A certificate for teaching in Ontario High Schools must take a Minor in addition to their Latin programme. In Greek as a minor subject, three courses (nine hours) are required. In French or English, five courses (fifteen hours) are required. The electives each year provide room for these requirements.

Note 3 A total of 22 courses must be successfully completed before graduation.

Note 4 The degree requirements of the Faculty of Arts (see page 97) must be met for the B.A. degree.

Latin Joint Honours Programmes The Department of Classics and Romance Languages recognizes combined honours programmes in Latin and the following disciplines:

- English
- French

Other combinations must be approved on an individual basis with the departments concerned.

Recommended Programme (Latin)

Year 1 Latin 190

Year 2 Three full courses in Latin or equivalent

Year 3 Two full courses in Latin or equivalent

Year 4 Two full courses in Latin or equivalent

Note 1 Before graduation, the student must complete a minimum of eight full courses (or equivalent) in Latin.

Note 2 Latin 251*/352* are required before graduation.

Note 3 A total of 23 courses must be successfully completed before graduation.

Note 4 The degree requirements of the Faculty of Arts (see page 97) must be met for the B.A. degree.

Honours Philosophy Twenty full course equivalents

- Ten in Philosophy, including 221*/222*, 240, 280*/281*, 282*/283*, 399 (tutorial), 499 (tutorial)
- Ten others, including Group A and B requirements (see page 97).

Honours Philosophy and English Philosophy Requirements

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

English Requirements (See English Joint Honours Requirements)

Other Requirements

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

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

**Philosophy Requirements**
The equivalent of at least seven full courses in Philosophy which must include 140*, 221*/222*, 280*/281*, 282*/283*, 446*, and 399 (tutorial).

**History Requirements** (See History Joint Honours Requirements)

**Other Requirements**
Eight full course equivalents, including A and B requirements (p. 97)

Honours Philosophy and Literature

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

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

**Year 3**
Philosophy 331, 399 (tutorial), and
*One of Philosophy 221*/222* or 280*/281*
- French: minimum of two full courses or equivalent (see note)
  (or German 351*/352*; 361*/362*; 381*/382*)
- One elective

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

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

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

Joint Philosophy—Mathematics

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

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

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

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

Further requirements for the degree B.Math.
(Mathematics and Philosophy) see page 196
Further requirements for the degree B.A.
(Philosophy and Mathematics)
Six more courses, including: A and B requirements for an Arts Degree

Honours Philosophy and Political
Science

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

Political Science Requirements (See Political Science Joint Honours Requirements)

Other Requirements
Either Philosophy 325*/326* or Political Science 220
The equivalent of seven full courses, one of which must satisfy the Faculty’s foreign language requirement and one of which should be in a social science other than Political Science

Honours Philosophy and Psychology

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

Psychology Requirements (See Psychology Joint Honours Requirements)

Other Requirements
Either Philosophy or Psychology 499
Seven full course equivalents, including A and B requirements (see p. 97)

Honours Philosophy and Religious
Studies

Philosophy Requirements
Philosophy 140* (or 240), 221*/222*, two half courses in the history of Philosophy, 335*, 399 (tutorial), three (or 2½) other full course equivalents in Philosophy.

Religious Studies Requirements (See Religious Studies Joint Honours Requirements)

Other Requirements
8 full course equivalents to make a total of 22 full course equivalents including A and B requirements (see p. 97)
Honours Programmes

Honours Philosophy and Sociology

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

*Sociology Requirements* (See Sociology Joint Honours Requirements)

*Other Requirements*
Either Philosophy or Sociology 499
Seven full course equivalents, including A and B requirements
(see page 97)

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

Honours Political Science

*Year 1* Recommended Programme
Political Science 115*/116*
The equivalent of four other full courses

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

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

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

*Note* Four of the nine Political Science courses above the 100 level must be selected from four different fields of the discipline. For further information on this please consult the Department.

Political Science Joint Honours Programmes

*Year 1* Political Science 115*/116*
Introductory course in the other discipline
The equivalent of three other full courses

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

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

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

*Note* Three of the six Political Science courses above the 100 level must be selected from three different fields of the discipline. For further information on this please consult the Department.
Honours Psychology

**Recommended Programme**

**Year 1**
- Psychology 101*/102*
  - The equivalent of four additional full courses

**Year 2**
- Psychology 283*/284*
  - The equivalent of one full course in Psychology (see Note 1)
  - The equivalent of three additional full courses

**Year 3**
- Psychology 285*/331*
  - The equivalent of two additional full courses in Psychology (see Note 1)
  - The equivalent of two additional full courses

**Year 4**
- Psychology 499
  - The equivalent of two additional full courses in Psychology (see Note 2)
  - The equivalent of two additional full courses

**Note 1** Honours students are required to complete one research half course from each of the following groups before entering the fourth year of the programme.

  Group 1: 293*, 295*, 297*
  Group 2: 393*, 395*, 397*

**Note 2** Honours students should include at least two fourth-year seminars in their programme.

*Psychology Joint Honours Programmes*

Students choosing a joint Honours programme involving Psychology must complete the equivalent of seven full courses in Psychology and an Honours thesis course. Unless other arrangements are approved by the Department, all students in joint Honours programmes must complete, before entering the fourth year, Psychology 283*, 284*, 285*, 331*, and one research half course from each of the following groups.

  Group 1: 293*, 295*, 297*
  Group 2: 393*, 395*, 397*

In the fourth year, all students must complete Psychology 499 or the Honours Thesis course in the related discipline.

Joint Honours programmes other than these already approved may be arranged by consultation with the Psychology Department and the department concerned.

*Minor Programme*

The department offers a minor programme in Psychology. Any student interested in planning a sequence of five courses to complement his major field of study is encouraged to consult the Undergraduate Officer. All minor programmes must be approved by the Department.

*Honours Sociology*

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

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

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

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

Note 1 Students may elect Honours Sociology [Canadian Studies] by fulfilling the Honours requirements in Sociology and the requirements listed under Canadian Studies in this Calendar.

Sociology Joint Honours Programmes
Sociology has joint honours programmes with the following:
Anthropology, Classics and Romance Languages, English, History, Philosophy, Political Science, Psychology, Recreation, and Mathematics.
The usual recommended programme in Sociology for joint honours is seven and one-half full course equivalents distributed as follows:
a half course in introductory sociology (101*); a half course in statistics (202*); two half courses in research methods (321*/322*); two half courses in sociological theory to be chosen from (331*, 402*, 425*, 425*); the equivalent of three and one-half full courses of electives in Sociology; and an honours thesis course (499*) or the equivalent in the related department.

Note 1 For requirements in joint honours with History, Philosophy, Psychology, and Mathematics see the Department Undergraduate Officer.

Note 2 In the joint honours programme with French (Classics and Romance Languages) Soc. 202* may be replaced by an elective in Sociology.

Honours Religious Studies

Year 1 Any first year programme that fulfills the general requirements of the Faculty of Arts and includes one of the following full R.S. courses:
103G*/104G*, 110*/111*, 130P*/131P*, or 160R*/161R*

Years 2, 3, and 4 Nine full R.S. courses (or the equivalent) and seven electives. The R.S. courses are to include:

a) Two courses in one religious tradition (i.e., Buddhism, Christianity, Hinduism, Islam, Judaism).
b) One course in another religious tradition.
Note: if (a) is a “Western” tradition, (b) must be an “Eastern” tradition, or vice versa.
c) Two full courses at or above the 398 level.
d) Methodology course in the fourth year that will include the elements of a thesis course.

Note 1 Total number of courses required, twenty-one.

Religious Studies Joint Honours Programmes
The Religious Studies requirements in joint honours programmes are the same as the honours programme except for the overall number of R.S. courses—honours requires 10, joint honours 7.
Honours Russian

Year 1  Russian 101*/102* or equivalent
Four additional full courses

Year 2  Two full courses in Russian
Four additional full courses

Year 3  Three full courses in Russian
Three additional full courses

Year 4  Three full courses in Russian
Two additional full courses

Note  Before graduation students must complete the group A (i) and B requirements listed on page 97.

Russian Joint Honours Programmes

English and Russian
French and Russian
German and Russian
History and Russian
Political Science and Russian

Other joint honours programmes may be arranged by consultation between the student and the departments concerned.

Note 1  A student in a Joint Honours Programme will take a minimum of 20 full courses before graduation, including seven in Russian.

Note 2  Before graduation students must complete the Group A (i) and B requirements listed on page 97.

Honours Spanish

Recommended Programme

Year 1  Spanish 190 (Students with no high school Spanish will take Spanish 110 in the first year and Spanish 190 and 250 in the second year)
Four more courses

Year 2  A minimum of three full courses or equivalent in Spanish
Three more courses

Year 3  A minimum of three full courses or equivalent in Spanish
Three more courses

Year 4  A minimum of three full courses or equivalent in Spanish
Two more courses

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

Note 2  To establish a Minor in a sister discipline, the student must complete five courses (fifteen hours) in that discipline. Students registering in Honours Spanish are strongly advised to minor in French.

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

Note 4  A total of 22 courses must be successfully completed before graduation.

Note 5  The degree requirements of the Faculty of Arts (see page 97) must be met for the B.A. degree.

Note 6  Students in honours Spanish may receive only half credit for Spanish 210.
The Department of Classics and Romance Languages recognizes combined honours programmes in Spanish and the following disciplines:

- English
- French
- History
- Latin

Other combinations must be approved on an individual basis with the departments concerned.

**Recommended Programme (Spanish)**

**Year 1** Spanish 190 (Students with no high school Spanish will take Spanish 110 in the first year and Spanish 190 and 250 in the second year).

**Year 2** Three full courses in Spanish or equivalent.

**Year 3** Two full courses in Spanish or equivalent.

**Year 4** Two full courses in Spanish or equivalent.

**Note 1** Before graduation, students in combined honours programmes must complete a minimum of eight full courses (or equivalent) in Spanish.

**Note 2** Those planning to enter the teaching profession must complete Spanish 190, 250, 350 and 450.

**Note 3** A total of 23 courses must be successfully completed before graduation.

**Note 4** The degree requirements of the Faculty of Arts (see page 97) must be met for the B.A. degree.

**Note 5** Students in honours Spanish may receive only half credit for Spanish 210.
Faculty of Engineering
The Co-operative Engineering Programme

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

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

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

The co-operative programme brings a student into direct contact with industry and the engineering profession and exposes him to problems typical of those encountered in practice. Students are introduced to full-scale engineering projects and operations, far beyond the scope of any university laboratory. Employment on the work terms generally is secured by students through on-campus interviews with Cooperative employers. Such arrangements and other features of the work terms are the responsibility of the Department of Co-ordination and Placement of the University which produces the necessary liaison between the University and the employers. It should be understood that there can be no guarantee of work term employment, although the Department of Co-ordination will make every effort to provide as many opportunities as possible. Through personal experience in industry, the student's educational environment is extended and his total education advanced. The co-operative experience represents much more than an opportunity to secure financial assistance, or to make an early start of a vocation. It provides the maturing prospective engineer with an opportunity for self-discipline and direction, and allows an early appreciation of the social and personal aspects of engineering through direct association with a technological environment.
The Co-operative Engineering Programme

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 clearly understand the relationship of their profession to industry and society. A more detailed explanation of the Co-operative programme is given in Section 6.

**Degrees**

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

*Chemical Engineering*
*Civil Engineering*
*Electrical Engineering*
*Mechanical Engineering*
*Systems Design Engineering*

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

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

**Co-operative Programme**

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

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<tbody>
<tr>
<td>&quot;A&quot;</td>
<td>First Term</td>
<td>Second Term</td>
<td>Work Term</td>
<td>Third Term</td>
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<td>1B</td>
<td>1</td>
<td>2A</td>
<td>2</td>
<td>2B</td>
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</thead>
<tbody>
<tr>
<td>&quot;B&quot;</td>
<td>First Term</td>
<td>Work Term</td>
<td>Second Term</td>
</tr>
<tr>
<td>1A</td>
<td>1</td>
<td>1B</td>
<td>2</td>
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<th>1977 Winter</th>
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</thead>
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<tr>
<td>&quot;A&quot;</td>
<td>Fifth Term</td>
<td>Work Term</td>
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<tr>
<td>3A</td>
<td>4</td>
<td>3B</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Stream</th>
<th>1977 Fall</th>
<th>1977 Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;B&quot;</td>
<td>Work Term</td>
<td>Fifth Term</td>
</tr>
<tr>
<td>4</td>
<td>3A</td>
<td>5</td>
</tr>
</tbody>
</table>

All Year 1 students enrol in September. These Year 1 students spend the first term together at the University, and, as indicated on the diagram also complete the programme and graduate together. Between the first and last terms, the diagram shows that each of employment opportunity on the co-operative programme. Both groups, of course, have the same total time on campus and in industry; one group having a double
Examinations and Promotions

academic term at the start of the programme and the other having a
double academic term at the end of the programme. The division at the
end of the first term of study is based upon student preferences, financial
considerations of students, etc. Precise dates for the beginning and end
of the various terms are shown in academic calendar for the year.
The programme in Systems Design is not divided into two streams.
All students in this programme follow a Stream "B" pattern.

Admission

The admission requirements and procedures for all programmes are
outlined in detail in Chapter 2 of this Calendar. The following
emphasize some of the admission requirements which relate specifically
to the Faculty of Engineering.

Applicants From Ontario

Grade 13

Applicants must present the following Mathematics courses –
Relations and Functions, Calculus, Algebra, as well as Chemistry and
Physics in their overall Grade 13 programme. Applicants who do not
have these specific Grade 13 courses but who have obtained a high
overall standing, including at least Relations and Functions and
Calculus, are encouraged to apply for admission.

Admission As An Adult Student

It is recommended that applicants attempt to obtain standing in Ontario
Grade 13 Mathematics and Science courses or their equivalent.

Admission to Advanced Standing

Because of the cooperative nature of the Engineering programme, no
student will be admitted above Year 3, term A level. Any student thus
admitted will be required to register in the January term "A" stream
and to complete a minimum of three satisfactory work terms. The level
of advanced admission is determined by an examination of the
applicant's academic and work experience.

Credit for previous work experience can be applied only to those work
terms preceding the level of admission and cannot exceed three work
terms.

Registration

September 5, 6, 7, 8, 1972.
September 4, 5, 6, 7, 1973.

Fees

Refer to Section 3 page 43.

Examinations and Promotions

The Faculty constitutes the examining body for all examinations and is
responsible for all decisions on grades, promotions, failures, deferred
examinations, appeals and the preparation of recommendations for the
granting of degrees. Students are examined and marks are set for
individual subjects on completion of the work for that subject. With few
exceptions beyond first year, subjects are one term in length, and
promotion decisions are made at the end of each term.
Examinations and Promotions

For the purposes of promotion the two terms of first year are considered as a unit and promotion decisions are made at the conclusion of the second term only. However, a first year student’s progress is reviewed at the end of the first term and the Engineering Faculty Council may recommend or require a student to withdraw if, in the opinion of the Council, the student is unlikely to benefit from further study.

The procedures through which promotion decisions are made are as follows:

1) At the end of each term, examining faculty members submit marks to the Engineering Examinations and Promotions Committee, who prepare promotion recommendations for subsequent approval by the Engineering Faculty Council. Once approved, the decisions are reported to the students through the Registrar’s Office. All recommendations to award degrees must be approved by Senate.

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

There is no "passing" or "failing" of individual subjects. Promotion is based on the weighted overall average and a minimum grade is not normally required in any one subject, although individual departments may designate minimum grade requirements in certain courses. There are no supplemental examinations except in the last term of the programme.

3) All promoted students will be shown as having obtained First, Second or Third Class Honours according to the following table:

<table>
<thead>
<tr>
<th>Average</th>
<th>Honours</th>
</tr>
</thead>
<tbody>
<tr>
<td>80.0 to 100%</td>
<td>First Class</td>
</tr>
<tr>
<td>70.0 to 79.9%</td>
<td>Second Class</td>
</tr>
<tr>
<td>60.0 to 69.9%</td>
<td>Third Class</td>
</tr>
</tbody>
</table>

The exception to this will be those special cases where a student has less than 60% but who has been given a "Promotion Granted" decision.

It should be specially noted in such "Promotion Granted" cases from 1B that emphasis is placed on Math 12 and 21, Physics 11 and GE 122. Students will be ranked in order of overall averages. A student's class standing will be shown on his report. Failing students will be given their failing average.

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

5) Students who are not promoted at the end of the third or subsequent terms will be required to repeat all or part of the work of the term failed.
Where timetables permit, repeating students may be excused from repeating individual courses in which good marks have been obtained, and permitted to register in other appropriate courses, at the discretion of the student's department.

Previous marks in exempted courses will not be included in the average of the repeated term.

6) A student may not repeat a given term more than once. The Examinations and Promotions Committee decisions "Failed, May Repeat" and "Promotion Granted" are to be considered equivalent in that the maximum number of such decisions a student may accumulate is two.

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

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

9) Courses taken by students that are in addition to the degree requirements will not be included in a student's average. Marks obtained in extra courses will be reported on a student's transcript.

10) Courses taken by students during work terms will not be included in a student's average for any term. The marks, however, will be reported on a student's transcript. Normally students will be expected to register for the minimum number of courses specified by the calendar for the appropriate term.

11) In special cases other symbols may be substituted for marks and the following list summarizes these symbols and their meanings:

**AEG**
- Student was ill as per medical evidence.
- Performance was **Satisfactory**.
- Student was **Exempt** from taking the course because of previous work.
- Student is given a **Pass** with no specific mark or grade assigned.

**CR**
- Performance was **Unsatisfactory**.
- Student obtained permission not to write because of illness or death in family, etc. The exam is **Deferred** to a later date.
- The course and project cannot be completed until the next term thus mark is **Postponed** in meantime.
- Course work is **Incomplete**.

**DNW**
- Student **Did Not Write** the exam and did not officially drop the course.

**AUD**
- Course **Audited** only. This symbol is generated by the Registrar's Office.
12) Students who feel that assigned grades or the promotion decision do not reflect a just evaluation of their achievement, or who have done poorly because of sickness or unavoidable absence, may appeal faculty decisions. All appeals should be addressed to the Chairman of the Engineering Examinations and Promotions Committee, Registrar's Office, University of Waterloo. Reasons in support of the appeal must be provided. Doctor's certificates and similar supporting documents where appropriate should be included with the student's statement. It is to the student's advantage to file his appeal as early as possible, preferably before the Examinations and Promotions Committee meets to discuss the grades affected. Appeals must normally be submitted no later than three weeks after the promotion decisions are mailed by the Registrar's Office.

13) Changes to a student's original registration form may be permitted at the discretion of a student's department. All such arrangements must be indicated and approved before the end of the normal "Change Period", which is a period of three weeks at the beginning of each term. After the end of the three week period, only exceptional cases for change will be considered.

Undergraduate Co-operative Work Term Reports

Work reports are recognized formally as part of the requirements for the bachelor's degree. The regulations related to work term reports are:

1) Each Engineering student is required to submit a minimum of four satisfactory work reports prior to graduation. For those students admitted to advanced standing into 3A 'A' stream, only 3 satisfactory work reports would be required.

2) All work reports shall be submitted to the Co-ordination Department within 2 weeks of registration for the academic term following the work term and subsequently distributed to departments within 3 weeks. Failure to comply with the 2 week deadline will result in no work term report credit for that term.

3) Work reports shall be compulsory for all students in their first work term and these reports shall be assessed by the Co-ordination Department. The reports and evaluation forms shall be returned to the students and copies of the evaluation forms shall be placed in the students' files in the Co-ordination Department.

4) Three additional work reports shall be submitted for the remaining five work terms. Students are encouraged to reserve a report for their final work term. If a student wishes, he may submit the additional reports and the evaluations of these reports will be added to his work term record. Students may be required to submit work reports to employers.

5) Work reports, other than those completed by first year students, shall be evaluated by the Engineering Faculty following the same procedure as suggested in Item 3. This shall include reports marked by employers.

6) Work reports rated as unsatisfactory may be re-written and re-submitted during the academic term. Students with unsatisfactory work reports may be required to take formal instruction in technical report writing.
Academic Programmes

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

Rigorous work in Mathematics and the Sciences is emphasized throughout the course, and the common work in these basic areas of Science in the first and second years is used in each departmental programme to support advanced studies in engineering analysis and synthesis. It should be noted that the first year of the engineering course provides almost the same Mathematics, Physics, and Science courses as found in the first year in the Faculty of Science.

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

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

It is important to realize that the separation of engineering studies into five basic curricula areas reflects primarily divisions of learning in engineering, rather than divisions by classes of industry, for instance. It is to be noted that the chemical industry, the aeronautical industry, the mining industry, the pulp and paper industry—every major industry in fact—requires engineers from all primary divisions of the profession. Undergraduate study in any of the five basic divisions provided may lead, perhaps with further study or special experience as necessary, to professional activity in consulting work, or to staff positions in any kind of industry or any government agency, in research, education, design, design development, or administrative work.
**Year 1 Engineering Students**

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

a) General and Chemical Engineering  
b) Systems Design

Students enrolling in General and Chemical Engineering must register in the courses indicated in the following table:

**Term 1A**
- Mathematics 12  
- Mathematics 21  
- Chemistry 11  
- Physics 11  
- G.E. 111 Graphics or, Ch.E. 100 Introductory Engineering Concepts 1  
- G.E. 113 Measurement  
- One of G.E. 101, 102, or 103

**Term 1B**
- Mathematics 12  
- Mathematics 21  
- G.E. 111 Graphics or, Ch.E. 101 Introductory Engineering Concepts 2  
- G.E. 120 Synthesis  
- G.E. 121 Digital Computation  
- G.E. 122 Electricity & Magnetism  
- One of G.E. 101, 102, or 103

Students in Systems Design have an entirely separate programme as described on page 145 under the Department of Systems Design. They must register for the courses as described in Year 1 Systems Design.

At the completion of the First Year, students in the General and Chemical Engineering programme are required to select one of the following major divisions of engineering for the second year of study:
- Chemical Engineering  
- Civil Engineering  
- Electrical Engineering  
- Mechanical Engineering

Students intending to go into Chemical Engineering are encouraged to take Ch.E. 100 and 101 in place of G.E. 111, 113, 120. Other students may easily transfer into second-year Chemical Engineering by completing aspects of Ch.E. 100 and 101 which are not covered in that section of the General Engineering programme; this may be carried out by reading assignments during the 1B off term.

Students interested in pursuing an Engineering Physics option may do so by taking suitable advanced Science and Mathematics courses in the electives scheme described later, for each of the four basic engineering programmes.

**Note**  *Detailed course descriptions commence on page 267. Asterisks signify a course given on alternate weeks.*
Chemical Engineering

There are many possible answers to most problems. Society expects engineers to choose the best answers to practical problems. The modern engineer is involved not only with his traditional goals of satisfying material needs but also with the overall quality of life which is affected by his processes and products.

Chemical engineers in particular apply the natural and social sciences to solve problems where physico-chemical transformation of matter plays a significant role. Examples of the broad fields of application are: design, construction, operation, quality control, sales, management, research, education and government.

In contrast to chemists or other kinds of engineers, chemical engineers are generally involved with large-scale operations based on the chemical sciences.

Chemically-based technologies produce metals, drugs, food, alcohol, soap, fertilizers, gasoline, plastics, rubbers, paper, paint, textile fibres and many other products. Some of these technologies can also generate pollution problems which must be solved by chemical engineers in their overall process operations and designs.

Most chemical engineers are employed in the general areas of production, sales, management and research. A substantial number go into government and teaching. An increasing number are entering interdisciplinary areas such as food engineering, biomedical engineering and environmental engineering. The solution to crucial problems of health, nutrition, ecology, and pollution require chemical engineering expertise.

More women enter chemical engineering than any other branch of engineering and this trend is increasing, as women become more aware of the career possibilities in this profession.

The basic objective of the undergraduate programme is to provide the student with an education appropriate for a career in one of the above fields or, for further studies in Science or Engineering, or in other professions such as Medicine, Law, Business, etc. To be most effective in a rapidly changing technological age, the programme deals primarily with scientific and engineering principles. In the early years chemistry, physics and mathematics form the foundations. In the senior years, subjects such as economic analysis and pollution control enable the student to reach a more relevant understanding of his earlier studies. Specialization is available through five options oriented towards Biochemical and Food Engineering, Extractive and Process Metallurgy, Polymer Science and Engineering, Transport Processes, and Mathematical Analysis and Control.

The Biochemical & Food Engineering option

The Biochemical and Food Engineering option is concerned with the economic processing of materials of biological character or origin. It is primarily involved with waste treatment, food processing and the manufacture of microbial products such as alcoholic beverages, yeasts, antibiotics, vitamins, enzymes, etc. The usefulness of these studies is obvious in an underfed, unhealthy and over-populated world with pollution problems, and for the Canadian economy in which agricultural products play a significant role.
Extractive & Process Metallurgy

Extractive and Process Metallurgy as presently practiced in industry requires further understanding of the principles of chemical engineering applied to metallurgical processes in order to improve many of the present pyrometallurgical, electrolytic and hydrometallurgical processes used in Canada. The Waterloo programme inter-relates chemical engineering and chemical metallurgy in order to achieve this goal.

The Polymer Science & Engineering option

The Polymer Science and Engineering option covers a wide scope but special emphasis is placed on the physics and physical chemistry of polymers, and on the modification of polymer structure by physical or chemical means. At present, a significant percentage of the Canadian chemical industry is directed towards products classed as polymers (plastics, elastomers, synthetic fibers) and most of their production is in Ontario.

Transport Processes

Transport Processes form a core area of chemical engineering and in this option aspects of fluid flow, heat transfer and mass transfer which are important in all chemical and allied industries are developed further in the senior years.

Mathematical Analysis & Control

Mathematical Analysis and Control also form a core area involving studies in optimal control, economic or process optimization, and simulation. At Waterloo, this is probably the most developed area of its type at a Canadian university.

The department's vigorous postgraduate research activities provide necessary vitality and up-dating of the undergraduate programme in all the above-mentioned fields.

The Curriculum

The curriculum is constantly under revision to meet changing needs. At present about one-quarter of the curriculum consists of elective courses. Half of these electives may be chosen from non-technical courses in the humanities or social sciences; the remaining electives are technical courses, of which three are normally selected from one of the five option groups. The other technical electives may be chosen from any other approved science or engineering courses according to individual student interest and career objectives.

The Waterloo programme is the most comprehensive and flexible of its kind in Canada. It is also unique in Ontario in that the co-operative system of education provides an integrated pattern of academic study and practical experience, which allows the prospective engineer an opportunity to secure financial assistance and to make an early start on a vocation.

Guide to Undergraduate Ch.E. Course Numbers

Starting in the academic year 1972-73 a new revised curriculum has been developed and a new three digit number will be assigned to each course offered by the Chemical Engineering Department. Wherever possible, any old course numbers have been given in brackets. These course numbers are prefixed by the abbreviation Ch.E.; courses offered by other departments are also identified, e.g. Math., Chem. It is to be noted that transition to the revised curriculum will not be completed until 1974-75. The code for the new numbers is consistent with the graduate course numbers and is as follows:
Chemical Engineering

First digit (1-5): year
1-4: Year of study, core courses
5: Fourth year, elective courses

Second digit (0-8): subject matter
0: General engineering
1: Transport Processes
2: Mathematics, Control, Economics
3: Chemistry, Kinetics, Catalysis
4: Polymer Science and Engineering
5: Extractive and Process Metallurgy
6: Biochemical and Food Engineering
7: Ecology, Environmental Engineering
8: Projects, seminars, etc.

Third digit (0-9): term
Even numbers: first term
Uneven numbers: second term

Core Courses (Beyond Year 1)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Subject</th>
<th>Lectures (hr/wk)</th>
<th>Labs/Problems (hr/wk)</th>
<th>Tutorials (hr/wk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch.E. 220 (18)</td>
<td>Applied Mathematics</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ch.E. 230 (31)</td>
<td>Physical Chemistry 1</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 232 (16)</td>
<td>Inorganic Chemistry 1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ch.E. 260</td>
<td>Organic Chemistry 1</td>
<td>3</td>
<td>2</td>
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</tr>
<tr>
<td>Math. 22</td>
<td>Calculus 2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ch.E. 211 (21)</td>
<td>Transport Processes 1</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 231 (32)</td>
<td>Physical Chemistry 2</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 233 (36)</td>
<td>Physical-Chemical Laboratory</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ch.E. 360</td>
<td>Organic Chemistry 2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math. 31</td>
<td>Differential Equations</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ch.E. 312 (22)</td>
<td>Transport Processes 2</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 320 (17)</td>
<td>Applied Mathematics 2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ch.E. 330 (33)</td>
<td>Chemical Engineering Thermodynamics</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ch.E. 332 (35)</td>
<td>Inorganic Chemistry</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ch.E. 334</td>
<td>Instrumental Methods Laboratory</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ch.E. 313 (23)</td>
<td>Transport Processes 3</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 335 (71)</td>
<td>Chemical Engineering Laboratory</td>
<td>3</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Ch.E. 331 (42)</td>
<td>Chemical Reaction Engineering</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ch.E. 420 (51)</td>
<td>Process Dynamics and Control 1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ch.E. 422 (61)</td>
<td>Engineering Economics</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ch.E. 482 (95)</td>
<td>Technical Seminar</td>
<td>3</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Ch.E. 280, 281</td>
<td>General Awareness Seminar</td>
<td>3</td>
<td>480, 481</td>
<td>1</td>
</tr>
</tbody>
</table>

B. Elective Courses
A minimum of 12 elective courses must be taken in addition to the core courses listed above. Four to six of these courses may be chosen from non-technical electives in the humanities or social sciences (one required in each of the terms 2A, 2B, 3A and 3B, and one open elective in each of the terms 4A and 4B). The remaining six to eight courses must be technical electives, of which at least three are to be selected from one of the option groups listed below. An elective course is normally based on three lecture hours per week for one term unless otherwise specified in
the detailed course description. The other technical electives may be
chosen from other Chemical Engineering courses or from other science
or engineering courses according to interest, but the choice must be
approved by the Associate Chairman (Undergraduate Studies).

The three technical electives for each of the five Chemical Engineering
option groups, as well as Research/Design project electives are identified
below. Within each option group, the first course is normally taken in
the 4A term and the other two courses in the 4B term.

1) Transport Processes
Ch.E. 510 (535) Physico-chemical Properties of Gases and Liquids
Ch.E. 511 (537) Selected Topics in Process Applications
Ch.E. 513 (536) Non-Newtonian Flow and Heat Transfer

2) Mathematical Analysis and Control
Ch.E. 520 (554) Chemical Engineering Analysis
Ch.E. 521 (552) Process Dynamics and Control 2
Ch.E. 523 (73) Process Control Laboratory

3) Polymer Science and Engineering
Ch.E. 540 (80) Introduction to Polymer Science
Ch.E. 541 (81) Physical Chemistry of Polymers
Ch.E. 543 (82) Polymer Technology

4) Extractive and Process Metallurgy
Ch.E. 550 (85) Introduction to Extractive Metallurgy
Ch.E. 551 (86) Metallurgical Chemistry
Ch.E. 553 (87) Principles of High Temperature Extractive Metallurgy

5) Biochemical and Food Engineering
Ch.E. 560 (590) Introduction to Biochemical Engineering
Ch.E. 561 (591) Fermentation Operations
Ch.E. 563 (592) Food Processing

Research and/or Design Projects
Ch.E. 580 (98) Research-Design Project 1
Ch.E. 581 (99) Research-Design Project 2
Ch.E. 583 (62) Process Systems Design
Ch.E. 585 Technical Elective Project

Academic Programme for Each Term (1972-73) This represents the transitional period between the old and the new
revised curriculum described above.

Year 2A, Fall 1972
Math. 22, Chem. 26, Ch.E. 230 (31), Ch.E. 232 (16), Non-technical
elective.

Year 2B, Fall 1972
Math. 31, Chem. 26, Ch.E. 232 (16), Ch.E. 231 (32), Ch.E. 233 (36),
Non-technical elective

Year 3B, Fall 1972
Ch.E. 313 (23), Ch.E. 332 (35), Ch.E. 331 (42), Ch.E. 315 (71),
Technical elective, Non-technical elective.
Year 4A, Fall 1972
Ch.E. 315 (23), Ch.E. 422 (61), Ch.E. 420 (51), Ch. E. 482 (95), Technical elective, Non-technical or Technical elective.

Year 2A, Winter 1973
Ch.E. 220 (18), Ch.E. 230 (31), Ch.E. 232 (16), Math. 22, Chem. 26, Non-technical elective.

Year 3A, Winter 1973
Ch.E. 211 (21), Ch.E. 312 (22), Ch.E. 320 (17), Ch.E. 330 (33), Ch.E. 332 (35), Non-technical elective.

Year 3B, Winter 1973
Ch.E. 313 (23), Ch.E. 315 (71), Ch.E. 331 (42), Technical elective, Non-technical elective.

Year 4B, Winter 1973
Ch.E. 583 (62), or Ch.E. 581(99), or 585, Technical elective, Technical elective, Technical or Non-technical elective. Students taking Ch.E. 581 (99) (the equivalent of two courses) would be required to complete three rather than four electives in this term.

Year 2B, Spring 1973
Math. 31, Chem. 36, Ch.E. 211 (21), Ch.E. 231 (32), Ch.E. 233 (36), Non-technical elective.

Year 3A, Spring 1973
Ch.E. 211 (21), Ch.E. 312 (22), Ch.E. 320 (17), Ch.E. 330 (33), Ch.E. 332 (35), Non-technical elective.

Year 4A, Spring 1973
Ch.E. 422 (61), Ch.E. 420 (51), Ch.E. 482 (95), Technical elective, Technical elective, Technical or Non-technical elective.

Detailed course descriptions are given in the appropriate Departmental sections of this calendar.

Civil Engineering

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

The curriculum provides a modern approach to the subject based on a thorough grounding in mathematics and natural sciences. Because of the need for a broad understanding of engineering as it relates to society, socio-economic aspects of civil engineering are also dealt with.

Whereas complete professional specialization can be achieved only in postgraduate study and in engineering practice, the students can find opportunity to pursue advanced undergraduate study in a variety of areas. For example:
a) Structural Engineering—intended for students primarily interested in design and construction of structures; emphasis is placed on a broad foundation in mechanics and behaviour of materials.

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

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

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

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

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

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

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

i) Construction—is intended for students who have spent at least two years in the construction industry and who would like to update their technical knowledge.

A. Core Programme

a. Engineering Courses
M.E. 12 Dynamics

b. Civil Engineering Core Courses
C.E. 200 Project Course
C.E. 203 Statistics
C.E. 205 Mechanics of Deformable Solids 1
C.E. 206 Mechanics of Deformable Solids 2
C.E. 221 Calculus
C.E. 222 Differential Equations
C.E. 224 Probability and Statistics
C.E. 265 Materials
C.F. 280 Fluid Mechanics
C.E. 291 Survey Camp
C.E. 292 Socio-Economic Aspects of Civil Engineering
C.E. 298 Seminar
C.E. 299 Seminar
C.E. 303 Structural Analysis 1
C.E. 304 Structural Analysis 2
C.E. 322 Engineering Analysis  
C.E. 342 Transportation Engineering  
C.E. 351 Hydraulics  
C.E. 353 Geology and Soil Mechanics  
C.E. 362 Transportation Engineering  
C.E. 371 Geology for Engineers  
C.E. 372 Soil Mechanics  
C.E. 375 Sanitary Engineering  
C.E. 381 Hydraulics  
C.E. 393 Environmental Engineering  
C.E. 398 Seminar  
C.E. 399 Seminar  
C.E. 400 Systems 3 (Project)  
C.E. 401 Structural Steel  
C.E. 402 Reinforced Concrete 1  
C.E. 451 Water Resources and Sanitary Engineering  
C.E. 471 Soil Engineering  
C.E. 498 Seminar  
C.E. 499 Seminar  

B. Elective Courses  
The technical electives may be selected from the list below in consultation with a Civil Engineering faculty advisor.  

G.E. 61 History and Philosophy of Science  
C.E. 403 Reinforced Concrete 2  
C.E. 404 Design of Steel Structures  
C.E. 481 Engineering Law  
C.E. 501 Approximate Analysis of Structures  
C.E. 504 Structural Analysis 3  
C.E. 506 Project Management  
C.E. 508 Structural Dynamics and Stability  
C.E. 518 Plates and Shells  
C.E. 520 Advanced Computer Programming for Engineers  
C.E. 522 Engineering Analysis  
C.E. 524 Probability, Statistics and Decision Theory  
C.E. 526 Continuum Mechanics  
C.E. 534 Model Analysis of Engineering Structures  
C.E. 536 Model-Aided Design of Engineering Structures  
C.E. 540 Highway Design  
C.E. 541 Traffic  
C.E. 542 Pavement Structural Design  
C.E. 543 Land Use Models  
C.E. 544 Systems Analysis  
C.E. 551 Engineering Terrain Analysis  
C.E. 558 Soil Engineering (Case Histories)  
C.E. 560 Mechanical Behaviour of Materials  
C.E. 572 Topics in Wastewater Treatment  
C.E. 573 Pollution in the Aquatic Environment  
C.E. 580 Elements of Water Resources Management  
C.E. 583 Water Distribution and Collection Systems  
C.E. 586 Hydrology  
C.E. 589 Open Channel Flow  
C.E. 590 Advanced Mathematics  

Appropriate courses offered in other Departments and certain graduate courses are also available as technical electives upon the consent of the instructor.
Academic Programmes for Each Term (1972-73)

<table>
<thead>
<tr>
<th>Year 2A</th>
<th>Lectures hrs./week</th>
<th>Labs or Tutorials hrs./week</th>
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<tbody>
<tr>
<td>M.E. 12 Dynamics</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>C.E. 203 Statistics</td>
<td>1</td>
<td>1</td>
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<tr>
<td>C.E. 205 Mechanics of Deformable Solids 1</td>
<td>2</td>
<td>2</td>
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<tr>
<td>C.E. 221 Calculus</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 265 Materials</td>
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<td>1</td>
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<tr>
<td>C.E. 291 Survey Camp*</td>
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<tr>
<td>C.E. 292 Socio-Economic Aspects of Civil Engineering</td>
<td>3</td>
<td>2</td>
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<td>C.E. 298 Seminar</td>
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<table>
<thead>
<tr>
<th>Year 2B</th>
<th>Lectures hrs./week</th>
<th>Labs or Tutorials hrs./week</th>
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<tr>
<td>C.E. 200 Project Course</td>
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<td>C.E. 206 Mechanics of Deformable Solids 2</td>
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<td>C.E. 222 Differential Equations</td>
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<td>C.E. 224 Probability and Statistics</td>
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<td>C.E. 280 Fluid Mechanics</td>
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<th>Year 3A</th>
<th>Lectures hrs./week</th>
<th>Labs or Tutorials hrs./week</th>
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<tr>
<td>C.E. 303 Structural Analysis</td>
<td>2</td>
<td>2</td>
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<td>C.E. 342 Transportation Engineering</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 353 Geology and Soil Mechanics</td>
<td>3</td>
<td>3</td>
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<tr>
<td>C.E. 381 Hydraulics</td>
<td>3</td>
<td>2</td>
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<td>C.E. 393 Environmental Engineering</td>
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<th>Year 3B</th>
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<th>Labs or Tutorials hrs./week</th>
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<tr>
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<td>C.E. 322 Engineering Analysis</td>
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<td>C.E. 351 Hydraulics</td>
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<td>C.E. 362 Transportation Engineering</td>
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<td>C.E. 372 Soil Mechanics</td>
<td>2</td>
<td>2</td>
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<th>Year 4A</th>
<th>Lectures hrs./week</th>
<th>Labs or Tutorials hrs./week</th>
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<th>Labs or Tutorials hrs./week</th>
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<tbody>
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**Electrical Engineering**

The curriculum in Electrical Engineering is designed to teach those fundamental physical and engineering sciences which form the basis of the work of electrical engineers. After the common first year programme in Engineering, the programme in Electrical Engineering consists of sixteen core courses and a minimum of nine technical electives (taken during the last two terms): these technical electives include the possibility of working on a design type of project. In addition, students are required to take one non-technical elective course in the first three terms and a general elective course in the last three terms. A general elective is one which is either technical or non-technical. During each
The normal recommended programme shown below involves a course load (excluding seminar) of five courses per term; however, students are allowed to depart from this normal load within the framework of the following rules and within the constraints of the timetable.

The technical programme will consist of a minimum of all sixteen core courses and nine technical electives, normally chosen from the listing below (including the possibility of one or two final year project electives).

The non-technical programme will consist of one general seminar course, which deals with topics of general interest, and an elective course as noted above, except that students requiring more than six successful terms to complete the technical programme are not required to pass more than six of these electives.

A student must carry at least four courses per term and may carry at most six courses per term (excluding the seminar course).

The maximum number of terms of resident study to be as stipulated in the Calendar (viz. ten terms, see page 121).

The normal rules of the cooperative programme will apply. By special permission the number of cooperative work terms may be reduced, but a student must complete at least four work terms (including that done in his first year)—unless he is a student admitted to advanced standing, as defined in the Calendar (see page 123).

The student must register his course load at the start of each term. Departmental permission at the time of registration will be required for departing from the normal load of five courses (excluding seminar course) in any one term.

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

The promotion criteria will be as laid down in the Faculty rules, (see page 123) and the student will be examined on the basis of the courses for which he is registered at the time of examination.

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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Lect.</th>
<th>Lab.</th>
<th>Tut.</th>
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<td>E.E. 233</td>
<td>Physical Electronics</td>
<td>2</td>
<td>0</td>
<td>2</td>
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<tr>
<td>E.E. 241</td>
<td>Electric Networks 1</td>
<td>3</td>
<td>3(open)</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 261</td>
<td>Energy Transformation, Storage and Conversion</td>
<td>2</td>
<td>3(open)</td>
<td>1</td>
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<tr>
<td>E.E. 271</td>
<td>Electric &amp; Magnetic Fields</td>
<td>3</td>
<td>3*(open)</td>
<td>1</td>
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<tr>
<td>E.E. 316</td>
<td>Probability &amp; Statistics</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 324</td>
<td>Principles of Digital Computers</td>
<td>2</td>
<td>3**</td>
<td>1</td>
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<tr>
<td>E.E. 342</td>
<td>Electric Networks 2</td>
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<td>0</td>
<td>2</td>
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<tr>
<td>E.E. 351</td>
<td>Electronics 1</td>
<td>2</td>
<td>3*(open)</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 352</td>
<td>Electronics 2</td>
<td>2</td>
<td>3*(open)</td>
<td>1</td>
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<td>E.E. 362</td>
<td>Energy Conversion</td>
<td>2</td>
<td>3*(open)</td>
<td>1</td>
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<tr>
<td>E.E. 372</td>
<td>Electromagnetic Theory &amp; Applications</td>
<td>2</td>
<td>3*</td>
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<tr>
<td>E.E. 380</td>
<td>Introduction to Systems &amp; Control</td>
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<td>0</td>
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<td>0</td>
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<tr>
<td>Math 25</td>
<td>Advanced Calculus 1</td>
<td>2</td>
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<td>Math 35</td>
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### (b) Technical Electives (Year 4)

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<tr>
<td>E.E. 425</td>
<td>System Simulation</td>
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<td>E.E. 426</td>
<td>Switching Systems</td>
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<td>E.E. 427</td>
<td>Design of Discrete Signal Systems</td>
<td>3</td>
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<tr>
<td>E.E. 428</td>
<td>Communication Theory 1</td>
<td>3</td>
<td>0</td>
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<td>E.E. 429</td>
<td>Communication Theory 2</td>
<td>3</td>
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<tr>
<td>E.E. 434</td>
<td>Magnetic Materials and Quantum Electronics</td>
<td>2</td>
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<tr>
<td>E.E. 435</td>
<td>Semiconductor Devices 1</td>
<td>3</td>
<td>0</td>
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<td>Semiconductor Devices 2</td>
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<td>Electric Networks 3</td>
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<tr>
<td>E.E. 446</td>
<td>Algebra of Linear Systems</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>E.E. 453</td>
<td>General Electronic Circuits</td>
<td>2</td>
<td>3**</td>
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<tr>
<td>E.E. 454</td>
<td>Pulse and Switching Circuits</td>
<td>2</td>
<td>3**</td>
</tr>
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<td>E.E. 459</td>
<td>Sound, Noise and Electroacoustics</td>
<td>2</td>
<td>3**</td>
</tr>
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<td>E.E. 463</td>
<td>Energy Conversion &amp; Power Applications</td>
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<td>Microwave Engineering</td>
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<td>3**</td>
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<td>E.E. 474</td>
<td>Antenna &amp; Propagation Engineering</td>
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<td>3**</td>
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<tr>
<td>E.E. 499B</td>
<td>Project</td>
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<tr>
<td>Math 44</td>
<td>Complex Variables</td>
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With the approval of the Department, students may take technical courses offered by other departments.

### (c) Non-Technical

<table>
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<td>0</td>
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<td>F.E. 401</td>
<td>Seminar</td>
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<td>E.E. 402</td>
<td>Seminar</td>
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</table>

**Note**
- *held on alternate weeks
- **held once every three weeks

“Open” laboratory signifies that the student may schedule his own time to use the facilities, within some constraints of the timetable. The number of laboratory hours listed indicate the laboratory time a student is expected to spend each week in the laboratory. All laboratory exercises are compulsory.

### Academic Programmes for each term (1972-73) Electrical Engineering

**Note**
- Students may depart from this programme within the framework of the rules given above, and within the constraints of the timetable.
### Electrical Engineering

#### 2A Term: Fall and Winter

<table>
<thead>
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<th>Course Title</th>
<th>Lect.</th>
<th>Lab.</th>
<th>Tut.</th>
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<td>E.E. 271</td>
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#### 2B Term: Fall and Summer

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#### 3A Term: Winter and Summer

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<td>E.E. 342</td>
<td>Electrical Networks 2</td>
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<td>E.E. 351</td>
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<td>2</td>
<td>3*(open)</td>
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<td>Energy Conversion</td>
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#### 3B Term: Fall and Winter

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<td>3**</td>
<td>1</td>
</tr>
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<td>E.E. 352</td>
<td>Electronics 2</td>
<td>2</td>
<td>3(open)</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 372</td>
<td>Electromagnetic Theory &amp; Applications</td>
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<td>3*</td>
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<tr>
<td>E.E. 380</td>
<td>Introduction to Systems &amp; Controls</td>
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#### 4A Term: Fall and Summer

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<td>3</td>
<td>0</td>
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<td>E.E. 435</td>
<td>Semiconductor Devices 1</td>
<td>3</td>
<td>0</td>
<td>1</td>
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<tr>
<td>E.E. 446</td>
<td>Algebra of Linear Systems</td>
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<tr>
<td>E.E. 454</td>
<td>Pulse &amp; Switching Circuits</td>
<td>2</td>
<td>3**(open)</td>
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<td>3**</td>
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<td>3**</td>
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<td>E.E. 481</td>
<td>Control Systems</td>
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<td>0</td>
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<td>Project</td>
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Mechanical Engineering

4B Term: Winter
E.E. 402 Seminar 1 0 0
1 General Elective 2 0 0
Four Technical Electives from:
E.E. 427 Design of Discrete Signal Systems 3 3** 0
E.E. 429 Communication Theory 2 3** 0
E.E. 434 Magnetic Materials & Quantum Electronics 2 0 2
E.E. 436 Semiconductor Devices 2 0 1
E.E. 443 Electrical Networks 3 0 1
E.E. 453 General Electronic Circuits 2 3** 1
E.E. 459 Sound, Noice and Electroacoustics 2 3** 1
E.E. 464 High Voltage & Insulation Engineering 3 project 1
E.E. 465 Power Systems 2 0 2
E.E. 474 Antenna & Propagation Engineering 2 3** 1
E.E. 499B Project 0 4(open) 0

Service Courses
Chem.Eng.2A E.E. 10 Introduction to Electrical Engineering 3 2* 2*
Mech.Eng.2A E.E. 14 Electromagnetics 2 3* 3*
Mech.Eng.3A E.E. 32 Electronic Instrumention 3 3* 2

Non-Technical Electives
The Electrical Engineering Department also offers the following non-technical elective courses:
E.E. 391 Signals and Human Communications 3 0 0
E.E. 392 Information in Science & Society 3 0 0

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

* General Elective is any course that is not a repeat of course material already taken.

3* 3 hours every two weeks.

3** 3 hours every third week.

The undergraduate course descriptions will be found on page 340.

Mechanical Engineering

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

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

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

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

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


e) Geophysical (Environmental) Fluid Dynamics Option: For students interested in the control of air and water pollution and noise abatement, or who wish to embark later on a research career in meteorology, oceanography, ocean engineering, weather modification, pollution problems or related fields.
**General Mechanical Engineering Option:** The General Mechanical Engineering Option is designed to give the student a general background rather than specialize in any particular option. The course material has been carefully chosen to equip the student for a broad range of Mechanical Engineering practice including research.

### A. Core Programme

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lect.</th>
<th>Prob.</th>
</tr>
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<tr>
<td>E.E. 14</td>
<td>Electromagnetics</td>
<td>2</td>
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<td>E.E. 32</td>
<td>Electronics</td>
<td>3</td>
<td>3*</td>
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<tr>
<td>M.E. 1</td>
<td>Advanced Calculus</td>
<td>2</td>
<td>2*</td>
</tr>
<tr>
<td>M.E. 2</td>
<td>Statistics for Engineers</td>
<td>3</td>
<td>2*</td>
</tr>
<tr>
<td>M.E. 3</td>
<td>Ordinary Differential Equations</td>
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<td>M.E. 4</td>
<td>Numerical Analysis</td>
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<tr>
<td>M.E. 10</td>
<td>Systems Dynamics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M.E. 12</td>
<td>Dynamics</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>M.E. 15</td>
<td>Structure and Properties of Matter</td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td>M.E. 19</td>
<td>Mechanics of Deformable Solids 1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>M.E. 20</td>
<td>Mechanics of Deformable Solids 2</td>
<td>2</td>
<td>2</td>
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<tr>
<td>M.E. 21</td>
<td>Kinematics and Dynamics of Machines</td>
<td>2</td>
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<tr>
<td>M.E. 30</td>
<td>Structure and Properties of matter 2</td>
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<td>3*</td>
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<tr>
<td>M.E. 50</td>
<td>Thermodynamics</td>
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<td>M.E. 51</td>
<td>Fluid Mechanics 1</td>
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<tr>
<td>M.E. 53</td>
<td>Heat Transfer 1</td>
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<tr>
<td>M.E. 60</td>
<td>Control Theory</td>
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### b) Non-Credit Courses

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

### B. Elective Course

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

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

**Thermodynamics—Fluid Mechanics Option**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>M.E. 52</td>
<td>Air Conditioning</td>
</tr>
<tr>
<td>M.E. 54</td>
<td>Thermodynamics 2</td>
</tr>
<tr>
<td>M.E. 55</td>
<td>Refrigeration Engineering</td>
</tr>
<tr>
<td>M.E. 56</td>
<td>Heat Transfer 2</td>
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<tr>
<td>M.E. 58</td>
<td>Internal Combustion Engines</td>
</tr>
<tr>
<td>M.E. 59</td>
<td>Energy Conversion</td>
</tr>
<tr>
<td>M.E. 62</td>
<td>Fluid Mechanics 2</td>
</tr>
<tr>
<td>M.E. 64</td>
<td>Industrial Aerodynamics</td>
</tr>
<tr>
<td>M.E. 555</td>
<td>Thermodynamics 3</td>
</tr>
<tr>
<td>M.E. 557</td>
<td>Combustion 1</td>
</tr>
<tr>
<td>M.E. 560</td>
<td>Instrumentation</td>
</tr>
<tr>
<td>M.E. 561</td>
<td>Fluid Control Systems</td>
</tr>
<tr>
<td>M.E. 562</td>
<td>Control Theory 2</td>
</tr>
<tr>
<td>M.E. 563</td>
<td>Turbomachines</td>
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<tr>
<td>M.E. 564</td>
<td>Dynamics of Biomedical Systems</td>
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</tbody>
</table>
Neutral Engineering 143

M.E. 565 Gas Dynamics 1
M.E. 566 Turbulent Flow 1
M.E. 567 Aerodynamics of Flight
M.E. 568 Acoustics
M.E. 576 Control System Design

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

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

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

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

Suggested electives from other options and departments
M.E. 22 Mechanical Design 1
M.E. 41 Manufacturing Science 1 (Plasticity)
M.E. 56 Heat Transfer 2
M.E. 527 Mechanics of Deformable Solids 3
M.E. 544 Manufacturing Science 5 (Welding)
C.E. 611 Elementary Mechanics of Continua
e) Geophysical (Environmental) Fluid Dynamics Options

M.E. 62 Fluid Mechanics 2
M.E. 69 Introduction to the Environment Sciences
M.E. 566 Turbulent Flow 1
M.E. 568 Acoustics
M.E. 570 Geophysical Fluid Dynamics 1
M.E. 571 Air Pollution 1
M.E. 572 Ocean Engineering

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

f) General Mechanical Engineering Option Programme should include all of the following courses:

M.E. 22 Mechanical Design 1
M.E. 32 Physical Metallurgy
M.E. 41 Manufacturing Science 1
M.E. 56 Heat Transfer 2
M.E. 62 Fluid Mechanics 2
M.E. 528 Experimental Mechanics
M.E. 563 Turbomachines

g) Courses Open to All Options

M.E. 2 Statistics for Engineers
M.E. 501 Partial Differential Equations
M.E. 502 Functions of Complex Variables
M.E. 503 Advanced Vectors, Tensors and Matrices
M.E. 504 Numerical Analysis 2

Academic Programmes for Each Term (1971-72)

Year 2A Fall 1972 and Winter 1973

M.E. 1
M.E. 2
M.E. 15
M.E. 19

Year 2B Summer 1972 and 1972

M.E. 2 (Summer 1972 only)
M.E. 3 (Fall 1972 only)
M.E. 20

Year 3A Summer 1972 and Winter 1973

M.E. 10
M.E. 21
M.E. 30

Year 3B Fall 1972 and Winter 1973

M.E. 53
M.E. 60
E.E. 32

Year 4A Summer 1972 and Fall 1972

M.E. 82 or 2 technical electives
1 non-technical elective
3 technical electives
M.E. 400
Year 4B Winter
M.E. 82 or 2 technical electives
3 technical electives
1 non-technical elective

Systems Design

The Department of Systems Design (formerly the Department of Design) was formed at Waterloo in 1965. Since that time it has received international recognition for its graduate programmes, research activities and design projects.

The undergraduate programme in Systems Design Engineering encompasses a study of the basic skills required for systems analysis, simulation, optimization and design. In particular the first three years of the programme are intended to provide each student with a broad background and capability in the areas of:

- applied mathematics
- engineering systems and systems theory
- socio-economics systems
- human systems engineering and,
- computer systems and applications

Throughout these three years the student's ability to grasp real engineering problems is enhanced by an early course in Engineering Design and an intensive experience in the Systems Design Workshop. It is here that a focus is given to the whole curriculum and the student learns to apply his lecture material, to develop his skills in solving problems that cut across the traditional disciplines, and to develop his design, planning and organizational abilities.

The beginning three years of the programme are followed by one year in which the problem-solving capabilities of the student may be applied with emphasis in one particular area of technology, as chosen by the student. This prepares him for a further year of advanced study to the MASc degree if he so wishes, or for a meaningful career in industry or government with his Bachelor's degree.

The general core curriculum of the first three years is given flexibility through two means. Firstly, in each term of the 2nd and 3rd years the student may elect one course freely from any of the offerings of the University, provided only that these courses do not duplicate the core programme. Secondly, in the third year, the student is provided with two additional technical elective courses which serve as precursors to the technical option areas selected for study in the fourth year.

General Description of the Technical Options

The Systems Design Department is offering a variety of technical options to its students. The technical disciplines encompassed by the defined options are in areas in which individual faculty members of the department are involved but a procedure for devising special options outside of these areas is outlined below. There is considerable overlap among the disciplines encountered in the various options; indeed, this overlap extends to the objectives of the options in terms of engineering problem solving and design.
In general, it is possible to define technical options for engineering students either through the specific engineering disciplines to which they are oriented or through the special problem-solving skills to which they are directed. The Systems Design options are characterized by an amalgamation of these two points of view. This is emphasized by the continuation of the Systems Design Workshop through the fourth year. At this time each individual student will be required to attack a major problem taken from his technical option area, but with strong involvement in other disciplines. In addition, each student is encouraged to structure his technical elective courses so that his studies include not only the major technical option area but also a “minor” study from a second technological discipline.

Nonetheless, the technical options are named in terms of the major engineering disciplines that they encompass. This has the advantage of identifying the general problem areas which are to be studied in the options, and gives a specific professional identity to the students who choose them.

If he wishes to select an area not included in the general Systems Design programme, the student may structure a special option with the advice and approval of his supervisor. A special option will include a core of four Systems Design courses taken from within any Systems Design option series, one per semester, with an additional four courses which may be taken from well structured options offered outside of the Systems Design department, e.g. water resources, transportation, etc.

**Structure of the Options**

Each technical option is characterized by a series of option core subjects, and an additional set of technical elective courses. The option core consists of four courses, one given in each term of the third and fourth years. When a student has chosen a particular option he must take all of the associated option core courses. His remaining courses are chosen with the advice of his faculty advisor, in such a way as to strengthen his knowledge of particular facets of the option discipline and to provide for an integrated minor study of a second area. The third and fourth year curriculum is structured as follows:

**3A**
- 4 courses Systems Design general core programme
- Systems Design Workshop
- 1 free elective course
- 1 technical option course, from the option core

**3B**
- 4 courses Systems Design general core programme
- Systems Design Workshop
- 1 free elective course
- 1 technical option course, from the option core

**4A**
- 1 Systems Design mandatory course
- Systems Design Workshop
- 1 free elective course
- 3 technical option courses, at least one from the option core

**4B**
- 1 Systems Design mandatory course
- Systems Design Workshop
- 1 free elective course
- 3 technical option courses, at least one from the option core
Computer Systems Option

During the past decade, the phenomenal advances in computer technology have had a profound effect on systems problem solving. Not only have the labour and time required for conventional problem solutions been considerably reduced, but many new and more meaningful problem areas may now be successfully explored. One of the growing areas of interest is the simulation of large systems (ecological, transportation, communication, resource management, production and inventory control, etc.) using electronic computers.

The Computer Systems Option is intended to provide a course structure for those students who wish to gain additional background and expertise in the application of electronic computers to the analysis, simulation and design of systems. This option provides access to information in three fundamental areas:

1) computer hardware—physical structures of digital, analog and hybrid computers.
2) computer software—procedural languages, simulation languages and problem-oriented languages.
3) application techniques.

The Computer Systems Option core courses are intended to provide a broad background in the above three areas. By selecting certain additional technical electives and through experience in the fourth year Systems Design Workshop, the students in the Computer Systems Option may gain specific in-depth expertise in the field of their choice.

Option Core Courses

3A: normally Math 240(b) Non-Numeric Applications in Computer Science
3B: normally EE 324 Principles of Digital Computers
4A: SD 521 Analog and Hybrid Computing Systems
4B: SD 522 Computer-Aided Design 2

Suggested Technical Electives

EE 425 System Simulation
EE 426 Switching Systems
Math 427a Introduction to Automata Theory
EE 427 Design of Discrete Signal Systems
Math 427b Introduction to Turing Machines and Computability Theory
ME 622 Mechanical Design 4
or other courses with the approval of the supervisor

Human Systems Engineering And Design Option

Human Systems Engineering and Design embraces in whole or in part a wide spectrum of "professional" areas known as human factors engineering, human engineering, ergonomics, engineering ecology, biomedical engineering, and elements of various technical and non-technical disciplines such as aesthetics, perceptual psychology, marketing, mechanics, materials, etc.

As an option within the Systems Design programme, however, it is defined by the human problem to be solved rather than by concentration on one of the professional or discipline areas noted above. Thus, courses will be selected, under supervision, to provide the knowledge and expertise required to define and solve problems arising at the interface between man and machine (artifact), or man and environment.
For students interested in developing their design expertise in their chosen problem area, course requirements in the 4A and 4B terms can be reduced to five courses with more emphasis placed on the Workshop as a major design project.

Problem areas chosen might include:

design for extreme human environments
design where anthropometric aspects are dominant
design of instrumentation for human operators
design problems associated with safety in industry, transportation, etc.
medical design problems involving engineering technology
design involving human engineering
design of consumer products used in recreation and normal living
human aspects of engineering ecology
design of human "micro-environments"
problems of ergonomics and industrial hygiene

Option Core Courses: 3A SD 341 Human Engineering and Rational Design
3B SD 342 Problems of Man in the Operational Environment

Two of the following:
4A SD 541 The Ergonomics of Special Environments
4A SD 563 Aesthetic and Perceptual Aspects of Design
4B SD 542 Human Engineering and System Development
4B SD 564 Methodological Processes in Design

Suggested Technical Electives
Phys 301 Physical Instrumentation for biologists 1
Phys 302 Physical Instrumentation for biologists 2
Phys 481 Biophysics of organ systems
ME 564 Dynamics of biomedical systems
ME 568 Acoustics
ME 571 Air pollution
MS 509 Industrial psychology
MEnv 358 Environmental pollution and its control
CE 398 Environmental engineering
CE 573 Pollution in the aquatic environment
Phys 380 Molecular biophysics
Phys 381 Cell biophysics
Phys 480 Radiation biophysics
MEnv 351 Organization and Environmental change
ME 45 Manufacturing Science 6
ME 47 Analysis and Design of Manufacturing Systems
etc.

Socio-Economic Systems Option
Many large scale design projects have important socio-economic consequences. Also social and political forces may affect the design process. Under this option a student can study the various interactions between a project and its social environment.

In the option core, techniques are taught for analyzing this interaction by the use of statistics, operations research, game theory and the social sciences. Through his electives a student may pursue further various topics in the social sciences and operations research.

The distinction between free and technical electives is expected to be less clear-cut under this option than under certain others. Hence the list of technical electives is at the same time a list of suggestions for free electives.
The Option Core 3A: SD 333 Experimental Design
3B: SD 334 Metagame Analysis
4A: SD 411 Operations Research 3
4B: SD 432 Policy Studies

Option Electives (including technical electives and suggested free electives)
SD 533 Production and Inventory Control
SD 535 Queuing Models
SD 515 Networks and Combinatorics
SD 513 Mathematical Programming
MS 420 Organization Theory
SOC 339 Industrial Sociology
SOC 360 Political Sociology
SOC 315 Social Stratification
Man Env 335 Management of Environmental Resources
Man Env Government, Politics and Environmental Programmes
Man Env Seminar on Urban Environment
SD 534 Planning of Facilities
SD 536 Economic Planning Models
SD 538 Special Topics in O.R.

Systems Theory Option
In this option the student is given the opportunity to study in some depth Physical Systems Theory as it has evolved as a discipline over the past decade. Students are expected to be able to apply this theory to problems involving electrical, mechanical and hydraulic systems and their combinations. There is a considerable need for and overlap with the area of computer aided analysis and design. The concepts of systems theory are not only applicable to the systems mentioned above but also have considerable value in the understanding of wide varieties of other systems, involving both engineering and non-engineering disciplines.

Option Core Courses 3A: SD 353 Time Domain Models for Physical Systems
3B: SD 354 Algorithms for Computer-Aided System Analysis
4A: SD 451 Multi-terminal Representations and Piece-wise Analysis of Physical Systems
4B: SD 452 Introduction to Linear Control Systems

Suggested Technical Electives
SD 453 Power Systems 1
SD 455 Transportation Systems
SD 454 Hydraulic Systems
EE 425 System Simulation
SD 511 Linear Graph Theory
EE 351 Electronics
ME 502 Functions of Complex Variables
SD 512 Applications of Linear Graph Theory
EE 352 Electronics 2
ME 501 Partial Differential Equations
SD 552 Power Systems 2
SD 521 Analog and Hybrid Computing Systems
SD 522 Computer Aided Design 2
or other courses with the approval of the supervisor
### Systems Design Undergraduate Curriculum Listing by Terms**

<table>
<thead>
<tr>
<th>Term</th>
<th>Course</th>
<th>Lect.</th>
<th>Lab.</th>
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<tbody>
<tr>
<td>1A SD 111</td>
<td>Calculus 1</td>
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<td>SD 113</td>
<td>Finite Mathematics</td>
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<td>Linear Algebra</td>
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<td>Digital Computation 1</td>
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<td>SD 151</td>
<td>Physics 1</td>
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<td>SD 181</td>
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<td>SD 001</td>
<td>Focal Issues in Contemporary Society</td>
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<td>2B SD 212</td>
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<td>4</td>
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<tr>
<td>SD 282</td>
<td>Mechanics of Deformable Solids</td>
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<td>Systems Design Laboratory 2</td>
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<tr>
<td></td>
<td>1 Free Elective</td>
<td>3</td>
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<td>0</td>
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<tr>
<td></td>
<td></td>
<td>13</td>
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<tr>
<td>3A SD 311</td>
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<td>SD 331</td>
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<td>SD 381</td>
<td>Materials Engineering</td>
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<td>SD 351</td>
<td>Physical Systems 2</td>
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<td>0</td>
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<td>SD 361</td>
<td>Systems Design Workshop 3</td>
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<td>4</td>
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<tr>
<td>SD 391</td>
<td>Systems Design Laboratory 3</td>
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<td></td>
<td>1 Technical Elective</td>
<td>2</td>
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<td>1 Free Elective</td>
<td>3</td>
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<td>7</td>
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3B SD 312 Operations Research 2  2  0  0
SD 322 Computer Simulation of Systems  2  0  0
SD 362 Systems Design Workshop 4  0  4  2
SD 382 Applied Electronics  2  0  0
SD 384 Thermodynamics  2  0  0
SD 392 Systems Design Laboratory 4  0  3  0
   1 Technical Elective  2  0  0
   1 Free Elective  3  0  0
   13  7  2

4A SD 421 Computer-Aided Design 1  3  0  0
SD 461 Systems Design Workshop 5  0  6  0
   1 Free Elective  3  0  0
   3 Technical Electives  9  0  0
   15  6  0

4B SD 432 Macro-Economic Analysis and  3  0  0
   Public Policy
SD 462 Systems Design Workshop 6  0  6  0
   1 Free Elective  3  0  0
   3 Technical Electives  9  0  0
   15  6  0

Option Core Courses

3A Computer Systems Option: M 240(b) Non-numeric Applications in
   Computer Science
Human Systems and Design Option: SD 341 Human Engineering and
   Rational Design
Socio-Economic Systems Option: SD 333 Experimental Design
Systems Theory Option: SD 353 Time Domain Models for Physical
   Systems
3B Computer Systems Option: EE 324 Principles of Digital Computers
Human Systems & Design Option: SD 342 Problems of Man in the
   Operational Environment
Socio-Economic System Option: SD 334 Metagame Analysis
Systems Theory Option: SD 354 Algorithms for Computer-Aided
   Systems Analysis
4A Computer Systems Option: SD 521 Analog & Hybrid Computing
   Systems
Human Systems & Design Option: SD 541 Ergonomics of Special
   Environments
or SD 563 Aesthetic & Perceptual Aspects of Design
Socio-Economic Systems Option: SD 411 Operations Research 3
   Systems Theory Option: SD 451 Multi-terminal Representations and
   Piece-wise Analysis of Physical Systems
4B Computer Systems Option: SD 522 Computer-Aided Design 2
   Human Systems & Design Option: SD 542 Human Engineering &
   System Development
or SD 564 Methodological Processes in Design
Socio-Economic Systems Option: SD 434 Policy Studies
   Systems Theory Option: SD 452 Introduction to Linear Control Systems
Systems Design Elective Courses (not core to any option)

Term available Course

3A SD371 Introduction to Human Communication Systems

4A SD453 Power Systems 1
SD455 Transportation Systems
SD471 Communication Media
SD473 Intercultural Communication
SD475 Man-machine Communication Systems
SD511 Linear Graph Theory
SD513 Mathematical Programming
SD515 Networks & Combinatorics
SD533 Production & Inventory Control
SD535 Queuing Models

4B SD454 Hydraulic Systems
SD512 Applications of Linear Graph Theory
SD514 Multivariate Statistics
SD534 Planning of Facilities
SD536 Economic Planning Models
SD538 Special Topics in Operations Research
SD552 Power Systems 2

**All Systems Design courses below the fourth year level are given on the basis of 2 lecture hours per week.**

Note The numbering of Systems Design courses is as follows:
1) If the course is given in the “A” term the number in the units place normally is odd. Otherwise, it is even.
2) The number in the 10’s place refers to the field of the subject matter of the course, according to the following code.

1 - topics in mathematics required for Systems Design
2 - computer systems
3 - socio-economic systems
4 - human systems
5 - physical systems
6 - the design of engineering systems
7 - human communication systems
8 - engineering sciences
9 - laboratories

3) The number in the 100’s place refers to the year in the programme in which the student will encounter the course. The only exception is that courses in the 500 series are available to fourth year students.
Division of Environmental Studies
Preparation for Exhibition—1st Year Architecture Student
Division of Environmental Studies

Introduction

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

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

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

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

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

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

The School of Architecture

Architecture is the art of translating the needs, aspirations and abilities of society into the structuring of man-built shelters and their environments. It must reflect the greatness and excitement inherent in the exuberance of life and society. An architect must be the creator of buildings, systems of buildings and major segments of the physical environments within which contemporary and future society will function. The School’s overriding task is to help students become sensitive to the needs of mankind, and to the changes in these needs commanded by science and technology. The School explores a wide variety of disciplines to equip students with a correlated understanding of these disciplines to Architecture.
The school strives to be a centre for research in order to generate new knowledge and understanding of Architecture and bridge the gap between the humanities and the engineering sciences. The concepts of systems engineering and applied computer science are part and parcel of the new generation of Architects as they strive to solve the realities of human societies. Creative imagination superimposed on such a system of understanding gives these Architects their excellence. The School of Architecture, in the Division of Environmental Studies, interacts with other environmental disciplines, and draws upon the strengths of other faculties within the University.

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

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

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

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

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

Geography is concerned with both the natural and man-made environment, studying how man has shaped it to his needs, how patterns of human activities are structured over space, and how these are influenced by environmental factors. Geography is considered both a natural and social science and flourishes in an academic organization where the multidisciplinary approach is emphasized. The new Bachelor of Environmental Studies (B.E.S.) programme in Honours Geography provides students with almost unlimited freedom to choose supporting electives from across the whole university. Thus, in consultation with professors, every student will be able to have a tailor-made programme to suit his particular needs, whether he is primarily interested in physical or human geography, regional or systematic topics, or a combination of these.

Besides educating geographers for further graduate work, for teaching, or for jobs with government, industry, and planning agencies, the Geography Department makes a major contribution to the programmes in other units of the Division and other parts of the University. For example, a student registered in Arts may still take a substantial number of Geography electives. Also, the students in the Planning programme will continue to take a core of Geography courses most relevant to urban and regional planning.

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

The Department of Man-Environment Studies

This Department presents a new approach to honours-level education through its use of a significant major theme to organize a programme of study rather than one particular academic discipline or profession. The theme of man-environment interrelationships provides wide scope and considerable relevance for understanding a rapidly changing world.

The programme gives explicit recognition to the value of obtaining a broadly based education and wide perspective at the undergraduate level prior to more directed or specialized studies at later stages.

The Department is unique in having a multidisciplinary faculty whose formal education and experience ranges over a number of disciplines in the natural sciences, social sciences and the fine arts. They bring to the programme education qualifications in fields such as anthropology, agriculture, biology, communications science, earth sciences, economics, fine arts, geography, mathematics, planning, political science, psychology, sociology and social work, as well as a variety of experience in such diverse areas as the planning of education systems, ecological research, geological development, economic studies and urban affairs.

For the approach used in man-environment studies, considerable academic innovation has been necessary.

Degrees

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

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

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

Admission

The admission requirements and procedures for all programmes are outlined in detail in Chapter 2 of this Calendar. The following points emphasize some of the admission requirements which relate specifically to programmes in the Division of Environmental Studies.

Applicants From Ontario

Because of the increasing use of statistics and quantitative methods in environmental research, it is recommended that students present at least one Grade 13 Mathematics course for admission to programmes in Environmental Studies.

Interviews

Students being seriously considered for admission to the Schools of Architecture and Urban and Regional Planning are normally required to participate in an interview as part of the admissions procedure.

Registration

September 5, 6, 7, 8, 1972
September 4, 5, 6, 7, 1973

Fees

Refer to Section 3 Page 43.

Examinations and Standings

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

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

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

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

c) A student will be eligible for make-up examinations only when failure to pass is attributable to extraordinary circumstances. In addition, he 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 have secured the permission of the professor concerned.

d) Appeals against faculty decisions made under these regulations may be made in writing to the Undergraduate Affairs Committee of the Division through the appropriate Undergraduate Affairs Officer. The form of examination is at the discretion of the individual faculty member. Where final written examinations are required they shall be held at the end of a course in December or April; oral examinations may be required at the discretion of individual departments. The normal time for written examinations is three hours.

2) Standing

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

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

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

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

<table>
<thead>
<tr>
<th>Grade</th>
<th>Numerical Weight</th>
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<tbody>
<tr>
<td>A+</td>
<td>95</td>
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<tr>
<td>A</td>
<td>89</td>
</tr>
<tr>
<td>A-</td>
<td>83</td>
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<tr>
<td>B+</td>
<td>78</td>
</tr>
<tr>
<td>B</td>
<td>75</td>
</tr>
<tr>
<td>B-</td>
<td>72</td>
</tr>
<tr>
<td>C+</td>
<td>68</td>
</tr>
<tr>
<td>C</td>
<td>65</td>
</tr>
<tr>
<td>C-</td>
<td>62</td>
</tr>
<tr>
<td>D+</td>
<td>58</td>
</tr>
<tr>
<td>D</td>
<td>55</td>
</tr>
<tr>
<td>D-</td>
<td>52</td>
</tr>
<tr>
<td>F+</td>
<td>46</td>
</tr>
<tr>
<td>F</td>
<td>38</td>
</tr>
<tr>
<td>F-</td>
<td>32</td>
</tr>
</tbody>
</table>

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

d) To be considered in good standing in the Honours programmes, a student must maintain a cumulative over-all average of at least B− (70.0) as well as an average of at least B (73.0) in his field of specialization (unless otherwise specified in a departmental Honours programme). If an Honours programme candidate's average falls below the prescribed minimum, he or she can be given conditional standing if in the opinion of the School or Departmental Promotions Committee he or she can attain Honours standing before graduation. If not, he or she will be considered a candidate for the degree in the General programme and the regulations in (e) below will apply.
e) To be considered in good standing in the General programme, a student must maintain a cumulative over-all average of at least C—(60.0) as well as an average of at least C (63.0) in his field of specialization. If at any time a student's over-all average falls below C—(60.0) or his average in his field of specialization below C (63.0), he will be granted conditional status for one year, during which period he must make reasonable progress toward obtaining good standing or he will be asked to withdraw. A student whose cumulative over-all average falls below D (53.0) may continue only with the permission of the Undergraduate Affairs Committee.

f) The only general programme in the Division is the General Geography programme. The B.E.S. programme in the School of Architecture is a pre-professional programme. A regular (full-time) student in the General programme must in each academic year enrol in at least five courses, but in not more than six. A regular student in the Honours programmes must each year enrol in at least six courses (unless otherwise specified in a departmental Honours programme), but in not more than seven.

g) Students may be enrolled for reduced programmes after obtaining the approval of the appropriate Undergraduate Affairs Officer. While such reduced programmes are intended to provide greater flexibility, no degree at the Honours level shall be granted to a student who has not completed at least one year (other than year one) of his academic work as a full-time student in the Honours Programme.

h) Even while otherwise in good standing, a student who fails more than two full-credit courses or the equivalent over the academic year may be required to withdraw regardless of his cumulative average.

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

3) Additional Regulations, School of Architecture

Examinations and Promotions

To pass from one term in the B.E.S. and B.Arch programmes to the next term it is necessary for the student to:

1) obtain an over-all average of 60.0 in any term.
2) fail not more than two courses; a passing grade in any course is D—.

The following procedures have been set out for those students who have not met the above conditions.

Failing average

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

Supplementary Examinations

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

Incomplete Marks

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

Deferred Examinations

Arrangements will be made in accordance with University policy.

4) Appeals

Appeals against faculty decisions (whether dealing with grades or with the application of any other Division rules) made under these regulations may be made to the appropriate Undergraduate Affairs Officer or the Undergraduate Affairs Committee of the Division.
Academic Programmes

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

Course and Programme Changes

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

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

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

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

e) Students may reduce their programmes below the specified minimum only upon the recommendation of the undergraduate officer of their major department.

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

Environmental Studies Courses

Some courses are offered in the Division of Environmental Studies under an Environmental Studies heading. These courses are integrative in nature and extend across the academic interests of the Division. They are Env.S. 195* – Environmental Problems; Env.S. 200* – Field Ecology; Env. S. 358* – Environmental Pollution; Env. S. 380*/381* – Environmental Studies Workshop; Env. S. 400 – Environmental Law. Full course descriptions are given in Section 16 of the Calendar under the heading Environmental Studies.
School of Architecture

Philosophy of the School of Architecture

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

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

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

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

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

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

Degrees

The pre-professional architecture programme comprises six academic terms of study and three, four-month co-operative work terms† leading to the degree, Bachelor of Environmental Studies. This degree indicates appropriate preparation for four subsequent academic terms of study and two co-operative work terms†, one four months and one eight months, leading to the degree, Bachelor of Architecture (B. Arch).

†See section on Co-operative Programme.
Non-Architecture Students

Students not enrolled in the curriculum of Architecture may take any architectural course listed in the recommended core programme with the exception of courses in the theme area of Design. Prerequisites indicated in the course descriptions are primarily for Architectural students. For Non-Architectural students, prerequisite evaluation must be carried out by the respective teaching staff.

Bachelor of Environmental Studies Programme

The purpose of the B.E.S. Programme is to educate future architects to an understanding of the beliefs and needs of the individual and of society, and to a willingness to take an active role in creating and improving the environment; to a clarification of the interaction of seemingly unrelated disciplines, and to know the principles and values that surround the creation of any artifact; to a comprehension of the many forms of creative expression; and to an understanding of the present as a part of a historical process. The programme helps the student to predict the effects of science, technology and man's creations on the environment, and to understand that continuing studies will help the future architect to become sensitive to the needs of mankind in a never-ending cycle of change.

The programme is founded on four broad study themes:

1) the design studio, theories and methods, and a workshop for application and experimentation of theories.
2) Studies of systems and measures including computer, physical and material sciences
3) cultural history in the human environment.
4) environmental studies, including natural and human ecology

See section 16 of the Academic Calendar for course descriptions and arrangement. p. 267

Bachelor of Architecture Programme

The purpose of the Bachelor of Architecture programme is to permit the student who has earned his Bachelor of Environmental Studies degree to concentrate more deeply on courses from areas such as city and regional planning, structural synthesis, and related mechanical engineering, selected with regard to the student's capabilities and interests; and a new emphasis on architecture and parametric design, systems and computer-aided design and analysis to gain knowledge, skill and the critical sense needed to render effective his professional role as an architect. Certain courses and skills such as specification writing, estimation and quantity surveying, laws of professional practice, building bylaws, etc., will be taken as continuing education co-operatively with the Ontario Architectural Association, or other professional organizations prior to professional registration.

See section 16 of the Academic Calendar for course descriptions and arrangement. p. 267

Co-operative Programme

The Bachelor of Environmental Studies programme includes six terms of study, three four-month co-op work terms and one four-month self-arranged work term in which it is the student's responsibility to find employment. The subsequent Bachelor of Architecture programme consists of four terms of academic study and two co-op work terms, one four months and one eight months. The terms are arranged as indicated on the following chart.
Objectives of the Work Terms

At the end of the self-arranged work term of the B.E.S. programme a student should:

1) have attained some skill in non-verbal communication;
2) have identified the role in the profession for which he has aptitude and interest;
3) have become knowledgeable of the more common processes by which the man-built environment is changed.

At the end of Co-op Work Term 1, a student should:

1) have attained skill in non-verbal communication;
2) recognize the constraints of current practice;
3) have learned to perform some activity related to the roles in the profession for which he has aptitude and interest.

At the end of Co-op Work Term 2, a student should be able to:

1) detail some aspect of the man-made environment and appreciate the contribution details make to the whole;
2) demonstrate skills for professional roles;
3) reflect broadened experience in the process of creating the man-made environment.

At the end of Co-op Work Term 3, a student should be able to:

1) understand thoroughly the real-world constraints on the creative process and the methods and procedures in the current practice of the profession to be effective within these constraints;
2) demonstrate skills and maturity of judgement for the roles in the profession his interests and aptitudes have directed.

For the Bachelor of Architecture programme, at the end of Co-op Work Term 4, a student should be able to:

1) separate, organize and conceptualize some real-world aspects of the man-built environment for either a governmental agency, planning office, an industry related to architecture, a research agency involved in studying problems related to human settlements, or an architect’s office;
2) demonstrate skills and maturity in judgments based on experience.
3) reflect his broadened experience in the process of creating the man-made environment.

At the end of Co-op Work Term 5 a student should have:

1) completed all the research work related to his thesis, utilizing multidisciplinary resources and work experience;
2) broadened his experience in the process of creating the man-made environment;
3) demonstrated professional skills and mature judgments for the roles experienced.
Co-operative Work Term Schedule

Bachelor of Environmental Studies

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<tbody>
<tr>
<td>Fall</td>
<td>Winter</td>
<td>Spring</td>
<td>Fall</td>
</tr>
<tr>
<td>Term 1</td>
<td>Term 2</td>
<td>Term 3</td>
<td>Co-op</td>
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</tbody>
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Bachelor of Architecture

<table>
<thead>
<tr>
<th>1976</th>
<th>1977</th>
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<tr>
<td>Winter</td>
<td>Spring</td>
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<tr>
<td>Co-op Work</td>
<td>Term 7</td>
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</tbody>
</table>

Student must find his own employment

School of Urban and Regional Planning

Bachelor of Environmental Studies (Honours Urban and Regional Planning Programme)

Nature of the Programme

The Honours Programme in Urban and Regional Planning is offered by the School of Urban and Regional Planning, Division of Environmental Studies.

The emphasis of the programme is on Planning as a process, conceived in terms broad enough to include policy-making, research, and decision-making. The subject focus is regional, including urban-centered or core regions, in which the policy emphasis is on environmental issues; and other regional contexts, typical of the Canadian scene, in which resource potentials are not yet realized, and where development issues and problems of human adjustment are in the forefront. These features of the programme are placed in the main stream of liberal, humanist education.

The broad educational aim of the School is to prepare the student for active participation in the planning process. This leads to an approach which gives equal emphasis to the 'why' and 'how' of Planning. To make this effective, and vital, has required that a style be adopted that strives for a continuum between classroom and field experience, between Planning studies and related disciplines, and between academic studies and future professional practice.

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

The integration of planning experience into the programme is considered an important part of the education process. Students are expected to gain planning experience during the summer vacation period if opportunities are available. The School endeavours to help students find suitable work, particularly between their second and third, and third and fourth years. Appropriate experience provides the maturing prospective planner with an opportunity for a better understanding of the discipline and allows for the testing of personal leanings and aptitudes. It is hoped that through the work of the Professional Liaison Officer, the student will be brought into direct contact with the profession and will be exposed to problems typical of those encountered in practice, as well as being introduced to projects and operations far beyond the scope of any university laboratory.

In seeking assistance for finding meaningful planning experience, students will be asked to give permission for the release of their marks to employers.

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

### Notes

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

**Note 2** To enter Year 2 of the Honours Planning Programme, a student must obtain a minimum overall average of B— and a B in Planning 100, and must obtain credit standing in 6 full courses. In subsequent years, a student must maintain a cumulative, overall average of B— as well as an average of B in his required Planning courses.

**Note 3** Students interested in the Political Science electives: Pol.Sci. 330 and 340 are advised to first complete an introductory course from Pol. Sci. 115*/116*, or Pol. Sci. 260.

**Note 4** Planning 307* may be taken in Year 2 or Year 3.

**Note 5** Students selecting the Quantitative Methods elective in the Fourth Year are required to select Planning 319*; and, if they wish, any of Planning 316*, 317*, 318*.

**Note 6** Planning 156* (fall and winter terms) and Planning 342* and 343* are intended for students in other disciplines.

**Note 7** Not all the courses listed below are offered each year. Students should consult the School prior to registration.

**Note 8** The number of hours of lectures shown after the course description is an attempt to indicate the "normal"; each instructor determines how often his particular class will meet.
<table>
<thead>
<tr>
<th>Year 1</th>
<th>Required Planning Courses</th>
<th>Elective Planning Courses</th>
<th>Required Other Courses</th>
<th>Other Electives</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Plan 100 - Introduction to Planning Concepts and Methods (1 credit)</td>
<td>Plan 158* - Special readings in Planning—chosen in consultation with instructor. (½ credit) Plan 159* - Graphics for Planning (½ credit)</td>
<td>Geog. 101* - Introduction to Human Geography or Env.S. 195* - Introduction to Environmental Problems Geog. 102* - Introduction to Physical Geography Econ. 101* - Introduction to Economics Econ. 102* - Introduction to Economics An introductory course offered by the Sociology Department.Introductory Philosophy or Political Science. (A total of 3 or 3½ credits)</td>
<td>1½ or 2 courses depending on whether Philosophy or Political Science is elected. Electives may be chosen from Elective Planning courses or from any available credit courses offered by the University in general. The following are suggested: - Math - Computer Science - Man-Environment - French or any other language - Biology - Earth Sciences - Music - Drama - Civil Engineering</td>
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<p>| Year 2 | Env.S. 200* - Field Ecology Plan 255* - Planning Surveys and Analysis Plan 256 - Principles of Environmental Design Plan 271* - Introduction to Quantitative Research Methods (2½ credits) | Plan 258* - Special readings in Planning Plan 222* - Canadian Regional Issues (Geog. 322* - Regional Geography of Canada, may be substituted). Plan 272* - Computer Programming and Selected Terminal Systems Plan 307* - Social Survey Techniques | Geog. 270* - Introduction to Cartography and Air Photo Interpretation. (If Plan 159* was taken in Year 1, then Geog. 275* Introductory Air Photo Interpretation will be taken instead of Geog. 270*) Geog. 202* - Some Basic Topics of Economic and Urban Geography A full-year course with a Sociology theme is required in Year 2 or Year 3. If taken in Year 2 this will reduce the number of other electives to 1½ courses. | 2½ courses including any elective Planning courses. Electives may be chosen from any available courses offered by the University for which the student has the prerequisite. The following are suggested: - Economics - Anthropology - Geography - Man-environment - Political Science |</p>
<table>
<thead>
<tr>
<th>Year 3</th>
<th>Required Planning Courses</th>
<th>Elective Planning Courses</th>
<th>Required Other Courses</th>
<th>Other Electives</th>
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<tr>
<td></td>
<td>Plan 300 - Seminar/Workshop in Urban and Regional Planning</td>
<td>Plan 301* - Planning Design Projects</td>
<td>A full credit course or two ½ credit with a sociology theme are required in years 2 or 3 in addition to the Introductory course taken in Year 1. Courses may be selected from: - Plan 314* - Plan 332* - Plan 333* - Plan 415* or Sociology courses offered by the Department of Sociology and Anthropology.</td>
<td>Two courses including any elective planning courses other than those included in the 4 required courses – see note under required Planning courses and such courses as the following: Economic Issues Geography 310*/311* Urban Issues Geography 330*/351* Recreation Issues Geography 410* Philosophy of the City Philosophy 425 or any other courses in the student's field of interest.</td>
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<td>Plan 307* - Social Research Techniques, if not taken in Year 2.</td>
<td>Plan 314* - Urban Society Statistics</td>
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<td>Plan 391* - Field Research Methods and Projects</td>
<td>Plan 316* - Multivariate Statistics</td>
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<td>Field Trip related to Plan 300. Also courses chosen from the Elective Planning courses to make a total of 4.</td>
<td>Plan 317* - Nonparametric Statistics</td>
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<td>Plan 318* - Spatial Analysis</td>
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<td>Plan 319* - Regional Planning Techniques</td>
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<td>Plan 332* - The Sociology of Regions</td>
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<td>Plan 333* - The Sociology of Regional Planning</td>
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<td>Plan 344* - Principles of Recreation Planning</td>
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<td>Plan 357* - Conservation and Resource Management</td>
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<td>Plan 358* - Regional Planning and Development</td>
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<td>Plan 414* - Housing Policies</td>
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<td>Plan 415* - The Small Group in the Planning Process</td>
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<td>Plan 470* - History of Urban Planning</td>
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<td>Plan 475* - Projects, Problems and Readings in Planning</td>
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<td>Plan 476* - Projects, Problems and Readings in Planning</td>
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<td>Year 4</td>
<td>Plan 456 (2 credits)</td>
<td>As Year 3</td>
<td>None</td>
<td>Two full-credit courses in student's field of interest.</td>
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<td></td>
<td>Plan 480 (2 credits)</td>
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<td>Plan 490 (4 credits)</td>
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Department of Geography

Bachelor of Environmental Studies
(Honours Geography Programme)

Undergraduate Geography Courses

Note 1 All courses are open to any student from any Faculty or School of this University whenever prerequisites are met.

Note 2 The Department of Geography offers General and Honours programmes both in the Faculty of Arts (B.A.) and the Division of Environmental Studies (B.E.S.). Joint honours programmes with any other subject in the University may be arranged subject to departmental approval. Some examples of such programmes may be seen under the Faculty of Arts programme section earlier in the calendar.

Note 3 The letter R designates courses given through Renison College.

Note 4 Geog. 101* and Geog. 102* are given in both fall and winter terms. It is immaterial which of these course is taken first, neither is sequential to the other.

Note 5 A full credit can be either a course of two terms duration or two separate courses each of one term duration.

Nature of the Programme

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

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

Although the programme is broad in scope, it permits a student to specialize in one of three major aspects of the discipline: physical, economic-urban, or cultural-regional geography. Advanced elective courses are available in each of these three streams, and further concentration is possible by careful selection of courses from related fields in other parts of the university.

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

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

Honours Geography

Year 1
Geography 102* Introduction to Physical Geography

and one but no more than three of:

Geography 101* Introduction to Human Geography
Environmental Studies 195* Introduction to Environmental Problems
Geography 110* Tutorial in Geography
Geography 125R* Introduction to the Developing World
Geography 126R* The Emerging “Third World”
Geography 127* Regional Problems of Eastern Europe and the Soviet Union.

Plus additional credits chosen after consultation with the department so that the student has 6 full credits. Note that all of these courses (except Geography 110*) are available to any student in the University.

Year 2
Environmental Studies 200* Field Ecology
Geography 201* Climatology and Geomorphology
Geography 202* Economic and Urban Geography
Geography 260* Cartography
Geography 275* Air Photo Interpretation
Geography 271* Introduction to Quantitative Research Methods

and one of:

Geography 203* Cultural and Regional Geography
Geography 232* Geography of Population
Geography 320 World Regional Geography

and additional credits so that a student should have completed by the end of second year, 11 full credits.

Year 3
Geography 391* Field Research
Two and one half credits of geography electives.
Two credits chosen after consultation with the Department.

Year 4
Geography 481* Frontiers of Geography
Geography 490 Senior Honours Essay

and additional credits so that a student should have a minimum of 21 full-credits.

* An asterisk indicates a half-credit course.

Note 1  While twenty-one full credits is the minimum required for the degree of Bachelor of Environmental Studies (Honours Geography), students may take an enriched programme of up to twenty-four full credits maximum.

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

Note 3  Students must take a minimum of five full credits in Faculties or Schools other than the Division of Environmental Studies.
Note 4 To enter Year 2 of the Honours Geography programme, a student must achieve in Year 1 a minimum overall average of B- (70.0) and an average of B (73.0) in his/her Geography courses. In subsequent years, a student must continue to achieve an overall average of B- (70.0) and an average of B (73.0) in his Geography courses.

Note 5 It is recommended that all honours students concentrate their studies in third and fourth year. The department offers specialized Streams in (a) Applied Physical Geography (b) Economic Geography (industrial resources, rural, and urban aspects) (c) Regional/Cultural Geography. Additional courses in areas of specialization can be obtained from other disciplines in the University.

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

Note 7 Students intending to teach in Secondary Schools are advised to take at least two full credit or equivalent Regional Geography courses.

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

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

Note 10 For some courses participating students may be expected to make a small financial contribution to defray heavy equipment/travel costs, e.g. Geog. 391* (Field Camp), which is mandatory for all third year honours students and make-up students. The Department will pay transportation and accommodation, but not meals.

Joint Honours Joint Honours programmes exist between geography and several other departments in the University. Detailed programmes have been worked out with Anthropology, Canadian Studies, Earth Science, Economics, English, History, Man-Environment Studies, Mathematics, Political Science.

For details of these programmes students should contact the undergraduate officer of the appropriate departments. Geography students may also arrange a joint honours programme with any other discipline in the university provided that the joint programme is approved by both departments concerned.

General Geography Programme

Year 1 Geography 102* Introduction to Physical Geography

and one of, but not more than three of:

Geography 101* Introduction to Human Geography
Environmental Studies 195* Geography and Environmental Problems
Geography 110* Tutorial in Geography
Geography 125R* Introduction to the Developing World
Geography 126R* The Emerging “Third World”
Geography 127* Regional Problems of Eastern Europe and the Soviet Union

Four credits selected in consultation with the Department. (Note that all of these courses (except Geog. 110*) are available to any student in the University.)
Department of Man-Environment Studies

**Year 2**
- Environmental Studies 200* Field Ecology
- Geography 201* Climatology and Geomorphology
- Geography 202* Economic and Urban Geography

one of:
- Geography 203* Cultural and Regional Geography
- Geography 232* Geography of Population
- Geography 320 World Regional Geography

and additional credits so that a student should have completed by the end of second year 10 full credits.

**Year 3**
- Geography 381* Nature of Geography

Three courses selected in consultation with the Department.

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

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

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

**Note 4**
Students must maintain an overall average of C— (60.0) with an average of C (63.0) in their geography courses.

**Geography Minor for Honours Students in Other Faculties**
The requirements are the same as those noted on The General Geography Programme.

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**Department of Man-Environment Studies**

**Bachelor of Environmental Studies**
*(Honours Man-Environment Studies Programme)*

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

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

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

By making some of its elective courses available to students based elsewhere in the university, the Department gives encouragement to the development of an environment-oriented outlook among students whose primary interest otherwise lies in some one particular discipline or profession. The Department can also play a useful function in provided an interdisciplinary focus whereby on-going research in a number of departments in several faculties of the university could be related in a problem-oriented manner. From the point of view of society in general, the programme offers an educational opportunity which many of today's students find more challenging than some traditional alternatives. The programme being developed is one which encourage students to acquire an intellectual acumen that is not artificially constrained by academic disciplinary boundaries, to obtain a considerable degree of understanding of complex environmental problems, and to develop some of the technical and other pre-requisite skills which are related to their solution. To the extent the programme succeeds in doing this, it would provide for society a type of well educated person who in due course could usefully contribute to the policy-making function in the public service or in the private sector, or serve particularly well the role of advocate, critic, or initiator in the continuous process of social change and adjustment.

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

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

**Year 1**
- M.Env. 120*/121* Environmental Issues and the Natural Sciences
- M.Env. 130*/131* Environmental Issues and the Social Sciences
- M.Env. 150*/151* Environmental Issues: Research and Analysis
- M.Env. 190*/191* Seminar-Workshops
  - *Electives:* Two full credits: Four half-year courses or equivalent

**Year 2**
- Env. S. 200* Field Ecology
- One of M.Env. 240* Small Groups and the Environment
- M.Env. 241* Social Change
- or any half-year course in the social sciences
- M.Env. 271* Quantitative Techniques for Environmental Problems
- M.Env. 290*/291* Seminar-Workshop
  - *Electives:* Three and one-half full credits: seven half-year courses or equivalent

**Year 3**
- M.Env. 390*/391* Seminar-Workshop (Credit value 1 or 2 by consent of faculty)
  - *Electives:* Three or four full credits: six or eight half-year courses or equivalent

**Year 4**
- M.Env. 490*/491* Seminar-Workshop (Credit value 1 to 3 by consent of faculty)
  - *One credit of:* M.Env. 410 Honours Seminar: Natural Resources Management
  - M.Env. 420 Honours Seminar: Community Environments
  - M.Env. 430* Honours Seminar: International Cooperation on Environmental Problems
  - M.Env. 431* Honours Seminar: Comparative Approaches to Environmental Management
  - M.Env. 440 Honours Seminar: Communication and Education
  - M.Env. 450 Honours Seminar: Environmental Design
  - *Electives:* One to three full credits: two to six half courses or equivalent

**Note 1**
Students wishing to enrol in M.Env. 390*/391* and 490*/491* for more than one credit will submit a proposal to the faculty outlining the nature and scope of project to be undertaken.

**Joint Honours:** Joint Honours programmes exist between Man-Environment and Anthropology, and Man-Environment and Geography. For details of these programmes students should contact the undergraduate officer of the appropriate departments. Man-Environment students may also arrange a joint honours programme with other disciplines in the university provided that the joint programme is approved by both departments concerned.
11

Integrated Studies Programme
Programme of Integrated Studies

The programme is designed to be largely student initiated and student oriented. The student may set his own goals and proceed toward them by whatever means he deems fit. He may integrate his areas of interest through independent research, course work, seminars and tutorials, special projects and field work, or any combination of the above.

The student’s resources are many. There are resource people assigned within the unit for the purpose of guiding him toward integration of the material he gathers; there is the valuable interchange and interaction between himself and his fellow students in the unit and there is the opportunity to turn to the wider University community for knowledge. All the resources of the University are available to him, subject only to the limitations of time and space. Resource people conduct seminars, are available for tutorials on an individual basis and will help direct a student’s work if he so wishes.

The Integrated Studies programme has quasi-faculty status in that it is responsible to Senate via a subcommittee (the Senate Council for Integrated Studies), which functions similarly to a faculty council and is composed of ten faculty members from the University community at large and six members from Integrated Studies including students and/or resource persons. The Senate Council is responsible for administering the programme.

Year One Each student, towards the end of the first year, submits a brief review of his work and activities. This can take any form, but should include a factual description. A committee of students, faculty and resource persons studies the student’s presentation and makes recommendations which may include advice as to how to proceed in following years, or whether or not to pursue course work or independent study. These recommendations are advisory and are not binding on the student.

Year Two Towards the end of the second year in Integrated Studies, the student prepares a descriptive summary of his first two years which becomes part of his permanent record. A review committee will advise and consult and submit a written recommendation as the committee does at the end of Year One. If the committee recommends that a student withdraw from further work in Integrated Studies, the decision can be appealed.

Year Three If the degree of Bachelor of Independent Studies is desired, a student applies to the Senate Council for Integrated Studies to be considered for a degree. An examining committee (whose membership is chosen by the student in consultation with the Council and includes at least one examiner from outside the University) reviews the student’s work and examines the candidate. Each student may demonstrate his merit in whatever way he finds most suited to the nature of his work and his approach to it.
Admission Requirements  The admission requirements and procedures for all programmes are outlined in detail in Chapter 2 of this calendar. The following points emphasize some of the admission requirements which relate specifically to the Integrated Studies Programme.

Applicants to Integrated Studies are admitted on the basis of a personal interview with a committee composed of students and faculty. General University admission standards are applicable, although consideration will be given to those not possessing these minimum requirements. Applicants showing the strongest aptitude for self-direction and independent study and the ability to flourish in an unstructured academic setting will be given first consideration. Students are normally admitted only in September.

Admission procedure information may be obtained by writing directly to the Assistant Registrar for Integrated Studies.

Note  Since this material was prepared for the calendar, the structure and operation of Integrated Studies has been under review by the University Senate. Details concerning the changes in the programme are available from the Assistant Registrar, Integrated Studies.
The Inter-Faculty Programme Board

The Inter-Faculty Programme Board of the University of Waterloo was established by the Senate in 1970 in response to a particular need. It was felt that the University should offer a number of broadly structured courses covering wide areas and designed, not so much to prepare students for further work in a concentrated area or discipline, as to contribute more generally to their educational development. These are the kinds of courses that the Inter-Faculty Programme Board will make available.

The Board, whose membership is broadly representative of Faculties, Divisions, and Colleges, will sponsor a variety of multi-disciplinary courses available as electives to students throughout the University. In addition, the Board, when invited to do so, will assist in implementing certain non-specialist courses that Faculties may request for students in particular programmes. From time to time the Board will sponsor seminars, colloquia, and lectures on topics of broad general interest to the University at large. Also under consideration at the present time is the possible introduction of clusters of thematically related courses.

Courses offered by the Inter-Faculty Programme Board are intended to enrich existing University offerings, to provide a multi-disciplinary context within which students may deal with fundamental issues and problems confronting today's world, and to foster co-operation and awareness of others' interests and goals among the various members (students and professors alike) of the University community. Courses in Inter-Faculty Studies are concerned with the dilemmas that confront man as he approaches the last quarter of the twentieth century, and, in particular, with such urgent questions as these:

How may the university student himself contribute to solutions to urgent social problems? What tools are available to enable one to cope with the mass of information and pseudo-information encountered in the communications media? What are the dominant issues facing man today? How does one determine values appropriate for man in today's world? How can human conflict be resolved in a non-violent way? How is social justice to be achieved through social planning? In what ways can leisure contribute to the future of mankind? What sort of university is appropriate in the closing years of the twentieth century?

Each one of the following courses deals with one or more of these questions.

Courses marked * are half courses. All others are full courses.

**Arts 100 Communications**
An examination of the origins, evolution, and future dimensions of communications media designed to facilitate an understanding of the adequacies and inadequacies of media, to relate them to the purposes of human awareness, and to explore needs and means of maintaining accountable controls over the media. The course seeks to assist students in discovering the range of informational, research, and exploratory resources open to them; in gaining some preliminary experience in utilizing such resources; and in applying a critical judgment to material secured. (Arts 100 is a multi-media course offered in part on Channel 19 TV.)
The Inter-Faculty Programme Board

Arts 120*/121* Focal Issues in Contemporary Society

An attempt to bring together and condense what are believed to be essential elements of the several social science disciplines. The core of the study is a group of selected contemporary issues with implications that cut across the various disciplines. An effort will be made to discuss values appropriate for our age. Integrating concepts are personality and culture.

(Among specific issues discussed are race, class, violence, pollution, youth culture, family, the new consumerism, and democracy. Regular lectures and discussions will be supplemented by film, visiting lecturers, student-directed research, and role-playing.)

Inter-Faculty Studies 201*
Student-Initiated Workshops on Technological and Social Problems (WOTASP)

The Student-Initiated Workshops on Technological and Social Problems have been established in response to the needs felt by faculty and students at the University of Waterloo for

1) increasing the involvement of the University, as an institution with a unique concentration of knowledge, resources, and expertise, in seeking solutions to urgent technological and social problems, and
2) developing in students the ability to work with fellow students from a variety of disciplines in
   a) formulating and defining complex problems,
   b) demonstrating initiative and resourcefulness in obtaining relevant information from documents, interviews, and field work, and
   c) evaluating and weighing the relative merits of alternative solutions with a view toward constructive utilization of the findings.

Workshops are to be student-initiated, student-planned, and student-directed. Each Workshop will be set up to examine a particular problem or portion of a problem over a one-term period, and satisfactory completion of the Workshop will result in a half-course credit.

It is assumed that the idea for a Workshop will originate with a group of interested undergraduate students, who will then submit to the WOTASP Coordinator, preferably before the start of the term, a one-page statement presenting the problem that is to be the subject of investigation. The statement should outline
   a) the problem,
   b) some possible approaches that might be used within the Workshop,
   c) suggestions as to how the findings might contribute to a constructive solution to the problem,
   d) references to relevant information sources, research reports, and publications,
   e) a statement from each faculty resource person (if possible, more than one) who has agreed to consult with the students as necessary,
   f) a list of resources needed (technical apparatus, paper materials, and other items),
   g) proposed grading criteria, and
   h) names and telephone numbers of students interested in enrolling in the Workshop.

The Inter-Faculty Programme Board will provide, as necessary, consultation and advice to the students on all aspects of the proposal, including assistance in locating resource persons and other students with similar interests. Normally, no fewer than three students will be involved in any Workshop. It will be the responsibility of the faculty resource persons to evaluate student performance and assign grades, in consultation with the Coordinator.

Further details may be obtained from the WOTASP Coordinator.
Inter-Faculty Studies 220 Social Philosophy and Social Justice
This course provides partly an introduction to, and partly an overview and synthesis of, social philosophy and the social sciences. The unifying themes are the continued emphasis on normative questions and foundational and methodological questions about social philosophy and social science. Although all the social sciences are touched upon, somewhat more emphasis is given to politics, economics, sociology, and anthropology than to psychology as such. In general, questions are raised via normative issues, especially the issues of social justice; and, through interaction, the idea of social planning becomes prominent.

Inter-Faculty Studies 230* Nonviolence and Political Reality
This course will concentrate on the question of the possibility of a nonviolent approach to resolving human conflict, with special emphasis on the nature and uses of power, the nature of the nation state, and the problem of relating a personal ideal to the realities of communal life. (First-year students admitted with permission of the instructor.)

Inter-Faculty Studies 240* Man, Leisure, and Society
Leisure from both historical and contemporary perspectives: leisure as viewed by the Utopians—the dream versus the reality; as a class phenomenon; as non-work; as culture—pop and otherwise; and as a problem.
Leisure and social institutions: the family, the school, the church, the polity, the economy. Leisure and the future of man.

Inter-Faculty Studies 320* The Universities in Transition
This course will attempt to formulate the ideas and concepts that gave shape to the aims and purposes of the university in particular times and particular places in the West and to trace a pattern in the changing and evolving goals of the university from the rise of the European universities in the Middle Ages to the period of accelerated growth of universities in Britain, Canada, and the United States in the mid-twentieth century. Emphasis will be given to a critical examination of developments during the past quarter century. Finally, the course will attempt to suggest a description of appropriate university structures for our time and place.

Inter-Faculty Programme Board
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Members of the Board
Inter-Faculty Programme Board

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R. G. Woolford, M.Sc. (Western), Ph.D (Illinois) Faculty of Science

Associated Faculty
D. R. Gordon, B.A. (Queen's), M.A. (Toronto) Associate Professor (Arts 100: Communications)
J. E. Robinson, B.Sc. (Waterloo) Instructor (Coordinator of Workshops)

Inquiries concerning Inter-Faculty Studies should be addressed to the office of the Director, Inter-Faculty Programme Board.
Faculty of Mathematics
Mathematics High School Lecture given by Co-operative Student
Faculty of Mathematics

The Faculty of Mathematics of the University of Waterloo was inaugurated as a separate faculty in 1967. General and Honours programmes in Mathematics had been offered through the Faculties of Arts and Science for a number of years and the continued growth and development of these programmes made it natural to unite them under one faculty. At the same time, this unification has led to greater flexibility in the choice of overall programmes.

The Faculty of Mathematics is a close association of the Departments of Applied Analysis and Computer Science, Applied Mathematics, Combinatorics and Optimization, Pure Mathematics, and Statistics. Programmes in each of these areas are offered, commencing in the third year of study, to honours students of Mathematics.

The Graduate school in the Faculty is very active. A large number of graduate degrees have been conferred and active research is carried on in many areas. For information governing Graduate Programmes, please see the University of Waterloo Graduate Studies Calendar.

St. Jerome's College also offers some of the courses leading toward the B. Math. degree in conjunction with the University, applicants may register for the regular programmes (not co-operative) through St. Jerome's College.

Students in the Faculty of Mathematics may take a three-year Pass Degree programme, a four-year General Degree programme, or a four-year Honours Degree programme. The Co-operative Mathematics programme is merely a rearrangement in the scheduling of academic terms so as to permit considerable practical experience.

Students who successfully complete programmes in the Faculty of Mathematics will be awarded the degree of Bachelor of Mathematics (B. Math.) by the University. A student may, as the programme descriptions on pages 192 to 194 show, specialize in various areas within the departments of Applied Mathematics, Combinatorics and Optimization, Pure Mathematics, or Statistics. (See page 203.)

Faculty of Mathematics Brochures

The Faculty publishes two brochures, one of which is specifically designed as an information booklet for high-school students in Ontario. Copies of this booklet are available in high-school guidance offices.

The second brochure which summarizes admission procedures and programmes information is designed to assist 'Out of Province' applicants. Copies may be obtained upon application to the Registrar.

Admission

The admission requirements and procedures for all programmes are outlined in detail in Chapter 2 of this Calendar. The following points emphasize some of the admission requirements which relate specifically to programmes in the Faculty of Mathematics.
Faculty of Mathematics

Applicants from Ontario Grade 13

Applicants must present the following Mathematics courses – Relations and Functions, Calculus, and Algebra in their overall Grade 13 programme.

Admission As An Adult Student

It is recommended that applicants attempt to obtain standing in Ontario Grade 13 Mathematics courses or their equivalent.

Advanced Standing

Students being re-admitted to the Faculty of Mathematics or accepted by transfer from other faculties at the University of Waterloo will normally be given credit for a course taken if the mark obtained was (1) at least 60% for Mathematics courses, (2) at least 50% for other courses.

Students accepted by transfer from other universities will be given credit for a course taken if the mark obtained was at least 60% or equivalent.

The places available in Year 2A of the Co-operative Mathematics Programme into which non-Co-operative students may transfer are normally reserved for Regular Mathematics students who apply to transfer into the Co-operative Programme from Year 1.

Part-Time Studies

Any candidate wishing to apply as a part-time student may be allowed to take a maximum of two courses per session as a non-degree student. If the applicant wishes to take courses on a regular basis toward a B.Math degree, the regular admission requirements must be met.

Procedures for making application are as previously outlined.

On Campus Courses

Although the Faculty of Mathematics does not as a general rule offer courses on the campus in the evenings, it does allow students to take courses on a part-time basis. In such cases it is the responsibility of the student to ensure that the course(s) he wishes to take are offered at a time at which he can attend classes. Information is available from the Assistant Registrar, Mathematics, University of Waterloo.

In the past the Faculty of Mathematics has offered courses during the Summer Session. Since these courses are not offered unless the demand warrants it, applicants are advised to express an interest in summer courses as early as possible. Although the courses are primarily offered to assist Secondary School teachers in upgrading their teaching qualifications, other students may be allowed to enrol.

Summer students are not encouraged to take more than one full course each session.

Correspondence Courses

The University of Waterloo offers a number of Mathematics courses by correspondence. This is a unique offering in that lectures are recorded on magnetic tape. The tapes are accompanied by diagrams and worked examples.

Persons interested in obtaining information on courses offered by correspondence may do so by writing to:

The Director
University of Waterloo Correspondence Programme,
c/o Department of Physics,
University of Waterloo,
Waterloo, Ontario.
Telephone: (519) 885-1211 (Extension 2430, 2196, or 2410)
Standings and Promotions

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

Since September 1970, the Faculty has been operating under a "course credit system" in which student progress will be measured by courses successfully completed rather than by years. A student who has passed fewer than Five courses is considered a first-year student. A student who has passed at least Five courses, but fewer than Ten is considered a second-year student; at least Ten but fewer than Sixteen a third-year student; Sixteen or more, a fourth-year student.

The following regulations govern the practice of the Faculty in regard to standings, promotions, and supplemental examinations:

1) All examination results are considered by the Faculty Committee on Standings and Promotions and, subsequently, by Faculty Council and are then issued to individual students by the Registrar.

2) At the end of each academic year a student's standing is determined by the cumulative average of all courses, previously taken at the University of Waterloo, whether passed or failed. To proceed in good standing requires a minimum cumulative average of 50% overall and 55% in Mathematics. If a student fails to meet the above required averages the Committee on Standings and Promotions may admit the student to a probationary year. If the student fails to improve his average he may be required to withdraw from the Faculty. Normally a student will not be allowed more than one probationary year.

3) In addition to the numerical scale 0-100, the following designations may be used from time to time.

INC (term work, lab. work, examinations, etc. are incomplete).
AEG (aegrotat – signifying the student's work or examination was incomplete for some acceptable reason (such as illness) and his instructor felt the student should receive credit for the course but a numerical mark could not be set).
CR (credit granted – in rare cases not covered by AEG).
NMR (No mark reported).
DEF (deferred examination officially permitted).
AEG or CR will count as a course passed towards the total necessary but will not count in the cumulative averages.
INC or DEF will indicate a situation that will have to be resolved to the satisfaction of the Standings and Promotions Committee.

4) Full time students are required to take a minimum of five courses (except in their terminal year). No course may be dropped later than one month prior to the end of lectures in the term/year of the course. (N.M.R.'s will automatically count as zero in the cumulative averages.)
5) Cases may arise where a student passes a course but would like to repeat it in order to raise his mark. This may be done but both marks will show on his record and both marks will be counted in the cumulative average and the course will count only once toward the total number of required courses for a degree.

6) Failed non-compulsory courses need not be repeated but may be replaced by some other non-compulsory course.

7) If a student fails to write an examination for medical reasons, a doctor's certificate covering the precise period must be filed in the Office of the Registrar before the end of the examination period.

8) All examinations which receive a failing mark are automatically re-read.
   Any student wishing to appeal his mark(s) must do so by contacting the Registrar's Office within one month of the official announcement of term or year marks. There will be a charge of $5.00 per course appealed, to be refunded if the mark is raised.

9) A student may normally spend only four academic years to complete a three-year programme or five academic years to complete a four-year programme.

10) After four years students must have completed the requirements at least for the Pass degree. Within five academic years the student must apply for the award of a particular degree by filling out an "Intent to Graduate" form. In doing so he presents the courses considered to satisfy the requirements for the degree. If, at the end of five years, a student has fulfilled the requirements for two or more degrees he will be awarded the highest degree (Pass, General, Honours).

11) Continuance in the Co-operative programme is contingent upon acceptable performance on work terms.

12) A student may withdraw from the University up to and including the last day of lectures without being held responsible for that term's/year's courses.

Degrees

Mathematics Degrees
The interests of students majoring in mathematics range from those desiring a very general education with an emphasis on mathematics to those wanting a very intensive programme leading to graduate study in mathematics. In order that each student may select that degree programme suiting his own requirements, the Faculty of Mathematics offers three Bachelor of Mathematics (B. Math.) degree programmes; Pass, General, and Honours.
Degrees

Degree Programme

<table>
<thead>
<tr>
<th></th>
<th>Pass</th>
<th>General</th>
<th>Honours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Total Credits</td>
<td>16</td>
<td>21</td>
<td>24</td>
</tr>
<tr>
<td>Minimum Math Credits</td>
<td>6</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Minimum Non-Math Credits</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Optional Credits (Math or other)</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Minimum Overall Average</td>
<td>50%</td>
<td>50%</td>
<td>60%</td>
</tr>
<tr>
<td>Minimum Math Average</td>
<td>55%</td>
<td>55%</td>
<td>65%</td>
</tr>
</tbody>
</table>

Note 1  Credit refers to a normal eight-month (two-term) course. A one-term (four-month) course counts as 1/2 credit.

Note 2  The averages referred to in the table include all courses taken at the university, whether passed or failed.

There are certain Faculty minimum course requirements for a B. Math degree. Each student proceeding toward a Pass Degree must have credit in at least Maths 119, 120, and 132 (or the honours course equivalents). A student proceeding to a General Degree must have, in addition to these, credit in Maths 217, 219, 312, and 319 (or the honours course equivalents). A student proceeding to an Honours Degree must have credit in Maths 129, 130, 132, 229, 233, 237, 329 or 341 and 332 or 342-343. He must also complete certain Departmental requirements before acquiring the Honours Degree. These are discussed in the section on Programmes.

The essential difference in the three degrees is in the number of mathematics courses taken and the number of these which are specified. A student is not required to state in advance which degree he is seeking, although his selection of mathematics courses can determine his eligibility for an Honours Degree as early as his first year. In the selection of which degree he wishes to pursue, a student will thus be guided by the amount and intensity of mathematics he wishes. He will also be guided by his intended vocation after graduation. For example, a person who wishes to study extensively in mathematics, specializing in one particular area such as computer science, and possibly going on to post-graduate study, will certainly require an Honours Degree. A person who wishes to study less intensively, and who wishes to acquire a fairly broad understanding of a number of mathematics areas will most likely take a General Degree. That person who desires a more limited knowledge still, where he prefers mathematics as a major but also wishes to include a number of liberal arts or science courses, will probably elect a Pass Degree. It should be noted that the Pass Degree could also be elected by a person wishing to take a number of mathematics courses but who, for one reason or another wishes to complete his degree in three years.

For each academic year, except the graduating year, a student must register in N courses where 5 ≤ N ≤ 8, and these must include at least two mathematics courses. In his graduating year, he must take two mathematics courses and at least as many other courses as are needed to satisfy degree requirements.
The normal course load in year 1 is six courses, of which three are the first year mathematics courses. The remaining three are non-mathematics electives, such as Economics, Philosophy, etc. In other years the normal load depends on the degree sought. Students seeking a Pass Degree will usually take two mathematics courses and three electives, students seeking a General Degree will usually take three mathematics courses and two electives, and students seeking an Honours Degree will usually take four mathematics courses and two electives. This means that a Pass Degree is usually completed in three years, and a General or Honours Degree in four academic years.

All required courses, with the exception of Math 132 and Math 233, are offered at the general level and the honours level. The differences between the two levels are emphasis, approach, and depth of exploration of the subject matter, with a greater emphasis on problem solving rather than theory in the general courses. Also, some topics included in the honours courses may be omitted in the general courses. However, the descriptions of general and honours courses are the same.

*Descriptions of the foregoing courses and other courses in Mathematics appear on pages 421 to 449.*

### Academic Programmes

In each of the following programmes a student must take a minimum of 5 courses and may take no more than 8 courses in each academic year. This requirement is waived in the terminal year.

A student is required to take at least two Mathematics courses in each year including the terminal year.

In his third academic year each student is expected to affiliate himself with a department.

The first year Mathematics programme is set up so that students who select Physics and Chemistry as elective courses may, on successful completion of Year 1 apply to transfer to the second year of the Faculty of Science or the Faculty of Engineering. Similarly, students who complete successfully Year 1 Science or Year 1 Engineering may apply to transfer to Year 2 in the Faculty of Mathematics.

Students who have successfully completed Year 1 Arts at the University and who have taken two of Mathematics 129, 130, 132 may transfer to Year 2 of the Faculty of Mathematics. Similarly, students who successfully complete Year 1 Mathematics may transfer to Year 2 of the Faculty of Arts.

### Credits for Elective Courses

The following courses will not be accepted for credit toward a B. Math Degree:

- Kinesiology 185, 285, 385;
- Recreation 185, 285, 385;
- Science 237; G.E. 121;
- Architecture 102, 103, 112, 113, 163;
- Arts 211, 212.

Credit will not be given for both
- Economics 300 and Math 233
- Psychology 282 and Math 233
- Sociology 202 and Math 233
Three Year Pass Degree Programme

The minimum requirements for this degree are a total of 16 courses including: A minimum of 6 Mathematics courses. A minimum of 6 electives.

The following courses are compulsory and must be included in the programme. Mathematics 119 or 129; 120 or 130; 132.

The cumulative averages required are 50% overall and 55% in the Mathematics courses.

A normal programme is described below:

Year 1 6 courses of which 2 are Mathematics courses and 4 are electives, one of which may be another Mathematics course.

Year 2 5 courses of which 2 are Mathematics courses and 3 are electives, one of which may be another Mathematics course.

Year 3 Similar to Year 2.

Four Year General Programme

The minimum requirements for this degree are a total of 21 courses including: A minimum of 12 Mathematics courses. A minimum of 6 electives.

The following courses, or the corresponding courses for Honours students, must be included: Mathematics 119; 120; 132; 217; 219; 312; 319.

The cumulative averages required are 50% overall and 55% in the Mathematics courses. A student must complete this programme in not more than five academic years.

A normal programme is:

Year 1 3 Mathematics courses and 3 electives.

Year 2 3 Mathematics courses and 2 electives, one of which may be another Mathematics course.

Year 3 3 Mathematics courses and 2 electives, one of which may be another Mathematics course.

Year 4 3 Mathematics courses and 2 electives, which may be Mathematics courses.

Students interested in one of the following areas are encouraged to incorporate any or all of the suggested courses.

Actuarial Science 235; 243; 335; 336
Computer Science 132; 240; 334; 340; 470; 471; 472; 473
Combinatorics and Optimization 239; 243; two of 351a, 351b, 351c; 351d, 352a, 352b
Statistics 233 or 243; 349; 339a or 339b; 449
Teaching Option Additional requirements:
Mathematics 300, 446.
Psyc. 241/242, Phil. 311/312, Soc. 207G.
Recommended courses include Math 239a, 239b, 240, 307, 330, 334, 425, 426.
Students in the co-operative teaching option must obtain two credits in Computer Science.
Four Year Honours Programme

The minimum requirements for this degree are a total of 24 courses including: a minimum of 15 Mathematics courses; a minimum of 6 electives. The following courses must be included: Mathematics 129; 130; 132; 229; 233; 237; 329 or 341; 332 or 342-343.

The cumulative averages required are 60% overall and 65% in the Mathematics courses. A student must complete this programme in not more than five academic years.

A programme which will provide the minimum course requirements is described below. Better students are encouraged to taken an additional elective in each of years 2, 3, and 4.

Year 1  Mathematics 129; 130; 132 and three electives.

Year 2  Mathematics 229; 233; 237. One other Mathematics course. Two electives, one of which may be another Mathematics course.

Year 3  At least four three hundred level Mathematics courses which include the Departmental requirements. Two electives, one of which may be another Mathematics course.

Year 4  Honours Mathematics students will normally take at least four four-hundred level Mathematics courses or their equivalent. Students in Joint Mathematics programmes will normally take at least two four-hundred level Mathematics year courses or equivalent. Two electives, one of which may be another Mathematics course.

It should be noted that timetables are based on recommended programmes and students deviating markedly from these programmes may encounter timetable conflicts. Each student entering Year three is to be affiliated with a department and all Honours students should consult with their department to ensure that the departmental regulations are fulfilled. Some of the departmental requirements are set out below.

Applied Analysis and Computer Science  Mathematics 240; one of 334, 340, 363; at least two of 470, 471, 472, 473.

Applied Mathematics  Four full year courses chosen from 234a, 234b, 360a, 360b, 361a, 361b, 362a, 362b, 363, 434, 462.

Combinatorics and Optimization  Mathematics 239a and 239b; two third and two fourth year course credits from the department.

Teaching Option  Additional requirements: Mathematics 300a, 300b, 446a, 446b
Psyc. 241/242, Phil. 311/312, Soc. 207G. Recommended courses include Math 239a, 239b, 240, 307, 330, 334, 425, 436.

Students in the co-operative teaching option must obtain two credits in Computer Science.

Pure Mathematics  Mathematics 341; 342; 343; 344; two four hundred level courses in Pure Mathematics.

Statistics  Mathematics 338, 339; 438; 439.

Actuarial Science  Mathematics 235; 336; 437; one of 335; 435; 461.
Joint Mathematics Programmes

Honours Applied Mathematics with Physics Minor

Year 1
- Mathematics 129, 130, 132
- Physics 121*/122* or 162*/163*
- Chemistry 121*/122*
- One elective

Year 2
- Mathematics 229, 233, 234, 237
- Physics 252*/253*, 255*
- Physics 256* or 259* or 1/2 elective

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

Year 4
- Mathematics 329, 441, two of 361, 434, 462
- Physics 435, 441*
- One Half Elective.

Mathematics – Economics Programme

Choice of Degree

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

Requirements for all students

(Other requirements will depend on which degree is taken; the student will have to add to these to meet the requirements of his faculty.)

Economics
- 101/2.
- 201/2 or 203/4.
- 231/2 or 205/6. 460.
- Three others, one of which must be 300 if Math 233 is not selected.

Mathematics
- 1) 129, 130, 229.
- 2) 237; one of 228, 233, 234, 239, 240.
- 3) Two others.

†Math 132 is a prerequisite for Math 240, and should be taken in Year 1 by students wishing to specialize in Computer Science.

Further requirements for the degree B.Math. (Mathematics and Economics)

Students entering Year 3 must have credit for the five Mathematics courses specified under (1) and (2) above. They must pass at least seven further Mathematics courses approved by one of the departments in the Mathematics Faculty.

See page 194 for Mathematics courses required for students studying toward a B.Math. (Honours).

Further requirements for the Degree B.A. (Economics and Mathematics)

Please refer to the Faculty of Arts portion of the Calendar.

Mathematics – Geography Programme

Choice of Degree

Students in Years 1 and 2 may take this programme in either faculty, but at the end of the second year, they will decide whether to continue toward the degree B.E.S., B.A. or B. Math. The programme must then be approved by both the Geography Department and by the appropriate department in the Faculty of Mathematics.
Requirements for all students  
(Other requirements will depend on which degree is taken; the student will have to add to these to meet the requirements of his faculty.)

**Geography**
101/2, 202/1, 202/3, 375. Three others.

**Mathematics**
1) 129, 130, 229.
2) 237; one 228, 233, 234, 239, 240.
3) Two others.

*Math 132 is a prerequisite for Math 240, and should be taken in Year 1 by students wishing to specialize in Computer Science.*

Further Requirements for the
Degree B. Math.  
(Mathematics and Geography)
Students entering Year 3 must have credit for the five Mathematics courses specified under (1) and (2) above. They must pass at least seven further Mathematics courses approved by one of the departments in the Mathematics Faculty.

See page 194 for Mathematics courses required for students studying toward a B. Math. (Honours).

Further Requirements for the
Degree B.A.  
(Geography and Mathematics)
*Please refer to the Faculty of Arts portion of the Calendar.*

Mathematics - Philosophy Programme

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

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

**Philosophy**
280/1, 282/3, 340, 358/9. Three others, one of which is in a value area.
1) 129, 130, 229;
2) 237; one of 228, 233, 234, 239, 240+
3) Two others.

Others: One foreign language.

*Math 132 is a prerequisite for Math 240, and should be taken in Year 1 by students wishing to specialize in Computer Science.*

Further Requirements for the
Degree B. Math.  
(Mathematics and Philosophy)
Students entering Year 3 must have credit for the five Mathematics courses specified under (1) and (2) above. They must pass at least seven further Mathematics courses approved by one of the departments in the Mathematics Faculty.

See page 194 for Mathematics courses required for students studying toward a B. Math. (Honours.)

Further Requirements for the
Degree B.A.  
(Philosophy and Mathematics)
*Please refer to the Faculty of Arts portion of the Calendar.*
Mathematics – Psychology Programme
Choice of Degree

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

Requirements for all students

(Other requirements will depend on which degree is taken; the student will have to add to these to meet the requirements of his faculty.)

Psychology

101/2; 499; five additional psychology courses chosen in consultation with the Psychology Department to fulfill their research requirements.

Mathematics

129; 130; 132; 229; 233; 237; 329 or 341; 332 or 342/3, and four additional mathematics courses chosen in consultation with a department in the Faculty of Mathematics.

Further Requirements for the Degree B. Math.
(Mathematics and Psychology)

Students entering Year 3 must have credit for the five Mathematics courses specified under (1) and (2) above. They must pass at least seven further Mathematics courses approved by one of the departments in the Mathematics Faculty.

See page 194 for Mathematics courses required for students studying toward a B. Math. (Honours).

Further Requirements for the Degree B.A.
(Psychology and Mathematics)

Mathematics – Sociology Programme
Choice of Degree

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

Requirements for all students

(Other requirements will depend on which degree is taken; the student will have to add to these to meet the requirements of his faculty.)

Sociology

101*, 321*/322*, 425*/426*, 480*/481*, 499; Plus 3-1/2 other full courses in Sociology.

Mathematics

1) 129, 130;
2) 229, 233, 237;
3) two other full courses.

Further Requirements for the Degree B. Math.
(Mathematics and Sociology)

Math 132 must be taken by students wishing a B. Math degree.

Students entering Year 3 must have credit for the five Mathematics courses specified under (1) and (2) above. They must pass at least seven further Mathematics courses approved by one of the departments in the Mathematics Faculty.

See page 194 for Mathematics courses required for students studying toward a B. Math. (Honours).

Further Requirements for the Degree B.A.
(Sociology and Mathematics)

Please refer to the Faculty of Arts portion of the Calendar.
Co-operative Mathematics Programme

The arrangement of a Co-operative programme is as shown. Students, when they arrive on campus, may elect to spend either eight months in university before proceeding on their first work term, or four months in university before proceeding on their first work term.

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</thead>
<tbody>
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<td>Stream</td>
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<tr>
<td>Stream</td>
<td>1</td>
<td>W 1 W</td>
<td>2 W 2</td>
<td>W 3 W</td>
<td>3 W 4</td>
</tr>
</tbody>
</table>

Students entering in September 1972 split into two streams which spend alternating four-month terms in University (the numbered squares) and in Industry; these students will graduate in May 1977 with the equivalent of two year's work experience. The University's Co-ordination Department provides liaison between the University and Industry and makes arrangements for placing of students during their work terms.

The University does not guarantee that all students will obtain positions. Every effort is made to place each student in a position consistent with his interests and capabilities. Experience indicates that there are sufficient positions for all conscientious students who maintain good academic records. However, some students do not obtain positions because of lack of maturity or ability to impress company representatives. Students are required to work at least two terms with each employer. However, companies are not obligated to have a student return if his performance or attitude is not acceptable. With each term the student is given more challenging work and assumes more responsibility. Because of this, most stay with their first employer for most, if not all, of their work terms. Many join the company after graduation; however, there is no obligation on either part.

Graduates of a Co-operative programme, because of the experience gained during their university careers, can generally expect to earn a higher salary and attain positions of greater responsibility sooner than graduates of the Regular programme.

It should be expected that a student in this programme will need financial assistance. By the time living expenses are paid, it is doubtful that enough money can be saved to completely cover the next term at university. However, since work terms occur more frequently in this programme than in the regular one, the student has a better opportunity to pay for his own education. This is particularly true in Years 3 and 4 when salaries are higher.

**Admission**

Students in the Co-operative programme are subject to the same rules as Regular students, modified as follows:

A student entering the Co-op programme must have a minimum Grade 13 average of 60% and must have at least 60% in Mathematics A or Mathematics B (or equivalent).
Co-operative Mathematics Programme

A student normally may transfer from a Regular programme into a Co-operative programme only at the beginning of year 2, and only if he has

1) successfully completed each of Math 129, 130, and 132, with an average of at least 65% for the three courses.

2) a cumulative average of at least 60%.

Standings and Promotions Students in the Co-operative programme are subject to the same rules as Regular students, modified as follows:

1) Continuance in the Co-operative programme is contingent upon acceptable performance on work terms.

2) Students with an overall-cumulative average of less than 55% in Years 1 or 2 may not proceed in the Co-operative programme. These students will become Regular students and they will be governed by the rules for Regular students.

Honours Programme A programme which will provide the minimum course requirements is described below. Better students are encouraged to take an additional elective in each of Years 2, 3, and 4.

Year 1 Mathematics 129; 130; 132 and three electives.

Year 2 Mathematics 229; 233; 237; 240. Two electives, one of which may be from Math. 234, 235, 239.

In years 3 and 4 the following options are available:

Year 3

Actuarial Science Students should have taken Mathematics 235 in Year 2. Mathematics 329; 332; 336; one additional Mathematics course. Two electives, one of which may be a Mathematics course.

Computer Science Students should have taken Mathematics 240 in Year 2. Four Mathematics courses including Mathematics 329; 332; at least one of 334, 340. Two electives, one of which may be another Mathematics course.

Combinatorics and Optimization Students should have taken Mathematics 239a and 239b. Four Mathematics courses including Mathematics 329; 332; one third year course credit from the department. Two electives, one of which may be another Mathematics course.

Statistics Mathematics 329; 332; 338; one additional Mathematics course. Two electives, one of which may be a Mathematics course.

Teaching Option Additional requirements: Mathematics 300a, 300b, 446a, 446b, 241/242, Phil. 311/312, Soc. 207G. Recommended courses include Math 239a, 239b, 240, 307, 330, 334, 425, 436. Students in the co-operative teaching option must obtain two credits in Computer Science.
Year 4

Actuarial Science  Four Mathematics courses including Mathematics 437, 461. Two electives, one of which may be another Mathematics course.

Computer Science  Four Mathematics courses chosen in consultation with the Department Chairman, including at least two of 470, 471, 472, 473. Two electives, one of which may be another Mathematics course.

Combinatorics and Optimization  Four Mathematics courses including two fourth year course credits from the department. Two electives, one of which may be another Mathematics course.

Statistics  Four Mathematics courses including Mathematics 438, 439, and 339 (if not taken in 3rd year). Two electives, one of which may be another Mathematics course.

Teaching Option  Additional requirements: Mathematics 300(a), 300(b), 446(a), 446(b), 241/242, Phil. 311/312, Soc. 207G. Recommended courses include Math 239(a), 239(b), 240, 307, 330, 334, 425, 436. Students in the co-operative teaching option must obtain two credits in Computer Science.

Business Administration Option  Those students enrolled in the Co-operative Mathematics Programme and who would like to combine a minor in Business Administration with their mathematics programme should choose their courses according to the schedule set out below. The Business Administration courses are given by professors in the School of Economics and Business Administration at Waterloo Lutheran University which is located in close proximity to the University of Waterloo.


Chartered Accountancy Option  It is possible for students enrolled in the Co-operative Mathematics Programme to choose their non-mathematics elective courses in such a manner that they may be able to write their final Chartered Accountancy examinations within a few months after graduation. This programme is offered in co-operation with the Institute of Chartered Accountants of Ontario.
Co-operative Mathematics Programme

Year 1  Mathematics 129, 130, 132.
   One elective.

Year 2  Mathematics 229, 233, 237
   Mathematics 240 or one other Mathematics course.
   A Term – Economics 356.  
   Auditing Theory.  
   B Term – Economics 357.  
   Law.

Year 3  Mathematics 329, 332.
   Two of Mathematics 338, 340, 352.
   Theory of Management.
   Corporate Finance 366, 367.
   One elective.

Year 4  Three fourth year Mathematics credits to be chosen from the
   Department of Combinatorics and Optimization listing.
   A course on Taxation
   A course on Management Accounting.
   A course on Theory of Financial Accounting.
   One elective.

Statistics-Economics Option

Year 1  Mathematics 129, 130, 132
   A Term: Economics 101; two electives  
   B Term: Economics 102; two electives

Year 2  Mathematics 229, 233, 237
   and two of
   Mathematics 234a, 239a, 239b, 240a, 240b, 235a
   A Term: Economics 203; one of Economics 205, 231
   B Term: Economics 204; one of Economics 206, 232

Year 3  Mathematics 329, 332a, 332b, 338
   Two of Mathematics 340a, 340b, 352a, 352b
   Two of Economics 330, 340, 368, 369, 380

Year 4  Two of Mathematics 339, 438, 439
   One other Mathematics course,
   Two of Economics 400, 460, 470
   One elective course
Electives

Students enrolled in the Co-operative Mathematics programme have a total choice of nine non-mathematics electives before graduating – 3 in Year 1, and 2 in each of the succeeding years. This permits a sampling of various courses in Science and/or Humanities or will permit a student to graduate with a strong minor subject.

A minor in Psychology may be taken. It should be noted that the following courses will be offered each Spring term: Psychology 112, 211, and 212. With this in mind, students should select other Psychology courses in Fall and Winter terms.

For a minor in Physics, it is recommended that students so interested should elect the stream which allows them to proceed on their first work term in January, since this stream coincides with the academic terms of the Co-operative Applied Physics programme. Recommended courses are:

Year 1  Physics 162, 163.

Year 2  Physics 252, 256 in A term
        Physics 253, 255 in B term

Year 3  Two of Physics 362/363, 355, 358/359.

Year 4  4A and 4B coincide with the regular academic year and Physics electives can be decided upon at the commencement of the academic year.

It is also possible to take a minor in Chemistry since the Co-operative Applied Chemistry programme has both streams as in Co-operative Mathematics. Recommended courses are:

Year 1  Chemistry 121/122.

Year 2  Chemistry 206 in A term.
        Chemistry 201, 205 in B term.

Year 3  Chemistry 301, 306 in A term.
        Chemistry 305 in B term.
        Laboratories in Years 2 and 3 are optional for Co-operative Mathematics students.
The great computational speed made available by the electronic computer has revolutionized the approach taken toward problem solving and research in many areas. In recent years a knowledge of Computer Science has become a valuable asset for work in many fields including various branches of Mathematics, Chemistry, Physics, the Biological Sciences, Economics, Business Administration and the various Social Sciences.

The usefulness of the computer to solve problems in so many fields has resulted in a shortage of people qualified to work in the area of Computer Science. This demand for qualified personnel is reflected in the large enrolment of students in the department’s Computer Science course, particularly in the Co-operative programme.

In addition to providing the student with a strong core of Mathematics subjects, the Computer Science programme gives him a solid ground in programming languages, computer systems, data structures and numerical analysis. At the more theoretical level, students are given basic courses in switching and automata theory, computer system organization and logic design, Turing machines and computability theory.

Upon completion of the Computer Science programme, the student is well prepared to pursue a high level career in the computing progression. In addition, he is groomed to enter into a graduate studies programme in Computer Science.

In Applied Analysis, among others, functional equations are studied, that is the theory of determining functions from elementary equations containing them. It is a field of mathematics with a two century history, although the somewhat more general theory has developed only in the last two decades. Functional equations have applications in many classical and modern disciplines including probability and information theory, mathematical psychology, nomography, functional analysis, geometry and universal algebra. After attending these courses, the student will be well prepared for graduate studies in several fields of Mathematics and its applications to science, engineering and social sciences.

Traditionally, Applied Mathematics has been almost synonymous with Mathematical Physics but times change and today Applied Mathematics, while retaining its interest in the physical sciences, is broadening its scope and is becoming concerned with the applications of mathematics to the social and biological sciences. To handle the sorts of problems that arise in these areas the Applied Mathematician requires two things: a firm background in mathematics with a mastery of techniques and an ability to understand a problem when that problem is stated in the language of biology, economics, engineering, chemistry, physics or business.
With these considerations in mind the Honours Applied Mathematics programme at Waterloo has been developed as follows: in the first two years the student follows essentially the same programme as every other student in the Faculty of Mathematics and acquires a basic mathematical background; in year three he is given some of the mathematical tools that will be indispensable—calculus of variations, tensor calculus and ordinary differential equations—gets a firm grounding in mechanics and a introduction to partial differential equations. In his fourth year he is expected to choose some of the purely mathematical subjects such as partial differential equations, non-linear differential equations, Lebesgue integration and operator theory but equal emphasis is placed on the application of mathematics; for example, there is a one term course in continuum mechanics which is followed by either a course in elasticity or hydrodynamics or (we expect) aerodynamics; other courses are: statistical mechanics, quantum mechanics, general relativity theory, electromagnetic theory, control theory and differential geometry.

It is our belief that a graduate from this programme will be able to turn his hand to many things ranging from meteorology, oceanography, seismic exploration and supersonic flow to the problems of navigation in space, control problems, ecological population studies and the study of epidemics.

The Applied Mathematics Department offers only an honours programme which is made up of courses chosen from M 234, 360, 361, 362, 363, 413, 434, 441, 442, 443, 444, 445, 447, 448, 462, 463, 464.

For those students who wish a strong emphasis on Physics, the Department offers the programme "Honours Applied Mathematics with Physics Minor."

Combinatorics, also referred to as combinatorial mathematics and combinatorial analysis, can be described as the study of the arrangement of elements into sets. Examples of this type of mathematics are found in magic squares known to the Chinese 4,000 years ago in permutations studied at least 3,000 years ago, and in today's newspapers which occasionally publish mathematical puzzles of combinatorial nature. Fascinating new combinatorial problems have arisen in the study of both Pure and Applied Mathematics and entire new subjects are developing. A particularly fine example is the theory of linear graphs which has recently blossomed. Combinatorics cuts across many areas of mathematics, and researchers in the field today study a wide diversity of intriguing problems.

Optimization

The ultimate objective of nearly every Applied Mathematics study is to improve something, and this is especially true in Business and Industry, and to a certain extent in Pure Science. A variety of mathematical methods have evolved which can be classified as optimization techniques. Every student of calculus finds the maximum of a function by setting its derivative equal to zero. The engineer uses more sophisticated methods of analysis to optimize hardware design. The well known travelling salesman problem in which a salesman desiring to visit a number of cities selects an itinerary to minimize travelling cost is an example of a combinatorial optimizing problem.
Optimization is particularly important in Business and Industry. For example, in an inventory or a scheduling problem the purpose of developing a mathematical model is to minimize cost or maximize efficiency or some other criterion. During the past decade several new general optimization techniques (e.g. linear programming, dynamic programming) have been developed specifically to handle such optimization problems.

The following undergraduate courses are offered by the Department of Combinatorics and Optimization: 239, 300, 307, 345, 351, 352, 417, 418, 419, 420, 446, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460.

Department of Pure Mathematics

In Pure Mathematics one is concerned with the structure of numbers, space and logical deduction and with more general structures based on these. Powerful methods and tools have been developed and investigated (and are being improved) in order to arrange, to condense and to simplify the overwhelming quantity of mathematical results men have created over thousands of years. The theories of sets, groups, rings, geometries, lattices, topological spaces are examples for this modern approach, which also led to spectacular solutions of famous problems unsolved in the past. Again and again new developments in Pure Mathematics have led to important discoveries in the applied areas. Study of Pure Mathematics leads to fundamental knowledge about mathematical structures, important for theory and applications, and moreover, to a general understanding of rigorous reasoning.

Among other things, geometrical and algebraical structures are studied, a field of mathematics with a two millennium history, although the development of the general theory began in the 19th century with the creation of non-euclidean geometries, group, rings, fields, geometries of Mobius, Lie, geometries over fields. The theory has applications in many mathematical disciplines, but also in physics (for instance, theory of relativity), astronomy, mineralogy (theory of crystals).

Department of Statistics

In science one attempts to learn about the real world by making inferences from experiments. In reasoning from observations to general conclusions, some degree of uncertainty results. One aspect of statistics studies this form of reasoning and utilizes probability theory to specify the exact degree of uncertainty involved. Other aspects of statistics deal with such subjects as the design of experiments which try to ensure that the results contain the required information, and decision theory, which considers the probable losses due to uncertainty when given courses of action are followed.

In addition to the Regular and Co-operative Honours Statistics programmes, the Department offers joint honours programmes with Psychology and Economics. Other joint honours programmes can be arranged. The following undergraduate courses in probability and statistics are offered by the Department: Mathematics 233, 243, 338, 339, 349, 438, 439, 449, 466.

The Department of Statistics also has the responsibility for Actuarial students and courses. The Regular and Co-operative programmes in Actuarial Science are planned to provide the knowledge of pure and applied mathematics which the Actuary must possess, and to provide theoretical preparation for the first five examinations of the Society of Actuaries. By carefully selecting their electives, students can also gain valuable background knowledge in economics, finance, administration and law. Courses designed specifically for actuarial students are: Mathematics 235, 335, 336, 435, 437, 461.
School of Physical Education and Recreation
School of Physical Education and Recreation

The School of Physical Education and Recreation was formed in 1966 as the School of Physical and Health Education and assumed its present name in 1968 when a degree programme in Recreation was added. The School consists of three departments: the Departments of Kinesiology and Recreation which administer the academic and research programmes of the school and, the Department of Athletics which conducts programmes of Intercollegiate and Intramural Athletics and, a service programme in physical education for all students, faculty and staff.

The programmes of the School have developed rapidly in response to student needs and interests and to the changing needs and demands of society. Two years ago a Regular stream was added to the Co-operative stream to enable students to attend Waterloo who wanted the programmes but did not want the Co-operative aspects. The Regular programme has grown to the point where it equals the Co-operative programme enrollment. At the same time elective courses were introduced into each department making it possible for students to pursue in some depth an area of Kinesiology or Recreation in which they had a special interest. 1972 will see even greater opportunities for study by the individual student.

Featured changes to the programmes in 1972 will include the option of a General as well as an Honours degree in Kinesiology. In addition, the Kinesiology Department will offer an Honours option in Health Studies into which students will be admitted directly. A similar option in Dance is in the planning stage. Honours Kinesiology students will have two areas of concentration (options) open to them: Kinesiological Sciences and Applied Kinesiology. The General student in Kinesiology may take elective courses from any of these areas including Health Studies and Dance. The Honours Recreation programme will feature four elective areas of concentration: Leisure Studies, Therapeutic Recreation, Recreation Administration and Outdoor Recreation and Education.

The programmes are designed to provide the graduate with maximum flexibility in choosing a career. Graduates of the Kinesiology programme are found in agencies ranging from secondary schools (the Honours programme meets the requirements for admission to the Type "A" Certificate Course in Physical and Health Education at the Colleges of Education of Ontario) to hospitals and university graduate programmes. Graduates of the Recreation degree programme are eligible to apply for the Municipal Recreation Directors' Interim Type "A" Certificate from the Youth and Recreation Branch of the Ontario Department of Education.

The co-operative course gives the student an opportunity, unique in Canada, to gain experience in several of the career fields open to Kinesiology and Recreation graduates. Work opportunities are planned in educational institutions, community recreation departments and private agencies such as YM-YWCA. Arrangements for work assignments are made through the Co-ordination Department of the University, which provides a liaison between the campus and the field. The co-operative programme besides presenting an opportunity for practical experience and financial assistance, enables the student to assess the several career areas and to bring a more mature outlook to his formal university preparation. Students should refer to section 6 of the calendar for further details of operation of the co-operative programmes.
Admission

The Kinesiology programmes are multi-dimensional studies of human physical movement incorporating the biological, physical and social sciences. Extensive laboratory facilities enable the students in the programme to be among the few undergraduate students in the world to examine at first hand the problems inherent in human physical activity.

The academic programme in Recreation has been designed to give each graduate the body of knowledge necessary to prepare for a professional position in the field of Recreation. Students completing the honours degree programme can in addition complete course sequences resulting in a declared option in Recreation Administration, Therapeutic Recreation Service or Outdoor Recreation and Education. A concentration in Leisure Studies is also available for honours degree candidates and double honours programmes with such related departments as Sociology, Psychology and Geography are encouraged.

Degrees

Graduates of the Kinesiology programme will receive either an Honours or General Bachelor of Science degree in Kinesiology. Recreation programme graduates are awarded an Honours Bachelor of Arts degree in Recreation.

Regular Programme

The regular programme consists of eight academic terms in a period of four years. All courses are offered in the Fall and Winter terms. Students in all years enrol in September.

Co-operative Programme

All Year I students enrol in September. Precise dates for the beginning and end of each of the other terms are shown in the academic calendar for the year. The eight terms of study and six terms of employment provided in the course are arranged as shown in the following diagram.

<table>
<thead>
<tr>
<th>1972</th>
<th>1973</th>
<th>1974</th>
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<tbody>
<tr>
<td>Fall</td>
<td>Winter</td>
<td>Fall</td>
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<tr>
<td>First</td>
<td>Second</td>
<td>Work</td>
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<tr>
<td>Term</td>
<td>Term</td>
<td>Period</td>
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<tr>
<td>1975</td>
<td>1976</td>
<td>1977</td>
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<tr>
<td>Winter</td>
<td>Spring</td>
<td>Fall</td>
</tr>
<tr>
<td>Fifth</td>
<td>Sixth</td>
<td>Work</td>
</tr>
<tr>
<td>Term</td>
<td>Period</td>
<td>Term</td>
</tr>
</tbody>
</table>

Admission

The admission requirements and procedures for all programmes are outlined in detail in Chapter 2 of this Calendar. The following points emphasize some of the admission requirements which relate specifically to programmes in the School of Physical Education and Recreation.
Applications From Ontario Grade 13

Applicants to the Kinesiology programme are advised to select a Grade 13 programme which includes one or more of the following courses: Calculus, Biology, Chemistry, Physics.

Applicants to the Recreation programme are advised to include both Geography and Biology in their Grade 13 programme.

Advanced Standing

In unusual circumstances advance standing may be granted for entry to Year 3 or 3A. All transfer students will be required to complete at least the equivalent of two years of study (i.e. at least 10 full year courses) regardless of the number of full year courses that are presented.

Examinations and Standings

The Following regulations govern the practice of the School of Physical Education and Recreation in regard to final examinations, standing and make-up examinations. These regulations also apply to part-time students and special programmes.

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

1) Final Examinations

a) The faculty constitutes the examining body for all examinations. All examination results are considered by the Examinations and Standings Committee and subsequently by the Faculty Council. After the results have been considered by these bodies, they will be issued to individual students by the Registrar. Appeals against faculty decisions made under these regulations should be made in writing to the Registrar within one month of publication of the official mark reports.

b) For Students in Regular Programmes:

Final examinations in one-term courses are held in December or in April-May. Final examinations for all full year courses are held in April-May, and cover the whole work of each course. Make-up examinations are held in July.

c) For Students in Co-operative Programmes:

In Year 1, final examinations in one-term courses are held at the end of the term in which the course is taken, whereas final examinations in full-year courses are held at the end of the second term and cover the whole work of each such course. Beyond first year, final examinations are usually held at the end of each term.

d) In all courses each student is required to submit, in such form and at such time as may be determined by the instructor, evidence of satisfactory participation in term work. The marks obtained for work during term are used, in part, in determining standing. The ratio in which marks for term work and written examinations are combined
Examinations and Standings

is at the discretion of the individual departments. To pass in a course, a student must obtain a minimum of 50% in the combined term and examination marks. At the discretion of the chairman of the department concerned and of the Dean, a student may be barred from the final examination if the course requirements are not completed to the satisfaction of his instructor. Some courses and/or instructors may not require final examinations; in such cases term work only will be used in determining a final grade.

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

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

2) Standing  
a) Marks in individual courses will be reported in numerical grades in the scale 0 to 100. These may be interpreted as follows:

<table>
<thead>
<tr>
<th>Numerical Range</th>
<th>Grade Equivalent</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>80-100</td>
<td>A- to A+</td>
<td>Excellent</td>
</tr>
<tr>
<td>70-79</td>
<td>B- to B+</td>
<td>Very Good</td>
</tr>
<tr>
<td>60-69</td>
<td>C- to C+</td>
<td>Good</td>
</tr>
<tr>
<td>50-59</td>
<td>D- to D+</td>
<td>Passing</td>
</tr>
<tr>
<td>Below 50</td>
<td></td>
<td>Failure</td>
</tr>
</tbody>
</table>

In addition to the numerical scale above, the following designations may be used from time to time:

DNW - student did not write final exam in a course not dropped officially.

INC - student's work in course is incomplete for reasons other than that he did not write final exams.

AEG - student's work is incomplete for reasons of illness; however, student is granted standing in the course.

CR - student has credit for the course although he was unable to complete work for the course; for use in rare instances not covered by AEG.

AUD - a course which is audited only and neither averaged nor counted for credit.

b) Overall standing will be determined at the end of each year or term in co-operative programmes, by the cumulative average of all courses taken at the University (at any time, whether passed or failed). The following cumulative averages are required to proceed in the programmes of the School:
Cumulative Averages

<table>
<thead>
<tr>
<th>Programme</th>
<th>Overall</th>
<th>Major Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recreation Honours</td>
<td>60%</td>
<td>70%</td>
</tr>
<tr>
<td>Kinesiology Honours</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>Kinesiology Honours (Health Studies Option)</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>Kinesiology General</td>
<td>50%</td>
<td>60%</td>
</tr>
</tbody>
</table>

* All courses designated Kinesiology, Health Studies and Dance will be included in the major field average.

If a student fails to meet either of the above required cumulative averages he may be designated as in Conditional Standing for the following year. A General student in Conditional Standing must improve his standing to at least the minimum overall level noted or else he will be required to withdraw from the Faculty. An Honours student in Conditional Standing may elect to transfer to the General programme in good standing (if this is possible) or may endeavour to improve his Honours average to the cumulative minimum required; if such improvement is not forthcoming such a student may be transferred to the General programme. An Honours student in Conditional Standing may be required by his major Department to repeat certain courses in which he has done poorly or he may elect to do so himself in order to improve his performance in subsequent years.

A student’s standing (overall and major field) will be recorded each year or term in co-operative programmes according to the following terms:

<table>
<thead>
<tr>
<th>Cumulative Average</th>
<th>Honours Programme</th>
<th>General Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>80-100</td>
<td>First Class Honours</td>
<td>A</td>
</tr>
<tr>
<td>70-79.9</td>
<td>Second Class Honours</td>
<td>B</td>
</tr>
<tr>
<td>60-69.9</td>
<td>Third Class Honours</td>
<td>C</td>
</tr>
<tr>
<td>50-59.9</td>
<td></td>
<td>D</td>
</tr>
</tbody>
</table>

Below these levels will be Conditional Standing (first time) or Failure, required to withdraw (second time such level in the same programme is achieved). If a regular (full-time) student, even in good standing, fails more than two full-year courses or their equivalent in a given year he may be transferred to the General programme or else he may be asked to withdraw if his Department feels he is making unsatisfactory progress towards a degree. Students thus asked to withdraw may be eligible to apply for re-admission only after a one year’s absence. Students asked to withdraw after the equivalent of two “years” in Conditional or “Failed” standing (here or elsewhere) will normally not be re-admitted.

Note  In cases where a course (failed or passed) is repeated, both marks will be used in calculating the student’s cumulative overall average. If a passing grade is achieved more than once in the same course, it will still only count as one course passed towards the total necessary for graduation. Students in good standing will not normally repeat courses they have passed. No course may be repeated more than once.
c) **Programme selection:**

Full-time students: All first year students must take a minimum of 6 courses. In subsequent years, a student will normally take 5 courses minimum, 6 courses maximum per year, unless fewer are needed for graduation. An extra course once completed will normally count as a course passed or failed as well as in calculation of the cumulative average (the only exception to this would be for graduating students taking more than the minimum number of courses needed for graduation). All students taking extra courses should have a cumulative average of 70% or better (or in the case of Year 1 students, a Grade 13 average of 70% or better).

Part-time studies or reduced programmes: Except in exceptional circumstances, an Honours programme may not be taken on a completely part-time or reduced-programme basis; at least seven academic terms must be taken on a full-time (full programme) basis and no student may spend more than 5 years of full-time study (or its equivalent) for an Honours degree. The School of Physical Education and Recreation does not encourage part-time studies but will allow the General degree to be pursued on a part-time or reduced-programme basis subject to approval by the Associate Dean (Undergraduate Affairs) and the Department concerned. Normally, no first year programme for a full-time student may be reduced below the 6 course minimum except in very exceptional circumstances.

**Make-up Examinations**

The School of Physical Education and Recreation will no longer grant automatic supplemental examinations to all students in good standing. This is in line with general practice in other Faculties and Universities operating on a credit system. The School of Physical Education and Recreation realizes the course prerequisites are important to students proceeding to a degree and will endeavour to grant make-up examination privileges to deserving students in good standing but only in a limited number of cases according to the following general principles:

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

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

c) In all other years, normally only where such failed courses could not be repeated and where a student's progress could be unduly held up by lack of one prerequisite. Non-prerequisite courses would have to be repeated, and many others could be repeated on a co-requisite basis.

In all cases regarding make-up examinations the student must have satisfied all term work requirements in the course and must have the permission of the Examinations and Standings Committee (who must be satisfied the student has a fair chance to pass the examination – the student's overall University record may be used in making this assessment). Regardless of standing, no student will be allowed make-up privileges if he has failed more than two full courses or their equivalent in a given year (except on medical grounds as in 'a').
Make-up examinations will be held in July for regular programmes. Applications for these examinations must be filed by the end of June on forms provided by the Office of the Registrar. In co-operative programmes, make-up examinations will be written in the term immediately following that in which the respective final examinations are written. Fees for make-up examinations must accompany the application. If the student decides not to write the examination, the fee is not refunded.

Except in extraordinary circumstances, (e.g. 'a' above), when a make-up examination is passed, the course will count as a course passed toward the degree, but the mark obtained will not be counted in determining cumulative averages (i.e. the original mark will normally be the mark which counts).

Course and Programme Changes

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

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

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

d) After these periods and until the last day of lectures, students may reduce their programmes from honours to general where appropriate.

e) Extra courses may be dropped after the normal three week change period but normally not after November 15 or July 1 for Fall and Spring one-term courses or March 1 for Winter one-term or full-year courses. An extra course is defined as one course beyond the minimum of six required in Year 1 or the minimum of five in any other year. Under the course-credit system, extra courses, once completed, are included in the cumulative average. All students other than those in Year 1 should clearly indicate to the appropriate Faculty advisor at Registration time which courses are to be regarded as extra.

Academic Programmes

Kinesiology

Listed below are the course combinations leading to the Honours and General degrees in Kinesiology. Of the total of forty-four term courses required for graduation, twenty-four are electives. The requirements are common to both degrees except as noted in C, Kinesiology electives. Students are encouraged to make full use of the advisory system of the Department in planning their programmes.
Degree Requirements - Honours and General Programmes


B) Required courses from other departments: Physics 103*, Biology 110*, 303* and 304*, Psychology 101*, Sociology 101* and one other Sociology or Psychology.

Note In the case of Physics 103* and Biology 110* students may elect to take full year courses in either subject in the appropriate department.

C) Kinesiology electives: eleven (11) courses from those offered in the Department in addition to the required courses.

1) Honours programme Each student must include in his programme at least seven (7) courses from one of the following two areas of concentration:


Note Kinesiology 346, 410, 451, 452, 453, and 455 are common to both areas.

2) General programme The eleven (11) elective courses in Kinesiology may be made up of any combination of Kinesiology, Health Studies and/or Dance courses.

D) Electives: The remaining thirteen term courses required for the degree are to be elected as follows:

1) Eight (8) term courses must be elected in departments outside the School of Physical Education and Recreation.

2) The remaining five term courses may be taken in any department of the University including Kinesiology and Recreation

Course Sequence - Honours and General Programmes

Year 1 (Common to Regular and Co-operative Programmes)

Fall
- Kin. 102
- Psych. 101
- Soc. 101
- Phys. 103
- Two electives

Winter
- Kin. 103
- One of Psych. or Soc.
- Biol. 110
- (Kin. 116 if no Grade 13 Chemistry)
- Two or three electives
Co-operative Programme

Term 2A Fall
Kin. 200, 222
Biol. 303
Two electives

2B Spring
Kin. 321, 330, 335.
Two electives

Term 3A Winter
Kin. 355
Biol. 304
Three electives

3B Fall
Kin. 300, 317
Three electives

Term 4A Spring
Kin. 430
Five electives

4B Winter
Kin. 470
Five electives

Regular Programme

Year 2 Fall
Kin. 200, 222
Biol. 303
Two electives

Winter
Kin. 321, 335
Biol. 304
Two electives

Year 3 Fall
Kin. 300, 317, 330
Two electives

Winter
Kin. 355
Four electives

Year 4 Fall
Kin. 430
Five electives

Winter
Kin. 470
Five electives

Health Studies Option
Students may apply for admission directly to the Honours option in Health Studies in the Department of Kinesiology.

Degree Requirements


d) Electives: Eighteen (18) Term courses selected in consultation with the student's advisor.
Course Sequence

**Year 1** (common to Co-operative and Regular Programmes)

**Fall**
- H.S. 140*
- Psych. 101*
- Soc. 101*
- Biol. 131
- Two electives

**Winter**
- H.S. 141*
- Psych. 211*
- Kin. 116* (or equivalent)
- Biol. 131
- Two electives

**Regular Programme**

**Year 2 Fall**
- H.S. 240*
- Kin. 200*, 222*
- Biol. 303*
- One elective

**Winter**
- H.S. 241*
- Soc. 270*
- Biol. 304*
- Two electives

**Year 3 Fall**
- H.S. 345*, 410
- Kin. 330*
- Biol. 245*
- One Elective

**Winter**
- H.S. 346*, 347*
- Biol. 246*
- Two electives

**Year 4 Fall**
- Kin. 300*
- Five electives

**Winter**
- H.S. 430*, 440*, 445*
- Three electives

**Co-operative Program**

**Term 2A Fall**
- H.S. 240*
- Kin. 200*, 222*
- Biol. 303*
- One elective

**2B Spring**
- H.S. 241*, 347*
- Three electives

**Term 3A Winter**
- H.S. 346*
- Biol. 304*
- Soc. 270*
- Two electives
3B Fall  
H.S. 345*  
Kin. 300*  
Biol. 245*  
Two electives

Term 4A Spring  
H.S. 410*, 430*  
Four electives

4B Winter  
H.S. 440*, 445*  
Biol. 246*  
Three electives

Dance Option  
An option in Dance is in the planning stages. For information, please contact the Department of Kinesiology. The option will be implemented in the Fall of 1972.

Graduate Programme  
For information on graduate studies in Kinesiology, see the Graduate Calendar of the University of Waterloo.

Recreation

Forty-four term courses are required for the honours degree in Recreation. The student begins study in one of the four areas of concentration available to him in the second year of the programme. Double honours programmes with other departments are being developed. For information about these programmes, please consult the Department of Recreation.

Degree Requirements:  
A) Recreation courses:

1) Required:


b) Each student normally must include in his programme the courses listed in one of the following areas of concentration (see note):


Note  
In exceptional cases, with departmental advice and approval, other course combinations may be developed to meet specific educational goals.
2) Electives:

Each student must complete 3 or 4 additional recreation electives to meet the required total of 21.

B) Courses outside the Department of Recreation:

1) Required:

Geography 101* or Geography 195*, Planning 156*, Psychology 101*, English 140, Science 351*, Sociology 101*, Plus 8 additional term courses chosen in consultation with a faculty advisor with regard to area of concentration.

2) Electives:

Each student must select at least 8 term courses from any Department of the University.

C) Additional Requirements:

Practical Experience. To complete the requirements for a degree, all students must complete a faculty approved work term, normally of at least three months duration, or successfully petition the Department for exemption on the basis of experience.

Course Sequence (Co-operative and Regular)

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Recreation 100*, 101*, 106*, 107*, 210*, 230*, 250*.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Geography 101* or Geography 195*</td>
</tr>
<tr>
<td></td>
<td>Planning 156*</td>
</tr>
<tr>
<td></td>
<td>Psychology 101*</td>
</tr>
<tr>
<td></td>
<td>English 140</td>
</tr>
<tr>
<td></td>
<td>Science 351*</td>
</tr>
<tr>
<td></td>
<td>Sociology 101*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 2</th>
<th>Recreation 270*, 271*, 108*, 109*.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 Recreation electives</td>
</tr>
<tr>
<td></td>
<td>6-8 electives</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 3</th>
<th>Recreation 300*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5 Recreation electives</td>
</tr>
<tr>
<td></td>
<td>6 electives</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 4</th>
<th>Recreation 400*, 470</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 Recreation electives</td>
</tr>
<tr>
<td></td>
<td>6 electives</td>
</tr>
</tbody>
</table>
Faculty of Science
Chemistry—Glass Blowing Class
The Faculty of Science

The first students were enrolled in the Faculty of Science in the autumn of 1959. Enrolments have increased significantly thereafter until by the autumn of 1971 over 1740 full-time students, of which more than 190 are graduate students, are taking programmes within the Faculty. In addition, courses are provided for students in arts, environmental studies, engineering, mathematics and kinesiology and recreation.

There are five teaching departments in the Faculty of Science: Biology, Chemistry, Earth Sciences, Physics and the School of Optometry. Extensive instruction is also given by members of the University's Faculties of Arts and Mathematics. Astronomy and Biophysics are taught in the Physics Department; Biochemistry is offered in the Chemistry Department; Botany, Microbiology and Zoology and certain courses embracing these fields together (e.g. Genetics, Cell Biology and Ecology) are taught in the Department of Biology. All the departments as well as the School of Optometry offer post-graduate programmes and research facilities and these are published in a separate Graduate Calendar. The new M.Sc. programme in Earth Sciences offers specialization in the area of Environmental Geology while the new Optometry graduate programme offers M.Sc. studies in Physiological Optics. The majority of the graduates in Honours programmes in Science undertake some post graduate study.

The School of Optometry in the Faculty of Science developed from the former College of Optometry in Toronto. This has been integrated into the Faculty of Science and offers a 5-year programme leading to the degree of Doctor of Optometry (O.D.). This new Programme commenced in September of 1967. Further information appears on page 250.

Most Science students are enrolled on a full-time basis. Each year of any programme in this Faculty except Co-operative Applied Physics and Co-operative Applied Chemistry is offered in two terms throughout a conventional academic year. The Applied Physics and Applied Chemistry programmes are given exclusively on a co-operative basis with alternating terms of academic and industrial work; refer to Section 6 for further information on the Cooperative programmes.

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

Degrees The degree of Bachelor of Science (B.Sc.) is awarded by the University on the successful completion of any of the undergraduate programmes involving Biology, Chemistry, Earth Sciences and Physics which are listed below. The ordinary or pass-level B.Sc. will be awarded on completion of the General Science Programme in either the three or four-year option. The honours degree, B.Sc. (Honours), will be awarded on completion of any of the honours programmes shown under Academic Programmes. The O.D. (Doctor of Optometry) degree is described above. M.Sc. and Ph.D. degrees are discussed in the Graduate Calendar.
Admission

The admission requirements and procedures for all programmes are outlined in detail in Chapter 2 of this Calendar. The following points emphasize some of the admission requirements which relate specifically to programmes in the Faculty of Science.

Applicants From Ontario Grade 13

Applicants must present the following Mathematics courses – Relations and Functions, and Calculus (or the old 2-credit Math A), and two Science courses, one of which must be Physics or Chemistry. Both Physics and Chemistry are strongly recommended.

Year One Programmes

The following specifically labelled Year One programmes are offered: Co-operative Applied Chemistry, Co-operative Applied Physics and Regular Science. The Year One Regular Science Programme is a common first year for all students whether General or Honours and for all non-major or majoring programmes; there are a wide variety of elective courses available with certain courses required if a particular majoring area is desired in year two. Year One Regular Science also provides the background of the pre-professional year necessary to apply for admission to Year Two Optometry (the first year of the professional programme).

Admission as an Adult Student

It is recommended that applicants obtain standing in Ontario Grade 13 Mathematics and Science courses or their equivalent in order to have the proper background for first year University courses in these areas.

Advanced Standing

Students applying to Co-operative programmes in the Faculty of Science will not be admitted above the Year 3 Term A level. Any student thus admitted would be required to complete a minimum of three work terms.

Students within the University desiring to transfer into the Faculty of Science will be given a choice of two methods as follows:

1) Admission credit for courses passed with a grade of C or better without a cumulative average or
2) Admission credit for all relevant courses (including Ds) passed, but with a cumulative average based on all courses attempted, whether passed or failed.

Students transferring from other universities are judged on their merits and will be allowed transfer credits on a basis similar to those allowed Waterloo students.
Examinations and Standings

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

Students should note that the Faculty of Science now operates under a "course system" in which student progress is measured by courses successfully completed rather than by years. Students who have passed fewer than five courses will be considered Year 1 students; those who have passed at least five courses but fewer than ten will be considered Year 2 students; those with at least ten but fewer than fifteen, Year 3; and those with fifteen or more, Year 4; Year 5 students will exist only in the Optometry programme for those students in their graduating year.

1) Final Examinations

a) The faculty constitutes the examining body for all examinations. All examination results are considered by the Examinations and Standings Committee and subsequently by the Faculty Council. After the results have been considered by these bodies, they will be issued to individual students by the Registrar. Appeals against faculty decisions made under these regulations should be made in writing to the Registrar's Office within one month of the official announcement of term or year marks.

b) For Students in Regular Programmes:
Final examinations in one-term courses are held in December or in April-May. Final examinations for all full year courses are held in April-May, and cover the whole work of each course. Make-up examinations are held in July. The time normally allowed for each examination is three hours.

c) For Students in Cooperative Programmes:
In Year 1, final examinations in one-term courses are held at the end of the term in which the course is taken, whereas final examinations in full-year courses are held at the end of the second term and cover the whole work of each such course. Beyond first year, final examinations are usually held at the end of each term. The time normally allowed for each examination is three hours.

d) In all courses each student is required to submit, in such form and at such time as may be determined by the instructor, evidence of satisfactory participation in term work. The marks obtained for work during term are used, in part, in determining standing. The ratio in which marks for term work and written examinations are combined is at the discretion of the individual departments. To pass in a course, a student must obtain a minimum of 50% in the combined term and examination marks. At the discretion of the chairman of the department concerned and of the Dean, a student may be barred from the final examination if the course requirements are not completed to the satisfaction of his instructor. Some courses and/or instructors may not require final examinations; in such cases term work only will be used in determining a final grade.
Examinations and Standings

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

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

2) Standing

a) Marks in individual courses will be reported as numerical marks on the scale 0 to 100. A mark of 50 or better is necessary to pass and receive credit for a course. For Science students, the lowest mark to be recorded and averaged will be 32, equivalent to the weighting factor for the F— on the common grading system.

In addition to numeric marks, the following designations may be used from time to time:

- INC (either term work, lab work, examinations, etc., are incomplete)
- AEG (aegrotat—signifying the student's work or examination was incomplete for some acceptable reason (such as illness) and his instructor felt the student should receive credit for the course but a numerical mark could not be set.)
- CR (credit granted where no specific mark is given in a course and AEG is not applicable.)
- AUD (a course which is audited only and is neither averaged nor counted for credit.)
- NMR (no mark reported)
- DNW (final examination not written in a course that has not been dropped officially.)

AEG or CR will count as a course passed towards the total necessary but will not count in the overall average. INC, NMR or DNW will indicate a situation that will have to be resolved to the satisfaction of the Examinations and Standings Committee.

Unless there are medical or other extenuating circumstances, a DNW will usually be weighted for averaging purposes as the lowest possible failing mark (32, equivalent to F— on the common grading system) in determining standing.

b) Overall standing will be determined at the end of each year by the cumulative average of all courses taken at the University (at any time, whether passed or failed).

To proceed in the General programme requires a cumulative average of 50% overall; if a field of specialization is chosen after Year 1, a 60% cumulative average in this field will also be required. To proceed in an Honours programme requires a cumulative average of 60% overall and 60% in the courses of the major subject(s). The Optometry programme is evaluated in the same manner as the regular Honours programmes of the Faculty.
Since Year 1 is essentially a common year any student passing all courses with the required overall average may enter any Year 2 programme in good standing (i.e. a 60% or better standing in a major field subject, while desirable, will not be required); the only exception to this is the Optometry programme where enrolment limitation may be necessary in Year 2 (see page 250 for further details). If an upper year student fails to meet either of the above required cumulative averages he will be designated as in Conditional Standing for the following year. A General student in Conditional Standing must improve his standing to at least the minimum overall level noted or else he will be required to withdraw from the Faculty; students in the 4-year majoring programme may be transferred to the 3-year programme where no major field average is required. An Honours student in Conditional Standing may elect to transfer to the General programme in good standing (if this is possible) or may endeavour to improve his Honours average to the cumulative minimum required; if such improvement is not forthcoming such a student will be transferred to the General programme. Alternatively, the Examinations and Standing Committee may decide that such a student must transfer to the General programme (either option). An Honours student in Conditional Standing may be required by his major Department to repeat certain courses in which he has done poorly or he may elect to do so himself in order to improve his performance in subsequent years.

A student's standing (overall) will be interpreted each year according to the following terms:

<table>
<thead>
<tr>
<th>Cumulative Average</th>
<th>Honours Programme</th>
<th>General Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>80.00-100</td>
<td>First Class Honours</td>
<td>Excellent</td>
</tr>
<tr>
<td>70.0-79.9</td>
<td>Second Class Honours</td>
<td>Very Good</td>
</tr>
<tr>
<td>60.0-69.9</td>
<td>Third Class Honours</td>
<td>Good</td>
</tr>
<tr>
<td>50.0-59.9</td>
<td></td>
<td>Passing</td>
</tr>
</tbody>
</table>

Below these levels will be Conditional Standing or Failure, required to withdraw, depending upon circumstances. Normally, Conditional standing will be allowed the first time unless the student's performance has been very poor: for such a poor first-time performance, or any time such a level is achieved twice, Failure, required to withdraw will be necessary. If a regular (full-time) student, even in good standing, fails more than two full-year courses or their equivalent in a given year he may be transferred to the General programme or else he may be asked to withdraw if his Department feels he is making unsatisfactory progress towards a degree. Students thus asked to withdraw may be eligible to apply for re-admission only after a one year's absence. Students asked to withdraw after the equivalent of two "years" in Conditional or "Failed" standing (here or elsewhere) will normally not be re-admitted.

Note In cases where a course (failed or passed) is repeated, both marks will be used in calculating the student's cumulative overall average. If a passing grade is achieved more than once in the same course, it will still only count as one course passed towards the total necessary for graduation. Students in good standing will not normally repeat courses they have passed. No course may be repeated more than once.
c) Programme selection:

*Full-time students.* All first year students must take a minimum of 5 courses and no more than 6 courses will be permitted except in exceptional cases. In subsequent years, a General student will normally take 5 courses minimum, 6 courses maximum per year, unless fewer are needed for graduation. Honours students in upper years will follow Departmental recommendations (usually 6-7 courses per year). An extra course once completed will normally count as a course passed or failed as well as in calculation of the cumulative average (the only exception to this would be for graduating students taking more than the minimum number of courses needed for graduation). All students taking extra courses should have a cumulative average of 70% or better (or in the case of Year 1 students, a Grade 13 average of 70% or better).

*Part-time studies or reduced programmes:* Except in exceptional circumstances, an Honours programme may not be taken on a completely part-time or reduced-programme basis; at least two of the upper three years must be taken on a full-time (full programme) basis and no student may spend more than 5 years of full-time study (or its equivalent) for an Honours degree. The Science Faculty does not encourage part-time studies but will allow the General degree in either option, to be pursued on a part-time or reduced-programme basis subject to approval by the Associate Dean (Undergraduate Affairs) and the Department concerned (where the programme involves a major field). Normally, no first year programme for a full-time student may be reduced below the 5 course minimum except in exceptional circumstances.

*d) Co-operative Programmes:* Students in Co-operative Honours Applied Chemistry and Co-operative Honours Applied Physics will be evaluated by the rules shown modified where necessary to suit their special needs. In particular:

**I** Evaluations in Year 1 will be made at the end of term 1B on the entire year's work. Students must have a 60% average to proceed to term 2A. Those below this average may be transferred to the General programme (non-Co-op) in good standing if possible or may be allowed to repeat the 1B term in Conditional Standing in order to remain in the Co-op programme. Students who have done very poorly and who are felt unable to repeat the 1B term will be transferred to the Year 1 regular programme in Conditional Standing, or else may be asked to withdraw from the Faculty.

**II** Upper year assessments will be made on a term by term basis and cumulative average, make-up examination privileges, conditional or good standing, etc., decided then. Beyond Year 1, the Chemistry and Physics programmes are mostly composed of one-term courses in which all marks are final. Depending on electives chosen there is some mixture of term and full-year courses. Assessments made in terms 2A and 3A will be on the basis of marks in all courses taken; no make-up examinations will be given in the first half of a full-year course; for assessments in terms 2B and 3B, marks given for the second half of a full-year course will be the final mark for the course and will replace the A term mark
for average purposes. Make-up examinations may be allowed in one-term courses at any time and in full-year courses at the end of the second term only. Terms 4A and 4B of the Physics and Chemistry programmes will normally be assessed as a unit at the end of the 4B term when both terms are taken consecutively from September to April. Students from both Applied Chemistry and Applied Physics may be transferred to the General programme (non-Co-op) if they are deemed to be making unsatisfactory progress towards their Honours degree. Normally, a student may take no more than two upper year terms on a part-time or reduced-programme basis and must have special permission from his Department to do so.

Make-up Examinations

The Faculty of Science will no longer grant automatic supplemental examinations to all students in good standing. This is in line with general practice in other Faculties and Universities operating on a credit system. It has been the experience in the Faculty of Science at Waterloo that the majority of students who have failed courses have subsequently failed to pass supplemental examinations. The Science Faculty realizes that course prerequisites are important to students proceeding to a Science degree and will endeavour to grant make-up examination privileges to deserving students in good standing but only in a limited number of cases according to the following general principles:

A) In any case where failure to pass is attributable to extraordinary circumstances, especially medical or health-related problems.
B) In failed courses for students in their graduating year where only one or two such courses remain to be completed for a degree.
C) In all other years, normally only where such failed courses could not be repeated and where a student's progress could be unduly held up by lack of one prerequisite. Non-prerequisite courses would have to be repeated, i.e. most Arts courses and non-required Mathematics or Science courses, and many others could be repeated on a co-requisite basis.

In all cases regarding make-up examinations the student must have satisfied all term work requirements in the course and must have the permission of the Examinations and Standings Committee (who must be satisfied the student has a fair chance to pass the examination—the student's overall University record may be used in making this assessment). Regardless of standing, no student will be allowed make-up privileges if he has failed more than two full courses or their equivalent in a given year (except on medical grounds as in A).

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

Except in extraordinary circumstances, (e.g. A above), when a make-up examination is passed, the course will count as a course passed toward the degree, but the mark obtained will not be counted in determining cumulative averages (i.e. the original mark will normally be the mark which counts).
Examinations and Standings

Other General Comments

a) **Transfer Students:** Students will be accepted for transfer from other Year 1 programmes in the University or from other Universities. Their programmes will be evaluated in terms of the number of course credits allowed and the number remaining for a degree. Students from other Universities will not have previous background used in calculating Cumulative Averages. Students from other Faculties at Waterloo may have cumulative averages which include courses transferred for credit (See Admission Requirements).

Students will be accepted for transfer at other than the Year 1 level but will normally be required to complete at least the equivalent of two years' work while registered in the Faculty of Science (i.e. at least 10 full-year courses) regardless of the number of transfer credits they present.

b) **Transferability or Upgrading of B.Sc. Degree:** A student who has graduated with a 3-year General degree may successfully complete the requirements of the 4-year degree with an official major field designation and exchange his old diploma for a new one, although he will not "graduate" a second time. Normally a student from this University or from another University may not upgrade a General B.Sc. or its equivalent to a Waterloo Honours B.Sc. However, from time to time such conversion privileges may be allowed in exceptional cases on the recommendation of the Department(s) concerned and with the approval of the Examinations and Standings Committee.

c) **Future Requirements:** The Faculty of Science changed to a course-credit system in 1969. As the Faculty gains experience in the operation of such a system, these rules may be modified from time to time. Every effort will be made to operate consistent practices within each programme and broadly across the Faculty and the University where desirable. Normally, students will be given advance warning of changes in regulations but the Faculty reserves the right to make changes without notice where necessary.

Course and Programme Changes

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

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

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

d) After these periods and until the last day of lectures, students may reduce their programmes from honours to general where appropriate.
e) Extra courses may be dropped after the normal three week change period but normally not after November 15 or July 1 for Fall and Spring one-term courses or March 1 for Winter one-term or full-year courses. An extra course is defined as one course beyond the minimum of five required in Year 1 or any year of the General Programme or one beyond the published minimum required for an Honours Programme (usually 6-7 courses depending on major field of study). Under the course-credit system, extra courses, once completed, are included in the cumulative average. All students other than those in Year 1 should clearly indicate to the appropriate Faculty advisor at Registration time which courses are to be regarded as extra.

Academic Programmes

Students entering first year in the Faculty of Science are essentially enrolled in a common year. Year 1 Co-operative Applied Chemistry and Co-operative Applied Physics are labelled as such but all other students are officially in Year 1 Regular Science. Year 1 Regular Science students are not designated as Honours or General or according to any specific programme. Essentially the same courses are available to all first year students and any student may enter any Year 2 programme in Science provided he or she has taken the necessary courses in Year 1 and has achieved the necessary passing average; the only exception to this is in the Optometry programme where enrolment limitation may be necessary in Year 2 (see page 250 for further details).

In descriptions of programmes to follow, the term “course” refers to a course which extends for one full academic year; two half-year (or one-term) courses are the equivalent of one full course (one-term courses are marked with* following the course number). The symbol* after the number of laboratory hours indicates a laboratory taken in alternate weeks.

First Year Programmes (Regular and Co-operative)

The Year 1 Science programme requires 5 full courses in first year of which at least two must be Faculty of Science courses and one of which should be an Arts elective (preferably English or Psychology). Only students whose Grade 13 average was 70% or better may select 6 courses if they wish and no more than 6 courses will be allowed except in exceptional cases.

Courses should be chosen with a Year 2 goal in mind or else should be made general enough to cover many Year 2 programmes. The recommended Year 1 selections for various Year 2 Honours or General Science-Major programmes are shown below; in most cases the number of required courses has been held to only two with up to two more recommended (but not compulsory). To enter a Year 2 programme a student must achieve the Year 1 average necessary and must have taken the required courses. Students who elect 6 courses instead of 5 will have one less elective to take in one of the upper years, or else may enrich their programme with extra courses.
### Regular Programmes

<table>
<thead>
<tr>
<th>Major Field of Study</th>
<th>Options Required in Year 1</th>
<th>Options Recommended in Year 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology (see Note 1)</td>
<td>Biology 132, Chemistry 121*-142*</td>
<td>Physics 101*-102*, Mathematics 101, Earth Sciences 130</td>
</tr>
<tr>
<td>Biology and Chemistry (see Note 1)</td>
<td>Biology 132, Mathematics 130, Chemistry 121*-122*</td>
<td>Physics 101*-102*, or 121*-122* or 162*-163*</td>
</tr>
<tr>
<td>Chemistry</td>
<td>Mathematics 130, Chemistry 121*-122*</td>
<td>Physics 121*-122* or 162*-163*</td>
</tr>
<tr>
<td>Chemistry (Mathematics Option)</td>
<td>Mathematics 130, 131</td>
<td>Mathematics 132</td>
</tr>
<tr>
<td>Chemistry (Physics Option)</td>
<td>Mathematics 130, Physics 121*-122* or 162*-163*, Chemistry 121*-122*</td>
<td></td>
</tr>
<tr>
<td>Earth Sciences</td>
<td>Earth Sciences 130, Chemistry 121*-142*</td>
<td>Physics 101*-102*, or 121*-122* or 162*-163*, Mathematics 130</td>
</tr>
<tr>
<td>Earth Sciences and Geography</td>
<td>Earth Sciences 130, Geography 101*-102*, Chemistry 121*-142*</td>
<td></td>
</tr>
<tr>
<td>Optometry (see Note 7 and page 223 for further details)</td>
<td>Mathematics 125 or 130, Physics 121*-122* or 162*-163*, Psychology 101*-102*</td>
<td>Biology 132, Chemistry 121*-142*</td>
</tr>
<tr>
<td>Physics (see Notes 2, 3, 4)</td>
<td>Mathematics 130, Physics 121*-122* or 162*-163*</td>
<td>Mathematics 131, Chemistry 121*-122*</td>
</tr>
</tbody>
</table>

### Co-operative Programmes

<table>
<thead>
<tr>
<th>Major Field of Study</th>
<th>Options Required in Year 1</th>
<th>Options Recommended in Year 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Chemistry</td>
<td>Mathematics 130, Chemistry 121*-122*</td>
<td>Mathematics 132, Physics 121<em>122</em> or 162*-163*</td>
</tr>
<tr>
<td>Applied Physics</td>
<td>Mathematics 130, Physics 121*-122* or 162*-163*</td>
<td>Mathematics 131, Chemistry 121*-122*</td>
</tr>
</tbody>
</table>

**Note 1** Students wishing to pursue Honours Biology or Honours Biology and Chemistry who elect Physics 121*-122* or Physics 162*-163* in Year 1 would normally be expected to elect Physics 222*-223* (Electricity and Magnetism) in Year 2 or 3. The one year sequence Physics 101*-102* is not normally followed by any upper year Physics courses except for 301*-302*.

**Note 2** Students desiring the Biophysics option of the Honours Physics programme are advised to include Biology 132 in their programme unless they achieved at least 75% in Grade 13 Biology. Students wishing the Theoretical Physics option are advised to select Mathematics 130, 131 and 132.

**Note 3** Students desiring the geophysics option of the Honours Physics programme are advised to include Earth Sciences 130 and Chemistry 121*-122* in Year 1.

**Note 4** Students wishing any of the Business Administration options are advised to select Economics 101*-102*. The special four-year General Science and Business Programme also requires Physics (101*-102* recommended), Chemistry (121* and 122* or 142*), Earth Sciences 130 and Mathematics 130.
Note 5  Students in the Co-operative Applied Chemistry programme have two methods of taking Year 1: (i) two terms in a row (September-April) or (ii) fall term on campus (September-December), winter term at work (January-April) and spring term on campus (April-August). Since no Biology or Earth Sciences courses are offered in the spring term (April-August), only students who plan to take two terms in a row may elect these courses. Students completing term 1B in the spring must elect both Chemistry 121*-122* and Physics 162*-163* or 121*-122* to fulfill the requirement of two Science courses in first year. All Co-operative Applied Physics students take Year 1 as two terms in a row.

Note 6  The Ontario Department of Education has strongly recommended that all students who are preparing to teach science in high school should take at least one full-year course in Biology.

Note 7  Students planning to apply for admission to Year 2 Optometry should note that Biology I32 is required for all students who have not taken Grade 13 Biology or its equivalent; also a year of Chemistry is required for all students lacking a good Chemistry background in Ontario Grade 13 or its equivalent — for these students Chemistry 111*-112* is recommended rather than 121*-142*.

A brief discussion of the above courses and some other courses available for selection is given below. See the course description section of this Calendar for more details.

Faculty of Arts Courses  Usually selections are made from the introductory courses offered in various Departments. English 102 (Regular students only), 105*, 108*, and 190* are strongly recommended for consideration as are Psychology 101* and 102*. Some other popular areas for consideration might be Anthropology, Economics, French, Geography, German, History, Philosophy, Political Science, Russian, Sociology or Religious Studies. Other areas may be suitable if available.

Faculty of Mathematics Courses  There are 3 first-year Mathematics courses, 130 (Calculus), 131 (Algebra and Solid Geometry) and 132 (Introduction to Computer Science) which may be chosen. Calculus is either required or recommended in all programmes in Science and should be strongly considered. Only students who are above average in Mathematics (e.g. approximately 70% or better in at least two Grade 13 Mathematics courses) should normally choose all three Mathematics courses. Mathematics 125 (Calculus plus other topics) is offered instead of Mathematics 130, for students planning to enter Optometry in Year 2.

Faculty of Science Courses  Introductory courses are offered in Biology, Chemistry, Earth Sciences and Physics. Courses from at least two of these areas must be elected. Although there are several first year courses available in Physics there is sufficient overlapping of material that only one of the full-year sequences may be chosen, i.e. only one of Physics 101*-102*, 121*-122*, 162*-163*. Chemistry 121* is available to all students in the fall term and a choice of 122* or 142* in the winter term (122* is also offered in the spring term for Co-op students). Because the material does not overlap, students may select both 122* and 142* if they wish.
Biology

Biology 132—Principles of Biology (2 lectures, 3 hours laboratory)

This course is the normal selection for those wishing a Biology elective in first year. It is for all students whether or not Grade 13 Biology was taken. Students with 75% or better in Grade 13 Biology may by-pass this course and select a year 1 programme without Biology 132—entry into Year 2 Honours Biology will be allowed. Alternatively, such superior Biology students who have achieved at least a 70% overall Grade 13 average will be allowed to select a second-year Biology course instead of Biology 132.

Earth Sciences

Earth Sciences 130—Introductory Geology (2 lectures, 3 hours laboratory)

This course is an ideal elective for first year students who are not familiar with this area. It is not necessary to have a Geography or other specific high school background for this course. Students with potential interest in Geochemistry or Geophysics should select this course.

Chemistry

Chemistry 121* Chemical Structure and Periodicity (3 lectures, 3 hours laboratory, fall term only)

Chemistry 122* General Chemistry for the Physical Sciences (3 lectures, 3 hours laboratory, offered in winter and spring terms.)

Chemistry 142* General Chemistry for the Life Sciences (3 lectures, 3 hours laboratory, winter term only)

Physics

Physics 101* General Physics (3 lectures, fall term)

Physics 102* General Physics (3 lectures, winter term)

Physics 121* Introductory Physics 1 (3 lectures, 3 hours laboratory or 2 hours tutorial, fall term)

Physics 122* Introductory Physics 2 (3 lectures, 3 hours laboratory or 2 hours tutorial, offered winter or spring term)

Physics 162* Mechanics, Wave Motion and Heat 1 (3 lectures, 3 hours laboratory or 2 hours tutorial, fall term)

Physics 163* Mechanics, Wave Motion and Heat 2 (3 lectures, 3 hours laboratory or 2 hours tutorial, offered in winter or spring term)

The normal prerequisite for all Chemistry and Physics courses beyond the first-year level is Physics 121*-122*. Students of demonstrated ability (at least 75% average in Grade 13 Physics and Functions and Relations and Calculus or their equivalent) who prefer an enriched, and slightly more challenging, course are encouraged to take Physics 162*-163*.

Physics 101*-102* is a one-year survey of the main fields of Physics for students who do not plan to take courses in this subject beyond the first year although it can be used as prerequisite for Physics 301*-302*.

Students do not need Grade 13 Physics as prerequisite to take 101*-102* or 121*-122* although it would be desirable.

Honours Programmes

The normal route to attain professional standing in Science is to take an Honours Programme in the appropriate field or combination of fields. The Honours Programmes are of four years' duration and are approximately 22-24 courses in length depending on the programme and in some cases on the electives chosen; they are rather specialized in content, and the syllabus in each is prescribed in terms of a core of compulsory courses plus various electives which allow some flexibility of choice. Students enrolled in a given programme must complete the total
Academic Programmes

number of courses listed for that programme before graduation. Most Honours Programmes allow at least 25% of the courses to be taken as electives of the student’s choice, although recommended courses are shown as a guide. The minimum standard for graduation from any Honours Programme is a cumulative (overall) average of 60% calculated for all courses taken (in any year—whether passed or failed) plus a 60% cumulative average for the major field courses. Those graduating with at least second-class honours standing are granted preferred treatment for post-graduate study in Canadian Universities. Graduates of certain Honours Programmes may be eligible for admission to Type A (specialist) courses for prospective high school teachers at a College of Education in Ontario.

The following Honours Programmes are available

Honours Biology (For Year 1, see page 232)

<table>
<thead>
<tr>
<th>Year 2</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 233 Vertebrate Zoology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 234 Plant Biology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 235 Fundamentals of Microbiology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 236 Ecology 1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 266 Organic Chemistry 1 (fall term)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 267 Organic Chemistry 2 (winter term)</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

One non-Biology elective (Physics 301*-302* and Chemistry 328 are recommended).

<table>
<thead>
<tr>
<th>Year 3†</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>At least two full courses of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology 333 Invertebrate Zoology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 334* The Flowering Plants</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 338* Plant Morphology &amp; Morphogenesis</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biology 335 Microbial Form and Function</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Plus at least two full courses of:

| Biology 341* Cell Physiology | 2 | 3 |
| Biology 342 Vertebrate Physiology | 2 | 3 |
| Biology 343* Histology & Cytology | 2 | 3 |
| Biology 344* Cytogenetics | 2 | 3 |
| Biology 345* Plant Physiology | 2 | 3 |

Two Electives (Chemistry 332*-333* recommended) as specified

†All Honours Biology students who have completed their third year are required to participate in an off-campus field course before entering Year 4; this will cost each student approximately $30-850.

Year 4 5 courses, at least 3 of which are Biology 400-level courses. This year is designed to be the specialist year. The student now has a wide grounding in basic biology and biochemistry and can choose courses covering his particular area of interest.

Note regarding electives A listing of Science and other electives is found on page 246. Although this list was prepared for the General Science programme many of the courses would be suitable here. Other Honours level courses in Chemistry, Physics or Psychology should also be considered.
### Honours Biology and Chemistry

*(For Year 1, see page 232)*

**Year 2**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 210*</td>
<td>Non-Aqueous Solvents and Non-Transition Metal Chemistry</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 211*</td>
<td>Chemical Bonding in Inorganic Chemistry</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 260*</td>
<td>Organic Chemistry 1</td>
<td>2</td>
<td>3+1</td>
</tr>
<tr>
<td>Chemistry 261*</td>
<td>Organic Chemistry 2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 220*</td>
<td>Introductory Analytical Chemistry</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry 221*</td>
<td>Analytical Chemistry of Multi-Component Systems</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

**Elective** *(Mathematics 236 recommended)*

Two of:

- Biology 233 Vertebrate Zoology
- Biology 234 Plant Biology
- Biology 235 Fundamentals of Microbiology
- Biology 236 Ecology 1

**Year 3**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 356*</td>
<td>General Physical Chemistry 1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 357*</td>
<td>General Physical Chemistry 2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 332*</td>
<td>Biochemistry 1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 333*</td>
<td>Biochemistry 2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 360*</td>
<td>Organic Chemistry 3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 361*</td>
<td>Organic Chemistry 4</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Elective** *(Physics 222*-223* and 222L*-223L* strongly recommended if Physics 121*-122* or 162*-163* taken in Year 1)*

Two full courses of:

- Biology 333 Invertebrate Zoology
- Biology 334* The Flowering Plants
- Biology 338* Plant Morphology & Morphogenesis
- Biology 335 Microbial Form and Function
- Biology 341* Cell Physiology
- Biology 342 Vertebrate Physiology
- Biology 343* Histology & Cytology
- Biology 344* Cytogenetics
- Biology 345* Plant Physiology

**Year 4**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 316*</td>
<td>An Introduction to Transition Metal Chemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 317*</td>
<td>Solid State Inorganic Chemistry</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 437</td>
<td>Biochemistry 2</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Three of: Any 400-level courses offered in Biology

**Elective** as specified
Honours Chemistry  (For Year 1, see page 232)

<table>
<thead>
<tr>
<th>Year 2</th>
<th>Fall Term</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chemistry 210*</td>
<td>Non-Aqueous Solvents and Non-Transition Metal Chemistry</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Chemistry 220*</td>
<td>Introductory Analytical Chemistry</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Chemistry 240*</td>
<td>Introductory Theoretical Chemistry</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Chemistry 250*</td>
<td>Introductory Thermodynamics</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Chemistry 260*</td>
<td>Organic Chemistry 1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>One elective</td>
<td>(Physics 222* and 222L* are recommended)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Winter Term</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 211*</td>
<td>Chemical Bonding in Inorganic Chemistry</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 221*</td>
<td>Analytical Chemistry of Multi-Component Systems</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 251*</td>
<td>Applications of Chemical Thermodynamics</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 252*</td>
<td>Quantum Chemistry 1</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 261*</td>
<td>Organic Chemistry 2</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 291*</td>
<td>Laboratory</td>
<td>0</td>
</tr>
<tr>
<td>One elective</td>
<td>(Physics 223* and 223L* are recommended)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 3</th>
<th>Fall Term</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chemistry 310*</td>
<td>Transition Metal and Coordination Chemistry</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Chemistry 350*</td>
<td>Spectroscopy and Molecular Structure</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Chemistry 351*</td>
<td>Statistical Thermodynamics</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Chemistry 360*</td>
<td>Organic Chemistry 3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Chemistry 390*</td>
<td>Advanced Laboratory 1</td>
<td>0</td>
</tr>
<tr>
<td>One elective</td>
<td>(subject to availability and compatibility with the timetable, the following are recommended: Chemistry 332*, Biochemistry 1; Chemistry 353*, Physical Chemistry of Polymers; or Physics 222* and 222L* if not taken previously.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Winter Term</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 311*</td>
<td>Radiochemistry</td>
<td>2</td>
</tr>
<tr>
<td>one of Chemistry 352*</td>
<td>Chemical Kinetics</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 354*</td>
<td>Applied Kinetics</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 361*</td>
<td>Organic Chemistry 4</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 391*</td>
<td>Advanced Laboratory 2</td>
<td>0</td>
</tr>
<tr>
<td>Two electives</td>
<td>(subject to availability and compatibility with the timetable, the following are recommended: Chemistry 333*, Biochemistry 2; Chemistry 362*, Theoretical Organic Chemistry; Chemistry 395*, History of Chemistry; or Physics 223* and 223L* if not taken previously.)</td>
<td></td>
</tr>
</tbody>
</table>

Note 1 Other suitable Arts, Science and Mathematics courses may be chosen as electives subject to Departmental approval.

Note 2 The present curriculum is under review. The new year 3 courses are given above. Year 4 will not be changed until 1973-74 and will appear in the next Calendar.
### Academic Programmes

#### Year 4

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 431</td>
<td>2</td>
</tr>
<tr>
<td>Inorganic Chemistry 2</td>
<td></td>
</tr>
<tr>
<td>Chemistry 435</td>
<td>2</td>
</tr>
<tr>
<td>Physical Chemistry 3</td>
<td></td>
</tr>
<tr>
<td>Chemistry 436</td>
<td>2</td>
</tr>
<tr>
<td>Organic Chemistry 3</td>
<td></td>
</tr>
<tr>
<td>Chemistry 439</td>
<td>0</td>
</tr>
<tr>
<td>Advanced Laboratory</td>
<td>9</td>
</tr>
<tr>
<td>Two full-year electives</td>
<td></td>
</tr>
</tbody>
</table>

Honours Chemistry (Mathematics Option)

*For Year 1, see page 232*

#### Year 2

**Fall Term**

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 210*</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Non-Aqueous Solvents and Non-Transition Metal Chemistry</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Chemistry 220*</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Introductory Analytical Chemistry</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Chemistry 240*</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Introductory Theoretical Chemistry</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Chemistry 250*</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Introductory Thermodynamics</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Chemistry 260*</td>
<td>2</td>
<td>3+1</td>
</tr>
<tr>
<td>Organic Chemistry 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics 240b*</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Non-Numeric Applications in Computer Science</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

One elective

**Winter Term**

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 211*</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemical Bonding in Inorganic Chemistry</td>
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</tr>
<tr>
<td>Chemistry 221*</td>
<td>2</td>
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</tr>
<tr>
<td>Analytical Chemistry of Multi-Component Systems</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Chemistry 251*</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Applications of Chemical Thermodynamics</td>
<td>1</td>
<td></td>
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<tr>
<td>Chemistry 252*</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Quantum Chemistry 1</td>
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<tr>
<td>Chemistry 261*</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Organic Chemistry 2</td>
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<td></td>
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<tr>
<td>Chemistry 291*</td>
<td>0</td>
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<tr>
<td>Laboratory</td>
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<tr>
<td>Mathematics 240a*</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Numerical Applications in Computer Science</td>
<td>2</td>
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</tbody>
</table>

One elective

**Note**  
Electives should be selected from Mathematics 236, 233 or 243, Physics 222*-223* or 252*-253* (and 222L*-223L* or 252L*-253L*)

#### Year 3

**Fall Term**

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 310*</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Transition Metal and Coordination Chemistry</td>
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<tr>
<td>Chemistry 350*</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Spectroscopy and Molecular Structure</td>
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<tr>
<td>Chemistry 351*</td>
<td>2</td>
<td>0</td>
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<td>Statistical Thermodynamics</td>
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<td>Chemistry 360*</td>
<td>2</td>
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<td>Organic Chemistry 3</td>
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<td>Chemistry 390*</td>
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<tr>
<td>Advanced Laboratory 1</td>
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<tr>
<td>Mathematics 219</td>
<td>3</td>
<td>0</td>
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<tr>
<td>Linear Algebra (first term)</td>
<td>0</td>
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<tr>
<td>Mathematics 237</td>
<td>3</td>
<td>0</td>
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<tr>
<td>Differential and Integral Calculus (first term)</td>
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One elective

(Subject to availability and compatibility with the timetable, the following are recommended: Chemistry 332*, Biochemistry 1; Physics 226L*-227L* or 256L*-257L*)
### Winter Term

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 311*</td>
<td>Radiochemistry</td>
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<tr>
<td>one of Chemistry 352*</td>
<td>Chemical Kinetics</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 354*</td>
<td>Applied Kinetics</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 361*</td>
<td>Organic Chemistry 4</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 391*</td>
<td>Advanced Laboratory 2</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Mathematics 219</td>
<td>Linear Algebra (second term)</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mathematics 237</td>
<td>Differential and Integral Calculus (second term)</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

One elective (Subject to availability and compatibility with the timetable, the following are recommended: Chemistry 333*, Biochemistry 2; Physics 227*, Optics; Physics 353*, Electronics; additional mathematics courses approved by the Chemistry Department.)

**Note**
The present curriculum is under review. The new Year 3 is shown above. Year 4 will not be changed until 1973-74 and will appear in the next Calendar.

### Year 4

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<th>Labs</th>
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<tbody>
<tr>
<td>Chemistry 431</td>
<td>Inorganic Chemistry 2</td>
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<td>0</td>
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<tr>
<td>Chemistry 435</td>
<td>Physical Chemistry 3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 436</td>
<td>Organic Chemistry 3</td>
<td>2</td>
<td>0</td>
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<tr>
<td>Mathematics 329</td>
<td>Abstract Algebra</td>
<td>2</td>
<td>0</td>
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<tr>
<td>Mathematics 343</td>
<td>Complex Variable Theory</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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<td>1</td>
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</table>

One of:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 437</td>
<td>Biochemistry 2</td>
<td>2</td>
<td>3</td>
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<td>Chemistry 440</td>
<td>Polymer Chemistry</td>
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<td>Chemistry 439</td>
<td>Advanced Laboratory</td>
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**Note**
Other Mathematics courses may be substituted for Mathematics courses listed subject to the approval of the Chemistry Department.

### Honours Chemistry (Physics Option) (For Year 1, see page 232)

#### Year 2

##### Fall Term

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs</th>
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</thead>
<tbody>
<tr>
<td>Chemistry 210*</td>
<td>Non-Aqueous Solvents and Non-Transition Metal Chemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 220*</td>
<td>Introductory Analytical Chemistry</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry 240*</td>
<td>Introductory Theoretical Chemistry</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 250*</td>
<td>Introductory Thermodynamics</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 260*</td>
<td>Organic Chemistry 1</td>
<td>2</td>
<td>3+1</td>
</tr>
<tr>
<td>Physics 222* or 252*</td>
<td>Electricity &amp; Magnetism 1</td>
<td>2</td>
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<tr>
<td>Physics 222L* or 252L*</td>
<td>Electricity and Magnetism Laboratory</td>
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<td>3*</td>
</tr>
<tr>
<td>Physics 226* or 256*</td>
<td>Optics 1</td>
<td>2</td>
<td>0</td>
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<tr>
<td>Physics 226L* or 256L*</td>
<td>Optics Laboratory</td>
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### Winter Term

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 211*</td>
<td>Chemical Bonding in Inorganic Chemistry</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 221*</td>
<td>Analytical Chemistry of Multi-Component Systems</td>
<td>2</td>
<td>0</td>
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<tr>
<td>Chemistry 251*</td>
<td>Applications of Chemical Thermodynamics</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 252*</td>
<td>Quantum Chemistry 1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 261*</td>
<td>Organic Chemistry 2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry 291*</td>
<td>Laboratory</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Physics 223* or 253*</td>
<td>Electricity &amp; Magnetism 2</td>
<td>2</td>
<td>0</td>
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<tr>
<td>Physics 223L* or 253L*</td>
<td>Electricity &amp; Magnetism Laboratory</td>
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<td>3*</td>
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<tr>
<td>Physics 227* or 255*</td>
<td>Optics or Quantum Physics</td>
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<tr>
<td>Physics 227L*</td>
<td>Optics Laboratory (if 227* selected)</td>
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### Year 3

#### Fall Term

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>Chemistry 310*</td>
<td>Transition Metal and Coordination Chemistry</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 350*</td>
<td>Spectroscopy and Molecular Structure</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 351*</td>
<td>Statistical Thermodynamics</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 360*</td>
<td>Organic Chemistry 3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 390*</td>
<td>Advanced Laboratory 1</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Mathematics 237</td>
<td>Differential and Integral Calculus (first term)</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 324*</td>
<td>Atomic and Nuclear Physics</td>
<td>3</td>
<td>0</td>
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<tr>
<td>Physics 352*</td>
<td>Electronics 1</td>
<td>2</td>
<td>0</td>
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<tr>
<td>Physics 352L*</td>
<td>Electronics 1 Laboratory</td>
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#### Winter Term

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>Chemistry 311*</td>
<td>Radiocchemistry</td>
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<td>0</td>
</tr>
<tr>
<td>one of Chemistry 352*</td>
<td>Chemical Kinetics</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 354*</td>
<td>Applied Kinetics</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 361*</td>
<td>Organic Chemistry 4</td>
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<td>0</td>
</tr>
<tr>
<td>Chemistry 391*</td>
<td>Advanced Laboratory 2</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Mathematics 237</td>
<td>Differential and Integral Calculus (second term)</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 325*</td>
<td>Atomic and Nuclear Physics</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Physics 353*</td>
<td>Electronics 2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Physics 353L*</td>
<td>Electronics 2 Laboratory</td>
<td>0</td>
<td>3*</td>
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</table>

**Note**

The present curriculum is under review. The new Year 3 is shown above. Year 4 will not be changed until 1973-74 and will appear in the next Calendar.
### Year 4

<table>
<thead>
<tr>
<th>Subject</th>
<th>Course Code</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Chemistry 431</td>
<td>Inorganic Chemistry 2</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 435</td>
<td>Physical Chemistry 3</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 436</td>
<td>Organic Chemistry 3</td>
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<tr>
<td>Mathematics 450</td>
<td>Applied Analysis</td>
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</tr>
<tr>
<td>Physics 362* - 363*</td>
<td>Classical Mechanics 1 and 2</td>
<td>3</td>
</tr>
<tr>
<td>Physics 435*</td>
<td>Solid State Physics</td>
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</tr>
</tbody>
</table>

**One of:**

- Chemistry 332* - 333* Biochemistry 1 and 2
- Chemistry 440 Polymer Chemistry
- Chemistry 439 Advanced Laboratory

**Note**

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

---

### Co-operative Applied Chemistry (Honours) *(For Year 1, see page 232)*

Information about the Co-op work terms and the Coordination Dept. can be found starting on page 76. Both streams run until the end of academic term 3B whereupon the stream taking 3B in the fall term will have a double work term to combine with the other stream. This procedure will allow both streams to take Year 4 over the regular academic year (fall-winter) when more course electives and opportunities exist and to graduate at the same time in May.

#### Year 2A

<table>
<thead>
<tr>
<th>Subject</th>
<th>Course Code</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Chemistry 210*</td>
<td>Non-Aqueous Solvents and Non-Transition Metal Chemistry (Fall term Stream)</td>
<td>2</td>
</tr>
<tr>
<td>or Chemistry 211*</td>
<td>Chemical Bonding in Inorganic Chemistry (Winter Term Stream)</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 240*</td>
<td>Introductory Theoretical Chemistry</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 250*</td>
<td>Introductory Thermodynamics</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 260*</td>
<td>Organic Chemistry 1</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 220*</td>
<td>Introductory Analytical Chemistry</td>
<td>1</td>
</tr>
<tr>
<td>One elective</td>
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</tbody>
</table>

It is recommended that Physics 222* - 223* or 252* - 253* be strongly considered as electives sometime during Years 2 & 3.

#### Year 2B

<table>
<thead>
<tr>
<th>Subject</th>
<th>Course Code</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Chemistry 211*</td>
<td>Chemical Bonding in Inorganic Chemistry (Spring Term Stream)</td>
<td>2</td>
</tr>
<tr>
<td>or Chemistry 210*</td>
<td>Non-Aqueous Solvents and Non-Transitional Metal Chemistry (Fall Term Stream)</td>
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<tr>
<td>Chemistry 261*</td>
<td>Organic Chemistry 2</td>
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<tr>
<td>Chemistry 251*</td>
<td>Applications of Chemical Thermodynamics</td>
<td>2</td>
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<td>Chemistry 252*</td>
<td>Quantum Chemistry 1</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 221*</td>
<td>Analytical Chemistry of Multi-Component Systems</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 291*</td>
<td>Laboratory</td>
<td>0</td>
</tr>
<tr>
<td>One elective</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Academic Programmes

#### Year 3
Terms 3A and 3B will be taken in different sequence for different Coop streams as noted

**Year 3A (winter) or 3B (winter)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 311*</td>
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<tr>
<td>Radiochemistry</td>
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<tr>
<td>Chemistry 320*</td>
<td>2</td>
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<tr>
<td>Chemical Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td>one of Chemistry 352*</td>
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<td>Chemistry 354*</td>
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<tr>
<td>Applied Chemical Kinetics</td>
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<td>Chemistry 391*</td>
<td>0</td>
</tr>
<tr>
<td>Advanced Laboratory 2</td>
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</tbody>
</table>

Two electives
(subject to availability and compatibility with the timetable, the following are recommended: one of Chemistry 332*, Biochemistry 1; Chemistry 333*, Biochemistry 2 (see note 1 below); Chemistry 362*, Theoretical Organic Chemistry; Chemistry 395*, History of Chemistry; Chemical Engineering 550*, Metallurgical Chemistry.)

**Year 3B (fall) or 3A (spring)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Chemistry 350*</td>
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<td>Spectroscopy and Molecular Structure</td>
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<tr>
<td>Chemistry 353*</td>
<td>2</td>
</tr>
<tr>
<td>Physical Chemistry of Polymers</td>
<td>0</td>
</tr>
<tr>
<td>Chemistry 363*</td>
<td>2</td>
</tr>
<tr>
<td>Applied Organic Chemistry</td>
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<tr>
<td>Chemistry 390*</td>
<td>0</td>
</tr>
<tr>
<td>Advanced Laboratory 1</td>
<td>9</td>
</tr>
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</table>

Two electives
(subject to availability and compatibility with the timetable, the following are recommended: Chemistry 310*, Transition Metal and Coordination Chemistry; Chemistry 332*, Biochemistry 2; Chemical Engineering 550*, Metallurgical Chemistry; Chemical Engineering 551*, Introduction to Extractive Metallurgy.)

**Note 1** Chemistry 332* and 333* are a full-year sequence. Chemistry 333* can only be taken if Chemistry 332* has been completed.

**Note 2** The Chemistry curriculum is under review. The new Year 3 is shown above. Year 4 will not be changed until 1973-74 and will appear in the next Calendar. Students taking the 3B term in the fall 1972 or winter of 1973 will follow the description in the previous Calendar, i.e. Chemistry 302*, 305* and three of Chemistry 303*, 307*, 318*, an elective, for a total of 5 term courses.

#### Year 4A

<table>
<thead>
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<tbody>
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<td>Electrochemistry and Corrosion</td>
<td>3*</td>
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<td>Chemistry 429</td>
<td>0</td>
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<tr>
<td>Project Laboratory</td>
<td>9</td>
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<tr>
<td>Chem. Eng. 422*</td>
<td>3</td>
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<td>Engineering Economics</td>
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Electives (2 required):

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 403*</td>
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<tr>
<td>or Chem. Eng. 541*</td>
<td></td>
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<tr>
<td>Physical Chemistry of Polymers</td>
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<tr>
<td>as specified</td>
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<tr>
<td>Chemistry 405*</td>
<td>3</td>
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<td>Surface Chemistry</td>
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<tr>
<td>Chemistry 407*</td>
<td>3</td>
</tr>
<tr>
<td>Applied Biochemistry</td>
<td>3</td>
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<tr>
<td>Chemistry 408*</td>
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<tr>
<td>Instrumentation 1</td>
<td>3</td>
</tr>
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</table>

Arts, Engineering or Science elective
(subject to availability and compatibility with the timetable, the following are recommended: one of Chemistry 332*, Biochemistry 1; Chemistry 333*, Biochemistry 2 (see note 1 below); Chemistry 362*, Theoretical Organic Chemistry; Chemistry 395*, History of Chemistry; Chemical Engineering 550*, Metallurgical Chemistry.)
### Year 4B

<table>
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<tbody>
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<tr>
<td>Chemistry 429 Project Laboratory</td>
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<tr>
<td>Chemistry 410* Applied Chemistry Seminar</td>
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**Electives (2 required):**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>Chemistry 412* Analysis of Materials</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 413* Properties of Polymers</td>
<td>3</td>
</tr>
<tr>
<td>or Chem. Eng. 543* Polymer Processing</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 415* Catalysis</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 418* Instrumentation 2</td>
<td>1</td>
</tr>
</tbody>
</table>

**Arts, Engineering or Science elective** as specified

---

**Note 1**
All electives chosen must be from those offered compatible with the timetable. Choice of electives must be approved by the Chemistry Department.

**Note 2**
Only two of the Chemistry electives in terms 4A and 4B will be offered each year according to demand.

---

### Honours Earth Sciences (Geology Option)

**Year 2**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Sciences 231* Mineralogy</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 232* Petrography</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 235* Stratigraphy</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 236* Paleontology 1</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 241* Crystallography and Optical Mineralogy</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 260* Introductory Structural Geology</td>
<td>2</td>
</tr>
</tbody>
</table>

Three full year electives (or their equivalent) as follows:

**Science elective:** Physics 101*-102*, General Physics, or an equivalent physics course.

**Mathematics elective:** By the end of Year 2, students will be required to have completed Mathematics 130, Calculus, and a course involving computer programming (Mathematics 132, Introduction to Computer Science or General Engineering 121*, Digital Computation).

For students who completed the Science or Mathematics electives in Year 1, the following electives are recommended: Biology 132, Principles of Biology (or a second or third year Biology course); Mathematics 236, Elementary Differential Equations.

**Arts elective:** as specified.

**Note**
The Earth Sciences curriculum is presently under revision. The new Year 2 is shown above. Years 3 and 4 will not be changed until 1973-74 and will appear in the next Calendar.
### Year 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Sciences 330</td>
<td>Igneous and Metamorphic Petrology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Earth Sciences 334</td>
<td>Paleontology</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 335</td>
<td>Stratigraphy and Sedimentation</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Earth Sciences 340</td>
<td>Structural Geology</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Arts Elective</td>
<td>as specified</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

One of:
- Biology 333 Invertebrate Zoology   2  3
- Physics 250*-251* The Solar System—The Stellar System  3  0

or other Science elective as specified

### Year 4

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Sciences 430</td>
<td>Economic Geology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Earth Sciences 436</td>
<td>Thesis</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Earth Sciences 437</td>
<td>Crustal Evolution</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

One non-Earth Sciences elective as specified

Two courses† from:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Sciences 368*-369*</td>
<td>Geophysics 1 and 2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Earth Sciences 431</td>
<td>Geochemistry</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 432*</td>
<td>Precambrian Geology</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 434*</td>
<td>Biostratigraphy</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 438*</td>
<td>Engineering Geology</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Earth Sciences 439*</td>
<td>Groundwater Geology</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Earth Sciences 440*</td>
<td>Quaternary Geology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Earth Sciences 455*</td>
<td>Mathematical Geology 1</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Earth Sciences 456*</td>
<td>Mathematical Geology 2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Earth Sciences 457*</td>
<td>Mathematical Geology 3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Earth Sciences 458*</td>
<td>Geology of Subsurface Fluids</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Earth Sciences 460*</td>
<td>Applied Geophysics 1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 461*</td>
<td>Applied Geophysics 2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

†Courses marked * are half courses: two of these make the equivalent of one course selection.

### Honours Earth Sciences and Geography

#### Year 1

(For a complete discussion of Year 1, see page 232)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lectures</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Sciences 130</td>
<td>Introductory Geology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Geography 101*</td>
<td>Introduction to Human Geography</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Geography 102*</td>
<td>Introduction to Physical Geography</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry 121*</td>
<td>Chemical Structure and Periodicity</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry 142*</td>
<td>General Chemistry for the Life Sciences</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Two electives as specified
### Year 2

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Sciences 236* Paleontology 1</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 231* Mineralogy</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 241* Crystallography and Optical Mineralogy</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 235* Stratigraphy</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 232* Petrography</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 260* Introductory Structural Geology</td>
<td>2</td>
</tr>
<tr>
<td>Geography 200* Principles of Biogeography and Ecology</td>
<td>2</td>
</tr>
<tr>
<td>Geography 201* Basic Topics of Physical Geography</td>
<td>2</td>
</tr>
<tr>
<td>Geography 202* Economic and Urban Geography</td>
<td>2</td>
</tr>
<tr>
<td>Geography 203* Cultural and Regional Geography</td>
<td>2</td>
</tr>
<tr>
<td>One elective</td>
<td></td>
</tr>
</tbody>
</table>

### Year 3

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Sciences 330 Igneous and Metamorphic Petrology</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 334 Paleontology</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 335 Stratigraphy and Sedimentation</td>
<td>2</td>
</tr>
<tr>
<td>Earth Sciences 340 Structural Geology</td>
<td>2</td>
</tr>
<tr>
<td>One Geography elective</td>
<td></td>
</tr>
<tr>
<td>One elective</td>
<td></td>
</tr>
</tbody>
</table>

### Year 4

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Sciences 436 Honours thesis</td>
<td>0</td>
</tr>
<tr>
<td>Three other Earth Sciences courses at the 400 level</td>
<td></td>
</tr>
<tr>
<td>One full-year Geography elective</td>
<td></td>
</tr>
<tr>
<td>One elective</td>
<td></td>
</tr>
</tbody>
</table>

### Honours Physics (For Year 1, see page 232)

The Honours programme is in the form of a core of required courses, plus appropriate electives. The elective courses may be chosen from a wide range of courses offered by the Physics Department and by other departments of the University. By careful selection of his electives, a student can deepen his knowledge of experimental or theoretical physics, or obtain a background in another subject (e.g. Astronomy, Geophysics, Chemistry, Mathematics, Computing, Business Administration). The choice of electives must be made to fit the student's timetable, and must be approved by the Chairman of the Department of Physics. The programme must include a total of twenty-four course credits (including year one). The normal rate of progress would be five course credits in first year, six and a half course credits in each of the second and third years and six course credits in fourth year. Examples of possible elective programmes are given in the following pages. The core programme is listed below. A detailed description of the courses is given on page 477.

### Year 2 Core

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 252*-253* Electricity and Magnetism 1 and 2</td>
<td>1.00</td>
</tr>
<tr>
<td>Physics 252L*-253L* Electricity and Magnetism Labs</td>
<td>.50</td>
</tr>
<tr>
<td>Physics 256* Optics (first term)</td>
<td>.50</td>
</tr>
<tr>
<td>Physics 256L* Optics Laboratory</td>
<td>.25</td>
</tr>
<tr>
<td>Physics 255* Quantum Physics (second term)</td>
<td>.50</td>
</tr>
<tr>
<td>Mathematics 237 Differential and Integral Calculus</td>
<td>1.00</td>
</tr>
<tr>
<td>Mathematics 31* Differential Equations</td>
<td>.50</td>
</tr>
</tbody>
</table>

Mathematics 31* may be replaced by Mathematics 236.
### Year 3 Core
- Physics 360A* Intermediate Laboratory: 0.25
- Physics 360B* Intermediate Laboratory: 0.25
- Two of Physics 371A*, 371B*, 352L* or 353L*: 0.50
- Physics 362*-363* Classical Mechanics 1 and 2: 1.00
- Physics 365* Physical Mathematics 2: 0.50
- Physics 354* Atomic and Molecular Physics: 0.50
- Physics 358* Thermodynamics: 0.50
- Physics 359* Statistical Mechanics: 0.50

**Note 1** Students desiring Physics 444* must elect Physics 355*.

**Note 2** Physics 364* is recommended.

### Year 4 Core
- Physics 434A* Introductory Quantum Mechanics: 0.50
- Physics 441 Electromagnetic Theory: 1.00
- Physics 355* (if not taken in Year 3)

**Note** Physics 434B* is strongly recommended for students intending to do graduate work.

### Elective Programmes
The flexibility of this “core plus electives” structure is demonstrated by the following examples of possible programmes, all of which are sufficient preparation for graduate work in Physics, although each has a slightly different emphasis. Details of other possible programmes may be obtained from the Chairman of the Physics Department.

#### Ex 1 Honours Physics (with extra emphasis on experimental physics)
- Core plus: Year 2 Physics 259*, 259L*, 270*-271*, Mathematics 240a* and 240b*
- Year 4 Physics 432*, 433, 434B*, 435*, 436
  - Two of: Physics 442*, 443*, 444*, 445*, 452*, 453*

#### Ex 2 Honours Physics (especially suitable as preparation for high school teaching)
- Core plus: Year 2 Physics 265*, Chemistry 210*-211*, Physics 250*-251* or Mathematics 240a*-240b*
- Year 3 Physics 352*, 352L*, 364*, 371A*-371B* and either (353*, 353L*) or (368*, 369*), Arts Elective*.
- Year 4 Physics 433, 435*, Chemistry 356*-357*, Science 400, Arts Electives totalling 1.00 credit.

#### Ex 3 Honours Physics (with Biophysics)
- Core plus: Year 2 Mathematics 51*, Three of: Chemistry 251*, 266*-267*, Biology 235
- Year 3 Physics 364*, 380*, 381*, 352*, 352L*, 371B*
- Year 4 Physics 434B*, 435*, 480*, 481*
  - Four of: Biology 434, 448, 449, Chemistry 403*, 413* 425*, 435

#### Ex 4 Honours Physics (with Computing)
- Core plus: Year 2 Physics 259*, 259L*, Mathematics 240a*-240b*, Physics 265* or Arts Elective*
- Year 3 Physics 352*, 352L*, 353*, 353L*
- Year 4 Physics 435*, 452*, 453*, E.E. 324*, electives totalling 2.00 credits.
Ex 5 Honours Physics (with Chemistry)

Core Plus:  
Year 2 Chemistry 210*-211*, 250*-251*, Mathematics 240a* or 240b*  

Ex 6 Honours Physics (with Astrophysics)

Core plus:  
Year 2 Physics 250*, 251*, 270*, Mathematics 240a*-240b*  
Year 4 Physics 434B*.  

Ex 7 Honours Physics (with Business Administration Option)

Core Plus: (special requirement in Year 1 – Economics 101*-102*)  
Year 2 Mathematics 132, Economics 256*-257*, Systems Design 311*.  
Year 3 Physics 355*, Economics 201*-202*, 303*-304*, Systems Design 312*  
(Physics 360A* and 360B* are not normally taken with this option)

Ex. 8 Honours Physics (with Geophysics)

Core plus:  
Year 2 Physics 259*, 259L*, Earth Sciences 231*, 235*, 241*.  

Theoretical Physics Programme

Students with an interest in theoretical physics may wish to emphasize the more mathematical aspects of the subject. A suitable programme consists of the “Honours Physics” core plus the following elective scheme:

Core plus:  
Year 2 Physics 259*, 259L*, Mathematics 229, elective*  
Year 3 Physics 355*, Mathematics 329, electives to total 1.00 credit  
Year 4 Physics 431, 434B*, 435*, 437* plus either Physics 436 and 1½ electives or one of Mathematics 312 or 343 and Mathematics 434, elective

Note 1 Students interested in this programme are advised to take Mathematics 130, 131 and 132 in Year 1 to ensure having the necessary prerequisites for later year Mathematics courses.

Note 2 The only restriction on elective courses is that there is to be a minimum of duplication.

Note 3 Physics 437* and 434B* must be chosen in the core of Year 4 for this programme.

Co-operative Applied Physics (Honours)

Applied Physics is an honours programme in the form of a core of required courses plus appropriate electives. The electives available in the second, third and fourth years allow students to strengthen complementary areas of interest whether in some specific field in physics or in some other subject area.

Through the Co-operative part of the programme Applied Physics students have the opportunity of exposure to practical research and development situations in Government and Industry. Work opportunities, which are available on a competitive basis, are co-ordinated to complement the student’s course work and interests where possible. Many work term experiences, especially in the upper
years, provide the student with a deeper insight into the meaning and methods of research as well as an incentive to develop course work. Such experience provides a contribution to the development of a scientist which cannot be learned in lecture courses, and helps prepare him to apply his fundamental physics background to the solution of practical problems.

The programme must include a total of twenty-four course credits (including Year one). The normal rate of progress would be a total of five course credits in terms 1A and 1B, a total of six and a half course credits in terms 2A and 2B, a total of six and a half course credits in terms 3A and 3B, and a total of 6 course credits in terms 4A and 4B. Examples of possible elective programmes are given in the following pages.

The core programme is listed below. A detailed description of the courses are given on page 477.

The following table shows the normal progress of students in the Applied Physics programme. This arrangement has been found advantageous since it provides more relevant work experience in senior years.

<table>
<thead>
<tr>
<th>1972</th>
<th>1973</th>
<th>1974</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Winter</td>
<td>Spring</td>
</tr>
<tr>
<td>First Term</td>
<td>Second Term</td>
<td>Third Term</td>
</tr>
<tr>
<td>1A</td>
<td>1B</td>
<td>2A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1975</th>
<th>1976</th>
<th>1977</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter</td>
<td>Spring</td>
<td>Fall</td>
</tr>
<tr>
<td>Work</td>
<td>Fifth Term</td>
<td>Sixth Term</td>
</tr>
<tr>
<td>4</td>
<td>3A</td>
<td>3B</td>
</tr>
</tbody>
</table>

Further information about the Co-operative work terms and the Co-ordination Department can be found starting on page 76.

**Year 2A** *(For Year 1 see page 232)*

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 252*</td>
<td>.50</td>
</tr>
<tr>
<td>Physics 252L*</td>
<td>.25</td>
</tr>
<tr>
<td>Physics 256*</td>
<td>.50</td>
</tr>
<tr>
<td>Physics 256L*</td>
<td>.25</td>
</tr>
<tr>
<td>Mathematics 237a*</td>
<td>.50</td>
</tr>
<tr>
<td>Mathematics 31*</td>
<td>.50</td>
</tr>
</tbody>
</table>

**Year 2B**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 253*</td>
<td>.50</td>
</tr>
<tr>
<td>Physics 253L*</td>
<td>.25</td>
</tr>
<tr>
<td>Physics 255*</td>
<td>.50</td>
</tr>
<tr>
<td>Mathematics 237b*</td>
<td>.50</td>
</tr>
</tbody>
</table>
Academic Programmes

Year 3A
Core
Physics 354* Atomic and Molecular Physics .50
Physics 358* Thermodynamics .50
Physics 360A* Intermediate Laboratory .25
Physics 362* Classical Mechanics 1 .50
One of Physics 371A*, 352L* Laboratory .25

Note: Physics 364* is recommended.

Year 3B
Core
Physics 360B* Intermediate Laboratory .25
Physics 359* Statistical Mechanics .50
Physics 363* Classical Mechanics 2 .50
Physics 365* Physical Mathematics 2 .50
One of Physics 371B*, 353L* Laboratory .25

Note: Students desiring Physics 444* must elect Physics 355*.

Year 4A - 4B
Core
Physics 434A* Introductory Quantum Mechanics .50
Physics 441 Electromagnetic Theory 1.00
Physics 355* (if not taken in Year 1)

Note: Physics 434B* is strongly recommended for students intending to do graduate work.

Options
Some suggested programmes are given below.

Ex 1 Co-op Applied Physics (Solid State)
Core plus: Year 2A Physics 270*, Mathematics 240b*.
Year 2B Physics 259*, 259L*, 271*, Chemistry 311* or Mathematics 240a*.
Year 3A Physics 352*, 352L*, 364*, 371A*.
Year 3B Physics 353*, 353L*, 355*, 371B*.
Year 4A Physics 433, 435*, 436, 452*.
Year 4B Physics 433, 434B*, 436, 442*, 432* or 453*.

Ex 2 Co-op Applied Physics (Biophysics)
Core plus: Year 2A Chemistry 260*, Elective*.
Year 2B Physics 265*, 380*, Mathematics 51*, Chemistry 261*.
Year 3A Physics 352*, 352L*, 364*, 371A*.
Year 3B Physics 353*, 353L*, 355*, Chemistry 250*.
Year 4A Physics 433, 435*, 480*, Elective*.
Year 4B Physics 381*, 481*, 433, 434B*, 444*.

Ex 3 Co-op Applied Physics (and Chemistry)
Core Plus: Year 2A Chemistry 260*, Arts Elective*.
Year 2B Chemistry 211*, 250*, Physics 259*, 259L*.
Year 3A Chemistry 311* or 261*, Physics 352*, 352L*, 364*.
Year 3B Physics 353*, 353L*, Chemistry 251*.
Year 4A Physics 371A*, 435*, 436, Chemistry 400*.
Year 4B Physics 371B*, 432*, 434B*, 436, Chemistry 332* or 353*. 
Optometry Programme

Ex 4 Co-op Applied Physics (with Computing)

*Year 2A* Mathematics 219a*, 240b*.
*Year 2B* Mathematics 219b*, 240a*, Physics 259*, 259L*.
*Year 3B* Mathematics 340b*, Physics 353*, 353L*.
*Year 4A* Mathematics 334a*, Physics 435*, 436, 452*.
*Year 4B* Mathematics 51*, 334b*, Physics 436, 453*.

Ex 5 Co-op Applied Physics (with Business Administration Option)

Core plus: (special requirement in Year 1 – Economics 101*-102*)

*Year 2A* Economics 256*, 303*.
*Year 2B* Economics 257*, General Engineering 121*, Systems Design 311*.
*Year 3A* Economics 201*, Systems Design 312*.
*Year 3B* Economics 202*, 304*.

(Physics 360A* and 360B* are not normally taken with this Option).

Optometry Programme

Within the Science Faculty, the School of Optometry offers a five year programme leading to the degree Doctor of Optometry. The first is a pre-optometrical year preparatory to the four years of the professional optometrical programme.

The immediate purpose of the programme is to qualify men and women for the practice of Optometry. However, the programme is designed to provide the student with sufficient general and specialized knowledge in Science so that he may follow a career in research and teaching if he so wishes. Students who desire to transfer from Optometry to other areas in Science, especially General Science, may do so at any time, although it is best to do so after Years 1 or 2. Students thus transferring will receive credit for all appropriate courses taken and will then take whatever courses are necessary to complete the programme chosen.

Upon completion of their training in Optometry graduates will be eligible to apply for registration as optometrists in the province of their choice† or to undertake Graduate Studies. Graduate training will lead to the degrees of Master of Science and Doctor of Philosophy. A graduate programme in Physiological Optics, leading to the Master of Science degree, is now available.

Inquiries regarding admission requirements should be sent to the Registrar of the University. Specific admissions requirements and regulations for Examinations and Standings may be found on page 225. The Optometry programme requires the same academic standard as do the Honours programmes in the Faculty. All other inquiries relating to the course should be sent to the Undergraduate Officer of the School of Optometry at the University.

Students who enroll at the University of Waterloo and intend to proceed in Optometry will register in Year 1 Regular Science and should receive counselling regarding the prerequisites for continuing in Optometry in their second year.
All University of Waterloo students interested in continuing in Optometry will be requested to pre-register for second year Optometry during the spring preregistration period. In the event that the number of students preregistering for second year Optometry exceeds the enrolment limitation for that year, the chief criterion for admission will be the academic standing of the applicant. All prospective students in Optometry should be advised that priority in admission will be given to Ontario students completing their first year requirements at the University of Waterloo.

A student who has met the requirements for admission to Year 1 Regular Science (the pre-Optometrical year) and who has in addition completed with satisfactory standing at a recognized university a programme equivalent to that taken by Year 1 Regular Science students at the University of Waterloo may apply for direct admission to the first professional year (Year 2) of the Optometry programme; priority in admissions will be given to Canadian students if enrolment limitation is necessary. Students granted direct admission to the first professional year (Year 2) who have taken courses equivalent to those required in the upper years of the programme may upon registration apply for exemption from these courses. Exemption will not be granted for courses in which the grade obtained was less than "C" (60%). Exemptions are not normally granted for any optometry courses, e.g., Optometry 211*, Optometry 224*, etc. Applications for direct admission to the first professional year should be forwarded as early as possible in the calendar year. The required transcripts, letter of reference, etc., should be forwarded to the Registrar when available.

Note: *As in the case of other professions, graduates in Optometry must hold the certificate of the licensing body of the Province in which they elect to engage in practice.

### Academic Programme

For Year 1, see page 232. This Pre-Optometrical year is the normal Year 1 programme of the Faculty of Science with Mathematics 125 or 130, Physics 121*-122* or 162*-163*, Psychology 101*-102* required. Recommended options are Biology 132 and Chemistry 121*-142*.

**Note 1** Biology 132 is required for all students who have not taken Grade 13 Biology or its equivalent.

**Note 2** A year of Chemistry is required for all students lacking a good Chemistry background in Ontario Grade 13 or its equivalent. For these students, Chemistry 111*-112* is recommended rather than Chemistry 121*-122*.
Year 2

Fall Term

<table>
<thead>
<tr>
<th>Course</th>
<th>Lectures</th>
<th>Labs</th>
<th>Clinics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 201</td>
<td>2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Anatomy, Histology and Embryology (first term)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry 216*</td>
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<tr>
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Winter Term

<table>
<thead>
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Note: An elective from Arts, Science or Mathematics may be substituted for the Psychology elective with the permission of the School of Optometry.

Year 3

Fall Term

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Winter Term

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Note: An elective from Arts, Science or Mathematics may be substituted for the Psychology elective with permission of the School of Optometry.

Year 4

Fall Term

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<td>Physiology of Visual Systems</td>
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</table>
The General Science Programme

Winter Term
Optometry 411* Physiological Optics 3 3 0
Optometry 412* Clinical Optometry 3 2 0
Optometry 414* Physiology of Visual Systems 2 2 0
Optometry 415* Ocular Pathology 2 1 0
Optometry 417* Optometric Specialities 3 2 0
Optometry 418* Optometry Clinic 0 0 7

Summer
Optometry 428* Summer Clinic (total 60 hours)

Year 5

Fall Term
Optometry 500* Optometrical Jurisprudence and 2 0 0
Praxis
Optometry 501* Physiological Optics 0 3 0
Optometry 502* Advanced Clinical Optometry 3 0 0
Optometry 504* Ocular Pharmacology 2 1 0
Optometry 508* Optometry Clinic 0 0 24
Optometry 509* Public Health Optometry 2 2 0
Psychology 357* Psychopathology 3 0 0

Winter Term
Optometry 510* Optometrical Jurisprudence and 2 0 0
Praxis
Optometry 511* Physiological Optics 3 0 0
Optometry 512* Advanced Clinical Optometry 3 0 0
Optometry 513* Optometric Communication 2 0 0
Optometry 514* Genetics for Optometrists 2 0 0
Optometry 518* Optometry Clinic 0 0 24
Optometry 519* Public Health Optometry 2 2 0

Note: Students with a particular interest in and an aptitude for research in physiological optics may substitute Optometry 501*-511* for Psychology 357* and Optometry 513*. A student is required to complete one or the other of these alternatives.

The General Science Programme

The General Science Programme is available as a three- or four-year option. Students may specialize in a particular subject area in the three-year programme or may elect to pursue a broad range of Science subjects (essentially a "non-major" programme). The three-year programme is titled "General Science" with no area of specialization designated. The four-year programme is the official majoring General Science programme. It is only available with a selected major field (Biology, Chemistry, Earth Sciences, Physics, or as a General Science and Business programme in which a broad range of specified Science courses is required, rather than a majoring area. It is officially titled "General Science, Biology Major", "General Science, Chemistry Major", etc.

Graduates of the three-year programme who have taken the required courses are qualified to apply for admission to medical school in Ontario. Students who have passed the first year of the programme with
appropriate choice of courses are qualified to apply for admission to a dental school. Graduates also may be eligible for admission to the Type B course at a College of Education in Ontario or for various industrial positions such as senior laboratory technicians, technical sales representatives, and so forth.

Graduates of the four-year programme who have taken appropriate courses will be eligible for certain categories of industrial and government employment for which the three-year programme will not fit them; likewise they can meet the subject requirements for application to Type-A courses at a College of Education in Ontario with specialization in a single subject.

Depending on the option chosen, a student may graduate with the General B.Sc. after either three or four years; the graduation diploma will indicate whether the three or four-year programme has been completed. A student who has graduated from the three-year programme may apply to register for the four-year programme; upon successful completion of the latter, a new graduation diploma will be issued in exchange for the original, but the student will not "graduate" a second time. Students may transfer from one of these options to the other; for transfer from the three- to the four-year programme, the student must have the necessary course selection and standing required for a major field.

General Science—Three-year Programme

The three-year programme requires the successful completion (with at least a passing mark in each) of 15 courses for the B.Sc. Normal progress is 5 courses per year. At least half of the 15 courses must be Science courses and normally no more than 7 courses are allowed from the same subject area (i.e. no more than 7 Biology courses or 7 Mathematics courses or 7 English courses, etc.). Also, at least 6 of the 15 courses must be at the 200-level or higher.

If a student wishes to specialize in a particular subject area in Science he (or she) is advised to follow the recommendations of Years 1-3 of the four-year programme. Alternatively, a broader selection of science subjects may be chosen but students should be warned not to make their course selection so broad and varied as to find their background of little use following graduation. The responsibility of arranging a programme selection over the three years ultimately rests with the student and he (or she) should ensure it meets his (her) needs. To ensure that proper advice is available and given regarding course selection, the student’s programme must be approved at Registration time each year by a Faculty advisor.

Students are encouraged to take at least 4 courses (an average of better than one per year) from non-Science areas such as Arts or Mathematics.

The minimum standard for graduation from the three-year programme will be a cumulative (overall) average of 50% calculated for all courses taken (in any year—whether passed or failed).

Recommended Programme

Year 1 Any 5 courses, two of which must be Science courses. Since Year 1 is common to all subsequent programmes in Science, the student is advised to select a Year 1 programme which can lead to an area of specialization in Year 2 if desired (see page 232).
Year 2 5 courses of which 2 or 3 should normally be Science courses.

Year 3 5 courses of which 2 or 3 should normally be Science courses.

Note Selections should be made so that at the end of Year 3 the total programme will include 15 courses (total) completed with at least half of them in Science and no more than 7 from the same subject area. In addition at least 6 of the 15 courses must be 200 or higher level courses.

Some possible electives (other than Year 1 courses described on page 232).

The following list, while not complete, indicates some of the courses from which a choice should be made. Since some Departments offer Honours or General equivalents of the same course area or Co-operative or Regular versions of the same course area, duplication of subject matter is not allowed. It is usually obvious from the course descriptions where such duplication is possible and care should be taken to avoid it as credit for only one of such overlapping courses will be allowed (e.g. credit for one of Chemistry 26*, 236, 266*-267*; one of Chemistry 202*, 242, 226*-227*, 328; one of Physics 101*-102*, 121*-122*, 162*-163*; etc.) In addition, where Departmental course listings clearly indicate an elective as available only to Arts students, or Engineering students or Physical Education students, etc., such courses may not be selected in the General Science programme. Students must also have any necessary prerequisites listed before attempting upper year courses; these are listed in the Departmental descriptions. More courses are offered under the Science listing this year (e.g. Science 251*) and are especially recommended for consideration.

Science courses recommended (other than Year 1 courses)

Biology 234, 236, 243*-244*, 245*-246* 333, 334*, 335, 338*, 341*, 342, 343*, 344*, 345* but not 110*, 131, 201, 233, 235, 301, 303*-304*

Chemistry 218*-219*, 226*-227* or 328, 266*-267*, 316*-317*, 332*-333*, 356*-357*, 366*-367* but not 216*


Physics 222*-223* and 222L*-223*L, 226*-227* and 226L*-227*L, 250*-251*, 301*-302*, 324*-325*, 352*-353* and 352L*-353L*, 358*-359*, 368*-369*, 380*-381*


Mathematics courses recommended

Mathematics 130, 131, 132 (if not taken in Year 1): 236, 240a*, 240b*, 243
**Arts courses recommended**

It is impossible to list all options here since tastes vary. Many students select first or second year options from the following subject areas: Anthropology, Arts, Economics, English, French, Geography, German, History, Philosophy, Political Science, Psychology, Russian, Sociology, Religious Studies. Subject to prerequisites and timetable a wide range of Arts courses is available.

**General Science—Four year Majoring Programmes**

The four-year programme requires the successful completion with at least a passing mark in each of 20 courses for the B.Sc. Normal progress is 5 courses per year. An official major field (from Biology, Chemistry, Earth Sciences and Physics) must be selected: at least 8 courses from this major field must be completed as specified and normally not more than 10 courses from the major field area will be allowed. The only exception to the requirement of a major field is in the General Science and Business programme where a broad range of specified Science courses is required.

While considerable flexibility to take electives exists in this programme, students must take the courses required by their major Departments (there are at least 8 free electives available in each programme; Departments may have published recommendations regarding electives which should be strongly considered although they are not compulsory). Upon graduation, at least half of the 20 courses presented must be Science courses. Students are encouraged to take at least 4 courses (an average of one per year) from non-Science areas such as Arts or Mathematics.

The minimum standard for graduation from the four-year majoring programmes will be a cumulative (overall) average of 50% calculated for all courses taken (in any year—whether passed or failed) plus a 60% cumulative average for the major field courses. Students who do not maintain their major field average in the four-year programme will be transferred to the three-year ("non-major") programme where a major field average is unnecessary.

**Recommended Programme**

The selection of courses in upper years will be restricted partly by limitations imposed by the timetable, and partly by the necessity in many courses of having completed prerequisites. Each student's programme must, therefore, be approved by the Chairman of the Department of his major field.

The following programmes are those recommended by the department for major study in their fields. The university will make every effort to ensure that the timetable accommodates these programmes.

**Biology Major**

*Year 1* Including Biology 132 and Chemistry 121*-142* (see page 232).

*Year 2* Two of: Biology 233, 234, 235, 236  
Chemistry 266*-267*  
Two non-Biology electives
Year 3 Two or three full courses† of: Biology 333, 334*, 335, 338*, 341*, 342, 343*, 344*, 345*
Chemistry 332*-333*
Two or one non-Biology electives.

†Students wishing to apply for the Ontario Department of Education Type A certificate must choose three courses in Biology in Year 3 or take a third Biology course as an extra course. In Year 4, three Biology courses should be selected.

Year 4 Five courses at least two† of which are 400-level Biology courses or courses from the above list.

Note Some possible electives are shown in the list under the three-year programme. These courses would be suitable choices here. (Physics 301*-302* and Chemistry 328 are especially recommended.)

Chemistry Major

Year 1 Including Chemistry 121*-122* and Mathematics 130 (see page 232).

Year 2 Chemistry 226*-227*, 266*-267*
Three full-year electives (or their equivalent)†

Year 3 Chemistry 218*-219*, 356*-357*
Three full-year electives (or their equivalent)†

Year 4 Chemistry 316*-317*, 366*-367*
Two other 300- or 400-level one-term Chemistry courses
Two full-year electives (or their equivalent)†

†Electives At least 3 other full-year non-Chemistry Science courses (or their equivalent), usually one per year, should be selected in Years 2 - 4. Some possible choices can be found in the elective listings for the three-year programme. Courses specially recommended for consideration are Mathematics 236, Biology 245*-246*, Physics 222*-223* and Physics 222L*-223L* (Year 2); Mathematics 243, Science 251*-252*, Physics 226*-227*, 250*-251*, Chemistry 332*-333*, 395* (Year 3); Science 400 (Year 4). Other Year 3 and Year 4 Chemistry courses may be chosen subject to prerequisite and timetable requirements.

Earth Science Major

Year 1 Including Earth Sciences 130 and Chemistry 121*-142* (see page 232).

Year 2 Earth Sciences 231*, 232*, 236*, 235*, 260*, 241*
Two electives

Note The Earth Sciences curriculum is presently under revision. Year 3 and 4 will not be changed until 1973-74 and will appear in the next calendar. Students should note that Physics 101*-102* will be a prerequisite for a proposed Applied Geophysics course to be given in the third year. Mathematics 130 and an introductory course in computer programming will be prerequisites for a proposed Mathematical Geology course to be given in the third and fourth years.
The General Science Programme

Year 3 Two or three of: Earth Sciences 330, 334, 335, 340
One or two of: Chemistry 226*–227*, Biology 234, Physics 250*–251*, Mathematics 132
Arts elective

Year 4 Two or three of: Earth Sciences 368*–369*, 430, 431, 432*, 434*, 437, 438*, 439*, 440*, 460*, 461*
Three or two non-Earth Sciences electives

* Half courses: 2 of these make the equivalent of one course selection

Physics Major

Year 1 Including Physics 121*-122* or 162*-163* and Mathematics 130 (see page 232).

Year 2 Physics 222*-223* and 222L*-223L*, 226*-227* and 226L*-227L*
One of: Mathematics 132, 236, 217
One of: Chemistry 218*-219*, 266*-267*, Science 251*-252*, Earth Sciences 130 or 231*-241*
Elective

Year 3 Physics 324*-325*
One or two of: Physics 250*251*, 352* and 352L*, 353* and 353L*, 358*-359*, 368*-369*, 380*-381*; or 364*-365* (especially recommended if Business Administration Option chosen)
Two or one of: Mathematics 219 or 243; Chemistry 218*-219* or 356*-357*
Arts or Mathematics Elective

Year 4 Two or three of: Physics 250*-251*, 352* and 352L*, 353* and 353L*, 358*-359*, 362*-363*, 364*-365*, 368*-369*, 480*-481*, 441
Two or one non-Physics Science courses
Arts or Mathematics Electives

Business Administration Option

There is a growing need for graduates who have a competence in the combined disciplines of science and business administration. For those students whose leanings are towards administration in industry, marketing, analysis, etc. rather than scientific research or teaching, the following courses are strongly recommended for inclusion in the *four year majoring programmes* shown above. (These business and economics courses normally provide the prerequisite background for a one year Master of Business Administration course.)

Year 1 Economics 101*-102*, Introduction to Economics

Year 2 Mathematics 31*, Differential Equations
Mathematics 237, Calculus
General Engineering 121*, Digital Computation
Economics 256*-257*, Introduction to Accounting 1 and 2
**General Science and Business**

A four-year General Science Programme

The following programme provides a broad scientific background in many relevant areas of Science and Mathematics (without requiring a particular majoring area of Science) and is designed for the student wishing to combine the disciplines of science and business administration/economics. Students whose leanings are towards administration in industry, marketing, analysis, etc. will find it ideal for their purposes.

The programme is made up of 20 courses with 10 required in Science (including at least 4 at the 300 level or higher) and the remainder in Mathematics, Economics and Business Administration. The Business courses are given at Waterloo Lutheran University and may be taken by University of Waterloo students through co-operation between the two Universities; Economics courses are offered by the Department of Economics, University of Waterloo. The business and economics courses normally provide the prerequisite background for a one-year Master of Business Administration programme. Some variation in the Science courses recommended will be allowed for timetable and other valid reasons, but alternate courses must be relevant to the intentions of this programme. Massive substitutions will not be allowed. Transfer into the programme will not normally be made beyond the Year 2 level.

**Year 1**

Physics 101*-102* General Physics  
Chemistry 121*-122* Chemical Structure and Periodicity; General Chemistry for the Physical Sciences  
Earth Sciences 130 Introductory Geology  
Mathematics 130 Calculus  
Economics 101*-102* Introduction to Economics

**Note** Physics 121*-122* is an acceptable alternative to Physics 101*-102* and Chemistry 142* is acceptable instead of 122*)

**Year 2**

Science 251*-252* Genetics and Evolution; Biology and Society  
Chemistry 266*-267* Organic Chemistry 1 and 2  
Mathematics 132 Introduction to Computer Science  
Economics 256*-257* Introduction to Accounting 1 and 2  
Business 212*, 222* Introduction to Marketing; Marketing Functions (W.L.U.)

**Year 3**

Science 209* Scientific Literature and Writing  
Science 250* Environmental Geology  
Science 351*-352* Human Biology 1 and 2  
Physics 324*-325* Atomic and Nuclear Physics 1 and 2  
Economics 201*-202* Intermediate Price Theory 1 and 2  
Economics 300 Statistical Methods
Year 4  Science 400  History of Science
  Physics 368*-369* Geophysics 1 and 2
  Economics 366*-367* Corporate Finance
  Business 388*, 398* Organizational Behaviour; Administrative Practices
  (W.L.U.)
  Elective
  Recommended are: a) Math 235 - Actuarial Mathematics
  b) Chemistry 356*-357* - Physical Chemistry
  c) Chemistry 332*-333* - Biochemistry
  d) Science 451*-452* - Our Biological Environment: The Land The Water
  e) Two of: Science 260* - Man and Vision
  Science 220* - The Chemistry of Pollution
  Science 238* - General Astronomy
  Science 270* - Nuclear Science
  Systems Design 311* - Operations Research 1 (strongly recommended for students intending to do graduate work in Business Administration)
Grading System

The University uses a grading system whereby grades for all courses appear on grade reports and transcripts either as one of 15 letter grades from A-plus through F-minus or as numeric marks on a 100-point scale. Each Faculty (or comparable academic unit) chooses to display the grades obtained in each course by the grades or numeric marks. All Departments within the Faculty then use the system chosen.

<table>
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<td>80-84</td>
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**Interpretation of Averages**

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<tr>
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**Non-Graded Standings**

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<th>CR</th>
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<th>NCR</th>
<th>INC</th>
<th>DNW</th>
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<td>Did not write examination, no credit granted</td>
<td>Audit only, no credit granted</td>
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</table>
Cross Registration With Waterloo Lutheran University

Cross Registration procedures have been developed at the University of Waterloo to enable full-time students to take advantage of courses available at both the University of Waterloo and Waterloo Lutheran University.

Both universities conduct pre-registration in February or March for their own students who plan to return in the next academic year. Course limits are adjusted on the basis of the demand indicated and tentative space is provided for Cross-Registered students in the courses concerned. Formal requests to Cross-Register are accepted only after the academic timetables are finalized in August.

Students must pay all fees at their home University, regardless of the number of courses taken by Cross-Registration. Grades are reported to the student's home University based on the grading system of the host University and are combined with the results of the student's other courses to complete his examination report. A student's overall (academic) standing is determined solely by his home University.
Course Descriptions
Campus Scene—Humanities Building Courtyard
School of Architecture

Associate Professor and Deputy Director  R. M. Schuster, B.S., M.S. (North Dakota State), Ph.D. (Iowa State), P.Eng.
† Professor and Dean of Environmental Studies  P. H. Nash, B.A., M.A. (California), C.E. (Grenoble), M.C.P., M.P.A., Ph.D. (Harvard), A.I.P.

Professors  T. E. Bjornstad, B. Arch. (Iowa State), A.I.A., M.R.A.I.C.
† L. A. Cummings, A.B. (Washington), A.M. (Missouri), Ph.D. (Washington)

Associate Professors  A. Banerji, B. Arch. (Calcutta), M. Arch. (North Dakota State)
† E. M. Cartsonis, B. Arch. (Michigan), M.C.P. (Pennsylvania)
D. B. McIntyre, B. Arch. (Toronto)

Visiting Associate Professor  K. Otbo, B. Arch. (Artisans College, Haslev Denmark)

Assistant Professors  O. Dutt, B.A. (Punjab), B.Sc. (London), M.S. (Wisconsin), Ph.D. (Waterloo), P. Eng.
M. Elmitt, DipI, in Art and Design (High Wycombe)
† S. K. Gupta, B.Sc., M.Sc. (Punjab), M.A., Ph.D. (Toronto)
† E. M. Pallett, B.S., M. Music (Oregon), Ph.D. (Michigan State)
J. C. Somfay, B. Arch. (N.S.W. Sydney), M. Arch. (Toronto)
F. Thompson, B. Arch., M. Arch. (Toronto)
J. Zvilna

†Faculty members appointed also in other Schools or Departments of the Division of Environmental Studies

Undergraduate Architecture Courses

Courses for Bachelor of Environmental Studies

Systems and Measures  Preparation leading to the application of mathematics, statistics and computer science as tools for analyzing quantitative and behavioral problems as prerequisites for ensuing studies; to deliberately develop an understanding of the qualities of materials and structural behaviour; to propose alternatives in structural engineering; and to perform independent mathematical checks on simple, statically determinate and indeterminate structures.

102* Mathematics  Calculus and Vector Geometry
Purpose: To prepare the student to use mathematics for analyzing quantitative, behavioural and simple engineering problems.
Content: Elementary differential and integral calculus, applications to problems involving rates of change, areas, volumes, centroids, moments of inertia; introductory vector geometry in two and three dimensions.
Prerequisite: none
4 hours per week (Fall term)
103* Statistics
Purpose: To provide the base for valid surveying, researching and analyzing of quantitative and behavioural problems.
Content: Descriptive statistics, sampling, curve fitting, regression and correlation; elementary queueing models; emphasis on the description of environmental processes through observational data.
Prerequisite: Arch 102* or Math 130*
3 hours per week (Winter term)

112* & 113* Computer Science
Introduction to Programming
Purpose: To convey a brief understanding of computers as operating systems and a working knowledge of computers as problem solving tools.
Content: This course is essentially the same as Math 132. However, efforts are made to spend more time on an overview of computer systems and on solving architectural problems.
The Programming language applied is Fortran with Watfive. A machine language simulation “Spectre” is also taught for a better understanding of the way computers operate.
Prerequisite: none
3 hours per week (Fall and Winter terms)

163* Statics
Purpose: To teach the student the basic fundamentals of statics through the process of solving routine problems in mechanics.
Content: Basic concepts, forces, moments, moment of a force and system of forces, resolution of forces, transformation of couples; resultant of concurrent and non-concurrent force systems; centre of gravity of a system of forces and moments, of a body or mass, of composite body; equilibrium, free body diagrams, calculation of reactions, shears, moments, bar forces in trusses; friction, moment of inertia.
Prerequisite: Arch 102* or Math 130*
4 hours per week including laboratory session (Winter term)
Instructor: Dutt, Schuster

212* or FE† Computer Science
Simulation
Purpose: To understand how to simulate interacting time/space event by use of computer, and to apply such simulation techniques to the solution of architectural problems.
Content: The simulation programming will be developed in Fortran so as to build up meaningful architectural simulation concepts necessary in architectural planning. Specific simulation languages such as G.P.S.S. will be introduced.
Prerequisite: none
3 hours per week (Winter term)

213* or FE† Computer Generated Design
Architectural Design I
Purpose: To develop an understanding of the design logic used for generating preliminary design layout through applied methodologies, analysis and synthesis.
Content: An overview of design logic and computer system requirements currently used for architectural design.
Prerequisite: Arch 212* or consent of instructor.
4 hours per week (Spring term)
262* Strength of Materials  
**Purpose:** To understand the internal action and behaviour of structural members; to diagram and calculate action and behaviour for simple beam and column systems.  
**Content:** Concept of simple stress and strain; statically indeterminate axially loaded members; thermal stresses, torsion; shear and bending moments in simple beam systems; shear and moment diagrams, qualitative deflected shapes; flexural and shearing stresses, deflection calculations; combined stresses, beams of different materials; compression members, Euler's formula.  
**Prerequisite:** Arch 163*  
4 hours per week including laboratory session (Fall term)  
**Instructor:** Dutt, Schuster

263* Theory of Structures 1  
**Purpose:** To analyze the behaviour of statically determinate structural building systems and to calculate reactions, shears, moments of their components subjected to live and dead loads.  
**Content:** Historic review of building structures; live and dead loading, wind, snow, earthquake, reactions, determinancy and indeterminancy, stability and indeterminancy of structural systems, shears, moments and qualitative deflected shapes of compound beams and rigid frames; bar forces in pin-connected frameworks; approximate methods of analysis for high rise building frames; deflection calculations by the moment area method, moment diagrams by parts; influence lines, loading criteria, introduction to arches.  
**Prerequisite:** Arch 262*  
4 hours per week including laboratory session (Spring term)  
**Instructor:** Dutt, Schuster

282* Industrial Systems  
**Analysis, Synthesis and Evaluation of Industrial Plant Layouts and Materials Handling Systems**  
**Purpose:** To present specific methodologies to aid in the development of efficient and effective plant layouts and associated materials handling plans.  
To give students an insight into and practice in the solution of a variety of real life plant layout and materials handling problems which will be the basis for rearrangement in existing or an input into the design of new structures.  
**Prerequisite:** Consent of instructor  
3 hours per week (Fall-Winter)

44*, 285* Architectural Research  
**Purpose:** To allow students an opportunity for independent research study into architectural problems not offered in the regular curriculum.  
**Content:** Guided exploration of specific architectural problem area, of appropriate complexity to the particular term.  
**Prerequisite:** Faculty Committee approval  
Equivalent of 3 hours per week (Fall-Spring)
303* or FE† Economics  
*Economic Structure of the Urban Environment  
*Purpose: To understand and to relate his talents to the dynamic process of economic interactions in public and private sectors that shape the environment.  
*Content: The economic structure of the urban environment; the function of the enterprise system in private, public and public-private sectors and its organizational patterns for shaping the environment.  
*Prerequisite: none  
*2 hours per week (Fall term)

313* of FE† Computer Generated Design 2  
*Architectural Design 2  
*Purpose: To use the computer for generating architectural design directly from constraint factors. To display the resulting plans by use of the plotter.  
*Content: Input from various other courses is formulated into comprehensive data structures and simulated behaviour patterns; methods of synthesis problem-solving techniques, analysis of thought processes and protocol analyses. Project oriented course, where student chosen projects with instructor approval can be processed.  
*Prerequisite: Arch. 213*  
*4 hours per week (Fall or Winter term)

363* Theory of Structures 2  
*Purpose: To analyze the behaviour of statically indeterminate structural building systems and to calculate reactions, shears, moments of their components subjected to live and dead loads.  
*Content: Advantages, limitations and principles of indeterminate structures; analysis of compound and continuous beams and rigid frames by consistent deformations, moment distribution, slope deflection; analysis of continuous beams having differential support settlement, of frames subjected to side-sway; analysis of pin-connected frameworks by virtual work; joint loading, thermal stresses; application of loading criteria, arches.  
*Prerequisite: Arch 263*  
*4 hours per week including laboratory session (Fall term)  
*Instructor: Dutt, Schuster

372* Mechanical Systems 1  
*Purpose: Introduction to basic fundamentals of the controlled environment.  
*Content: Thermodynamics; combustion; heat transfer; aerodynamics; illumination; acoustics.  
*Prerequisite: Arch. 293*  
*4 hours per week including laboratory session (Winter term)

384*, 385* Architectural Research  
*Purpose: To allow students an opportunity for independent research study into architectural problems not offered in the regular curriculum.  
*Content: Guided exploration of specific architectural problem area, of appropriate complexity to the particular term.  
*Prerequisite: Faculty Committee approval  
*Equivalent of 3 hours per week (Fall-Winter)

†See section on Electives for explanation of FE.
Ecology

Courses in this Theme Area prepare the student to understand the structure and function of Man in the pre-existing environment as an individual and as a social animal; to recognize and be critical of the human/physical complex and its management for desirable human goals and quality in the natural and man-made Environments.

223* or TE† Human Ecology  
**Social Behaviour as the Human/Physical Interface**

*Purpose:* To understand the psycho-biological and social basis of human behaviour as individuals and in groups.

*Content:* The biological and psychological basis of perception and cognition of environments; factors affecting percepts, images and meanings; small groups and the social environment; the structure, functioning and change of neighbourhoods and communities.

*Prerequisite:* Env. Studies 195*

2 hours per week (Spring term)

†See section on Electives for explanation of TE.

Culture

Courses in cultural history give the student a critical and creative understanding of the basic ingredients of all creative work, recognizing the seemingly unrelated forces for change in the cultural history of man, and comprehending the present as a part of the historical past.

142* Iconography 1  
**Conventions**

*Purpose:* To understand that every stage of Western Culture expresses its notions of environmental order through its arts by conventional expressions and to be able to view contemporary culture by identifying our own inventions and what is part of our inheritance from the past.

*Content:* Selected schemes of order, such as fate, providence, natural law, the human will, as expressed in plays, poems, and fiction from various ages; selected conventions in literature, cinema, and the visual arts; the development of one or two archetypal symbols in literature and the visual arts; directed to lead into more detailed studies of symbolic patterns in Iconography 2.

*Prerequisite:* none

4 hours per week including laboratory session (Fall term)

143* Iconography 2  
**A survey of the symbolic Nature of the Environment**

*Purpose:* To critically and creatively understand the basic unit of "material" in all artistic creation: the icon.

*Content:* A study centred on ancient art to initiate the student into the stream of cultural history and the complex problems of what the artist is, the quality of human existence, culture, environment, as well as the working of the icon from raw state of perceived image to its function as an expressive symbol in poetry, music, dance, architecture and other works of art; a study of modern work in comparison to ancient achievement.

*Prerequisite:* Arch. 142*

4 hours per week including laboratory session (Winter term)
242* The Roots of Civilization  
*Purpose:* An introduction to the ways in which primitive and ancient men brought culture into being. Through studies from the areas of archeology, anthropology, mythology, art, philosophy, and literature.  
*Content:* The course attempts to establish a basis for the understanding of the functions of myth, ceremony and ritual, the structures of primitive and ancient built environments, their attitude towards nature, and their use of the resource environment, the development of classical culture, and the beginnings of science.  
*Prerequisite:* Arch. 143* or consent of instructors  
4 hours per week including laboratory session (Fall)

243* or FE† Foundations of Europe  
*Purpose:* Awareness of the foundations of Europe.  
*Content:* Recognition of patterns of life and concepts of order and conduct, models of the universe and other, moving metaphors and myths by means of study of the thoughts, acts, art, architecture, technology, literature, music and town design of the West from the break-up of the Roman Empire until the Renaissance, with attention to such styles as the Latin Provincial, the early Christian, the early Celtic, the Anglo-Saxon, the Norse, the Carolingian, the Ottonian, the Romanesque, and the several Gothic.  
*Prerequisite:* Arch. 242*  
4 hours per week including laboratory session (Spring term)

342* or FE† Renaissance to Revolution  
*Purpose:* To follow in sequence the understanding of the history of the West and its metaphorical imagination.  
*Content:* Analysis of the various styles emerging out of provincial and international Gothic, especially Italian use of classical models, the spread of this “renaissance” mode, leading to considerations of the Mannerist, the Baroque, the Rococo, the Neoclassical; investigation of the course of men’s attitudes from humanism, nationalism, and Reformation through the Enlightenment until the French Revolution and Hume's dethronement of Reason.  
*Prerequisite:* Arch. 243*  
4 hours per week including laboratory session (Winter term)

343* or FE† Romanticism and 20th Century  
*Purpose:* To provide an understanding of the 19th and the first half of the 20th Centuries.  
*Content:* Depicts “modern” culture as one in which the notion of environmental order as the fulfilling of natural law is replaced by a notion of order as the creation of the autonomous human will; studies the revolutionary rhetoric and style of the early 19th Century Romantic writers, the “alienation” in the writings of Marx, Nietzsche, and other writers of the 19th and 20th Centuries, the changing views of humanity arising out of the insights of such writers as Darwin, Freud and Jung, and some conventions of romantic art and architecture of both 19th and 20th Centuries.  
*Prerequisite:* Arch. 342*  
2 hours per week (Fall term)

†See section on Electives for explanation of FE.
Design

The courses in design studio combine design fundamentals and design concepts, along with the opportunity to involve analysis and synthesis, professional and scientific insights, application of tools and methods for designing artifacts for man, and an awareness of the inherent physical characteristics and limitations of media and materials. The objectives of the studio are: (1) to guide the student in observing aspects of the physical and social environment; to find, categorize and associate the information into fundamental structures and patterns of relationships; (2) to apply theories generated in the lecture courses to situations in the physical environment, implementing by categorizing the courses into behaviour of materials, structures and mechanical systems, behaviour of man, and communications; (3) to provide the student with an opportunity to develop skill in using different “techniques” for analyzing and synthesizing problems in the physical environment; (4) to establish a relationship between faculty and students where all faculty members are consultants to the students; (5) to provide a vehicle for persons from faculties of different disciplines and from the real-world to discuss with students their problems and projects from different points of view.

192 Design Fundamentals

Design Fundamentals and Workshop

Purpose: To give the student a working knowledge of qualities of materials and structural forms, and of the fundamentals of observation and graphic communication.

Content: Perceptual techniques and methods; principles of graphic communication, what “media” are and what are their best application; the qualities of materials in construction and the qualitative, behavioural characteristics of structural forms and shapes; perspectives, and instrument and free-hand drawing.

Prerequisite: none

8 hours per week including lectures and workshop (Fall term)

Instructors: Elmitt, Zvilna

193 Design Fundamentals & Studio

Purpose: To teach the student to see, to be aware of his surrounding environment, to record this awareness, analyze and evaluate it critically.

Content: Space notation, serial vision; the sensory input and stimuli of the environment to man, pattern recognition; design exercises for the student to observe and communicate about the action and reaction of materials in the environment, the individual responses physiologically and psychologically to objects in the environment, and the methods of communicating specific messages from man to man using graphic media.

Prerequisite: Arch. 192

14 hours per week including lectures and workshop (Winter term)

Instructors: Elmitt, Zvilna
194* Visual Interdisciplinary Language  
*Purpose:* To increase interdisciplinary awareness and understanding of our environment by identifying and developing patterns of various phenomena as seen in nature, life, and laboratory.  
*Content:* Visual patterns identified in nature, life, and laboratory considered as a structured interdisciplinary language through which knowledge can be transmitted between people of different backgrounds. Through laboratory work, and from natural phenomena patterns such as those of gravitational forces, surface tension, and shrinkage stresses will be used to suggest relationships between different disciplines.  
*Prerequisite:* Consent of instructors  
*Instructors:* Zvilna, Elmitt

252* Creative Problem Solving  
*Purpose:* Development of creative skills through group behaviour in problem solving sessions by: 1) Developing a clearer understanding of the participants' own creative thought processes; 2) Increasing his ability to consciously and deliberately make use of his own creative potential; 3) An awareness of the capacity to use himself and the people he works with to produce better solutions to the problems found by the group.  
*Content:* An intensive week (approx. 40 hours) is spent learning about and practicing successful problem solving in a group of 7. Audio visual equipment is used to record and re-play the group's progress. A sample problem is given the first day and the participants' own problems are used on subsequent days.  
*Prerequisite:* Consent of instructors  
*Instructors:* Somfay, Thompson

292 Design Concepts & Studio  
*Purpose:* To develop in each student an ability to design using methods adapted to the individual's aptitudes, and an attitude to people and their ideas in the creative process.  
*Content:* Aesthetics, its philosophy and application to design; empirical methods, systematic methods, intuitive and creative processes; individual and group designing behaviour, synectics and other group interaction techniques; student involvement in small space design exercises where students try methods to define problems, analyze problems, define methods of solution, generate alternative solutions, and evaluate the alternatives.  
*Prerequisite:* Arch. 193  
*14 hours per week including lectures and workshop (Fall term)*

293 Design Concepts & Studio  
*Purpose:* To develop in the student an ability to generate alternative solutions to problems and to critically evaluate them.  
*Content:* Design morphology and evaluation techniques; synectics and other group action techniques and the role other disciplines play in the architectural design process; current symbolism in design of large spaces (for "privacy and community") to develop skills in brainstorming, synectics as solution generators, defining methods of solution, formulating alternatives and evaluating alternatives.  
*Prerequisite:* Arch. 292  
*14 hours per week including lectures and workshop (Spring term)*
392 Design Concepts & Studio  
**Purpose:** To develop in the student the skill for designing buildings using rational methods in which disparate systems are analyzed for alternative forms and synthesized with the help of other disciplines.  
**Content:** Design team concept; selecting appropriate analysis for design and communication technique to facilitate decision-making; the affect of legal and administrative controls on the design process; the influence of mechanical and structural systems on form, some historical examples; industrialization of buildings and building components; student selected project on building scale to develop design skill and meaningful coordination of the task with other disciplines.  
**Prerequisite:** Arch. 293  
21 hours per week including lectures and workshop (Winter term)

393 Design Concepts & Studio  
**Purpose:** To develop the ability in the student to design some aspect of the urban environment in collaboration with other disciplines.  
**Content:** The analysis and exploration of relationships between physical, social, political and economic systems that influence the physical environment; techniques for defining the patterns of interaction and predicting the influence on physical form involving other disciplines; student selected project to explore the techniques and design with others at the city or community scale.  
**Prerequisite:** Arch. 392  
21 hours per week including lectures and workshop (Fall term)

**Courses for Bachelor of Architecture Programme**

The courses for the Bachelor of Architecture Programme are intended to prepare the student to demonstrate professional skill in separating, organizing, and conceptualizing actual problems in the man-made environment in his role as an architect, alone and in a team; to synthesize mechanical, structural and functional systems into architectural expressions which adapt to social needs and aspirations of society, user, client and community, alone and with the help of others; to adapt his skills to (a) real world constraints, (b) to the evolution of social, economic and technological changes, and (c) to influence change both in constraints and evolution, alone and with the aid of others; to communicate skillfully, verbally and graphically, the solutions to environmental problems and know the current methods and procedures in professional practice for defining and solving environmental problems; to organize patterns of behaviour which assure continuing development for professional competence and relevance at all times; and to pass the examination for registration as an architect if he aspires to become a practicing professional.

423 Urban Planning  
**Introduction to Urban Theory**  
**Purpose:** To understand the forces for obsolescence, change and to critically analyze and define patterns of interaction in the urban scene.  
**Content:** The changing ecological structure of the city and consideration of the technological, economic and social forces accounting for these changes; ecological and location theories; accelerated urbanization; large scale urban systems.  
**Prerequisite:** none  
2 per week (Fall term)
452* Specifications

Purpose: To introduce the student to the format, methods and problems of modern specification writing for architects and engineers.

Content: Architectural working drawings and specifications; bidding requirements; general conditions; general requirements trade divisions; reference and source material; assembly and reproduction; structural, mechanical and electrical consultants.

Prerequisite: B.E.S. standing

2 hours per week (Spring term)

Instructor: Otbo

453* Professional Practice

The Profession

Purpose: To acquaint the student with the legal and ethical aspects of architectural practice in Canada and in Ontario in particular.

Content: Contracts, bonds and insurance, mechanics liens, by-laws and regulations, architectural partnership. The legal background, client-architect relations, partial services, professional problems.

Prerequisite: B.E.S. standing

2 hours per week (Fall term)

Instructor: Otbo

462* Structural Synthesis 1

Steel and Concrete Design

Purpose: To give the student a working knowledge of the behaviour and design of the structural components of systems constructed with steel.

Content: Design and behaviour of structural steel systems, application of current building specifications, proportioning structural elements based on pertinent design considerations; preliminary design of structural steel frames, connections, bolted and welded; criteria for choosing steel systems; introduction to plastic design.

Prerequisite: Arch. 363*

4 hours per week including laboratory session (Spring term)

Instructors: Schuster, Dutt

463* Structural Synthesis 2

Concrete and Timber Design

Purpose: To gain a working knowledge of the behaviour and design of concrete and timber structures.

Content: Design and behaviour of structural concrete systems, application of building specifications; analysis and design of concrete elements using ultimate strength principle and moment coefficients; criteria for choosing structural concrete systems; introduction to prestressed concrete. Behaviour and design of modern wood structures; fasteners, ring connectors and their significance in timber construction; proportioning and design of sawed and laminated timber members, using analytical methods.

Prerequisite: Arch. 462*

4 hours per week including laboratory session (Fall term)

Instructors: Schuster, Dutt
472* Mechanical Systems 2  
**Purpose:** To teach the student the rational and analytical approach for selecting and sizing devices for mechanical systems.  
**Content:** Heating, ventilating and air conditioning systems for buildings; plumbing and drainage; electrical distribution for power and light in buildings; illumination; acoustics, geometrics and materials; and vertical transportation systems.  
**Prerequisite:** Arch. 372*  
3 hours per week including laboratory session (Spring term)  
**Instructor:** Otbo

*, 485* Architectural Research  
**Purpose:** To allow students an opportunity for independent research study into architectural problems not offered in the regular curriculum.  
**Content:** Guided exploration of specific architectural problem area, of appropriate complexity to the particular term.  
**Prerequisite:** Faculty Committee approval  
Equivalent of 3 hours per week (Spring-Fall)

552* or FE† Management & Estimating  
**Purpose:** To expose the student to the administrative responsibilities of the practicing architect's work in the building industry.  
**Content:** Bidding, bid opening and analysis; contract award; administration of the contract; contractors organization; sub-contractors; labour relations; estimating and cost control.  
**Prerequisite:** Arch. 453*  
3 hours per week (Fall term)  
**Instructor:** Otbo

553* or FE† Development & Financing  
**Purpose:** To introduce the student to the important determinates of the development, growth and re-planning of the various man environments.  
**Content:** Development law; land use development; land use planning; appraisal; mortgage lending and accounting.  
**Prerequisite:** Arch. 552*  
3 hours per week (Winter term)  
**Instructor:** Otbo

563* Suspended and Space Structures  
**Purpose:** To study the behaviour and analyze suspended and space structures in a space-coordinate framework.  
**Content:** Analysis of cable-suspended roof networks; comparisons of elastic theory and conventional deflection theory; study of finite difference method; approximate methods in selecting cable-suspended roof networks; analysis of total structures in three-dimensional coordinate system; space frames and roof systems; one and two-way design.  
**Prerequisite:** 4B architecture standing or equivalent  
3 hours per week (Winter term)  
**Instructor:** Schuster

4*, 585* Architectural Research  
**Purpose:** To allow students an opportunity for independent research study into architectural problems not offered in the regular curriculum.  
**Content:** Guided exploration of specific architectural problem area, of appropriate complexity to the particular term.  
**Prerequisite:** Faculty Committee approval  
Equivalent of 3 hours per week (Fall-Winter)
Architectural Design and Correlation

Purpose: To give the student an opportunity to select the area of concentration which he wants to search and expand for developing his aptitudes, and which will through research and scholarship contribute to the base of knowledge for architecture.

Content: In term 7 the student will apply himself to architectural design and correlation directed by the faculty. In term 8 a thesis or thesis project will be chosen by the student with the approval of the faculty advisor in one of the areas of concentration offered that matches his interests and aptitudes. The thesis programme will be developed and written in Term 9. All research work regarding the thesis must be completed by the end of Co-op Work Term 5†; his work during the Co-op Work Term 5 will be compatible and will be integrated with the nature of the thesis. Term 9 will be spent on developing the thesis. In Term 10 the student will be required to analyze and evaluate his thesis as to its validity and success as a solution for the established needs and constraints of the project, and present it for faculty evaluation before obtaining his Bachelor of Architecture degree. The use of the computer is encouraged. Maximum effort will be spent in the Studio where the student will be exposed to a variety of disciplines, viewpoints and personalities in their observation of environmental aspects, structures of relationships and application of theories to achieve architectural design and correlation. The student shall be involved in the total process of architectural design. Five areas of concentration in Architectural Design are offered; other areas might be developed to match the student's area of interest in consultation with his faculty advisor and within the strengths of the University.

a) Building design, a concentration in the programming for, the design of, and the presentation of decision-making of a complex building or building type.

b) Urban Design, a concentration in the aspects of providing a group of buildings for a urban social group and the presentation of its provision for decision-making.

c) Parametric Design, a concentration in the scientific approach to architectural design, incorporating systems and computer aided analysis and design; design parameters, their definitions and evaluation; data storage, retrieval and methods of manipulation for architectural design. Develop a design of an aspect of building, urban or structural design and its presentation for decision-making.

d) Architectural Structural Design, a concentration in the design of structures for buildings meeting current and emerging needs, the development of an aspect of architectural design and its presentation for decision-making.

e) Building Technology, a concentration in the new fabrication techniques, structural possibilities, materials in modern industry for the design of new industrialized application for buildings or building components; the development of an aspect of building technology and its presentation for decision-making.

Prerequisite: B.E.S. or its equivalent.

21 hours per week in Terms 7 and 8; 32 hours per week in terms 9 and 10.

†See section on Electives for explanation of TE.

‡See co-operative work term schedule chart.
Electives Students are permitted to study courses given by the University at large which are in the area of the student's individual interest. This will hopefully provide better orientation and more interdisciplinary communication relevant to the student's academic pursuits.

Electives are divided into the following two categories:

(TE) Courses selected by the student, but restricted to a certain theme area of the recommended core programme, thus termed theme elective (TE). Departmental approval required.

(FE) Courses selected by the student without restrictions as long as the course is approved by Senate. Courses in this category are termed free electives (FE). Departmental approval is suggested.

Each student pursuing a B.E.S. degree must have accumulated one and a half course credits in the theme area of Ecology by or before his 6th academic term.

Each student pursuing a B/Arch degree must have one half course credit in the theme area of Ecology by or before his 10th academic term.
### Recommended Core Programme for the Degree of Bachelor of Environmental Studies

<table>
<thead>
<tr>
<th>Theme Areas</th>
<th>Term 1 (1A) F</th>
<th>Term 2 (1B) W</th>
<th>Term 3 (2A) F</th>
<th>Term 4 (2B) S</th>
<th>Term 5 (3A) W</th>
<th>Term 6 (3B) F</th>
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<tbody>
<tr>
<td><strong>Systems and Measures</strong></td>
<td>½ Arch 102*</td>
<td>½ Arch 103*</td>
<td>½ Arch 212* or FE Computer Science Simulation</td>
<td>½ Arch 213* or FE Computer Generated Design I</td>
<td>½ Arch 303* or FE Economics</td>
<td>½ Arch 313* or FE Computer Generated Design II</td>
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<td>Math</td>
<td>Statistics</td>
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<td></td>
<td>½ Arch 112*</td>
<td>½ Arch 113*</td>
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<td>½ Arch 163*</td>
<td>½ Arch 262*</td>
<td>½ Arch 263*</td>
<td>½ Arch 372*</td>
<td>½ Arch 363*</td>
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<td>Statics</td>
<td>Strength of Materials</td>
<td>Theory of Structures 1</td>
<td>Mechanical Systems 1</td>
<td>Theory of Structures 2</td>
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<td><strong>Ecology</strong></td>
<td>½ E.S. 195*</td>
<td>½ E.S. 200* or TE Ecology and the Ecosystem</td>
<td>½ Arch 223* or TE Human Ecology</td>
<td>½ FE*</td>
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<td>Man &amp; His Environment</td>
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<td><strong>Culture</strong></td>
<td>½ Arch 142*</td>
<td>½ Arch 143*</td>
<td>½ Arch 242*</td>
<td>½ Arch 243* or FE Foundations of Europe</td>
<td>½ Arch 342* or FE Renaissance to Revolution</td>
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<td>Iconography 2</td>
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<td><strong>Design</strong></td>
<td>1 Arch 192</td>
<td>1½ Arch 193</td>
<td>1½ Arch 292</td>
<td>1½ Arch 293</td>
<td>2 Arch 392</td>
<td>2 Arch 393</td>
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**Note:** Bold blocks indicate elective courses: see section on electives.

*(TE)* Elective in the same theme area.

*(FE)* Free elective with Department approval.

Also, each course has credit value indicated in small square.
### Recommended Core Programme for the Degree of Bachelor of Architecture

<table>
<thead>
<tr>
<th>Theme Areas</th>
<th>Term 7 (4A) S</th>
<th>Term 8 (4B) F</th>
<th>Term 9 (5A) F</th>
<th>Term 10 (5B) W</th>
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<tr>
<td>Systems and Measures</td>
<td>½ Arch 452*</td>
<td>½ Arch 453*</td>
<td>½ Arch 552* or FE</td>
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<td>Specifications</td>
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<td>Professional Practice</td>
<td>Management &amp; Estimating</td>
<td>Development &amp; Financing</td>
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<td>Mechanical Systems 2</td>
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<td>½ Arch 462*</td>
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<td>½ Arch 463*</td>
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<tr>
<td>Structural Synthesis 1</td>
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<td>½ Arch 423* or TE</td>
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<td>Urban Planning</td>
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<td>Ecology</td>
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<tr>
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<td>3 Arch 592</td>
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<tr>
<td>Design Studio</td>
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</tbody>
</table>

**Note**  
*Bold blocks indicate elective courses; see section on electives.*  
*(TE) Elective in the same theme area.*  
*(FE) Free elective with Department approval.*  
*Also, each course has credit value indicated in small square.*
Undergraduate Courses

Courses designated “Arts”, such as those listed below, usually cover some topics and themes of general interest to several disciplines and their presentation is often made with this inter-disciplinary perspective in view. Arts courses are elective courses in General and Honours programmes and do not satisfy either the Group A or Group B requirements. Arts courses are administered through the Office of the Dean of Arts.

100 Communications
An examination of the origins, evolution and future dimensions of communications media designed to facilitate an understanding of the adequacies and inadequacies of media, to relate them to the purposes of human awareness and to explore needs and means of maintaining accountable controls over the media. The course seeks to assist students in discovering the range of informational, research and exploratory resources open to them; in gaining some preliminary experience in utilizing such sources; and in applying a critical judgment of material secured.

105* Introduction to the Sciences of Man
The course is intended to introduce the engineering, mathematics and science undergraduates to two of the sciences of man (anthropology and sociology). The course will be conducted on the basis of both lecture and tutorial hours. Lectures will be under the supervision of a single person responsible for the conduct of the course. He will have charge of inviting participants from among faculty members in the interested disciplines.

Note
This course will not substitute for Anthropology 101*/102*; Sociology 101*.

190*/191* Introductory Chinese
A course designed to impart a knowledge of the basic structure and grammar of modern Chinese. Emphasis will be placed upon a reading knowledge of (modified) historic and philosophical sources, and the student will be expected to master a minimum of 500 characters. Some conversational work may be included.
3 hours per week.
Prerequisite: Permission of instructor.

192*/193* Introductory Japanese
A course in modern conversational Japanese. Though the emphasis will be upon the spoken language, students will be introduced to hiragana, katakana, and some kanji.
3 hours per week.
Prerequisite: Permission of instructor.

211*/212* Computing Techniques in Language and Literature
An introduction to computer programming, with special emphasis on the manipulation of language data. The programming language used will be PL/1. Applications will include word indexes, text concordances, methods of computer-aided text comparison.
No prerequisite: No previous knowledge of computing is assumed.
212* presupposes 211* or permission of the instructor.
215 Man in Crises (Literary Views) The study of representative European prose, drama, and poetry, from the writings of Dostoevsky, Nietzsche, Zamiatin, Hesse, Kafka, Brecht, Pasternak, Solzhenitsyn, Camus, Malraux, Sartre, and others. An attempt will be made to critically analyse the creative writer's artistic presentation of the ever-widening rift between environment and "inner man", the will of the collective and non-conformity of the individual; nihilism — the result of extreme rationalization —; the mystic longing for the transcendental, and other related themes. 
Prerequisite: Open to all students. Taught in English.

290 The Literary Revolution in China The course is centred upon the twentieth century revolution in the language and literature of China, but will survey also the earlier forms of prose and prose fiction, and the later polemics and philosophical writings of the Nationalists and Communists. 
3 hours per week.
Prerequisite: Permission of instructor.

Topics in Japanese Literature The course is designed to trace the evolution of peculiarly Japanese forms of poetry and prose, with emphasis upon the aesthetic and world-view therein reflected. Some of the literature will be studied in translation, and some wider questions, such as those of foreign influence and cultural transmission, discussed. 
3 hours per week.
Prerequisite: Permission of instructor.

The following courses are administered by Conrad Grebel College.

120*G/121*G Focal Issues in Contemporary Society An attempt to bring together and condense what are believed to be essential elements of the several social science disciplines. The core of the study of a group of selected contemporary issues with implications that cut across all the various disciplines. An effort will be made to discuss values appropriate for our age. Integrating concepts are personality and culture.

200*G Issues in Mass Communication A broad approach to the mass communication field including communication systems, media, content, audiences, processes, and effects; seen in historical, philosophical, national, international, sociological, and/or psychological perspectives. Emphasis on mass media role in national and international life.
3 lectures. Winter term.

1*G Love in the Western World Historical, psychological and sociological study of romantic love in contemporary culture rooted in the Tristan myth with its emphasis on love as passion, death and irrationality. Earlier conceptions by Plato and Christian thinkers and later views of Freud and N.O. Brown will be considered. Sociological analysis will include love in the market-place, the tension between love and justice and the several quests for communities of love and brotherhood. A basic work will be Denis de Rougemont's Love in the Western World.
3 lectures. Fall term.
219G Dissent  A study of individuals who emerge in every society to challenge the prevailing consensus as advance agents of a new cultural outlook. Consideration will be given to Socrates, Jeremiah, Jesus, Galileo, Conrad Grebel, Marx, Wilberforce, Woodworth, Riel, Gandhi and Martin Luther King. Through these studies the course will formulate a conception of innovation and social change.
3 lectures. Winter term.

301G/302G Seminar in 20th Century Values  The purpose of this course is to help members of the University struggle with current value questions that have arisen because of the development of technology. The precise topics may vary from year to year. Examples might be the role of computers, genetic engineering, and “law and order”. Resource persons from within and outside the University will provide expertise.
Open to third and fourth year students.
3 lectures. Fall and Winter terms.

The following courses are administered by Renison College.

220R Chinese Thought and Culture  An introduction to China’s traditional culture nexus as shown in literature, religion, and philosophy.

221R Contemporary Changes in China’s Traditional Culture Pattern and its Institutional Framework.
Department of Biology

**Professor and Chairman of Department**
P. S. Corbet, B.Sc. (Reading), Ph.D. (Cambridge), D. Sc. (Reading).
F.I. Biol.

**Professor and Graduate Officer**
A. D. Harrison, M.Sc., Ph.D. (Cape Town)

**Associate Professor and Undergraduate Officer**
H. R. N. Eydt, M.Sc., Ph.D. (McMaster)

**Associate Professor and Associate Chairman of Department**
A. G. Kempton, M.S.A. (Toronto), Ph.D. (Michigan State)

**Professors**
C. H. Fernando, B.Sc. (Ceylon), D.Phil. (Oxford), F.R.E.S.
H. B. N. Hynes, Ph.D., D.Sc. (London), A.R.C.S.
W. B. Kendrick, B.Sc., Ph.D. (Liverpool)
J. K. Morton, B.Sc., Ph.D. (Durham), F.L.S.
G. Power, B.Sc. (Durham), Ph.D. (McGill)

**Associate Professors**
E. B. Dumbroff, M.Forestry, Ph.D. (Georgia)
H. C. Duthie B.Sc., Ph.D. (Wales)
W. E. Inniss, M.S.A. (Toronto), Ph.D. (Michigan State)
P. E. Morrison, M.Sc. (Western), Ph.D. (McMaster)
J. J. Pasternak, M.A. (Toronto), Ph.D. (Indiana)

**Assistant Professors**
A. M. Charles, M.Sc., Ph.D. (Manitoba)
R. G. H. Downer, M.Sc. (Queen's University, Belfast), Ph.D. (Western)
M. G. George, B.Sc. (Mysore), M.Sc. (Bombay), Ph.D. (Delhi)

**Biology and Urban and Regional Planning**
N. N. Kapoor, M.Sc. (Punjab), Ph.D. (McMaster)
C. I. Mayfield, B.Sc., Ph.D. (Liverpool)
S. M. Smith, M.Sc. (McMaster), Ph.D. (Manitoba)
J.B. Theberge, B.Sc.A. (Guelph), M.Sc. (Toronto), Ph.D. (U.B.C.)
J. E. Thompson, B.S.A. (Toronto), Ph.D. (Alberta)

**Undergraduate Course Descriptions**

By special arrangement, courses labelled (†) may be taken in 2 sequential halves by students in co-operative programmes. Co-operative students in other Departments or Faculties should note there are available a number of one-term electives (e.g. 243*, 244*, 245*, 246*) offered in the fall or winter terms.

All Honours Biology students who have completed their third year are required to participate in an off-campus field course before entering Year 4. These courses are held either in April (following examinations but before the end of term) or the following September (after Labour Day). The cost will be approximately $30-$50 per student.

Note: The Huntsman Marine Laboratory, St. Andrews, New Brunswick offers a summer course "Introduction to Marine Biology". This course will be accepted as 0.50 transfer course credit towards a B.Sc. if taken by students of the University of Waterloo.
110* Introductory Zoology  
An introduction to the principles of Zoology. The course will include a survey of cell structure and function, animal growth and development, genetics, and ecological concepts, with emphasis placed on the role of man as the central figure in the biosphere.

2 lectures, 3 hours laboratory, winter term. (Primarily for students of Kinesiology. Available also to students in Faculties other than Science.)

131 Introduction to Biology  
The principles of biology are developed by reference to all biology (including genetics), growth and development, and to selected organisms. Man is discussed as a biological organism.

2 lectures. 3 hours laboratory  
(For students in Faculties other than Science)

132 Principles of Biology  
An introductory course designed to give a grounding in the main branches of Biology. Emphasis is laid on an understanding of biological processes and on relating these to the structure and diversity of living organisms.

2 lectures, 3 hours laboratory  
(For Science students only)

201 Anatomy, Histology and Embryology  
A survey of functional mammalian anatomy and histology, with particular emphasis on the human, and an introduction to basic embryology.

2 lectures, 3 hours laboratory  
(For Optometry students only)

233 Vertebrate Zoology  
The evolution of the vertebrate body as exemplified by both living and fossil members of the group. Laboratory dissections form an integral part of the course.

Prerequisite: Biology 132

2 lectures, 3 hours laboratory  
(For Honours Biology and 4-year Biology majors only)

234† Plant Biology  
A survey of the major groups of plants, including their evolution, morphology, ecology and importance to man.

Prerequisites: Biology 131 or 132

2 lectures, 3 hours laboratory

235 Fundamentals of Microbiology  
Introduction to fundamental theories, principles and methods of microbiology. Structure, systematics, growth and metabolism of microorganisms. Outline of the major groups of microorganisms. Discussion of their role in natural habitats, industrial processes and disease.

Prerequisite: Biology 132

2 lectures, 3 hours laboratory  
(Only for Honours Biology and 4-year Biology majors and Regular Honours Chemistry students.)

236 Ecology 1  
An introduction to the study of the relationships of plants and animals to their environment. The nature of ecosystems, energy flow, biogeochemical cycling, concepts of habitat and ecological niche. Introduction to population and community ecology. Physiological ecology, environmental factor interaction. Plant and animal biogeography, the major ecosystems of the world. Ecology and man's welfare, conservation, pollution and environmental health.

Prerequisites: Biology 131 or 132

2 lectures, plus field trips as required
243* Principles of Vertebrate Zoology 1
An introduction to the vertebrates: their taxonomy, anatomy, distribution and evolution.
Prerequisite: Biology 110*, 131 or 132
2 lectures, 3 hours laboratory, fall term.
(Not available to students who are Honours Biology or 4-year Biology majors.)

244* Principles of Vertebrate Zoology 2
An introduction to important physiological processes in vertebrates, and a discussion of structure as it relates to organ systems and function.
Prerequisite: Biology 243*
2 lectures, 3 hours laboratory, winter term.
(Not available to students who are Honours Biology or 4-year Biology majors.)

245* General Microbiology 1
History and scope of microbiology. Study of the characteristics of bacteria and other microorganisms.
2 lectures, 3 hours laboratory, fall term.
(Not available to students who are Honours Biology or 4-year Biology majors.)

246* General Microbiology 2
Relationships of microorganisms to man and his environment.
Prerequisite: Biology 245*
2 lectures, 3 hours laboratory, winter term.
(Not available to students who are Honours Biology or 4-year Biology majors.)

251* Genetics and Evolution
252* Biology and Society
These courses are now offered as Science 251* and 252* and are described in the Science course listings

301 Vertebrate Physiology
The physiology of the major organ systems of the vertebrate body, with emphasis on the human. The topics discussed include circulation, respiration, digestion and nutrition, metabolism, muscle, nervous system, special senses, and the endocrine system.
Prerequisites: Biology 131 or 132.
2 lectures, 3 hours laboratory
(For Optometry students only)

303* Vertebrate Physiology
An integrated study of basic physiological phenomena with particular emphasis placed on the cardiovascular and respiratory systems. Other topics which will be discussed include digestion, excretion and endocrinology.
Prerequisites: Biology 110* or 131 or 132.
2 lectures, 3 hours laboratory, fall term. (Primarily for students of Kinesiology. Available also to students in faculties other than Science).

304* Vertebrate Physiology
A detailed study of physiological processes associated with nerve and muscle function, and consideration of the integrative role of the central nervous system.
Prerequisite: Biology 110* or 131 or 132.
2 lectures, 3 hours laboratory, winter term. (Primarily for students of Kinesiology. Available also to students in faculties other than Science).

333† Invertebrate Zoology
A survey of the major invertebrate phyla with emphasis on the anatomy, taxonomy, and ecology of selected representatives.
Prerequisite: Biology 110*, 131 or 132
2 lectures, 3 hours laboratory
334* The Flowering Plants  A study of floral morphology in relation to classification and evolution. An introduction to taxonomy and nomenclature. History of taxonomy. Systems of classification. Mechanisms of pollination and dispersal. (Students entering this course are required to make a plant collection during the long vacation prior to the course).
Prerequisite: Biology 234
2 lectures, 3 hours laboratory, fall term

335† Microbial Form and Function  An integrated study of the cultural conditions of microorganisms and its effects on their morphology and molecular architecture. Among other topics to be discussed will include the interactions of structure and function and the biology of bacterial viruses and their genetics.
Prerequisite: Biology 235 or permission of instructor
2 lectures, 3 hours laboratory

338* Plant Morphology and Morphogenesis  Plant structure in relation to function and development with particular reference to the vascular plants. Cell, tissue and organ differentiation.
Prerequisite: Biology 234
2 lectures, 3 hours laboratory, winter term

341* Cell Physiology  The functional organization of cells with particular reference to cell-cell interaction, the structure, function and development of organelles and the biological roles of cellular membranes.
Prerequisite: Biology 131 or 132
2 lectures, 3 hours laboratory, fall term
(Available only to students who are also taking Chemistry 332*-333*)

342 Vertebrate Physiology  A study of the physiology of vertebrate organ systems and their integration, with emphasis placed upon the effects of current developments on basic physiological concepts.
Prerequisites: Biology 233 or 243*-244*
2 lectures, 3 hours laboratory
(Available only to students who are also taking Chemistry 332*-333*)

343* Histology and Cytology  The structure of mammalian cells, tissues and organs interpreted in functional terms. Cell reproduction and differentiation, with some discussion of the embryological origin of tissues and the regulation of tissue growth. Light and electron microscopy techniques.
Prerequisites: Biology 131 or 132
2 lectures, 3 hours laboratory, winter term

344* Cytogenetics  Chromosomes as the physical basis of heredity. Chromosomal mechanisms in mitosis and meiosis. The origin, inheritance and results of aberrations and changes in number. Mechanisms of evolution.
Prerequisites: Biology 131 or 132
2 lectures, 3 hours laboratory, fall term

345* Plant Physiology  An integrated study of plant function: the dynamics of nutrient and water movement, photosynthesis, control mechanisms of growth and development.
Prerequisites: Biology 234, 236
2 lectures, 3 hours laboratory, winter term
(Available only to students who are also taking Chemistry 332*-333*)

351* Human Biology 1  These courses are now offered as Science 351* and 352* and are described in the Science course listings.
432 Microbial Ecology Roles of microorganisms in natural and special environments, with emphasis on the methods for studying the nature and functions of microbial populations. 
Prerequisites: Biology 235
2 lectures, 3 hours laboratory

433 Entomology An introduction to the classification, functional anatomy and physiology of insects.
Prerequisite: Biology 333
2 lectures, 3 hours laboratory

434 Genetics A survey of genetics with emphasis on bacterial and bacteriophage genetics and the molecular basis of gene action.
2 lectures, 3 hours laboratory

435 Microbial Physiology The study of microorganisms with special reference to the physiology and metabolism of bacteria. Cell-permeability, macromolecular biosynthetic processes, cellular regulatory mechanisms, quantitative experimental methodology.
Prerequisites: Biology 235, Chemistry 332*-333* or 337.
2 lectures, 3 hours laboratory

436 Biostatistics A critical consideration of statistical techniques used in the design and analysis of biological experiments.
2 lectures, 3 hours laboratory
(Only open to Biology majors)

437* Biosystematics A study of living organisms in relation to evolutionary processes and classification.
Prerequisite: Biology 333 and 334*
2 lectures, 3 hours laboratory, fall term

441 Plant Physiology A detailed study of the physical and chemical processes that govern plant growth and function.
Prerequisite: Biology 345*
2 lectures, 3 hours laboratory

442 Comparative Animal Physiology A comparative study of physiological processes in the animal kingdom and their relation to environmental adaption.
Prerequisite: Biology 342
2 lectures, 3 hours laboratory

443 Applied Microbiology Properties of pathogenic microorganisms and special groups related to food and fermentation microbiology.
Prerequisite: Biology 335
2 lectures, 3 hours laboratory

Prerequisite: Biology 233
2 lectures, 3 hours laboratory, winter term

Prerequisite: Biology 234
2 lectures, 3 hours laboratory, fall term
446* Phycology A study of selected topics in the biology of algae.

Prerequisite: Biology 234
2 lectures, 3 hours laboratory, winter term

447* History of Biology The development of biological thought from Greek and Roman times to the present; i.e. from classification to the present experimental approach.
No prerequisites
3 lectures, fall term (Not to be taken in conjunction with Science 400)

448 Developmental Biology Analysis of embryonic development of selected organisms with emphasis on growth and the processes of sub-cellular, cellular and organ differentiation stressing recent experimental methodology.
Prerequisite: Biology 233, 234
2 lectures, 3 hours laboratory

449 Immunology and Virology The course will consist of an introduction to the nature of antigens and antibodies and their reactions, hypersensitivity and blood groups, as well as a study of the nature and interactions of animal, insect, bacteria and plant viruses and their hosts.
Prerequisite: Biology 235
2 lectures, 3 hours laboratory

450 Limnology and Oceanography A survey course covering the following topics: physical and chemical properties of fresh and marine waters including temperature, salinity and light; waves and tides; circulation of the oceans; structure and origins of lakes and ocean basins; marine and freshwater sediments; coral reefs and atolls; circulation of nutrients and eutrophication; biologically important properties of marine and fresh waters; ecological divisions of the marine and freshwater biological communities; phytoplankton and aquatic plants; zooplankton; benthos; mekton; aquatic food chains and productivity; man’s influence on aquatic ecosystems.
Prerequisites: Biology 236, Biology 333, and a minimum of one week of off-campus field trips. (The prerequisite of Biology 236 is waived for the next two years.)
3 lectures

451 Ecology 2 Quantitative and dynamic ecology. The species and the individual in the ecosystem. Population and community ecology; competition and predation, population regulation, community metabolism and productivity. Plant synecology; vegetation and ecosystem classification, the analysis and description of plant communities. Experimental ecology. Introduction to systems ecology; the development of models, analysis of model properties.
Prerequisites: Biology 236, Biology 333, plus attendance of at least one off-campus field course.
It is recommended that this course be taken in conjunction with Biology 436, Biostatistics. (The prerequisite of Biology 236 is waived for the next two years.)
2 lectures plus field trips or projects.

499 Senior Honours Project Each student will work under the direction of a member of the department on an experimental study. The results of this will be presented in thesis form and this will be critically examined by members of this and, where pertinent, other departments. Before selecting this course students must obtain approval for doing so from both the professors under whose direction they wish to work and the chairman of Biology.
Canadian Studies

The Programme

The Departments of Economics, English, French, Geography, History, Political Science and Sociology co-operate in the offering of a special programme in Canadian Studies designed to provide the student with an interdisciplinary approach to the study of all aspects of Canada.

Students who propose to concentrate in Canadian Studies (see the outline of the programme on p. 101 of the Calendar) complete a standard first year programme (in which French 190 is required, or French 101*/102* if the equivalent of Grade 13 French has not been passed) and then follow the Honours programme of one of the above departments, or a double Honours programme with two of the above departments.

In each of Years 2, 3, and 4 the student takes the equivalent of three full courses (four if double Honours) in his major department(s), one of which (or one each if double Honours) is the department's principal Canadian course at that level. In each year electives are chosen from among the various Canadian content courses offered by each participating department (as listed below).

The core course for each year of the programme is an interdisciplinary study of Canadian problems, offered either in a lecture/tutorial format or a seminar format (depending on the number of students registered), and staffed by interested faculty members of the participating departments and of the University and by eminent scholars from other parts of Canada who will visit the University for brief or extended periods during the year.

The student is granted, upon successful completion of the 22-course programme, an Honours B.A. in his major subject with the subtitle of Canadian Studies.

Core Courses

Canadian Studies 201* An interdisciplinary course offered both through lectures and discussion groups devoted to the Canadian social and physical environments.

Canadian Studies 202* Also an interdisciplinary approach to the study of the cultural environment in Canada.

Canadian Studies 300 A seminar course, staffed by at least two faculty members from different departments, in which particular themes and problems relating to Canada will be investigated. The content of the programme each year will vary according to the interest and inclination of faculty and students.

Prerequisite: Canadian Studies 201*/202*

Canadian Studies 400 An extensive senior research essay, supervised by a committee composed of faculty members from two or more of the participating departments, which deals with a specific aspect of Canada utilizing material and methods from several different disciplines.

Prerequisite: Canadian Studies 300
## Principal Canadian Content Courses Offered by the Participating Departments

**Economics**
- 101* Introduction to Economics
- 102* Introduction to Economics
- 241* Economic History of Canada
- 242* Economic History of Canada
- 348* Environmental Economics
- 368* Wage and Manpower Economics
- 380 Industrial Organizations and Public Policy

**English**
- 313* Canadian Literature to 1920
- 314* Canadian Poetry Since 1920
- 315* Canadian Prose Since 1920
- 373 History of the Language
- 495 Senior Honours Essay in Canadian Literature

**French**
- 190 French Language and Literature (or French 101*/102* if students have not passed the equivalent of Grade 13 French)
- 250 Intensive Language Training
- 292* French Culture and Civilization 2
- 350 Advanced Instruction in Written French
- 365* French Canadian Novel
- 366* French Canadian Poetry and Theatre
- 420 The Novel in French Canada
- 455* Training for Proficiency in Oral and Written Expression
- 456* Stylistics, Advanced Grammar and Composition

**Geography**
- 195* Geography and Environmental Problems
- 322* Geographical Study of Canada
- 341* Historical Geography of Canada 1
- 342* Historical Geography of Canada 2
- 411* Resource Studies
- 422* Canada

**History**
- 222* Modern French Canada
- 224* Canadian History Since 1867
- 265* Canadian History 1
- 266* Canadian History 2
- 267* Canadian Non-Indigenous Minorities 1
- 268* Canadian Non-Indigenous Minorities 2
- 379 Pre-Confederation Canada 1760-1867
- 380* Canada 1867-1914
- 381* Canada Since 1914
- 383* History of French Canada to 1867
- 384* History of French Canada Since 1867
- 386* Ontario History to Confederation
- 387* Ontario History Since Confederation
- 389 Canada in World Affairs: The Twentieth Century
- 390 History of North American Indians
- 420 Senior Seminar in Canadian History
- 421 Senior Seminar in Ontario History
- 422 Senior Seminar in French Canadian History
- 423 Senior Seminar in Modern Quebec
- 425 Senior Seminar in Canadian Cultural History
Political Science
115* Introduction to Politics 1
116* Introduction to Politics 2
260 Canadian Government and Politics
330 Public Administration
341* Provincial Politics
442* Politics in Ontario
443* Politics in Western Canada
444* The Politics of French Canada
453* The Politics of Parochial Societies
561* Politics in Canadian Society

Sociology
101* Introduction to Sociology
200* Canadian Society in Comparative Perspective
205* Social Problems
250* Crime and Society
251* Ethnic and Racial Relations
262* Canadian Population
301* Urban Sociology
315* Social Stratification
321* Research Methods 1
323* Project in Sociological Research
334* Northern Lands and Peoples
499 Honours Essay

Principal Canadian Content Courses Offered by Other Arts Departments

Anthropology
233* Eskimo Cultures
234* North American Indians
235* Contemporary Canadian Indian Scene
310* Peoples of the North American Subarctic

Fine Arts
316* Canadian Art
317* Canadian Art

Philosophy
225* Problems in Social and Political Philosophy in Canada
312* Philosophy of Education 2

Psychology
242* Educational Psychology: Learning Disabilities
454* Senior Seminar in Educational Psychology
Department of Chemical Engineering

Professor and Chairman of Department K.F. O'Driscoll, B.Ch.E. (Pratt Inst.), M.S., Ph.D. (Princeton).
Professor and Associate Chairman (Graduate Studies) D.C.T. Pei, B.Eng. (McGill), M.Sc. (Queen's), Ph.D. (McGill).
Associate Professor and Associate Chairman (Undergraduate Studies) J.D. Ford, B.Eng. (McGill), M.A.Sc., Ph.D. (Toronto)

Professors T.L. Batke, B.A.Sc., Ph.D. (Toronto).
T.Z. Fahidy, B.Sc., M.Sc. (Queen's), Ph.D. (Illinois).
R.Y-M. Huang, B.Sc. (National Taiwan University).
M.A.Sc., Ph.D. (Toronto).
P.M. Reilly, B.A.Sc. (Toronto), D.I.C., Ph.D. (London), F.S.S.
P.L. Silveston, B.S., M.S. (M.I.T.), Dr. Ing. (Munich).
G.A. Turner, B.Sc. (London), Ph.D. (Manchester).
B.M.E. van der Hoff, Ing. (Amsterdam), Ir. (Delft).
M. Moo Young, B.Sc. (London), M.A.Sc. (Toronto), Ph.D. (London).


Associate Professors L.E. Bodnar, B.A., M.A. (Sask.), Ph.D. (McMaster).
C.E. Gall, B.A.Sc. (Toronto), M.Sc. (Queen's), Ph.D. (Minn.).

Assistant Professors C.M. Burns, B.A.Sc., M.A.Sc. (Toronto), Ph.D. (Brooklyn Polytechnic Inst.).

Undergraduate Course Descriptions

The number of lectures, laboratories and/or tutorials associated with each course is given in the earlier section of the calendar, on the general description of the Chemical Engineering Undergraduate Programme.
100 Introductory Engineering Concepts 1
An introduction to the basic methods and principles used by engineers in the analysis and design of physical processes. Topics covered by means of lectures, case studies, and problem assignments are: units, dimensions, and measurements; mass balances; behaviour of fluids. Consideration is given to the non-technical and social implications of the engineer's work. Laboratories on freehand sketching and blueprint reading are included.

101 Introductory Engineering Concepts 2
An extension of the topics covered in Ch.E. 100: energy balances; unsteady-state behaviour of engineering systems. Laboratory experiments illustrate the physical principles discussed.

211 Transport Processes 1 (Fluid Mechanics)
Fundamental physical concepts of fluid flow; conservation laws for mass, momentum and mechanical energy; flow of fluid in conduits; flow past immersed bodies. Description, collection and separation of particulate systems.

220 Applied Mathematics 1

230 Physical Chemistry 1
Introduction to Physical Chemistry. Ideal and real gases, the kinetic theory of gases. First law of thermodynamics (classical vs. statistical thermodynamics, energy, heat and work, functions of state, internal energy, enthalpy). Thermochemistry, heats of reaction. Second Law of thermodynamics (entropy of a system, reversible thermodynamic cycles, Carnot cycle). Chemical equilibria in simple systems (free energy function, criteria for equilibrium and spontaneity, free energy and the equilibrium constant). Phase equilibria in simple systems (Clapeyron equation, the phase rule). The third law of thermodynamics.

231 Physical Chemistry 2

232 Inorganic Chemistry 1

33 Physical-Chemical Laboratory
A laboratory to demonstrate common physico-chemical principles and techniques of physical measurements. Training in technical report writing is included. Experiments on viscosity of gases and liquids, chemical kinetics, adsorption, homogeneous and heterogeneous catalysis, thermochemistry, phase equilibria, diffusion, determination of molecular weight of polymers and complex formation.
296 Department of Chemical Engineering

312 Transport Processes 2
Prerequisite: Ch.E. 211

313 Transport Processes 3
(Mass Transfer) Mass transfer by molecular (diffusion) and convective action. The application of mass transfer concepts to the design and analysis of both stage-wise and continuous separation processes such as: distillation, extraction, absorption and others. Analogies and interrelationships between momentum, energy and mass transport phenomena. 
Prerequisite: Ch.E. 312

315 Chemical Engineering Laboratory Experimental application of physical and chemical principles using pilot scale equipment. Representative experiments illustrating major unit operations (distillation, absorption, extraction, drying, humidification) are available. 
Prerequisite: Ch.E. 312

320 Applied Mathematics 2 Review of determinants and basic matrix operations. Advanced functions: gamma-, beta-, and error-functions; sine-, cosine-, exponential-, and elliptic-integrals. Linear differential equations: Wronskian and Green function; initial and boundary value problems; Bessel functions; applications to certain chemical engineering problems. Fourier Series and Integrals: Application to ODE, Fourier transforms; Orthogonal functions; Application to PDE. Laplace Transforms: Review of fundamental theorems; application to ODE and PDE. Numerical Solution Techniques for ODE and PDE. 
Prerequisite: Ch. E. 220.

Prerequisite: Ch.E. 231

331 Chemical Reaction Engineering Applications of reaction kinetics. Homogeneous Reactors: batch, CSTR, tubular flow systems; ideal models (perfect mixing and plug flow); residence time distributions in ideal reactors; temperature effects; steady states; semibatch systems. Nonideal behaviour of homogeneous reactors. Elements of heterogeneous catalysis: mass transfer effects; catalytic rate equations. Simplified analysis and design of heterogeneous reactors: fixed-bed catalytic reactors; fluidized bed reactors. 
Prerequisite: Ch.E. 231.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
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</thead>
</table>
**Prerequisite:** Ch.E. 232 |
| 334        | Instrumental Methods of Chemical Analysis       | An introduction to modern methods of analysis including optical, electrochemical, radiochemical, chromatographic and spectroscopic methods.                                                                        |
| 420        | Process Dynamics and Control 1                   | Block and signal flow diagrams, proportional-integral-derivative controllers, frequency response techniques, analytical and graphical stability criteria. Introduction to modern control theory.  
**Prerequisites:** Math. 31, Ch.E. 312 |
| 482        | Technical Seminar                                | Study and presentation of material in recent literature, or from industrial experience.                                                                                                                     |
| 510        | Physical-chemical Properties of Gases and Liquids| The most up-to-date methods available for the estimation of the more important physico-chemical properties of gases and liquids in cases where experimental values are not to be found. Prediction is usually based on correlations of a form suggested in part by theory, with empirical constants based on experimental data.  
**Prerequisite:** Ch.E. 231 |
| 511        | Selected Topics in Process Applications          | Chemical Engineering fundamentals in process applications such as pipeline flow, fluidized-bed reactors, pneumatic reactors, two-phase systems, drying, multiple-component distillation, and other unit processes. |
| 520        | Chemical Engineering Analysis                    | Application of advanced mathematical techniques to the analysis of chemical engineering processes.  
**Prerequisite:** Permission of instructor. |
| 521        | Process Dynamics and Control 2                   | Analog computation, time domain analysis, control of complex chemical systems.  
**Prerequisite:** Ch.E. 420 |
| 523        | Process Control Laboratory                       | Experiments on process dynamics and control and analog simulation of chemical processes. Time constant, step and frequency response, controller settings, and cascade control of thermal, liquid level, and reaction systems.  
**Prerequisite:** Ch.E. 420  
4 hours laboratory, one term. |
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Prerequisite(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>540</td>
<td>Introduction to Polymer Science</td>
<td>Basic concepts of polymer chemistry, classification of polymers, introductory physical chemistry of polymers, organic chemistry of polymerization reactions of polymers, naturally occurring polymers.</td>
<td></td>
</tr>
<tr>
<td>541</td>
<td>Physical Chemistry of Polymers</td>
<td>Polymer solutions, molecular characterization of polymers, molecular weight distributions, morphology and crystallinity in polymers, reaction kinetics and mechanisms of addition and condensation polymerization.</td>
<td>Prerequisite: Ch. E. 540.</td>
</tr>
<tr>
<td>543</td>
<td>Polymer Technology</td>
<td>Technically important polymers, thermo-viscoelastic properties, dimensional and chemical stability, polymer processing, rheology, compounding and mixing, thermo-forming processes, film formation, fibre forming, chemistry of thermo-setting and curing reactions.</td>
<td>Prerequisite: Ch. E. 541.</td>
</tr>
<tr>
<td>553</td>
<td>Principles of High Temperature Extractive Metallurgy</td>
<td>Detailed study of the underlying principles of several metallurgical processes of importance in Canada. Subjects covered include kinetics and mechanisms of roasting and reduction reactions, industrial roasting, blast furnace and electric furnace reduction: nature of melts and slags, slag metal reactions; converting refining and fuse salt electrolysis. Problems being worked on in various extractive metallurgy research laboratories will be reviewed.</td>
<td></td>
</tr>
<tr>
<td>560</td>
<td>Introduction to Biochemical Engineering</td>
<td>Aspects of the biological sciences, primarily microbiology and biochemistry, of interest to the biological process industries (fermentation and food products) and to environmental pollution (air and water). Classification and growth characteristics of micro-organisms. Physico-chemical properties of biological compounds. Metabolism and biochemical kinetics. <em>(Lectures and laboratory exercises.)</em></td>
<td></td>
</tr>
<tr>
<td>561</td>
<td>Fermentation Operations</td>
<td>Methods of solving engineering problems imposed by physical and biological factors in fermentation systems. The unifying principles of the processing operations involved in the production of antibiotics, yeasts, enzymes, beverage alcohol and other microbial products, and in biological waste treatment. Specialized mass transfer, heat transfer, mixing and rheology applications. <em>(Lectures and laboratory exercises.)</em> Prerequisite: Ch. E. 560 or permission of instructor</td>
<td></td>
</tr>
</tbody>
</table>
563 Food Processing  Methods of solving engineering problems imposed by physico-chemical constraints in biological systems encountered in food processing technologies. Formulation, processing, preservation and quality evaluation of natural and textured foods, food components and additives: mixing, extrusion, sterilization, separation, purification and concentration operations. Engineering development of unconventional food resources. (Lectures and laboratory exercises.)
Prerequisite: Ch.E. 560 or permission of instructor.

580 Research-Design Project 1  An individually supervised research and/or design project on any Chemical Engineering subject chosen by the student-professor group.
Equivalent to one course, one term.

581 Research-Design Project 2  Continuation of Ch.E. 580.
Equivalent to two courses, one term.

583 Process Systems Design  The undergraduate curriculum is co-ordinated and brought together to accomplish by team effort the basic objective of the process engineer, the design of an integrated process.
Equivalent to one-and-half course, one term.

585 Technical Elective Project  An individually supervised research or design project, based on one of the technical elective courses taken in the 4A term.
Equivalent to one course, one term.

280, 281, 380, 381, 480, 481  Informal discussions on the Chemical engineering programmes. Descriptions of elective, option and research patterns available within the Department, as well as those in other Departments and Faculties. Professional ethics and the social implications of Chemical Engineering; career opportunities. Seminars by Alumni speakers. (Non-credit).
Department of Chemistry

Professor and Chairman of Department
W.A.E. McBryde, M.A. (Toronto), Ph.D. (Virginia), F.C.I.C.

Professor (Chemistry and Physics and Dean of the Faculty of Science)

Professor and Associate Dean of the Faculty of Science

Professors (Chemistry and Physics)
D. E. Irish, B.Sc. (Western), M.Sc. (McMaster), Ph.D. (Chicago)
H.G. McLeod, M.A., Ph.D. (Toronto)
L.W. Reeves, B.Sc., Ph.D., D.Sc. (Bristol), F.C.I.C.
A. Rudin, B.Sc. (Alberta), Ph.D. (Northwestern)
G. Scoles, B.Sc., Ph.D. (Genova)
H.D. Sharma, M.Sc. (Delhi), Ph.D. (California)
T. Viswanatha, M.Sc., Ph.D. (Mysore)

Adjunct Professor

Associate Professors
G.F. Atkinson, M.A., Ph.D. (Toronto), F.R.I.C.
D.A. Brisbin B.Sc. (Alberta), Ph.D. (Toronto)
J.B. Capindale, M.A., D.Phil. (Oxford)
A.J. Carty, B.Sc., Ph.D. (Nottingham)
W.L. Elsdon, M.Sc. (Western), Ph.D. (McGill)
B.O. Fraser-Reid M.Sc. (Queen's), Ph.D. (Alberta)
T.E. Gough, B.Sc., Ph.D. (Leicester)
R.M. Guest, M.A. (Western), Ph.D. (McGill)
F.W. Karasek, B.S. (Elmhurst), Ph.D. (Oregon State)
J.L. Koppel, B.A., Ph.D. (Toronto)
D. Mackay, B.Sc., Ph.D. (Aberdeen)
A.D. Maynes, M.A., Ph.D. (Toronto)
J.B. Moffat, B.A., Ph.D. (Toronto)
J.G. Smith, B.A., M.A., Ph.D. (Toronto)
V. A. Snieckus, B.Sc. (Alberta), M.S. (California), Ph.D. (Oregon)
G.E. Toogood, B.Sc., Ph.D. (Nottingham)

Assistant Professors
A. Balasubramanian, M.Sc. (Madras), Ph.D. (Indian Institute of Science)
L.J. Brubacher, B.A. (Goshen College, Indiana), Ph.D. (Northwestern)
P.C. Chieh, B.Sc. (Nat Taiwan) M.Sc. (Nat Tsing Hua), Ph.D. (British Columbia)
R.J. Friesen, B.Sc., M.Sc. (Manitoba)
R.J. Leroy, B.Sc., M.Sc. (Toronto), Ph.D. (Wisconsin)
F.R. McCourt, B.Sc., Ph.D. (British Columbia)
M. Tchir, B.Sc. (Alberta), Ph.D. (Western)

Instructors
W.J. Byars, H.N.C. (Dundee Technical College), B.Sc. (Waterloo)
M.C. Michael (Miss), B.Sc. (Waterloo)
D. Rees-Thomas, B.Sc. (Queen's)
M. Vatcher, H.N.C. (Bolton Technical College)
Undergraduate Course Descriptions

Details of the undergraduate programmes offered by the Faculty of Science are to be found on page 231.
Prerequisites for course are a reliable guide to the background necessary for the course. In lieu of the specific courses listed, an equivalent background from Waterloo or elsewhere is acceptable. With consent of the instructor, prerequisites may be waived in exceptional cases.

11* General Chemistry
Stoichiometry, properties of gases, liquids and solutions, gas phase chemical equilibria, ionic equilibria in aqueous solutions, oxidation-reduction, chemical kinetics.
3 lectures, 1 tutorial, fall term.
(For students registered in the Year 1 Engineering programme.)

26* Organic Chemistry 1
The basic chemistry of the important classes of aliphatic and aromatic compounds. A laboratory course on preparative organic chemistry and organic techniques accompanies the lectures.
3 lectures, 3 hours laboratory, alternate weeks; fall and winter terms

36* Organic Chemistry 2
An introduction to the important classes of heterocyclic compounds and natural products.
Prerequisite: Chemistry 26*
3 lectures, fall and spring terms (the laboratory described in Chemistry 26* will be offered in the fall term only with this course for those students who did not take in with Chemistry 26*)

111* Contemporary Chemistry 1
Structure of matter; Matter and energy; Chemistry of the environment; Chemistry of materials; Chemical aspects of pollution.
Prerequisite: Grade 12 Chemistry
3 lectures + discussion meetings, fall term only.

112* Contemporary Chemistry 2
Chemical reactions – How far and how fast; Organic chemistry; Biochemistry; Nuclear chemistry.
Prerequisite: Chemistry 111* or Grade 13 Chemistry
3 lectures + discussion meetings, winter term only.

Chemistry 111*-112* are designed for students in Arts, Environmental Studies and some students in Mathematics and Science who are unlikely to take further courses in Chemistry; they will be accepted for degree credit but will not be accepted as prerequisites for any other chemistry courses, nor will credit be allowed for both Chemistry 111*-112* and 121*-122* or 142*.

121* Chemical Structure and Periodicity
An introduction to atomic structure and bonding. Periodic atomic properties. Chemical implications of periodicity.
Prerequisite: Grade 13 Chemistry, Mathematics (Functions and Relations; and Calculus)
3 lectures, 3 hours laboratory, fall term.

122* General Chemistry for the Physical Sciences
An integrated approach to the structure and reactivity of molecules. Basic chemical kinetics. Selected reactions of hydrocarbons.
Prerequisite: Chemistry 121*
3 lectures, 3 hours laboratory, winter and spring terms.
142* General Chemistry for the Life Sciences

Equilibrium, energetics and mechanisms of reactions.
Prerequisite: Chemistry 121*.
3 lectures, 3 hours laboratory, winter term only.

Note
a) The normal first year Chemistry sequence recommended for Mathematics students (Regular or Coop) is 121*-122*.

b) The normal first-year pattern for most students will be to take 121* followed by 122* or 142*; however both 122* and 142* may be taken if desired.

209* Scientific Literature and Writing

This course is now offered as Science 209* and is described in the Science course listings.

210* Non-Aqueous Solvents and Non-Transition Metal Chemistry

Modern acid-base theory. Behaviour in specific non-aqueous systems. Application to the synthesis and reactivity of non-transition metal compounds. (Primarily for Honours Chemistry, Honours Applied Chemistry and Honours Biology and Chemistry.)
Prerequisite: Chemistry 121*-122*
2 lectures, 3 hours laboratory, fall term only.

211* Chemical Bonding in Inorganic Chemistry

Concepts of molecular orbital and valence bond theories. \( \sigma, \pi \) and \( \delta \) bonding in complex polyatomic inorganic molecules. Relationship of bonding to stereochemistry and electronic structure in specific groups of compounds. (Primarily for Honours Chemistry, Honours Applied Chemistry and Honours Biology and Chemistry.)
Prerequisite: Chemistry 121*
2 lectures, offered in winter and spring terms.

216* Introduction to Organic and Biochemistry

A general survey of the important principles and application of organic and biochemistry for Optometry students only.
3 lectures, fall term.

218* Development of Chemical Bonding and Structure

Prerequisite: Chemistry 121*
2 lectures, 1 tutorial, fall term.

219* Chemistry of Non-Transition Metals

Group trends in main group chemistry. Emphasis will be placed on correlation of structure with physical properties in various groups of compounds.
Prerequisites: Chemistry 218*
2 lectures, 1 tutorial, winter term.

220* Introductory Analytical Chemistry

The principles underlying quantitative chemical measurements, with experiments to develop confidence in personal laboratory techniques and to provide experience in comparing and choosing analytical methods. (Primarily for Honours Chemistry, Honours Applied Chemistry and Honours Biology and Chemistry.)
Prerequisite: Chemistry 121* and 122* or 142*
1 lecture. 6 hours laboratory. offered in fall and winter terms.
221* Analytical Chemistry of Multi-Component Systems

Applications of electroanalytical methods, spectroscopic methods, and analytical separations to the quantitative description of multi-component systems.

(Primarily for Honours Chemistry, Honours Applied Chemistry and Honours Biology and Chemistry.)

Prerequisite: Chemistry 220*

2 lectures offered in fall, winter and spring terms.

224 Chemical Spectroscopy

An introductory survey of the principles and applications of spectroscopic techniques used in the modern chemical laboratory. Topics will include electronic, vibrational and rotational spectroscopy, and magnetic resonance spectroscopy.

2 lectures per week. 2 terms. (full-year course).

226* Chemical Analysis 1

A variety of classical and modern methods will be discussed in principle, and applied in the laboratory.

Prerequisite: Chemistry 121* and 122* or 142.

2 lectures, 6 hours laboratory, fall term only.

227* Chemical Analysis 2

The evolution of some modern analytical methods will be discussed in the lectures. The laboratory will deal with their application to contemporary problems in chemistry and other sciences.

Prerequisite: Chemistry 226* or 220.

2 lectures, 6 hours laboratory, winter term only.

231 Chemical Bonding and Structure


Application of the concepts of chemical bonding to the stereochemistry, structure and properties of main group element compounds. Relationship of bonding to reactivity and electronic structure. Periodicity and periodic trends in group chemistry. Synthesis of selected groups of inorganic compounds.

Prerequisite: A first year Chemistry course, e.g. Chemistry 121*-122*

2 lectures, for two terms (full-year course).

240* Introductory Theoretical Chemistry

Partial differentiation and the calculus of several variables; solution of ordinary differential equations with emphasis on the special functions occurring in chemistry (e.g. Hermite, Legendre and associated Laguerre functions); fundamentals of linear algebra including vector spaces and matrices; introduction to operator concepts. All of these mathematical methods will be illustrated with examples taken from modern chemistry and their employment in further chemistry courses will be discussed.

Prerequisites: Chemistry 121* and Mathematics 130

2 lectures, 1 tutorial, offered in fall and winter terms.

250* Introductory Thermodynamics

Laws 0,1,2,3 of Thermodynamics and their application to the properties of ideal systems; thermochemistry; spontaneity of chemical reactions and the criteria for chemical equilibrium; derivation of the phase rule and its application.

Prerequisites: Chemistry 121* and 122* or 142*; Mathematics 130

2 lectures, 1 tutorial, offered in fall and winter terms.
251* Application of Chemical Thermodynamics to Real Systems
Partial molal quantities; Gibbs chemical potential and non-ideal systems; chemical equilibrium; theory of electrolytes.
Prerequisites: Chemistry 250*
2 lectures, 1 tutorial, offered in fall, winter and spring terms.

252* Quantum Chemistry 1
A review of classical wave motion; the postulates of quantum mechanics; quantum mechanics of the hydrogen atom; angular momentum and simple coupling schemes; selection rules and atomic spectroscopy of hydrogen-like systems and the helium atom; discussion of multi-electron atoms; fine and hyperfine structure.
Prerequisite: Chemistry 240*
2 lectures, 1 tutorial, offered in fall, winter and spring.

260* Organic Chemistry 1
The preparation and reactions of typical organic functional groups examined from the basis of the reaction mechanisms is presented. Spectroscopic correlations of these functional groups is introduced. Stereochemistry of organic molecules is discussed.
(Primarily for Honours Chemistry, Honours Applied Chemistry and Honours Biology and Chemistry.)
Prerequisite: Chemistry 121*-122*
2 lectures, 1 tutorial, 3 hours laboratory, offered in fall and winter terms.

261* Organic Chemistry 2
The treatment of organic chemistry in Chemistry 261* is continued and extended to aromatic compounds.
(Primarily for Honours Chemistry, Honours Applied Chemistry and Honours Biology and Chemistry.)
Prerequisite: Chemistry 260*
2 lectures, 1 tutorial, offered in fall, winter and spring terms.

266* Organic Chemistry 1
The properties, preparation, reactions and basic structural theory of the common classes of aliphatic compounds. Introduction to electrophilic and nucleophilic reaction mechanisms.
Prerequisite: Chemistry 121* and 122* or 142*
2 lectures, 1 tutorial, fall term.

267* Organic Chemistry 2
The properties, preparation, reactions and basic structural theory of the common classes of aromatic compounds. A continuation of organic reaction mechanisms. Introduction to the chemistry of carbohydrates, proteins, steroids, etc.
Prerequisite: Chemistry 266*
2 lectures, 3 hours laboratory, winter term.

(For students needing a full year of Organic Chemistry as a prerequisite to medicine, the sequence 266*-267* should be selected.)

291* Laboratory
Selected experiments to accompany the lecture work of Year 2 Honours Chemistry (incl. Math and Physics options) and Honours Biology and Chemistry and term 2B Honours Applied Chemistry. Only open to such students.
9 hours laboratory, offered in fall winter and spring terms.

Note: Most 300-level honours courses are listed as 2 hours lectures; an additional 1 hour tutorial may be scheduled at the discretion of the instructor.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Prerequisites</th>
<th>Credits</th>
<th>Hours</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>302*</td>
<td>Modern Organic Analysis</td>
<td>Application of wet chemical and instrumental methods in current use to the identification, determination and characterization of organic materials.</td>
<td>Pre-requisite: a background in Anal. and Org. Chem.</td>
<td>2</td>
<td>3</td>
<td>one term</td>
</tr>
<tr>
<td>303*</td>
<td>Introductory Polymer Chemistry</td>
<td>Polymer nomenclature; effects of intermolecular forces on properties of polymers; molecular weight distributions and averages; step-growth polymerization; states of aggregation of polymers; isomerism in polymeric structures; free radical chain-growth polymerization and copolymerization; ionic polymerization.</td>
<td>Pre-requisite: a background in Physical and Organic Chem.</td>
<td>3</td>
<td>3</td>
<td>one term</td>
</tr>
<tr>
<td>307*</td>
<td>Introductory Biochemistry</td>
<td>Carbohydrates; proteins; nucleic acids; lipids; metabolism of these compounds.</td>
<td>Pre-requisite: a background in Organic Chem.</td>
<td>3</td>
<td>3</td>
<td>one term</td>
</tr>
<tr>
<td>311*</td>
<td>Radiochemistry</td>
<td>An introduction to nuclear stability rules, radioactive decay processes and nuclear structure. $\alpha$, $\beta$, $\gamma$, emission. Nuclear reactions, fission; production of heavy elements. Interaction of radiation with matter. Radioisotopes. Brief introduction to actinide chemistry.</td>
<td>Pre-requisite: Chemistry 121* or equivalent</td>
<td>2</td>
<td></td>
<td>winter term</td>
</tr>
<tr>
<td>316*</td>
<td>An Introduction to Transition Metal Chemistry</td>
<td>The transition elements and their compounds. An elementary approach to crystal and ligand field theory will be used to rationalise the spectra, magnetism, structures and properties of transition metal complex compounds.</td>
<td>Pre-requisite: Chemistry 218*, 219* or 211*</td>
<td>2</td>
<td>3</td>
<td>fall term</td>
</tr>
<tr>
<td>318*</td>
<td>Instrumental Measurements</td>
<td>Extension of Chemistry 308 to dynamic measurements following the course of a chemical reaction or monitoring a continuous process.</td>
<td>Pre-requisite: Chemistry 308*</td>
<td>1</td>
<td>3</td>
<td>one term</td>
</tr>
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</table>
320* Chemical Instrumentation

The principles of operation, practical limitations and preferred uses of various devices commonly used to make accurate measurements of importance in modern chemistry. Transducers for temperature, pressure, solution potential, optical absorptivity, etc.

Prerequisites: Chemistry 220* or 226*-227*
2 lectures, 3 hours laboratory, offered in winter term

328 Chemical Measurements for Biologists

Basis methods of quantitative analysis and the proper use of instruments for extending and refining them, concentrating on problems of concern to biologists.

Prerequisite: Chemistry 121*-142*
2 lectures, 3 hours laboratory for both fall and winter terms, (full-year course).

332* Biochemistry 1

An introduction to the chemistry of amino acids, peptides, proteins, nucleic acids, carbohydrates and lipids.

Prerequisites: Chemistry 261* or Chemistry 267*
2 lectures; offered in fall, winter and spring terms.

Note: A 3 hour laboratory will be given for Honours Biology and for General Science students.

333* Biochemistry 2

Metabolism of carbohydrates and lipids. Structure and synthesis of proteins.

Prerequisite: Chemistry 332*
2 lectures, fall and winter terms

Note: A 3 hours laboratory will be given for Honours Biology and for General Science students.

337 Biochemistry

Carbohydrates, lipids, proteins, hormones, nucleic acids, and vitamins. Metabolism of these groups of compounds. Physicochemical aspects of biochemistry.

Prerequisite: Chemistry 260*, 261* or 266*, 267* or equivalent
2 lectures, two terms (full-year course for correspondence students, equivalent to 332*-333*)

344 Inorganic and Nuclear Chemistry

Survey of transition metal chemistry including ligand field theory of coordination compounds and an introduction to organometallic chemistry. Introduction to nuclear and radiochemistry.

Prerequisites: a background in Chemical Bonding, e.g. Chemistry 211* or 218* or 231
2 lectures, for two terms (full-year course)

350* Spectroscopy and Molecular Structure

Introduction to concepts and applications of microwave, Raman, IR, electronic and resonance spectroscopy with respect to molecular parameters.

Prerequisites: Chemistry 252*
2 lectures; fall and spring terms.

351* Statistical Thermodynamics

Ensembles, postulates of statistical mechanics; Boltzmann, Fermi-Dirac, and Bose-Einstein Statistics; microcanonical, canonical and grand canonical ensembles; Equilibrium statistical mechanics and statistical thermodynamics; application to ideal gases.

Prerequisites: Chemistry 240*, 250*
2 lectures; fall and spring terms
352* Chemical Kinetics
Introduction to kinetics and mechanism of elementary chemical processes in homogeneous systems; reversible, consecutive and simultaneous reactions, interpretation of kinetic data. Collision theory, absolute reaction rate theory.
Prerequisite: Chemistry 351*
2 lectures; winter term

353* Physical Chemistry of Polymers
Definitions and nomenclature of polymers, molecular weight averages and methods of measurements, linear step-growth polymerization, polymer constitution, configuration and conformation, free radical chain-growth polymerization and copolymerization.
Prerequisites: Chemistry 250* or 356*
2 lectures; fall and spring terms

354* Applied Kinetics
Introduction to kinetics and mechanism of elementary chemical processes in homogeneous systems, reversible, consecutive and simultaneous reactions, interpretation of kinetic data. Application to industrial processes, both batch and continuous.
Prerequisite: Chemistry 250* or 356*
2 lectures; winter term

156* General Physical Chemistry
An introductory survey of the thermodynamics of ideal systems; the application of thermodynamic principles to the study of solutions, phase equilibria, chemical equilibrium and the properties of electrolytes.
Prerequisites: Chemistry 122* or 142* and Math 130
2 lectures, 3 hours laboratory; fall term

157* General Physical Chemistry
An introductory survey of the concepts and principles of quantum mechanics; the application of these principles to the study of atomic and molecular structure and spectra, and to photochemical phenomena. Chemical kinetics.
Prerequisites: Chemistry 122* or 142*
2 lectures, 3 hours laboratory; winter term

360* Organic Chemistry 3
Stereochemistry of organic compounds; nucleophilic addition and substitution reactions with emphasis on enolate and related condensations; cycloaddition reactions.
Prerequisite: Chemistry 261*
2 lectures; fall and spring terms

Note: A 3 hour laboratory will be given for Honours Biology and Chemistry students.

361* Organic Chemistry 4
Aromaticity in heterocyclic and non-benzenoid compounds. Electrophilic and nucleophilic substitution of aromatic systems; formation and reactions of carbenes, nitrenes.
Prerequisite: Chemistry 360*
2 lectures; winter term

Note: A 3 hour laboratory will be given for Honours Biology and Chemistry students.

362* Theoretical Organic Chemistry
A number of topics in physical and organic chemistry treated from a semi-empirical consideration of molecular structure (e.g. MO theory and reactivity).
Prerequisites: Chemistry 240* 261*
2 lectures; winter term.
363* Applied Organic Chemistry
The organic chemistry involved in selected industrial processes will be discussed. Petroleum chemistry, synthesis of dyestuffs, pharmaceuticals, pesticides, organic polymers, etc.
Prerequisite: Chemistry 261*
2 lectures; fall and winter terms

366* Structural and Synthetic Organic Chemistry
Stereochemistry of organic molecules; synthesis of selected organic compounds examined in detail with emphasis on cyclo-addition reactions and condensation reactions.
Prerequisites: Chemistry 261* or 267*
2 lectures, 3 hours laboratory; fall term

367* Selected Topics in Organic Chemistry
Some of the following topics will be discussed; photochemistry, organometallic compounds, organic compounds of commercial interest, natural products.
Prerequisites: Chemistry 360* or 366*
2 lectures, winter term

390* Advanced Laboratory 1
Selected experiments to accompany lecture work of year 3 Honours and Applied Chemistry.
Prerequisite: Chemistry 291*
9 hours laboratory; fall and spring terms

391* Advanced Laboratory 2
Selected experiments to accompany lecture work of year 3 Honours and Applied Chemistry.
Prerequisite: Chemistry 291*
9 hours laboratory; winter term

395* History of Chemistry
The development of chemistry will be traced from alchemy to the 20th century. The contributions of famous scientists to the concepts and models of modern chemistry will be emphasized.
2 lectures; winter term

400* Electrochemistry and Corrosion
Electrolytic conductance and transport, thermodynamics of electrolytic cells. Reversible and irreversible electrode processes, metallic corrosion; study of selected industrial electrochemical processes.
Prerequisite: Chemistry 305*
3 lectures, 3 hours laboratory alternate weeks, one term.

403* Physical Chemistry of Polymers
Polymerization reactions; effects of monomer structure, stereoregularity; polymer solutions; degradation and stabilization of polymers; network polymers and polymerization reactions; polymer elasticity.
Prerequisite: Chemistry 303*, 305* or equivalent
3 lectures, 3 hours laboratory, one term.

405* Surface Chemistry
An introduction to the physical chemistry of surfaces. Properties of surfaces; quantitative description of a surface; interaction between phases at a surface. Thermodynamic treatment of surfaces; physical adsorption; chemisorption. Practical applications of surface chemistry in chemical industry.
Prerequisite: Chemistry 305*
3 lectures, one term.

407* Applied Biochemistry
Vitamins and hormones; chemistry, production, and mechanism of action of drugs; industrial applications of enzymes and other biological materials.
Prerequisite: Chemistry 307*

Prerequisite: Chemistry 318*
1 lecture, 3 hours laboratory, one term.

410* Applied Chemistry Seminar 1 hour seminar, one term


Prerequisite: Chemistry 310* or equivalent
2 lectures, fall term

412* Analysis of Materials  Techniques of separation, determination and characterization of complex materials including ores, resistant alloys, ceramics, synthetic polymers, food and drug products and pesticides.

Prerequisite: Chemistry 318*
2 lectures, 3 hours laboratory, one term.

413* Properties of Polymers  Transitions in polymeric systems, crystallization and effects of crystallinity on polymer properties; types of mechanical behaviour; flow of thermoplastic melts; measurement of mechanical properties; effects of molecular structure, molecular weight and processing history on polymer properties.

Prerequisite: Chemistry 403* or equivalent.
3 lectures, 3 hours laboratory, one term.

415* Catalysis  An introduction to homogeneous and heterogeneous catalysis; chemisorption and its relation to catalysis; geometrical and electronic factors. Industrial applications of catalysis. Problems in selection of catalysts.

Prerequisite: Chemistry 405*.
3 lectures, one term.

418* Instrumentation  The laboratory time will be divided between analytical study of instrument modules, and synthesis of an instrument system to meet a typical industrial need.

Prerequisite: Chemistry 318*.
1 lecture, 3 hours laboratory, one term.


Prerequisite: Chemistry 305* or equivalent
2 lectures, one term.

429 Project Laboratory in Chemistry  Students will be encouraged to submit a proposal for a project in any area of chemistry; alternatively, a project may be assigned.
9 hours laboratory, two terms (only for Year 4 Applied Chemistry students).
431 Inorganic Chemistry 2  Systematic inorganic chemistry of the transition elements; introduction to selected topics including ligand field theory, magnetochemistry; interpretation of electronic spectra. Organometallic chemistry, chemistry of metal corbonyls, and related compounds. 
Prerequisite: Chemistry 331.
2 lectures.

435 Physical Chemistry 3  Introduction to quantum chemistry and statistical thermodynamics. Application to kinetics, surface chemistry, and spectroscopy. 
Prerequisite: Chemistry 335.
2 lectures, 1 hour problems.

436 Organic Chemistry 3  The use of spectroscopic techniques in organic chemistry; analysis of reaction mechanisms; free radical chemistry; a brief introduction to natural product chemistry. 
Prerequisite: Chemistry 336.
2 lectures.

437 Biochemistry 2  Selected topics and techniques in modern biochemistry; energy transfer, transport across membranes, comparative aspects of metabolism, mechanism and kinetics of enzyme activity, structural macromolecules. 
Prerequisite: Chemistry 337.
2 lectures, 3 hours laboratory.

439 Advanced Laboratory  An introduction to research methods and techniques. The student will elect to concentrate this study in one of the following fields of chemistry, viz. analytical, inorganic, organic, physical or biochemistry. 
9 hours per week for Honours Chemistry students, 6 hours for Honours Chemistry (Mathematics or Physics Option). Only available to such Honours students.

440 Polymer Chemistry  Introductory concepts and definitions; polymer nomenclature; effects of intermolecular forces on polymer properties; molecular weight averages; step-growth polymerization; polymer constitution, configuration and conformation; radical chain-growth polymerization; vinyl copolymerization; cationic, anionic and coordinate polymerization. 
Prerequisites: a full year background in both organic and physical chemistry. 
2 lectures.
Department of Civil Engineering

Professor, Chairman of the Department
T. H. Topper, B.A.Sc. (Toronto), Ph.D (Cambridge)

Professor, Dean of Engineering

Professor, Associate Chairman of Graduate Studies
H.H.E. Leipholz, Dipl. Eng., Dr.Ing., Docent Habil (Stuttgart)

Associate Professor, Associate Chairman of Undergraduate Studies
J. Roorda, B.A.Sc. (Waterloo), Ph.D. (London)

Professors
S.T. Ariaratnam, B.Sc. (Eng.) (Ceylon), M.Sc. (London), Ph.D. (Cambridge)
M.Z. Cohn, C.Sc. (Bucharest)
W.R. Drynan, B.A.Sc. (Toronto), M.Sc., Ph.D. (Texas)
R.C.G. Haas, B.Sc., M.Sc. (Alberta), Ph.D. (Waterloo)
V.K. Handa, B.Sc. (Calcutta), B.Sc. (Eng.) (London), M.Sc. (Queen’s), M.A.Sc., Ph.D. (Waterloo)
B.G. Hutchinson, B.E. (Sydney), M.Sc. (Queen’s), Ph.D. (Waterloo)
N.C. Lind, M.Sc. (Tech. Univ. of Denmark), Ph.D. (Illinois)
W.A. McLaughlin, B.Eng. (Saskatchewan) M.S., Ph.D. (Purdue)
J.T. Pindera, Dr. of Tech. Sciences (Warsaw), Docent Habil, (Cracow)
T. Prasad, B.Sc., M.Sc. (Banaras Hindu Univ.), Ph.D. (Cambridge)
T.E. Unny, B.E. (Madras), M. Tech. (Kharagpur), Dr. Ing. (Dresden)
D.T. Wright, B.A.Sc. (Toronto), M.S. (Illinois), Ph.D. (Cambridge), (on leave of absence)

Associate Professors
E.F.P. Burnett, B.Sc. (Capetown), D.I.C., M.S., Ph.D. (London)
R.W. Cockfield, B.Sc., M.Sc. (Queen’s), Ph.D. (Waterloo)
R. Green, B.Sc. (Eng.) (London), M.Sc. (Queen’s), M.Sc. (Waterloo), Ph.D. (Texas)
D.E. Grierson, B.A.Sc., M.A.Sc., Ph.D. (Waterloo)
H.M. Hill, B.A.Sc., M.Sc. (Saskatchewan), D.Phil. (Oxford)
B. LeLievre, B.Eng. (West Australia), M.A.Sc., Ph.D. (Waterloo)
W.C. Lennox, B.A.Sc., M.Sc. (Waterloo), Ph.D. (Lehigh)
E.I. Matyas, B.A.Sc. (Toronto), D.I.C., Ph.D. (London)
G.M. McNeice, B.A.Sc. (Waterloo) Ph.D. (London)
J. Schroeder, B.Eng., M.Eng. (McMaster), Ph.D. (Waterloo)
J. Shortreed, B.Eng. Sc. (Western), M.Sc. (Queen’s), Ph.D. (Northwestern)
K.N. Smith, B.A.Sc. (Toronto), M.A.Sc. (Illinois), Ph.D. (Waterloo)
S.I. Solomon, Civ. Hyd. Eng. (Bucharest)
O.L. White, B.Sc. (Melbourne), M.A.Sc. (Toronto), Ph.D. (Illinois)

Assistant Professors
G.J. Farquhar, B.A.Sc., M.A.Sc. (Waterloo), Ph.D. (Wisconsin)
N. Kouwen, B.A.Sc., Ph.D. (Waterloo)
J.C. Thompson, B.A.Sc. (Toronto), M.S., Ph.D. (Illinois)
S. Yagar, B.A.Sc., M.A.Sc. (Toronto), Ph.D. (California)

Adjunct Professors
J.J. Munk, B.Sc. (Sir George Williams), B.Eng. (McGill), LL.B. (Osgood Hall)
N.W. McLeod, B.Sc. (Alberta), M.Sc. (Saskatchewan), Ph.D. (Michigan)

Special Lecturer P. Allen
Undergraduate Course Descriptions

200 Civil Engineering Project 1 Preliminary designs of standard civil engineering structures. The creation and evaluation of alternative locational and spatial configurations in accordance with user socio-economic and technological requirements. Informational content of previous courses is augmented with case studies of typical civil engineering problems and solutions.

203 Statics An analytic treatment of static equilibrium of particles and rigid and deformable bodies. Internal forces in straight beams and columns, diagrams of axial force, shear force and bending moment.

205 Mechanics of Deformable Solids 1 Introduction of the concepts of stress and strain. Stress-strain relations for linearly elastic and other materials; analysis of the response of prismatic members to axial, shearing, flexural or torsional loads.

206 Mechanics of Deformable Solids 2 An extension of CE205. Combined stress and strain states, Mohr’s circle, yield and failure criteria, energy methods, virtual work buckling of columns, and an introduction to simple statically indeterminate structures.

221 Calculus A continuation of Math 12. Infinite series and power series, partial derivatives, multiple integration with applications, vector analysis, theorems of Green and Gauss, line integrals and Fourier analysis.


224 Probability and Statistics A course in aspects of probability and statistics. Sample spaces, calculus of events, probability, conditional probability, independence, permutations and combinations, random variables, discrete and continuous distributions, mean and variance, Chebychev’s inequality, joint distributions, random sampling, the normal distribution, law of large numbers, central limit theorem, parameter and interval estimation, hypothesis testing, regression, analysis of variance.

265 Structure and Properties of Materials Structure of Materials – Topics include: crystalline and noncrystalline arrangements, bonding forces, structural defects, phase equilibria, non-equilibrium transformations, heat treatment of metals, deformation resistance; elasticity, anelasticity, plasticity and creep, fracture properties; brittle and ductile fracture, fatigue, embrittlement fractures, mechanical properties of plain concrete and polymers.

280 Fluid Mechanics An introductory course in fluid mechanics. Unit and dimension, fluid statics, fundamentals of fluid flow, viscous effects, closed conduit flow, pipe network analysis.

291 Survey Camp A one-week course in surveying. Introduction to surveying, length measurements, levelling, Transit Survey. Approximate costs to each student $50.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>292</td>
<td>Socio-Economic Aspects of Civil Engineering</td>
<td>An overview of the man-environment interaction. General economic concepts of human welfare and resource allocation, engineering economic decisions, breakeven and minimum cost analysis, engineering methods of resource allocation, scheduling of resource allocation, concepts of interest, time evaluation of practical and strategical alternatives.</td>
</tr>
<tr>
<td>300</td>
<td>Civil Engineering Project 2</td>
<td>The detailed design of comprehensive projects by student teams. Each team member is assigned a portion of a project which he is to design. Each of the individual designs are integrated to produce a complete design in the form of a report containing all appropriate calculations and drawings. Particular emphasis is placed on the utilization and integration of knowledge acquired in the more specialized courses.</td>
</tr>
<tr>
<td>303</td>
<td>Structural Analysis 1</td>
<td>An introduction to structural analysis. Degree of internal indeterminacy and stability of structural systems; analysis and construction of influence lines for beams, frames, arches and trusses, calculation of displacements; energy principles.</td>
</tr>
<tr>
<td>315</td>
<td>Structural Design 1</td>
<td>An introductory course in structural design intended to acquaint the student with the behaviour of typical engineering materials. The behaviour of sections under various loading conditions, the design of connections in steel and concrete structures, design of beams and columns.</td>
</tr>
<tr>
<td>342</td>
<td>Transportation Engineering</td>
<td>An introduction to analytical tools of transportation planning. Urban travel, trip generation, trip distribution, modal split, analysis; traffic flow characteristics; traffic assignment; project evaluation; welfare theory implications in transport systems; urban development concepts.</td>
</tr>
</tbody>
</table>

Department of Civil Engineering
### 375 Sanitary Engineering
An introductory course in sanitary engineering. Fundamentals of microbiology and chemistry, water treatment; water quality criteria, clarification, filtration, disinfection, removal of dissolved materials, waste water treatment; characteristics of waste water, disposal of water, primary treatment, secondary treatment, sludge handling, tertiary treatment, industrial wastes.

### 381 Hydraulics
An introductory course in Hydraulics. Open channel flow, hydrometerologic concepts, statistical hydrology, reservoir operation, dimensional analysis. hydraulic structures. hydro electric process.

### 393 Environmental Engineering
An introduction to environmental, urban and municipal engineering. Characteristics of urbanization, measuring demands for municipal services, developing and testing plans, implementation considerations, performance and measurement consideration.

### 398, 399 Seminar

### 400 Systems 3 (Project)
Design of civil engineering projects, building structures, bridges, highway and municipal engineering works. Emphasis is given to the interrelationship between practical design and the various sciences and disciplines covered in the undergraduate course of studies.

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

### 402 Reinforced Concrete 1
Properties of concrete and reinforcing steel. Section design: ultimate strength design and working stress design. Design principles.

### 403 Reinforced Concrete 2
**Prerequisite:** CE 402

### 404 Design of Steel Structures
**Prerequisite:** CE 401.

### 451 Water Resources and Sanitary Engineering
The physical, chemical and biological basis of water treatment and waste-water treatment and disposal. Principles of design and construction of facilities for the collection, treatment and distribution of water, and the collection, treatment and disposal of waste-waters. The lecture course is supplemented by a series of laboratory experiments related to the measurement of water quality and treatment process control. Field trips are arranged at a cost of approximately $10 per student per term.

### 471 Soil Engineering
Subsoil investigation. A study of the present theories of soil mechanics and their use in soil engineering. Procedures for the analysis, design and construction of earth structures, shallow and deep foundations. Stability of slopes and earth dams are considered. This course is a prerequisite for further soils courses in fourth year.
481 Engineering Law  General introduction to law and the Common Law legal systems; formation of contracts, effect of mistakes on contracts, interpretation of contracts, breach of contracts, legal remedies; scope and content of technical specifications; sale of goods; introduction to the Law of Agency; the Tort of Negligence, professional negligence; some aspects of restrictive trade practices; introduction to Patent Law.


501 Approximate Analysis of Structures  Simple alternative methods of structural engineering that provide independent checks on more complex analyses or designs are surveyed. Such methods are becoming necessary with the growing automation of structural computations. A deliberate development of understanding of structural behaviour ('structural intuition') is attempted. The role of approximation is discussed at all levels, ranging from accepted standard approximations in so-called exact structural mechanics to more intuitive proportioning of structures. Approximate equivalence of continuous and discrete systems: cantilever method, equivalent beams, plates and shells, trusses and grids. Finite element methods; Newmark's analysis and further simplifications. Moment balancing, load balancing and related methods of pragmatic design. Methods of negligible redundants: portal method, area method in shells.

504 Structural Analysis 1  
a) Computing and Numerical Methods: Fortran reviews, JCL, information storage and retrieval review of determinants and matrices, linear algebra, integration techniques, interpolation, errors, introduction to STRUDL.

b) Structural Analysis: Topology and determinancy, flexibility and stiffness methods applied to the analysis of beams, grids, space frames, etc.

506 Project Management  

508 Structural Dynamics and Stability  An introduction to the analysis of the dynamics and stability of civil engineering structures. Vibrations of single and multi-degree of freedom lumped-mass systems for imposed forces or support motions; vibrations beam-girder, plates and slabs; approximate design methods; stability of columns, buckling of continuous beams, buckling of frames, plates and plate-type structures; lateral and torsional buckling problems; approximate methods of analysis.

518 Plates and Shells 1  A simultaneous development of the elementary methods of analysis and design of plates and shells. Types, uses, typical materials and methods of construction; membrane theory for shells, derivation and solution of governing equation for various cases; elementary bending theory for plates and shells, derivation of governing equations, methods of solution (analytic, tables, codes, series, finite difference, finite elements); limitations of methods, solutions.
520 Advanced Computer Programming for Engineers
An advanced level study of the capabilities of the digital computer and the effective planning of large programmes. Use of functions, subroutines, object decks, load modules, programme libraries, overlay programmes; comparison of different compilers and various systems (FORTRAN, ICES, STRUDL, CPS, WITS, ICETRAN, PL/I); techniques for large systems of equations.
Prerequisite: CE 121 or the equivalent.

522 Engineering Analysis
An introduction to the analysis of lumped parameter problems in engineering. Examination of equilibrium, eigenvalue and propagation problems associated with the formulation techniques, mathematical properties and the various exact and approximate methods of solution; engineering applications: suitability of techniques for machine computation.

524 Probability, Statistics and Decision Theory
An extension of CE 224: objective, subjective and axiomatic probabilities; classical inference; Bayesian decision theory, terminal and pre-posterior analysis; game theory, zero and non-zero sum games, bargaining models; decisions under uncertainty; multiple regression analysis, principal components. Introduction to stochastic processes.

526 Continuum Mechanics
An introduction to the analysis of continuum. Vectors, Cartesian tensors; tensors of stress, strain and strain rate for a continuum; laws of motion-conservation of mass, momentum integral, kinetic equation of state, first and second laws of thermodynamics; linear elasticity – equations of equilibrium and compatibility, superposition principle, extension and flexure of beams, plane elasticity; plasticity – idealized behaviour, yield conditions and surfaces, plastic potential theory, hardening hypothesis, Hencky’s theory, slip line theory; linear viscoelasticity; viscoelastic models, creep, relaxation, hereditary integrals.

534 Model Analysis of Engineering Structures
A lecture-laboratory study of the use of mechanical models to predict the response to loads of civil engineering structures. Advantages, limitations of model-aided, analytic and code-based designs; principles of model similarity and behaviour of geometrically similar structures; investigation of limits of common design procedures; experimental evaluation of static and dynamic load response of models of structures not amenable to analytical solutions; transfer of data to geometrically similar structures; design, construction and test to failure of reduced models of simple structures.

536 Model-Aided Design of Engineering Structures
A lecture-project course requiring the model-aided design of civil engineering structures not amenable to design by analytic techniques. Students will design, construct, test and analyse the response of reduced models of structures required to satisfy specified criteria; evaluation of design will be made with recommendations for modification and optimization of original design. Lectures will include: case studies of model-aided optimization of structures and structural components, introduction to theory, principles and design of experiments, measuring systems and transducers.
540 Highway Design  A course in geometric design, highway organization and highway information systems. Freeway design, interchange design, interchange spacing, flexibility of freeways, transportation systems in metropolitan areas, freeway networks, safety.

541 Traffic  A course in traffic analysis and design. Car following theories, delays at street intersections, deterministic and stochastic traffic patterns, computer simulation of traffic behaviour.

542 Pavement Structural Design  A course in pavement design. Soil identification, subgrade design, base courses, flexible pavement design, dense to graded hot mix asphal tic concrete, surface treatments.

543 Land Use Models  An introduction to analytical models for forecasting urban land use patterns. Urban development in Canada, available urban development models, population forecasting, economic activity forecasting, the Lowry model.

544 Systems Analysis  A course in systems analysis technique, linear programming, dynamic programming, networks, decision theory.

541 Engineering Terrain Analysis  An introduction to engineering terrain analysis. Use of geologic and pedologic information and air photo interpretation principles and techniques in the prediction of engineering properties of soils and the planning of engineering soil surveys; geotechnical aspects of permafrost and organic terrain (muskeg); principles and geotechnical applications of other remote sensing systems; terrain evaluation systems.

558 Soil Engineering 1 (Case Histories)  A study of the application of current procedures of design and construction of foundations and earth structures through consideration of case histories. 
Prerequisite CE 471.


573 Pollution in the Aquatic Environment  A waste management course involving characteristics of receiving waters. Diffusion, biological responses to nutrients, self purification, thermal discharge, limnological aspects.

580 Elements of Water Resources Management  An introduction course in water resources management. Uses of water, institutional characteristics, multi-use of water, water quality management, systems analysis, comprehensive water resources planning.

583 Water Distribution and Collection Systems  A municipal hydraulic and hydrology course. Water and wastewater estimates, water supply and distribution systems, urban hydrology, wastewater collection, hydraulics of treatment works.
586 Hydrology  A course in hydrology following CE 381. Hydrologic cycle, river basin characteristics, climatologic, evaporation, probability in hydrology, hydrographs, time series, data banks, models, floods, groundwater.

589 Open Channel Flow  A course in open channel flow. Classification of open channel flow, energy and momentum principles, critical flow, uniform flow, design of channels, gradually and rapidly varied flows, flood routing.

590 Advanced Mathematics  Sets, functions, matrices, determinants, descriptive statistics. Introduction to statistical inference.

Note  Courses numbered within the 500 series are considered to be undergraduate courses but are intended to form a transition from the undergraduate to the graduate programme in certain areas of Civil Engineering. They serve two major functions:

1) to provide technical electives for the undergraduate so that he may specialize in a particular area.
2) to provide background information for the graduate student when such is lacking. Courses of this series may be credited toward a graduate degree.
Department of Classics and Romance Languages

Professor and Chairman of the Department
R.L. Myers, B.A. (Western), M.A. Ph. D. (Johns Hopkins)

Professors
A. Ages, B.A. (Carleton), M.A., Ph.D. (Ohio State)
D.C. Mackenzie, B.A., M.A., Ph.D. (Princeton)
J.C. McKegney, B.A. (Western), M.A. (Oregon) Ph.D. (Washington), Diploma (Santander)

Associate Professors
J.J. Binarné, L en Phil. rom., Agrégé (Brussels)
J.R. Dugan, B.A., M.A. (Toronto), Ph.D. (Yale)
E. Grey, B.A. (Texas Western), M.A. (Colorado), Ph. D. (Harvard)
P. Keresztes, M.A. (Toronto), Ph. D. (Graz)

Assistant Professors
J. Dumont, Licence-é-Lettres (Neuchâtel)
E. Evans, Laurea in pedagogia (Padua)
C.M. Fernandez (Mrs.), Lic. en Arq. (Madrid), M.A. (Tulane), D. Lit. et Phil. Universitas Complutensis (Madrid)
P. Forsyth (Mrs.), A.B. (Mount Holyoke), M.A., Ph.D. (Toronto)
M.V. Gold (Mrs.), M.A., D.Phil. (Oxford)
P.J. Gold, M.A., B.Litt., (Oxford)
J. Gualtieri, A., B.A. (Toronto), M.A. (Colorado)
S.B.P. Haag, B.A., M.A. (Queen's) M. Phil. (Toronto)
J. Lafrance (Miss). B. Paed., M.A., Ph.D. (Laval)
R.L. Porter, B. A. (McMaster), M.A., Ph.D. (Princeton)
B. Thalmann (Mrs.), B.A. (DePauw), M.A., Ph.D. (Ohio State)
W.D. Wilson, M.A., Ph. D. (Trinity College, Dublin)

Lecturers
P. Dubé, B.A., M.A. (Toronto)
R.J. Fournier, B. A., M.A. (Western)

(part-time)
C.C. Abbott (Mrs.), B.A., M.A. (Ohio State)
H. S. Fournier (Mrs.), B.A. (Toronto), M.A. (Western)

General Remarks
1) The number of lectures per week shown after certain course descriptions is an attempt to indicate the “normal”. The instructor will determine how often his particular class will meet.
2) In choosing his courses each year, the student should always bear in mind the requirements of the profession he intends to enter after graduation. The members of the department are at all times willing to advise the student if he so wishes.
3) Students entering their second year will require the following number of departmental courses in order to graduate with major or honours standing in French, Spanish or classics:
a) Major in 3 year programme—6 courses, except Classics—5 courses
b) Double honours programme—8 courses (except French and Political Science—7 courses)
c) Single honours programme—10 courses
Undergraduate Courses

Classics

Classical and Mediaeval Civilization (Courses in Translation)

201* Ancient Greek Society
A survey of several aspects of the civilization of Classical Greece. Topics studied, based on primary (in English translation) and secondary sources, will include the individual, the city, institutions and amusements.

_Three lectures. Fall term._

202* Ancient Roman Society
A course similar to 201* above, but dealing with Classical Rome.

_Three lectures. Winter term._

251* Near Eastern and Greek History
A survey of the civilizations of the Near East and of Greece, emphasizing their political, military, social and economic aspects.

_Three lectures. Fall term._

252* Roman History
A military, political, social, economic survey of Rome from earliest times to the Empire's fall.

_Three lectures. Winter term._

255* Mediaeval Civilization
Study of mediaeval literature, art, architecture, music and other expressive forms. The periods from late antiquity to the High Middle Ages will be studied.

_Three lectures. Fall term._

256* Mediaeval Civilization
Study of mediaeval literature, art, architecture, music and other expressive forms. The periods from the High Middle Ages to Renaissance and Reformation will be studied.

_Three lectures. Winter term._

265* Classical Verse in Greek and Roman Epic and Early Tragedy
A study of the evolution of ancient epic from Homer to Vergil. The beginnings of the art of tragic drama will be studied through the plays of Aeschylus.

_Three lectures. Fall term._

266* Classical Verse in Translation 2 Tragedy, Comedy, and Other Verse Forms
A study of classical Greek tragic drama featuring the plays of Sophocles and Euripides. The art of comedy will be examined through the plays of Aristophanes and Plautus. Other verse forms will be studied as time permits.

_Three lectures. Winter term._

270 Mythology and Religion
A general survey of Graeco-Roman mythology. Attention will also be devoted to such topics as the state cults, Oriental mystery religions in the Mediterranean area, and the Ruler Cult and worship of the Roman Emperor.

_Three lectures. Year course._

351* Greek Art and Architecture
A survey of the art and architecture of the ancient Greek world from the Minoan to the Hellenistic periods. (same as Fine Arts 310*)

_Three lectures. Fall term._
2* Roman Art and Architecture A survey of the art and architecture of the Roman world from Etruscan to Imperial times. (same as Fine Arts 311*)

*Three lectures. Winter term.*

5* Problems in Greek History 1 A detailed study of a selection of problems in Greek History.

*Prerequisite: Class. Civ. 251*. 

*Fall term.*

5* Problems in Greek History 2 A detailed study of a selection of problems in Greek History.

*Prerequisite: Class. Civ. 251*. 


71* Christianity and the Roman Empire 1 A study of the relationship between Christianity and the Roman Empire from the earliest beginning to 200 A.D. This course includes topics such as the trial of Christ; the trials of Paul before governors of the Empire; the burning of Rome in 64 A.D. and the subsequent outlawing of Christianity; the suppression of the Bacchanals; legislation governing the persecution of Christians, and other topics.

*No Prerequisite. Fall term.*

72* Christianity and the Roman Empire 2 A continuation of the course above. Topics included are the persecutions by the Emperors Decius and Valerian, the 'Great Persecution' and finally the triumph of Christianity under the Emperor Constantine. The course is open to all students.

*Winter term.*

375* Problems in Roman History 1 A detailed study of a selection of problems in Roman History.

*Prerequisite: Class. Civ. 252. 

*Fall term. Not offered in 1972-73.*

376* Problems in Roman History 2 A Detailed study of a section of problems in Roman History.

*Prerequisite: Class. Civ. 252. 

*Winter term.*

385* Classical Prose in Translation 1 A study of Herodotus and Thucydides and, if time and student interest make it advisable, one of the philosophers. Attention will be devoted to the historians' choice of subject matter, views on causation, analyses of character, and judgements about the historical process. 

*Three lectures. Fall term.*

386* Classical Prose in Translation 2 A study of some major prose writers of the Roman period. The works studied include both historical and philosophical writers.

*Winter term.*

495 Mediaeval Civilization Senior Essay. 

*Fall term.*
Greek

Note  *All courses in Greek include prose composition assignments.*

100 Introductory Greek  A course designed for students beginning the study of Greek or who have not yet reached the level expected in Greek 190. The aim is to attain as rapidly as possible the ability to read simple prose. The emphasis is on forms and structure: reading of connected passages will begin early in the first term.

*Four lectures. Year course.*

200 Epic and Philosophy  Readings in the Fall term centre on the last days of Socrates, with selections from Plato's account of the trial, self-defence, and execution of the teacher-philosopher. In the Winter term selections from Homer's *Iliad* will be read in Greek, and considered in their relation to the epic as a whole.

*Prerequisite: Grade 13 Greek, Greek 100 or instructor's permission.*

*Four lectures. Year course.*

265* History and Historiography  Selections from Herodotus.

*Fall term. Not offered in 1972-73.*

266* Tragedy  Euripides, *Medea* and other selections.


365* The Greeks at War  Selections from Thucydides' history of the struggle between Athens and Sparta.

*Three lectures. Fall term.*

366* Lyric and Elegiac Poetry  Selections from Lyric and Elegiac Poets.


375* Drama 1  Selections from Aeschylus.

*Fall term. Not offered in 1972-73.*

376* Drama 2  Sophocles and Aristophanes. An analysis of the female tragic figure in the *Antigone* of Sophocles, and of the female comic figure in the *Lysistrata* of Aristophanes.

Latin

100 Introductory Latin  A course designed for students beginning the study of Latin or who have not yet reached the level expected in Latin 190. The aim is to attain as rapidly as possible the ability to read simple prose. The emphasis is on forms and structure: reading of connected passages will begin early in the first term.

*Three lectures. Year course.*

190 Literature of the Republic  Selections from Plautus, Catullus and Cicero.

*Prerequisite: Grade 13 Latin, Latin 100 or instructor's permission.*

*Three lectures. Year course.*

251* Language Study  Composition, translation, basic grammar with intensive analysis of selected works.

*Three lectures. Fall term. Not offered in 1972-73.*
265* Letters  Selections from the letters of Cicero and Pliny.  
*Fall term.*

266* Epic  A study of three books of Vergil's *Aeneid* in Latin. The other books will be read in English. The aim is to reach some understanding of Vergil's language, thought and feeling.  
*Winter term.*

352* Language Study  Composition, translation, basic grammar, with intensive analysis of selected works.  

65* History and Historiography  Livy, 21, 22; *Res Gestae.*  
*Fall term. Not offered in 1972-73.*

366* Cicero  Selected orations, Caesar *De Bello Civili.*  

375* Lyric Poetry  Catullus and Horace.  
*Fall term. Not offered in 1972-73.*

376* Elegiac Poetry  Selections from Tibullus, Propertius and Ovid.  

395* Mediaeval Latin Literature  From Gregory of Tours to Abelard. Selected readings in various genres such as drama and the Cambridge Songs.  
*Fall term. Not offered in 1972-73.*

396* Mediaeval Latin Literature  From the twelfth century to the Renaissance. Selected readings in various genres such as the chroniclers and the Goliardic Songs.  

465* Philosophy  Lucretius, *De Rerum Natura,* 1, 3, 5 (selections); Cicero, *De Officiis* (Selections).  
*Fall term. Not offered in 1972-73.*

466* Horace the Satirist  Selections from the non-lyric poetry of Horace, particularly the Satires and Epistles Book I. The poet's survival in both imitations and translations will be briefly considered.  
*Winter term.*

*Fall term.*

76* Historiography and Literary Criticism  Tacitus, *Annals* 11-16 (selections); Quintilian 10.  

85* Roman Life in the Empire 1  Juvenal; Petronius, *Cena.*  
*Fall term. Not offered in 1972-73.*


490* Senior Seminar  On selected topics such as epigraphy, remains of old Latin, Roman law and society.  
*Year course. Not offered in 1972-73.*
Romance Languages

French

101* Elementary French (a) Intensive introduction to basic French grammar and acquisition of reading skills. Readings of texts in various fields in accordance with the students' interests: literature, history, politics, science, etc. A course designated for beginners.
Prerequisite: No prerequisite. Fall term. Computer drill, 3 hours in classroom, 1 hour in Language Laboratory.

102* Elementary French (b) A continuation of French 101*.
Prerequisite: French 101* or permission of the Department.
Winter term. Computer drill, 3 hours in classroom, 1 hour in language laboratory.

105* French Language 1 Intensive oral and aural training in the classroom as well as in the language laboratory, exercises in comprehension and conversation.
Prerequisite: Grade 13 French or permission of the department.
Note: This course is open only to non-Arts students in Co-operative programmes and will be offered only when enrolment is sufficient. Contact the department for further information.

106* French Language 2 A continuation of French 105*.
Prerequisite: French 105* or permission of the Department.
Note: This course is open only to non-Arts students in Co-operative programmes and will be offered only when enrolment is sufficient. Contact the Department for further information.

151* Intermediate French (a) A follow-up of French 102*. Grammar and composition, readings of texts in various fields in accordance with the students' interests: literature, history, politics, science, etc. Intensive oral and aural training in the classroom as well as in the language laboratory. Exercises in comprehension and conversation.
Prerequisite: French 102* or permission of the Department.
Fall term.
2 hours in classroom, 1 hour in language laboratory.
Not offered in 1972-73.

152* Intermediate French (b) A continuation of French 151*.
Prerequisite: French 151* or permission of the Department. Winter term.
2 hours in classroom, 1 hour in language laboratory.
Not offered in 1972-73.

190 French Language and Literature This course includes three different types of groups, all of which are designated for students entering with Grade 13, French 1 or French 2.
Year course. Prerequisite: Grade 13 French or permission of the Department.
190 Group A – Language
The emphasis here will be on the spoken language. Concentration on pronunciation, comprehension, fluency. An oral-aural approach involving both the classroom and the language laboratory.
3 hours in classroom, 2 hours in language laboratory.

190 Group B – Language and Literature
The language portion of this programme will stress spoken French. An oral-aural approach involving both the classroom and the language laboratory. This group is considered as the normal choice of students wishing to major or honour in French.
3 hours in classroom, 2 hours in language laboratory.

190 Group C – Literature
An introduction to the study of the literature of France and French Canada through the readings of some of the major works. Lectures and discussions in French. Essay writing and the “explication de texte” will be stressed.
3 hours in classroom.

200 French Literature
A survey in French designed to illustrate critical approaches to the study of French literature: the theory and practice of the “explication de texte”, the concept of “genre”, the literary uses of language, techniques of essay writing and general literary critical methods.
Prerequisite: French 190 or permission of the Department. Year course.
3 hours in classroom.
Instructor: W.D. Wilson

250 Intensive Language Training
Intensive practice in oral structures and corrective phonetics; exercises toward skill in writing.
Prerequisite: French 190 or permission of the Department. Year course.

260 Classical Literature
Offered in summer school and/or post-degree programme only.

291* French Culture and Civilization 1
A survey of cultural currents in France up to the Revolution. Lectures will examine the history of artistic expression and institutions as insights into French civilization.

291* Group A
Taught in English. Open to Arts students in second year and higher, and to others in any year. Not open to students majoring or honouring in French.
No prerequisite.
3 hours in classroom.

291* Group B
Taught in French. Open to all students including those majoring or honouring in French.
Prerequisite: French 190 or permission of the Department. Fall term.
3 hours in classroom.

292* French Culture and Civilization 2
Prerequisite: French 190 or permission of the Department. French 291* is recommended. Winter term.
3 hours in classroom.
Instructor: P. Dubé
Note  In the following series of courses, three areas will be included. These are indicated by the course numbers, which will fall into one of three ranges:

310-319 — 18th century
320-329 — 19th century
330-339 — 20th century

Courses in these ranges will vary from year to year and numbers will be adjusted accordingly. Although no firm prerequisites are set down it is recommended that the student have completed a course on the second year level.

310* Revolutionary Texts of the Eighteenth Century
Selected texts from Voltaire, Rousseau, Diderot, etc.
Fall term.
Instructor: A. Ages

311* Eighteenth Century Prose
Reading in the novel, drama and poetry.
Winter term. 2 hours in classroom.
Instructor: A. Ages.

321* Realism and Naturalism
A study of Balzac, Zola, etc.
Winter term.
Instructor: J.R. Dugan

322* The Romantic Movement
A study of the concept of the hero in France from 1800 to 1850.
Fall term. 2 hours in classroom.
Instructor: P. Dubé

330* The Novel in France, 1900-1939
A study of selected texts.
Fall term.
Instructor: W.D. Wilson

332* Twentieth Century French Literature of the Absurd
A study of selected texts by Camus, Sartre, Beckett, etc.; novel and drama.
Winter term.
Instructor: W.D. Wilson

350 Advanced Instruction in Written French
Advanced grammar and composition. Exercises in grammar, translation, oral practice and corrective phonetics.
Prerequisite: French 250
Year course.

360 French Literature of Enlightenment
Offered in summer school and/or post-degree programme only.

365* French Canadian Novel
A study of some representative novels of the 19th and 20th centuries.
Prerequisite: A French literature course on the 200 level or instructor's permission.
Fall term.
Instructor: J. LaFrance

366* French Canadian Poetry and Theatre
A survey of the Canadian works in poetry and drama.
Prerequisite: A french literature course on the 200 level or instructor's permission.
Fall term.
Instructor: J. LaFrance
370 Romanticism. Realism and Symbolism in French Literature
To be offered in summer school and/or post-degree programme only.

25* Mediaeval French Language and Literature
Special emphasis on contemporary novels.
Year course. Not offered in 1972-73.

120 The Novel in French Canada
Special emphasis on contemporary novels.
Year course. Not offered in 1972-73.

285* Mediaeval French Language and Literature
An introduction to the problems of mediaeval French language and readings from the major literary texts of the period.
Fall term. Not offered in 1972-73.

435* French Prose of the Renaissance
Readings in 16th century literature: Rabelais, and Montaigne, etc.
Winter term
Instructor: H. Fournier

436* French Poetry of the Renaissance
Readings in 16th century poetry: Marot, the Pléiaide, the baroque poets, etc.
Fall term
Instructor: H. Fournier

455* Training for Proficiency in Oral and Written Expression
A study of some finer grammatical points, with advanced composition, translation, oral practice and corrective phonetics.
Prerequisite: French 350.
Fall term.

456* Stylistics, Advanced Grammar and Composition
An introduction to the problems of comparative French and English linguistic stylistics, with advanced grammar, composition, oral practice and corrective phonetics. This course is not a repetition of French 455*.
Prerequisite: French 350.
Winter term.

Note
In the following series of courses two areas will be included as of special interest to advanced students. These are indicated by course numbers which will fall into one of two ranges:
460-465—17th Century
470-479—Criticism, thematic studies, senior seminar

Courses in these ranges will vary from year to year, and numbers will be adjusted accordingly.

460* The Comedy of Seventeenth Century France
Selected texts from Molière, Corneille, Racine, etc.
Winter term.
Instructor: R.J. Fournier

462* Classical Tragedy
Tragedy in 17th century French literature.
Fall term. 2 hours in classroom
Instructor: R.L. Myers

471* The Religious Impulse
Selected texts in French literature from the 17th to the 20th centuries.
Winter term.
Instructor: A. Ages

472* The Art of Theatre
A study of the evolution of theatrical techniques in French theatre.
Fall term.
Instructor: J.R. Dugan

480 Modern French Literature
Offered in summer school and/or post-degree Programme only.
The following courses are administered by St. Jerome's College.

110J Introduction to Italian
An intensive study of the fundamentals of grammar and conversation. The language laboratory will be used. In the first year of Italian, emphasis will be placed on the fundamentals of grammar and speech. In addition, liberal use will be made of the language laboratory where the student will hear and be able to imitate authentic pronunciation and intonation of the language as spoken by natives of sunny Italy. Simple readings in Italian literature will give the student an opportunity to become familiar with vocabulary and style, as well as idiomatic expressions that make up such a great part of the language.
3 lectures and laboratory.

210J Intermediate Italian
Advanced study of grammar. Survey of the history of Italian literature with selected readings in prose and poetry. Intensive study of one novel: "I Promessi Sposi".
In the second year some finer points of the grammar will be studied but will actually be a secondary aspect of this year. A survey course in Italian Literature from the Rinascimento (16th century) to the 18th century will be offered, giving special emphasis to the major writers of this period. Further familiarization with the spoken word will be afforded through the use of the language laboratory.
Prerequisite: Italian 110 or permission.
3 lectures and laboratory.

230J Italian Culture
This course, given in English, aims at giving the student a well-balanced view of Italy and her culture, through the study of her Geography, History, Religion, Literature, Art, Music and her contribution to the world and to North America in particular.
Prerequisite: Second Year standing.
3 lectures.

310J Italian Literature
Continued survey of Italian literature with selected readings in prose and poetry. Study of one novel: "Marito in Collegio". One semester devoted to the "Divina Commedia-Inferno".
In the third year the student will complete a survey course of Italian Literature of the 19th and 20th centuries. Once again stress will be placed on the major authors and one novel and one play will be selected for intensive study. One semester will be devoted to the study of the "Divina Commedia" by Dante.
Prerequisite: Italian 210J.
3 lectures.

320J Classical Literature
An anthology of Italian classics will be studied. A number of book reports are expected, and Italian essays are required. Two texts will be intensively studied: "Il Purgatorio" by Dante and "Il Gattopardo" by Prince Giuseppe Tomasi di Lampedusa.
Prerequisite: Italian 210J.
3 lectures. (not offered in 1972-73)
Spanish

110 Introduction to Spanish
Intensive drill in the fundamentals of grammar, composition and oral skills. The language laboratory is used as an integral part of the course.  
Year course. 3 hours class. 2 hours language lab.  
Instructors: B. Thalman, C. Fernández, P. J. Gold.

190 Intermediate Spanish
For students with some knowledge of Spanish. The course will work towards some measure of fluency in reading, writing, speaking and understanding the language. The language laboratory is used regularly.  
Prerequisite: Spanish 110 or Grade 13 Spanish.  
Year course. 3 hours class. 1 hour language lab.  
Instructors: J. C. McKegney, E. Grey.

210 Spanish Civilization
A study in English of the main historical and cultural currents in Spain and Spanish America. No knowledge of Spanish is required.  
Year course. 3 hours.  
Instructor: J. C. McKegney.

250 Composition and Conversation
Intensive language study based on literary texts, including grammar, comprehension, oral discussion and essay writing.  
Prerequisite: Spanish 190.  
Year course.  
Instructor: C. Fernández.

265* Survey of Spanish Literature
A brief survey of Peninsular Spanish Literature since the Poema Del Mio Cid.  
Fall Term.  
Year Course.  
Instructor: J. C. McKegney.  
Prerequisite: Spanish 190.

275* The Enlightenment in Spanish Literature
A study of the works of Luzán, Feijoo, Jovellanos, and Cadalso.  
Fall term.

276* Drama of the Nineteenth Century
A study in the development of the drama from the Duque de Rivas to Echegaray.  
Winter term.

295* The Novel of the Nineteenth Century
A study of the literary currents of the past century such as the costumbrista movements, realism and naturalism.  
Fall term. Not offered in 1972-73.

296* Galdós
Intensive study of the novels and the theatrical works of Galdós.  

315* Spanish Lyrics from Garcilosa to Góngora
Conceptism and Culturalism.  
Fall term. Not offered in 1972-73.

316* The Theatre of the Golden Age
Dramatic theory and practice. The innovation of Lope  

325* The Prose of the Golden Age
A study of Quijote and other major works of Cervantes.  
Fall term.
326* The Picaresque Novel
Intensive study of the major picaresque novels from *Lazarillo de Tormes* to *La Picara Justina.*
*Winter term.*

350 Advanced Composition and Conversation
Writing of essays and discussion based on selected themes or topics relating to Spain or Spanish America. Formal grammar and translation are also included.
*Prerequisite: Spanish 250.*
*Year course.*

385* Survey of Spanish American Poetry
A study of the major poets from *La Araucana* to the beginning of the Modernista movement.
*Fall term*

386* Modern Spanish American Poetry
A study of Spanish American poetry from the Modernista movement to the present.

395* Spanish American Prose
A critical study of Spanish American prose from the Cortés letters to the works of Sarmiento.
*Winter term.*

396* Spanish American Prose
A critical study of masterpieces in prose from Sarmiento to the present.

415* The Generation of '98
A study of selected prose with emphasis on the philosophical essay.
*Winter term.*

416* Drama and Poetry of the Generation of '98
Spanish poetry and drama from Antonio Machado to Juan Ramón Jiménez.
*Winter term.*

435* Modern Spanish Literature to the Civil War
A study of selected figures, most of whom wrote between the Generation of 1898 and the outbreak of the Civil War in 1936.
*Fall term.*

436* Contemporary Spanish Literature since the Civil War
The artist under the Franco regime; a non-political view of selected dramatists, poets and novelists whose major work has continued or commenced since 1940.
*Winter term.*

440 Mediaeval Spanish Literature and Linguistics
Readings in texts from the beginning to the end of the fifteenth century. The jarchas, the Cid, Gonzalo de Berceo, *Libro de Buen Amor, Romancero* and *La Celestina.*
*Year course. Not offered in 1972-73.*

450 Senior Spanish Composition and Conversation
This course will provide intensive practice in written and spoken Spanish on the advanced level.
*Year course.*
*Instructor: P.J. Gold*

495* The Novel in Mexico
Principal stress will be placed on novels dealing with the Mexican Revolution.
*Fall term.*
*Instructor: J.C. McKegney*
Department of Earth Sciences

Professor and Chairman of the Department
R.N. Farvolden, M.Sc. (Alberta), Ph.D. (Illinois)

Professor and President of the University
B.C. Matthews, B.S.A. (Toronto), A.M. (Missouri), Ph.D. (Cornell)

Professor
P.F. Karrow, B.Sc. (Queen's), Ph.D. (Illinois)

Associate Professors
E.C. Appleyard, B.Sc. (Western), M.Sc. (Queen's), Ph.D. (Cambridge)
C.R. Barnes, B.Sc. (Birmingham), Ph.D. (Ottawa)
J.A. Cherry, B.E. (Saskatchewan), M.S. (Cal., Berkeley), Ph.D. (Illinois)
P. Fritz, Dipl. Geol., Dr. Rer. Nat. (Technische Hochschule Stuttgart)

Assistant Professors
E.O. Frind, B.A.Sc., M.A.Sc., Ph.D. (Toronto)
D.E. Lawson, B.Sc., M.Sc. (New Brunswick)
A.V. Morgan, B.Sc. (Leicester), M.Sc. (Calgary), Ph.D. (Birmingham)
D.L. Salter, B.Sc., Ph.D. (Southampton)

Undergraduate Course Descriptions

Details of the undergraduate programmes offered by the Faculty of Science are to be found on page 231.

Earth Sciences 130, or the consent of the instructor, is prerequisite for all later courses in Earth Sciences with the exception of Earth Sciences 368*. However, Sciences 100* may be substituted for Earth Sciences 130 as prerequisite for Earth Sciences 232*, 235*, 236* and 334. Second and third year courses usually involve field trips in the fall. All those majoring in Earth Sciences are required to take a two-week field camp at the end of third year. Earth Sciences students are encouraged to seek geological employment in the summers.

100* Geological Foundations of the Environment
This course is now offered as Science 100*. Consult the Science course listings for details.

130 Introductory Geology
An elementary introduction to rocks, minerals, and fossils, geological processes and their effects, structural geology, economic geology, and historical geology. Map study. Field trips.
2 lectures, 3 hours laboratory.

231* Mineralogy
2 lectures, 3 hours laboratory, fall term.

232* Petrography
The classification and identification of sedimentary, igneous, and metamorphic rocks. The study of rocks in thin sections. Laboratory study of petrographic methods and problems.
2 lectures, 3 hours laboratory, winter term.
**236* Paleontology 1** The principles of Paleontology including the species concept and evolution. The origin of life; a detailed examination of the vertebrate and plant fossil record with special reference to evolution.
*2 lectures, 2 hours laboratory, fall term.*

**235* Stratigraphy** The principles of stratigraphy, and an introduction to the structural framework of North America.
*2 lectures, 2 hours laboratory, winter term.*

**241* Crystallography and Optical Mineralogy** Crystallography and stereographic projection. Principles of optical crystallography and the optical identification of minerals.
*2 lectures, 3 hours laboratory, fall term.*

**260* Introductory Structural Geology** An introduction to the deformation of rocks; the effect of stress on rock materials, the application of experimental and theoretical data to naturally deformed rocks (tectonites); elementary rock mechanics; the results of deformation, the types of structures produced; the analysis of simple structures.
*2 lectures, 2 hours laboratory, winter term.*

*Prerequisite: Earth Sciences 231*, 241*
*2 lectures, 3 hours laboratory.*

**334 Paleontology** The principles of paleontology, including the species concept and evolution. The morphology, taxonomy, evolution, paleoecology, and stratigraphic value of fossil animals and plants, with special reference to the invertebrates. Field trip and laboratory study of fossils and fossil assemblages.
*2 lectures, 2 hours laboratory.*

*2 lectures, 3 hours laboratory.*

**340 Structural Geology** Primary and induced structures in igneous, sedimentary and metamorphic rocks. Diastrophic and non-diastrophic deformations; diapirs. The physical properties of rocks and the effect of stress on them. Theories of rock failure. The relationship between major and minor structures. Laboratory will deal with techniques of analysis of deformed rocks.
*2 lectures, 2 hours laboratory.*

*Prerequisite: Mathematics 130, Physics 121*-122* or equivalent
*2 lectures, fall term.*
369* Geophysics 2 The geology of the ocean basins. Topics in physical oceanography. Physical properties of ocean water, heat budget of the world oceans. Oceanic circulations, Coriolis effects. Some idealized current regimes. (Identical to Physics 369*).
*Prerequisite: Earth Sciences 368*.
2 lectures, winter term.

430 Economic Geology Principles and processes governing the formation of metalliferous ore deposits, coal, petroleum and natural gas. The study of important examples primarily from Canada. Laboratory study will include instruction and practice in ore microscopy.
*Prerequisite: Earth Sciences 231*, 241, 231*
2 lectures, 3 hours laboratory.

431 Geochemistry A study of the origin and evolution of the Earth from a chemical standpoint. Fundamental chemical principles are reviewed and applied to the understanding of igneous, sedimentary and metamorphic rocks.
*Prerequisite: Earth Sciences 330.
2 lectures, 3 hours laboratory.

432* Precambrian Geology The geology, tectonics, stratigraphy and history of the Canadian Precambrian Shield. The Precambrian time scale and problems of geochronology. Life, climate and physical conditions in Precambrian time.
2 lectures, 2 hours laboratory, winter term.

434* Biostratigraphy A study of selected fossil groups to illustrate the application of paleontological data in solving stratigraphic problems. Methods of differentiation and correlation of rock units on the basis of their fossil assemblages. Field trips.
2 lectures, 2 hours laboratory, fall term.

436 Honours Thesis Each student will work under the direction of a member of the Department on a short research project. The results of this will be presented in thesis form and will be critically examined by members of this and, where pertinent, other departments.

2 lectures, 2 hours seminars.

438* Engineering Geology The application of geology to civil engineering problems. Introductory soil and rock mechanics. Urban and environmental geology.
2 lectures, 1 hour problems, fall term.

439* Groundwater Geology Groundwater hydrology. The location, exploitation, and conservation of groundwater resources.
2 lectures, 1 hour problems, winter term.

440* Quaternary Geology Stratigraphy and history of Quaternary Period with emphasis on glaciation. Laboratory studies on glacial deposits. Field trips. A previous course in geomorphology is recommended.
2 lectures, 3 hours laboratory, fall term.
Applications of the principles of soil and rock mechanics, hydrology, and geochemistry in the analysis of geomorphic processes: watershed behaviour, fluvial processes, sediment transport, dynamics of shoreline behaviour, evolution of natural slopes, chemical processes in weathering and applications to various geologic conditions, hydrologic and chemical interactions in karst phenomena, role of ice in river and frozen ground systems.

3 lectures, winter term.
Cross-listed with Geography 402*. Not normally taken by Earth Sciences students.

Introduction to the principles of probability and statistics and their application in the Earth Sciences. Evaluation of quantitative data; statistical models.

Prerequisites: Mathematics 130 and an introductory course in computer programming.

3 lectures, fall term.

Introduction to boundary-value problems in geophysics and geohydrology. Analytical and numerical solution of ordinary and partial differential equations.

Prerequisites: Mathematics 130.

3 lectures, winter term.

Introduction to systems analysis, conceptual and mathematical models, and simulation. Applications in the solution of problems in the Earth Sciences.

Prerequisites: Earth Sciences 455*

3 lectures, winter term.

Various topics of petroleum geology, hydrogeology and related fields: Principles of flow through porous-media, abnormal fluid pressures in sedimentary basins, migration and accumulation of petroleum, regional hydrodynamics, fundamentals of hydrogeology, subsurface waste management, development of water, oil or gas reservoirs, subsurface liquid injection.

3 lectures, fall term. Not for students who have taken Earth Sciences 438* or 439*

An introductory course in applied geophysics, seismic, gravity, electric, and electromagnetic methods, bore-hole logging, field methods.

2 lectures, 2 hours laboratory, fall term.

Physical and mathematical foundations of applied geophysics, advanced methods of treatment of geophysical data, with emphasis on problems from geophysical exploration.

2 lectures, 2 hours laboratory, winter term.
Department of Economics

Professor, Chairman of the Department
R.A. Mundell, B.A. (University of British Columbia), Ph.D. (M.I.T.)

Assistant Professor, Deputy Chairman
R. R. Kerton, B. Comm. (Toronto), M.A. (Carleton), Ph.D. (Duke)

Associate Professor, Associate Dean (Undergraduate Affairs)
W. R. Needham, B. Comm. (Carleton), M.A., Ph.D. (Queen’s)

Professors
S. N. Afriat, M.A. (Cambridge), D.Phil. (Oxford)
J. H. Hotson, B.A. (Colorado College), M.A., Ph.D. (Pennsylvania)
D. W. Katzner, B.A. (Oberlin), Ph.D. (Minnesota)
V. C. Walsh, B.A., M.A., Ph.D. (Trinity College)

Visiting Professor
I. F. Pearce, B.A. (Bristol), Ph.D. (Nott.)

Associate Professors
R. G. Blackhurst, B.S. (California), Ph.D. (Chicago)
I. P. Fletcher, B. Comm. (Mount Allison), A.M., Ph.D. (Brown)
S. K. Ghosh, B.S., M.S. (Calcutta), M.A., Ph.D. (Wisconsin)
N. E. Lavigne, C.R., B.A. (Western), M. Comm. (Ottawa), M.B.A. (Detroit)
G. Lermer, B.Sc., (M.I.T.), M.A., Ph.D. (McGill)

Assistant Professors
K. M. H. Bennett, B.A., M.A. (Queens)
S. G. Clarke, B.A., M.A., Ph.D. (Queen’s)
S. W. Kardasz, B.A. (Loyola)
F. Mueller, Dipl. Vw (Berlin), Dr. rer. oec. (Bochum)
A. Olsen, B. Comm. (Sir George Williams), M.B.A. (University of Western Ontario)

Lecturers
H. N. Gram, B.A. (University British Columbia)
E. C. Gram, B.A. (Bryn Mawr College), M.A. (Wisconsin)
J. D. Cianci, B.A.Sc. (University of New Brunswick)

Associated Faculty
Professors
G. Berman, Ph.D. (Toronto), Chairman, Department of Combinatorics and Optimization
D. A. Sprott, Ph.D. (Toronto), Chairman, Department of Statistics

Associate Professor
D. W. Conrath, B.A., M.S. (Stanford), M.A., Ph.D. (University of California at Berkeley), Department of Management Sciences

1) The number of courses offered in a particular year will not necessarily include all of those listed below.
2) The number of hours or lectures shown after the course description is an attempt to indicate the “normal”; each instructor determines how often his particular class will meet.

Undergraduate Courses

Economics 101, 102 comprise the regular sequence of courses in introductory economics for students majoring in this field, and for other students who plan to do additional work in economics. Students proceeding to a General Arts degree with a major in Economics are required to take as part of their programme Economics 201*, 202* and 231*, 232*, or 203*, 204* and 205*, 206*. 
101* Introduction to Economics
The first half of the course includes the discussion of the central problems of every economic society, the functioning of a mixed capitalistic enterprise system, the economic role of government, the composition and pricing of national output, pricing of productive factors and income distribution.
3 lectures.

102* Introduction to Economics
Subjects to be discussed in this half of the course include the determination of national income, the banking system and government fiscal and monetary policy, international trade and finance, and current economic problems.
3 lectures.

201* Intermediate Price Theory 1
Theory of consumer demand; production theory; resource pricing and allocation under perfect and imperfect competition.
Prerequisite: Economics 101. 3 lectures.

202* Intermediate Price Theory 2
Economic method; dynamic micro theory; distribution theory, general equilibrium, welfare economics.
Prerequisite: Economics 201. 3 lectures.

203* General Equilibrium Theory 1M
Theory of individual and group demand for one and several commodities, theory of individual and group production and supply under various types of market structure.
Economics 203* and 204* are similar to economics 201* and 202* but make greater use of mathematical techniques.
Prerequisite: Economics 101, Mathematics 129, 130.

204* General Equilibrium Theory 2M
Theory of price formation; the transition to dynamics. Some aspects of welfare economics.
Prerequisite: Economics 203.

205* Aggregate Economic Theory 1M
Theory of capital and investment; theories of general equilibrium of employment, output, price and money; processes of adjustments to changes in parameters and relationships.
Prerequisite: Economics 102.

206* Aggregate Economic Theory 2M
Theories of business fluctuations; models of growth and technological change.
Economics 205* and 206* are similar to Economics 231* and 232* but make greater use of mathematical techniques.
Prerequisite: Economics 205.

231* National Income Determination
National income measurement, and the theory of money, income and employment.
Prerequisite: Economics 101, 102.

232* Employment and Public Policy
Further exploration of the topics developed in Economics 231* within a Canadian setting.
Prerequisite: Economics 231.

235*/236* Canadian Money and Banking
This course studies the development of the Canadian financial system; the legislation governing financial intermediaries; the microeconomics of the financial sector; the practice and theory of the role of the financial sector vis-a-vis stabilization policy in closed and open economies.
Prerequisite: Economics 101, 102.
3 lectures.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1*</td>
<td>Economic History of Canada</td>
<td>The economic development of Canada to 1914. <strong>Prerequisite:</strong> Economics 101, 102. Lectures and seminars.</td>
</tr>
<tr>
<td>2*</td>
<td>Economic History of Canada</td>
<td>Canadian economic development since 1914; regional and national economic problems and policies. <strong>Prerequisite:</strong> Economics 241. Lectures and seminars.</td>
</tr>
<tr>
<td>256*</td>
<td>Introduction to Financial Accounting 1</td>
<td>Recording transactions; measuring income; preparation and analysis of financial statements; accounting for assets, liabilities, and equity. 2 lectures, 2 hours laboratory.</td>
</tr>
<tr>
<td>257*</td>
<td>Introduction to Financial Accounting 2</td>
<td>Analysis of accounting principles; preparation of source and use of working capital; cash flow analysis; basic concepts associated with manufacturing and responsibility accounting and budgeting. <strong>Prerequisite:</strong> Economics 256. 2 lectures, 2 hours laboratory.</td>
</tr>
<tr>
<td>51*</td>
<td>European Economic History</td>
<td>Selected topics in European economic development in the Medieval period. Emphasis is given to the nature and origin of the forces which gave rise to particular methods of economic organization and institutions and to the emergence of the market society. 2 lectures, 1 hour discussion.</td>
</tr>
<tr>
<td>52*</td>
<td>European Economic History</td>
<td>Selected topics in European economic development in the modern period. Particular emphasis is placed on a comparative analysis of the economic development of the countries of Europe, particularly England, France and Germany. 2 lectures, 1 hour discussion.</td>
</tr>
<tr>
<td>300</td>
<td>Statistical Methods</td>
<td>Frequency distributions; measures of central tendency, dispersion, skewness and kurtosis; probability theory; tests of hypotheses; sampling techniques; time series analysis; aggregation and index numbers; the estimation and testing of economic relationships using regression and correlation techniques, elementary decision theory. <strong>Prerequisite:</strong> Economics 101, 102, 3 lectures.</td>
</tr>
<tr>
<td>320</td>
<td>North American Economic History</td>
<td>An advanced level treatment of the economic development of North America with particular emphasis given to various facets of the economic inter-relationships between Canada and the United States. <strong>Prerequisite:</strong> Economics 201, 202. Lectures and seminars.</td>
</tr>
<tr>
<td>330</td>
<td>Public Finance</td>
<td>The economic rationale of governmental activity; budget systems and the elements of cost benefit analysis; the structure and economic effects of government revenues and expenditures; the role of fiscal policy in economic stabilization and growth. <strong>Prerequisite:</strong> Economics 201, 202.</td>
</tr>
</tbody>
</table>
340 International Trade and Finance
The pure theory of international trade; balance-of-payments statistics; meaning and measurement of payments imbalances; exchange rate systems; commercial policy, international investment and foreign aid; problems and suggested modifications of the international monetary system.
Prerequisite: Economics 201, 202. 3 lectures.

348* Environmental Economics
Prerequisite: Economics 101, 102. Also listed as Man Environment 320. 3 hours.

356* Intermediate Financial Accounting 1
The objective of this course is to provide an in depth analysis of accounting procedures and the rationale behind these procedures. A study is made of the reporting process, matching of costs and revenues, money value items, capital determination and presentation, and accounting for internal management.
Prerequisite: Economics 256, 257.

357* Intermediate Financial Accounting 2
Further development of techniques learned in part 1.
Prerequisite: Economics 356

358*/359* Cost Accounting
Prerequisite: Economics 257. (Not offered in 1972-73).

366*/367 Corporate Finance
The general problem of financing business activities; the financial organization and control of corporations, liquidations and re-organization; the operation of capital markets.
Prerequisite: Economics 256.

368* Wage and Manpower Economics
Wage theory; training and mobility theory; economics of information in Canadian labour markets; active manpower policies.
Prerequisite: Economics 201*, 202* or equivalent 3 Lectures, fall term.

369* Population Economics
Demographic techniques; economic interrelationships with fertility, mortality, morbidity; theory of an optimum population.
Prerequisite: Economics 201, 202, or permission of instructor.
3 lectures, winter term

371*/374* Special Subjects
One or more half courses will be offered at different times as announced by the department.
Prerequisite: Consent of instructor.

380 Industrial Organization and Public Policy
An analysis of the characteristics of industrial structure, behaviour and performance with special reference to Canada. Competition policy in Canada, the United States, and other selected countries.
Prerequisite: Economics 201, 202, or 203, 204. 3 lectures.

385 Business Cycles
Study of changes in the levels of national output; theories of the business cycle; proposals for controlling economic fluctuations.
Prerequisite: Economics 231, 232 or 205, 206.
400 Advanced Economic Theory
An advanced treatment of selected topics in economics.
Prerequisite: Economics 231, 232 or 205, 206.

421* Welfare Economics
Concept of efficiency; Pareto, Scitovsky, Hicks, and Little criteria for increase in welfare; application of welfare economics, location of industry, and public utilities.
Prerequisite: Economics 201, 202 or equivalent. 3 lectures.

0 History of Economic Thought
A survey of the historical development of economic theory.
Prerequisite: Economics 201, 202, 231, 232, or equivalent.

450 Economics of Development
The problem of economic development; theories of growth; the significance for economic development of capital accumulation, technology, natural resources and population. Allocation of investment resources; the role of economic institutions; public policies to stimulate economic development.
Prerequisite: Economics 201, 202, 231, 232 or equivalent. 3 lectures.

460 Econometrics
Theory of estimation of parameter of economic models and tests thereof. Both aggregative and micro-economic models will be considered. Students will be assumed to have and adequate knowledge of elementary calculus and algebra but other mathematical techniques will be developed as they become necessary.
A special section of this course is available for Mathematics students.
Prerequisite: Economics 201*/202*, 231*/232* 300, or equivalent.

465* Security Analysis and Investment Policy
This course is designed to develop corporate financing priorities and an individual's investment policy. The first part of the course includes a study of analytical techniques for the appraisal of corporate and government securities, security price movements, indentures, sources and interpretation of information and the technical character of security markets. The second part studies the management of portfolios of individuals and institutional investors; the relation of investment policy to individual acquirement, and national securities policy.
Prerequisite: Economics 366, 367. 3 lectures. (Not offered in 1972-73.)

470 Mathematical Economics
Mathematical formulation of economic theory; solutions to systems of simultaneous difference and differential equations; introduction to dynamic models; analysis of stability conditions; introduction to linear and non-linear programming, input-output analysis, game theory.
A special section of this course is available for Mathematics students.
Prerequisite: Economics 201, 202, 231, or equivalent. 3 lectures.

475*-478* Special Subjects
A series of half courses to be offered at different times as announced by the department.

480 Comparative Economic Systems
An analytical comparison of resource-allocation methods, growth and development under socialist and capitalist systems.
Prerequisite: Economics 202, 202, 231 or permission of instructor. 3 lectures.

491*/499 Special Studies
Research and reading courses under the direction of individual instructors.
Admission by consent of instructor.
Department of Electrical Engineering

Professor and Chairman
K. D. Srivastava, B.Sc., B.E. (Hons.) (Roorkee), Ph.D. (Glasgow)

Professor and Associate Chairman (Graduate Studies)
D.J. Roulston, B.Sc. (Belfast), Ph.D. (Imperial College, London)

Associate Professor and Associate Chairman (Undergraduate Studies)
R.G. van Heeswik, Dipl.Ing. (Delft, Holland)

Professor and Dean of Graduate Studies
L.A.K. Watt, B.Sc. (Manitoba), M.S. (Chicago), Ph.D. (Minnesota)

Professors
J.H. Anderson, B.Sc. (Leeds), M.Sc., Ph.D. (Manchester)
R.G. Anthes, B.A.Sc., M.A.Sc. (Toronto)
P.R. Bryant, M.Sc. (London), M.A., Ph.D. (Cambridge)
E.L. Heasell, B.Sc., Ph.D. (Imperial College, London)
S.N. Kalra, B.Sc. (Punjab), M.S., Ph.D. (Illinois)
H.C. Ratz, B.A.Sc. (Toronto), S.M. (M.I.T.), Ph.D. (Saskatchewan)
J. Reeve, B.Sc., M.Sc., Ph.D. (Manchester)
J. Vlach, Dipl. Ing., C.Sc. (Technical Univ. of Prague)
L.Y. Wei, B.S. (National Northwestern College, China), M.Sc., Ph.D. (Illinois)

Associate Professors
N.J. Bergman, B. Eng. (McGill), M.Sc., Ph.D. (State University at Buffalo)
I.F. Blake, B.Sc., M.Sc. (Queens), M.A., Ph.D. (Princeton)
S.G. Chamberlain, M.Sc., Ph.D. (Southampton)
Y.L. Chow, B.Eng. (McGill), M.A.Sc., Ph.D. (Toronto)
J.D. Cross, B.Sc. (Cardiff), M.Sc., Ph.D. (Carleton)
G. J. Dufault, B.A. (Ottawa), B.Sc. (Carleton)
J.A. Field, B.E. (Saskatchewan), M.A.Sc., Ph.D. (Toronto)
J.V. Hanson, B.A.Sc. (Toronto), M.Sc., Ph.D. (Imperial College, London)
J.S. Keeler, B.A.Sc., M.A.Sc. (Toronto)
W.D. Little, B.A.Sc., M.A.Sc., Ph.D. (U.B.C.)
J.W. Mark, B.Sc. (Toronto), M.Sc., Ph.D. (McMaster)
W.N. Meikle, B.A.Sc., M.A.Sc. (Toronto)
R.S. Ramshaw, B.Sc., Ph.D. (Nottingham)

Assistant Professors
J.D. Aplevich, B.E. (Saskatchewan), Ph.D. (Imperial College, London)
T. Kameda, B.S., M.S. (Tokyo), Ph.D. (Princeton)
J.C. Majithia, B.Sc. (London), M.Eng., Ph.D. (McMaster)
P.A. Vuorinen, B.A.Sc. (Toronto), Ph.D. (London)

Research Assistant Professor
I.N. Hajj, B.E. (Beirut), M.S. (U. of New Mexico), Ph.D. (Berkeley)

Visiting Associate Professors
R.E. Crosbie, B.Eng., Ph.D. (Liverpool), (September 1, 1972 – August 31, 1973)
R.I. Donocik, C.Sc., Dr.Sc. (Technical University of Prague), (August 1, 1972 – December 31, 1972)
A. Pugh, B.Sc. (Wales), Ph.D. (Nottingham) (January 1, 1972 – December 31, 1972)

Laboratory Director
R.L. Wright, P.Eng.
Undergraduate Programme

Details of the undergraduate programme in Electrical Engineering may be found on page 136. Each course extends over one term only.

Undergraduate Course Descriptions

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Prerequisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Introduction to Electrical Engineering</td>
<td>Kirchhoff’s Laws, mesh current and node voltage equations, behaviour of RC, RL, and RLC circuits, steady state a.c. circuits, polyphase circuits, superposition theorem, transforms, electromechanical transducer principles; rotating machines, transistor amplifiers, introduction to power plants.</td>
<td>GE122, Math 12, Math 21 or equivalent.</td>
<td>3 hours lectures, 2 hours laboratory alternate weeks, 2 hours tutorial alternate weeks, one term.</td>
</tr>
<tr>
<td>14</td>
<td>Electromagnetics</td>
<td>Kirchhoff’s Laws, mesh current and node voltage equations, superposition theorem, maximum power theorem, time domain analysis of RC, RL and RLC circuits, phasors, measuring instruments, power factor and its correction, magnetic circuits, transformers, electromechanical energy transducers, introduction to d.c. and a.c. motors and generators, polyphase circuits.</td>
<td>GE122, Math 12, Math 21, or equivalent.</td>
<td>2 hours lectures, 3 hours laboratory alternate weeks, 3 hours tutorial alternate weeks, one term.</td>
</tr>
<tr>
<td>32</td>
<td>Electronic Instruments</td>
<td>Introduction to the principles of instrumentation: transducers, amplifiers and readouts. Realization of these with emphasis on solid state electronic devices and circuits. The control of electric power with semi-conductor devices.</td>
<td>EE14 or equivalent.</td>
<td>3 hours lectures, 3 hours laboratory alternate weeks, 2 hours tutorial, one term.</td>
</tr>
<tr>
<td>201 Seminar</td>
<td>General Seminar.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>202 Seminar</td>
<td>General Seminar.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>217 Numerical Methods</td>
<td>Fundamentals of numerical methods, solution of non-linear equations, polynomial and zeros of polynomials, matrix methods and systems of linear algebraic equations, interpolation, estimation of parameters by least squares, numerical integration, solution of ordinary differential equations.</td>
<td>GE121, Math 25, or equivalent.</td>
<td>2 hours lectures, 2 hours tutorial, one term.</td>
<td></td>
</tr>
<tr>
<td>233 Physical Electronics</td>
<td>Electromagnetic radiation; wave aspects of particles; structure of Hydrogen atom; many electron atoms; molecular and solid state physics, semiconductors.</td>
<td></td>
<td>2 hours lectures, 2 hours tutorial, one term.</td>
<td></td>
</tr>
</tbody>
</table>
241 Electric Networks 1  Lumped circuits and Kirchhoff's laws; circuit elements and simple circuits; first order circuits; second order circuits; linear time-invariant circuits; sinusoidal steady state coupling elements and coupled circuits. 
Prerequisites: GE122 or equivalent.
3 hours lectures, 3 hours open laboratory, 2 hours tutorials, one term.

261 Energy Transformation, Storage and Conversion  Short review of magnetic circuits; permanent Magnetics energy transformation, two and three winding circuits; energy storage, a comparison of energy densities; electromagnetic forces, principles and examples of electro-mechanical energy conversion. 
Prerequisites: EE241, EE271, or equivalent.
2 hours lectures, 3 hours open laboratory, 1 hour tutorial, one term.

271 Electric and Magnetic Fields  Vector analysis; Coulomb's law and electric field intensity; electric flux density; Gauss' law and divergence; energy and potential; conductors, dielectrics, capacitance; experimental mapping methods; Poisson's and Laplace's equations; the steady magnetic field; magnetic forces, materials and inductance; time varying fields and Maxwell's equations. 
Prerequisites: GE122 or equivalent.
3 hours lectures, 3 hours open laboratory alternate weeks, 1 hour tutorial, one term.

301 Seminar  General Seminar.

302 Seminar  General Seminar.

316 Probability and Statistics  Sample spaces, events, relative frequency, basic notions of probability; conditional probability and independence; Bayes' theorem; random variables; continuous and discrete probability density function; cumulative distribution function; functions of a random variable; geometric interpretations of probability; marginal p.d.f.'s; expectation, variance, conditional expectation; correlation coefficients, Chebysher's inequality; regression of the mean, law of large numbers. 
Prerequisites: Math 25 or equivalent.
2 hours lectures, 2 hours tutorial, one term.

324 Principles of Digital Computers  Boolean algebra, number systems and data representation; flipflops and registers; computer operation, control unit, instruction sequencing, arithmetic unit; storage organization; operating systems, compilers, assemblers, multiprogramming, multiprocessing and timesharing. 
Prerequisites: EE217 or equivalent.
2 hours lectures, 3 hours laboratory every third week, 1 hour tutorial, one term.

342 Electric Networks 2  Network graphs and Tellegen's theorem; general network analysis; reduction of network equations; Laplace transforms; network functions; network theorems, two ports. 
Prerequisites: EE241 or equivalent.
2 hours lectures, 2 hours tutorial, one term.
351 Electronics 1  Doped semiconductors; charge neutrality, mass action law; equilibrium conditions; transport mechanisms; Boltzman relations; derivation of p-n junction, d.c. and a.c. characteristics; charge storage effects; the transistor; derivation of d.c. and a.c. terminal characteristics, equivalent circuits, temperature effects; thermionic emission vacuum diodes and triodes.

Prerequisites: EE233 or equivalent.
2 hours lectures, 3 hours open laboratory alternate weeks, 1 hour tutorial, one term.

352 Electronics 2  Large signal amplifiers; biasing networks and stability; single and multi-stage small-signal amplifiers; use of the hybrid-p model; high and low cut-off effects; feedback amplifiers; stability; oscillators; noise in electronic circuits; modulation and detection systems.

Prerequisites: EE351 or equivalent.
2 hours lectures, 3 hours open laboratory, 1 hour tutorial, one term.

362 Energy Conversion  Energy conversion problems; a general description of rotating transducers used in electrical and mechanical power production; principles of direct energy conversion.

Prerequisites: EE261 or equivalent.
2 hours lectures, 3 hours open laboratory alternate weeks, 1 hour tutorial, one term.

372 Transmission Lines and Electromagnetic Fields  Transmission lines; distributed parameters; telegrapher's equations; sinusoidal waves; terminated lines; matching with the Smith Chart; Electromagnetic Fields; Maxwell’s equations; plane waves; reflection and refraction, Poynting vector; waveguides.

Prerequisites: EE271 or equivalent.
2 hours lectures, 3 hours laboratory alternate weeks, 1 hour tutorial, one term.

80 Introduction to Systems and Control  Mathematical Modelling of Systems and Components; introduction to simulation; feedback systems; system stability and analysis using amplitude and phase plots and methods of Nyquist; Nichols and the Root Locus.

2 hours lectures, 2 hours tutorials, one term.

391 Signals and Human Communication (Non Technical Elective)  History of signals and information theory; models, mathematical models; applications to language, music, art; cybernetics and applications.

Advanced standing required.
Prerequisites: Math 100 or GE250 or consent of instructor.
3 hours lectures, one term.

392 Information in Science and Society (Non Technical Elective)  Information theory, measurement and observations; epistemology, inevitable errors, and determinism; technology in the industrial system; the role of the applied scientist; planning, motivation and enterprise; the organization, evaluation and survival of life and thought; the evolution of cultural complexity. Advanced standing required.
Prerequisites: Math 100 or GE250 or consent of instructor.
3 hours lectures, one term.

401 Seminar  General seminar.

402 Seminar  General Seminar.
425 System Simulation  
A study of computer simulation techniques; principles of analog computation; models, scaling and procedures; digital simulation languages; computer simulation and investigation of continuous systems; differential equations, transfer functions, boundary value problems, system design; elements and application of hybrid computers.  
3 hours lectures, 3 hours open laboratory every third week, one term.

426 Switching Systems  
Application of Boolean algebra to switching circuits; canonical forms for Boolean functions; analysis and simplification of switching functions; map and tabular methods of simplification; prime implicants; analysis of sequential circuits, synchronous and asynchronous systems; synthesis of sequential circuits; race conditions; static, dynamic and essential hazards.  
Prerequisites: EE324 or equivalent.  
3 hours lectures, 3 hours open laboratory every third week, one term.

427 Design of Discrete Signal Systems  
The object of this course is to relate the realization of digital systems to device technology. Integrated circuit logic and memory elements; magnetic memory systems; serial and parallel systems, counters, A/D, D/A, I/O systems and displays; computer design and interfacing.  
Prerequisites: EE324, EE426, EE454 or equivalent.  
3 hours lectures, 3 hours laboratory every third week, one term.

428 Communication Theory 1  
Introduction to Fourier Series and Transforms and their use in the analysis of deterministic signals in linear systems; bandwidth, distortion and filter characteristics; input output relationships in linear filters; linear modulation such as AM, SSB, VSB and demodulation techniques; sources of noise in a communication system including channel and receiver noise.  
Prerequisites: EE316 or equivalent.  
3 hours lectures, 1 hour tutorial, one term.

429 Communication Theory 2  
Probability theory and the description of random processes, the analysis of analog and digital communication systems including phase and frequency modulation of analog waveforms and pulse amplitude modulation, pulse code modulation for digital signals; the investigation of the performance of these systems in the presence of noise using various criteria, including probability of error and signal to noise ratios.  
3 hours lectures, 3 hours laboratory every third week, one term.

434 Magnetic Materials and Quantum Electronics  
Orbital and spin paramagnetism; the Langevin equation; the physical basis of Ferro-and Ferrimagnetism; technical magnetization: magnetic steels, permanent magnet materials; ferrites and ferrite devices; black-body radiation and the Einstein relations; stimulated emission; population inversion and maser action; maser amplifiers and frequency standards; lasers and their applications.  
Prerequisites: EE271, EE351 or equivalent.  
2 hours lectures, 2 hours tutorial, one term.
435 Semiconductor Devices 1  Basic physical processes affecting device characteristics; space charge generation and recombination; scattering, mobility, saturation of drift velocity, avalanche multiplication. Zener diodes; field emission, space-charge limited current flow, Schottky diodes; tunnel and back-diodes; photo-diodes, radiation detectors.
  Prerequisites: EE351 or equivalent.
  3 hours lectures, 1 hour tutorial, one term.

436 Semiconductor Devices 2  A discussion of the physical processes used in fabricating discrete and integrated devices; junction field effect transistors, surface phenomena, MOS field effect transistors; device configurations and equivalent circuits; high level effects in bipolar devices, conductivity modulation, high level injection and emitter crowding.
  Prerequisite: EE351 or equivalent.
  3 hours lectures, 1 hour tutorial, one term.

443 Electric Networks 3  Topics from the following: general passive network functions; passive driving point functions; reactance functions and reactance networks; scattering parameters, reactive passive filters; active networks and active filters.
  Prerequisites: EE342 or equivalent.
  3 hours lectures, 1 hour tutorial, one term.

446 The Algebra of Linear Systems  Continuous and discrete linear systems; linear transformations; finite field theory; polynomials over finite fields; matrix algebra, system decomposition.
  Prerequisite: EE380 or equivalent.
  3 hours lectures, 1 hour tutorial, one term.

453 General Electronic Circuits  Selected topics from: Multiple transistor circuits, cascading of amplifier stages; the difference amplifiers; Darlington configuration; feedback in amplifiers; input and output impedances; the operational amplifier; integrated circuits, analysis and design; high frequency response of amplifiers, the cascade amplifier, tuned amplifiers; field effect amplifiers; feedback power supply regulators.
  Prerequisites: EE352 or equivalent.
  2 hours lectures, 3 hours laboratory every 3rd week, 1 hour tutorial, one term.

54 Pulse and Switching Circuits  Selected topics from the following: switching characteristics of semiconductor devices, non-sinusoidal wave generation and shaping, voltage and current sweeps, binary circuits, NAND, NOR, AND, OR gates and compatibility requirements, digital integrated circuits, DTL, DCTL, ECL, and T1 L; the blocking oscillator.
  Prerequisite: EE351, EE352 or equivalent.
  2 hours lectures, 3 hours open laboratory every 3rd week, 1 hour tutorial, one term.

459 Sound, Noise and Electroacoustics  An interdisciplinary study of acoustical physics, human response to sound and audio engineering. Main topics include: the physics of sound, electro-acoustical systems, human audiology, acoustical measurements, and audio electronics.
  Prerequisite: Knowledge of the basic techniques for measurement and analysis of simple linear systems is required. Familiarity with simple electronic devices would be helpful.
  2 hours lectures, 3 hours laboratory every third week, 1 hour tutorial, one term.
463 Energy Conversion and Power Applications
The steady state control of electrical machines; thyristors for power applications; steady state control of apparatus by power electronics; transient response of electromechanical transducers; introduction to dynamic circuit theory for the transient analysis of individual rotating transducers; protection of plant, power generation, hydro, steam, tidal, nuclear, etc., superconductivity and power applications.
Prerequisites: EE261, EE362 or equivalent.
2 hours lectures, 3 hours laboratory every third week, 1 hour tutorial, project, one term.

464 High Voltage and Insulation Engineering
Nature and origin of high voltage surges encountered on power systems; travelling waves on transmission systems; insulation engineering; electrostatic fields in high voltage apparatus, insulation failure; corona; insulation testing; circuit breakers and surge protection devices; insulation coordination.
Prerequisite: EE463 or equivalent.
3 hours lectures, 1 hour tutorial, project, one term.

465 Power Systems
Introduction to system concepts of power plant; coordinate systems including symmetrical components; sequence impedances and transmission line constants; analysis of unbalanced systems and fault calculations; per-unit systems; protection techniques and fault analysis appropriate to protection; voltage and reactive power control; power transfer and system stability; load flow; introduction to computer methods for power system analysis; transient response of power systems; introduction to HVdc transmission; economic considerations.
2 hours lectures, 2 hours tutorials, one term.

473 Microwave Engineering
Rectangular and circular waveguides; simple waveguide discontinuity; periodic transmission systems; microwave scattering theory; ferrite components; klystrons; travelling-wave amplifiers; backward-wave oscillator; magnetron; solid-state microwave devices.
Prerequisite: EE372 or equivalent.
2 hours lectures, 3 hours laboratory every 3rd week, 1 hour tutorial, one term.

474 Antenna and Propagation Engineering
An introduction to the theory of radiation and of antenna and propagation engineering; linear antennas, linear arrays, aperture antennas, frequency independent antennas, measurement theory; ground wave propagation, ionospheric propagation, plasmas.
Prerequisites: EE372 or equivalent.
2 hours lectures, 3 hours laboratory every third week, 1 hour tutorial, one term.

481 Control Systems
Performance specification, synthesis of single-input single-output system; state variable representation for continuous and discrete time systems; analysis of multivariable systems.
Prerequisites: EE380 or equivalent.
2 hours lectures, 2 hours tutorials, one term.

499A, 499B Project
An engineering assignment requiring the student to demonstrate initiative and assume responsibility. The student will select a project at the end of the 3B term from an approved list prepared by the Department. A short progress report at the end of the 4A term and a full report at the end of the 4B term are required.
4 hours, one or two terms.
Department of English

Professor, Chairman of the Department
J. Gold, B.A. (Birmingham), Ph.D. (Wisconsin)

Professors
J.C. Gray, B.A. (Washington State), M.A. (Connecticut), Ph.D. (Syracuse)
G.R. Hibbard, B.A., M.A. (London)
K. Ledbetter, A.B. (Central College, Mo.), M.A., Ph.D. (Illinois)
C.F. MacRae, B.A. (Western), M.A. (McMaster), Ph.D. (Toronto)
W.R. Martin, M.A., D. litt. et Phil. (South Africa)
W.U. Ober, B.A. (Washington and Lee), Ph.D. (Indiana)
W.K. Thomas, M.A., Ph.D. (Toronto)

Associate Professors
A.I. Dust, M.A. Ph.D. (Illinois)
B.N. Honeyford, B.A., Ph.D. (Toronto)
H.E. Haworth (Mrs.) B.A. (Rollins), M.A., Ph.D. (Illinois)
N.C. Hultin, B.A. (Concordia), M.A. (Chicago), Ph.D. (Johns Hopkins)
J. R.M. Levitsky (Mrs.), B.S.Ed. (Central Missouri S.C.), M.S.Ed. (Illinois Normal), Ph.D. (Missouri)
H.M. Logan, A.B. (Franklin and Marshall), Ph.D. (Pennsylvania)
J.S. Stone, M.A. (British Columbia)

R. H. Tuyn, M.A. (Utrecht and Oxon.) Docteur de l'Université de Paris

Assistant Professors
R.R. Dubinski, B.A., M.A. (Western), Ph.D. (Toronto)
R.N. Gosselin, B.A. (Kansas), M.A., Ph.D. (Colorado)
J. P.M. Hinchcliffe, B.A. (British Columbia), M.A., Ph.D. (Toronto)

(part time) J. J. Hinchcliffe (Mrs.), B.A., M.A., Ph.D. (Toronto)

J. D.S. Keppel-Jones, B.A. (Natal), M.A., Ph.D. (Queen's)
W.R. Macnaughton, B.A. (Toronto), M.A., Ph.D. (Wisconsin)
J.S. North, B.A., M.A. (British Columbia), Ph.D. (Alberta)

(part time) J. Sister M. Leon, S.S.N.D., B.A. (Toronto), M.A. (Detroit)

J. D.R. Letson, B.A. (Waterloo), M.A. (McMaster), Ph.D. (Toronto)
E.F. Shields (Miss), B.A. (Chestnut Hill), M.A. (Villanova), Ph.D. (Illinois)
G.E. Slethaug, B.A. (Pacific Lutheran), M.A., Ph.D. (Nebraska)

Lecturers
P.D. Beam, B.A. (Waterloo), M.A. (McMaster)

(part time) J. L. Dorney, B.A., M.A. (Louisville)
M.J. Estok, B.A., M.A. (Saskatchewan)

(part time) M. Graham, A.O.C.A. (Ontario College of Art)

R. Lister (Mrs.), B.A., M.A. (Toronto)

J. E.P. McCormack, M.A. (Glasgow)
S.E. McMullin, B.A., M.A. (Carleton)
M.G. Thysell (Mrs.), M.A. (Montana)
K.J.R. Wylie, B.A. (British Columbia)
P. Young, B.A. (Toronto)

For programmes and courses in Drama, see Department of English, Division of Drama.
English Honours Programmes

For programmes in Honours English, Honours English (Drama), and dual Honours programmes involving English, see page 103.

English General Programme

To fulfill the requirements for a general degree in English, a student must take six courses in English consisting of: 101 or equivalent, 251, one full course equivalent from 270, 282*, 350, 362*, 363* (major figures); one full course equivalent from 261, 281*, 361*, 370, 373, 375, 380, 451 (Language and fields of Literature); two approved English credits.

First year

English 101 and 102 are the recommended first-year courses. However, a first year student may—without formal permission from the Department—take courses from the following list instead of 101 and 102: English 105*, 108*, 190*, 211*-212*, and 230*-231,. All other English courses are open to first year students, but only with the permission of the Chairman of the English Department and the instructor of the course. Students may use only one full course equivalent in English from the 100-level to fulfill the minimum English requirements.

Upper years

English 251 is strongly recommended for second year. With the consent of the Department upper year courses may be taken at any time during the upper years without regard to course number or “level.”

Restrictions

English 140*-141*, 335, and courses in theatre (designated “Drama” in the calendar) may not be included as approved English courses in fulfilling the minimum course requirements for an English Programme, but may be chosen as non-English electives.

Note 1

W. K. Thomas’s Correct Form in Essay Writing is the official style sheet for all undergraduate English courses.

Note 2

The “normal” number of lectures per week in each course is three; however, each instructor determines how often his particular class will meet.

Note 3

In all English courses, emphasis will be placed on student essays written in connection with the reading.

10 English as a Second Language

(a non credit course)

The course will aim at the improvement of both written and spoken English to bring about ease and facility of expression in assignments and oral discussions through a detailed study of basic patterns in Grammar and Idiom and their practical application in writing commentaries, essays or summaries.

49* Principles and Practice of Effective Speech (for non-Arts students only)

The course's purpose is to increase understanding of, and facility with, language . . . especially oral presentation. Students' attendance will be required for two hours per week. Each student will be required to give speeches, impromptu and otherwise, to participate in argument and in discussion, and to be prepared to give detailed analyses of others' performances. Each student will be asked to provide himself with a cassette tape. Required texts include Concise Oxford Dictionary and Methods and Means of Public Speaking. Smith & Canty (Bobbs-Merrill). Other texts will be announced.
101 The Living Tradition  An examination of examples of the greatest literature in English and its relation to the periods of its origin. Figures such as Chaucer, Shakespeare, Milton, Swift, Blake, Keats, Tennyson, Dickens, and T. S. Eliot will be examined. The precise list of readings will depend upon the individual instructor. The basic text will be the one-volume Norton Anthology of English Literature.

102 Poem, Play and Story  A study of the forms that imaginative literature assumes. Examples of different kinds of literature will be explored in detail so as to discover how the shape of a literary work of art gives to its meaning. Students will for instance read ballad, lyric, and narrative poetry; classic tragedy and comedy and absurdist, existential and expressionist plays; novels and short stories.

105* The Short Story and Its Origin  Examples are the stories of Hemingway, Faulkner, James, D. H. Lawrence and modern Canadian writers.

108* Themes of Literature  An exploration of the great variety of literature through thematic perspectives. Several of the following themes will be offered in the coming year:

108*A The Hero  A study of human excellence in thought and action, embodied in representative men and women, as seen through works of literature.

108*B Utopia and Anti-Utopia  The purpose of this course will be to acquaint the student with various forms of the literary artist's moral vision of man as it appears in "Utopian" writings. It will involve an examination of the role of the imagination in helping to inform and embody the cultural ideals of four periods: the Renaissance, the Eighteenth Century, the Romantic Age and the Modern Age.

108*C Literature and Morality  Works in English literature from its beginnings are selected for their bearings on questions of morality. The relationships include: (1) the moral values assumed by the writer and his culture; (2) the means by which moral values and ideals are clarified and promoted; (3) the consideration of true and false moral principles; (4) images of reward, nemesis, guilt, and redemption. Some attention will be given to the traditional categories of morality, especially the Deadly Sins and the Cardinal Virtues.

108*D The Quest Theme in Literature  The course will examine the "Quest Theme" as it occurs in various genres of literature. Among other things it will discuss the significance of Odysseus and Moses as archetypal figures, the importance of quest in Romantic poetry, the psychological quest in drama, and the connection between the "Quest Theme" and the concern of the Western World with the idea of progress as a movement toward the realization of the Promised Land through technology. The course will be presented through a combination of lectures and seminars.

108*E Women in Literature  A study of the nature and role of women in British, Canadian, and American literature from Chaucer to the present. Works by both men and women writers will be studied in which women are seen in such forms as earth mothers, people, sex objects, and bitches.
108*F The Rebel  
A study of various works of literature in which the protagonist is a rebel, a non-conformist to the standardized, existing norms of life and living. It will examine a number of rebel types and concepts, moral implications, final outcomes either in successful realization or in tragic defeat.

108*H Isolation and Alienation 
This course includes the study of a variety of works in literature centering on the theme of man in crisis, the stress being on the individual at variance with his inner self, his fellow man, his world. The inner struggle isolates him from society and alienates him from his fellow man. The course will discuss the process in which wisdom and maturity are gained as the ultimate product of suffering.

108*I Forms of Fantasy 
A view of the fabulous, fantastic, and enchanted in literature as embodied in fables, fairy tales, legends, science fiction, etc. Attention will be given to such authors as Malory, Grimm, Tolkien, Charles Williams, C. S. Lewis, Huxley, Ray Bradbury, and Arthur Clarke.

140* The Use of English 1  
The use and abuse of spoken and written English. The study and evaluation of language as it is used for various purposes (e.g. colloquial, scientific, legal, political, commercial, journalistic, literary) in order to increase critical awareness and help students to write clearly and effectively themselves.

141* The Use of English 2  
A continuation of English 140*. The study of factual, emotive, scientific and imaginative writing; relevance, context; meaning, tone, feeling and intention.  
Prerequisite: English 140*.

Note  
English 140*-141* replaces English 240, The Use of English.

190* Shakespeare  
Several of Shakespeare's Comedies, Histories, and Tragedies will be explored with the aim of introducing the student to something of the range of Shakespeare's themes and techniques.  
No previous work in Shakespeare is required.

202 The Bible and Literature  
The study of the major themes, stories, myths, and characters of the Old and New Testaments of the King James Bible, and their influence on other English literature.

203* Introduction to Folklore 1  
An introduction to the scope and aims of folklore, together with a survey of the major types of folklore in the English tradition from earliest times to the present and from the various nations of the English-speaking world. Topics such as the following will be discussed:  
Oral literature and traditional cultures of the English world; problems of the creation, transmission, and alteration in oral literature; myth, legend, tale, and marchen.

204* Introduction to Folklore 2  
Similar to 203* but dealing with folk-drama, ballads, songs, riddles, chants, proverbs, and charms.  
Prerequisite: English 203* or consent of instructor.

206* The Art of the Essay  
Essays of current and recurrent interest will be read both for the ideas presented and for the artistry involved in the presentation.
211* The Novel 1  A study of the novel in English from its beginnings to the later 19th century.

212* The Novel 2  A study of the novel in English from the later 19th century to the present.

230* Poetry 1  A study of English poetry before 1800.

231* Poetry 2  English poetry after 1800.

236* Literature of Ideas 1  This course, which deals chiefly with the moral implications of political thought, is designed both to stimulate controversy and to improve the student's ability to express himself in a clear, organized fashion. Students are required to conduct seminars on such topics as political realism, human rights versus civil rights, the difference between rebellion and revolution.

237* Literature of Ideas 2  Similar to 236*, but dealing with the moral implications of scientific and philosophical thought.

251 The Theory and Practice of Criticism  A study of the elements of criticism and their application to a variety of literary texts and contexts. Much of the work of this course consists of analysis and discussion of literary problems by the students themselves.

261 Old English  An introduction to the literature and language of pre-conquest England. The principal literary methods, themes, and types of English literature up to the 12th century constitute the material of study in this course.

270 Middle English  A study of Middle English literature with special emphasis on the works of Chaucer.

281* Elizabethan Literature 1 (excluding drama)  A study of the principal writers of prose and of lyric and narrative poetry in England during and immediately preceding the reign of Elizabeth 1. Native, classical, and Italianate influences are stressed in the erotic poetry of the period especially as manifested in the sonnet tradition and the mythological narrative poems of Marlowe and Shakespeare. Other writers represented are More, Wyatt, Surrey, Skelton, Gascoigne, Daniel, Lyly, Drayton, and Sidney.

282* Elizabethan Literature 2 (excluding drama)  A study of the rich and various literary achievements of the golden age of Elizabeth 1. Reserved for special attention is Spenser's epic poem glorifying Elizabeth 1 and England—The Faerie Queene. English 281* is recommended.

290* American Literature  The meaning of America—the myth, the dream, and the reality—as experienced through its major literary works. Sin, guilt, madness, mysticism, and grace: the search for fulfilment and peace by such writers as Thoreau, Whitman, and Hemingway.

* Modern American Literature (replaces English 344*)  Approaches to reality amid the confusion and uncertainty of 20th Century America. Emphasis on such major writers as Faulkner, Miller, and Cummings.

Prerequisite: English 290*.

312* Literature of the Commonwealth  A survey of Australian poetry and prose, with some consideration of the literatures, in English, from South Africa and the West Indies.
313* Canadian Literature to 1920  A study of Canadian prose and verse to 1920, with particular attention given to the poetry of the School of the Sixties and to the historical and idyllic novels of the 19th and early 20th centuries.


315* Canadian Prose Since 1920  The Canadian novel since the appearance of Morley Callaghan, with brief consideration of the essay, the short story, and drama during the period.

320* Fictional Prose, Not Including the Novel  The mutations of prose style and form as seen in the “romance” writers such as Malory, Sidney, Bunyan, Swift; in the Novella and picaresque writers such as Nashe and Defoe; in the short story and novelette writers such as Poe, Conrad, and Faulkner.  
(Not offered in 1972-73).

321* Personal and Utilitarian Prose  The mutations of prose style and form as seen in writers of biography and autobiography such as Boswell, Fraklin, Strachey; letter writers such as Chesterfield, Keats, Dickinson; essayists such as Bacon, Burton, Ruskin, Orwell; and writers of scientific, historical, and philosophical prose such as Browne, Darwin, Macaulay, and Trevelyan.  
(Not offered in 1972-73).

335 Creative Writing  Aimed at encouraging the student to develop his creative and critical potentials, the course consists of supervised practice, tutorials, and seminar discussions. Enrolment is limited and, in order to be accepted, an applicant must first submit a manuscript as evidence of his ability to profit from the course.

338* Sociology of Literature  This course attempts to provide the student with an opportunity for exploring literature as a social phenomenon. Specific areas to be dealt with might include: 1) the relationship of the artist to his social structure; 2) the nature of the relationship of the work and its audience; 3) the attitudes toward the social structure implicit in the work of art. In general the course is viewed as an attempt to combine both the scientific approach and the humanistic approach to literature. Here literature is viewed as including both belles lettres and popular culture. The course will be taught by someone in sociology and someone in literature in dialogue method. 
Prerequisite: Sociology 101*/102* and a first year English course.  
(Not offered in 1972-73)

339* Contemporary British Literature  A study of the major trends in British literature from World War II to the present. The course will examine the rise of the angry generation and social protest, the renaissance in drama, the return to tradition and the reaction against experimentation, and other topics related to the literary emergence of a new England.

345*(A-E) Studies in American Literature: Themes

Prerequisite: English 290* or consent of instructor.
345*B The Southern Myth
The Southern Myth: its origins in early literature, its flowering, testing, and shattering; as in the works of Twain, Faulkner, Grau, and O'Connor, as in the black literature of Wright, Ellison, Baldwin, and Jones.
Prerequisite: English 290* or consent of instructor.

346*(A-E) Studies in American Literature: Genres

46*A Realistic and Naturalistic Fiction
Special emphasis will be given to the works of Mark Twain, Henry James, and Stephen Crane.
Prerequisite: English 290* or consent of instructor.

347*(A-E) Studies in American Literature: Historical Periods

347*A Contemporary American Literature
A study of American literature from World War 2 to the present.
Prerequisite: English 290* or consent of instructor.

350 Seventeenth Century Non-Dramatic Literature
A study of the non-dramatic literature of the Jacobean, Caroline, and Interregnum periods, with special attention to Milton's major works.

341 The Development of Drama to 1660
A study of the origins and development of English drama, with special concentration on 16th century non-Shakespearean drama.

362* Shakespeare 1
A study of those plays of Shakespeare written up to 1600, including the early comedies, the histories, Romeo and Juliet and Julius Caesar.

363* Shakespeare 2
A study of those plays of Shakespeare written after 1600, including the late comedies and the major tragedies.

364* Drama from 1660
A study of the principal playwrights, plays, and movements in dramatic history from the re-opening of the theatres in 1660 to the present day.

365*-66* Selected Studies
Designed to provide a study in depth of problems and/or authors selected by the instructor. Students interested in initiating such courses are encouraged to do so by bringing their ideas to the attention of individual instructors.
Prerequisite: consent of instructor.

370 The Augustan Age
An historical and critical study of the drama, poetry, novels, and other writings of the Restoration and 18th century.

373 An Introduction to the History of English
The processes of linguistic change as exemplified in the development of the English language from its origins in Indo-European and Germanic through modern Canadian dialects and other forms of English in the twentieth century (British and American dialects, commonwealth dialects) forms the subject of this study. Traditional, structural and generative approaches to historical linguistics will be employed in this survey.

375 Linguistics and English Grammar
An interpretation of linguistics and its application in the English classroom to the study of grammar and language. The course will provide an introduction to descriptive and historical linguistics and the principles of linguistic analysis. It will include an evaluation of English grammars ranging from the traditional to the structural and transformational-generative.
380 The Romantic Movement
An historical and critical study of the principles and practice of the English Romantic authors from Blake to Keats, with primary emphasis on poetry.

451 Literature of the Victorian Age
An historical and critical study with emphasis on the major poets (Browning, Tennyson, Arnold), novelists (Dickens, Thackeray, Eliot), and essayists (Newman, Ruskin, Mill, Huxley). Prominent topics are relative morality, the role of the artist, freedom of speech, the idea of a university, and the effect of economic and social reform upon the human condition. Provision will be made for students who wish to study other writers such as Hopkins, Swinburne, Carroll, Morris or Pater.

456 Literature and History of the Victorian Age
A literary and historical survey of Victorian England through authors and works that have major significance in both fields. The student will be encouraged to use several approaches and forms of evaluation of this material. He will be obliged to register in English 456 or History 456 and to direct and concentrate his studies accordingly. (Not offered in 1972-73)

460 Modern British Literature
A study of the major writers in British literature from 1890 to World War 2, with special emphasis on such writers as Shaw, Yeats, Eliot, Conrad, Joyce, and Lawrence.

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. (Not offered in 1972-73)

495 Supervision of Senior Honours Essay.

The following course is administered by St. Jerome's College:

480 J Senior Seminar
Designed for fourth-year students in the Honours English or Combined Honours English programs, this course provides a study of the major works in those periods of English literature in which students have not taken courses. It also provides a study in depth of selected authors and topics. Individual syllabi are prescribed for each student, and the course is conducted on a seminar basis.

The following courses are administered by Renison College:

240R This course has been replaced by English 140*-141*.

245R Form and Function
The uses of literacy and the functions of language as acquired in the courses 240R or 140*/141*. These will be applied to the more advanced form of the literary and critical assignment essay, involving comparison, evaluation and exposition.

385R Contemporary Literature
A study of such writers as Graham Greece, Evelyn Waugh, Aldous Huxley, Henry Green, Kingsley Amis, Irwin Shaw, John O'Hara, Edward Albee and Harold Pinter. An examination of the anti-hero and the stream of consciousness from the psychoanalytical novel to the theatre of the Absurd.
Students may use either 385R or 339* and 347*A, but not both, to fulfill the minimum English course requirement.
Division of Drama and Theatre Arts

Drama General Programme Requirements

English 101, 361*, 362*, 363*, 364*; Drama 223*, 224*, 329, 429*, 430*; and nine other courses including the Faculty of Arts requirements, for a total of 15 courses.

First Year

English 101 and Drama 223* and 224* are the recommended first year courses. Students planning to major in drama should confer with the Undergraduate Adviser in Drama and Theatre Arts before registering.

Note

The normal number of lectures per week in each course is three; however, each instructor determines how often his particular class will meet. Laboratory sessions and rehearsal periods may be added to any course at the discretion of the instructor.

223* Introduction to the Theatre 1

The role of theatre as a major art. Contributions of playwright, actor, director, designer and technician to the theatrical production. Analysis and interpretation of selected plays. Class meets three hours per week.

224* Introduction to the Theatre 2

An extension of the studies described in 223* above. 

Prerequisite: Drama 223*

225 Fundamentals of Acting

An Introduction to the basic techniques of acting. Laboratory experience in movement, voice, improvisation, characterization, and scene study. Laboratory and production participation required. Class meets 4 hours per week.

Prerequisite: Drama 223* and 224* and consent of instructor.

228* Design for the Theatre

The aesthetics and creation of performance environment. Design as a theatrical medium.

Class meets 3 hours per week with laboratory hours by arrangement.

Prerequisite: Consent of instructor and Drama 223*, 224*

325 Fundamentals of Directing

Analysis of production and performance problems from the director's point of view. Planning the interpretative concept of a production. Study in the principles of stage direction. Laboratory and production participation required. Includes the direction of a production.

Class meets 2 hours lecture and 4 hours lab per week.

Prerequisite: Consent of instructor and Drama 223*, 224*

326* Special Studies in Drama 1

Production participation and the study of selected problems of theatrical production.

Classes meet 3 hours per night, 5 nights per week for 8 weeks during production rehearsals.

Prerequisite: Consent of Production Director for Fall term.

327* Special Studies in Drama 2

Production participation and the study of selected problems of theatrical production.

Classes meet 3 hours per night, 5 nights per week for 8 weeks during production rehearsals.

Prerequisite: Consent of Production Director for Winter term.
329 History of the Theatre  A survey of theatre history from ancient to modern times with attention to the development of theatre architecture and its relationship to the acting, directing, design, and literature growing out of the various periods and cultures.
Class meets 3 hours per week.
Prerequisite: Drama 223*, 224*

330 Costuming  Design and practice in the construction of costume for the stage. Research into the historical styles of costumes from antiquity to the present and the adaptation of these styles to stage use. Laboratory and production participation required.
Class meets 2 hours lecture and 4 hours lab per week.
Prerequisite: Consent of instructor and Drama 223*, 224*

425 Styles in Stage Production  Different methods of staging in the various types of theatre styles and forms. Practical work in the theatre based on plays representative of various periods.
Class meets 4 hours per week.
Prerequisite: Consent of instructor and Drama 223*, 224*

429* History of Dramatic Criticism  A study of dramatic criticism from antiquity to the present.
Class meets 3 hours per week.
Prerequisite: Consent of instructor and Drama 223*, 224*

430* Theatre Criticism  A study of the criticism of theatre production and performance.
Class meets 3 hours per week.
Prerequisite: Drama 429*

442 Theatre Technology  A study of and practice in the various aspects of the technology of the theatre: theatre architecture and equipment, scenery shop practice: methods and materials of construction and painting, furniture and properties; lighting: theory of light and theatre lighting, equipment and control systems, preparation of plots and production operation; sound: theatre acoustics, reinforcement systems, and preparation of effects. Production participation which involves 3 hours per night for 5 nights a week for 2 1/2 weeks in either the Fall or Winter term is required.
Class meets 2 hours lecture and 3 hours lab per week.
Prerequisite: Consent of instructor and Drama 223*, 224*

490*(a)-(e) Seminar in Drama and Theatre  A seminar in special areas of drama and theatre.
Prerequisite: Consent of instructor and Drama 223*-224*.
Environmental Studies

Adjunct Professors
D.B. Greenspan, B.A. (Toronto), LL.B. (Osgoode Hall)
W.A. MacDonald, B.A. (McGill), LL.B. (Osgoode Hall), Q.C.
B. Stuart, B.A. (Bishop’s), LL.B. (Queen’s)

195* Introduction to Environmental Problems
A discussion of some major environmental problems and issues such as the population explosion, the impact of urbanization on man’s environment, environmental pollution, resource management, conservation, and environmental planning.
No prerequisite.
3 hours lecture and discussion (Fall and Winter terms)
Instructors: Krueger, Keith

Note Students in the Division of Environmental Studies may take this course in their first or second year only.

200* Field Ecology
To introduce the main concepts and principles of ecology as a basis for understanding the consequences of man-made changes in the natural environment. Cycling of elements, energetics and structural organization of major ecological systems; population dynamics; impact of natural resource management practices and urban and industrial development on the environment; incorporating environmental quality considerations into development activities; “designing with nature”.
No prerequisite.
2 hours lecture, 2 hours lab (Fall and Winter terms)
Instructors: Davies, George, Kitchen, Theberge.

8* Environmental Pollution and its Control
A general overview course on environmental pollution, its causes and effects, human and technical aspects. Topics will cover air, water and soil pollution from waste products; biological, economic, political and legal aspects; technical and social control measures.
No prerequisite
3 hours (Fall and Winter terms)
Coordinating Instructor: Horton

10*/381* Environmental Studies Workshop
An interdisciplinary workshop focusing upon major environmental issues, with an emphasis upon problem solving processes; problem definition, obtaining the necessary data, analysis, alternative solution formulation and evaluation. Enrolment in the course is by interdisciplinary problem solving group only. Proposals must be approved before registration is final. Contact D.E.S. Student Affairs Secretary for detailed information.
Prerequisite: The course is open only to students in third and higher years.
Coordinating Instructors: Thompson, Arch.; Mitchell, Geog.; Keith, Man-Env.; Martin, Planning.

400* Environmental Law
Conflict as the core of all aspects of environmental relationships. A review of several current conflicts in each of the three sections of the course: community planning law; ecological law; and natural resource law. As these conflicts are examined, we will isolate and define the legal clubs available to the interests involved in such conflicts, and seek to understand both the effect and the limits of these clubs under current legislation and practice.
Prerequisite: Third or Fourth Year Students 3 hours lecture and discussion, evening (Year)
Instructor: Greenspan.
Fine Arts

Assistant Professor, Co-ordinator N.L. Patterson (Mrs.), B.A. (Washington)

Professors V. Burnett, B.S. (Columbia), M.A. (California)
A.M. Urquhart, B.F.A. (Buffalo)

Assistant Professors G. H. Martens (Miss), B.A., M.A. (Minnesota), Ph.D. (Columbia)

Lecturers (Part-time) C. Crockford, B.E. (Alberta), M.A. (British Columbia)
V. Taborsky, Dipl. (Prague)
B. Bald (Mrs.) B.A. (Guelph)

Instructor J. Uhde, M.A. (J.E. Purkyne University, Brno, Czechoslovakia)

Requirements for Fine Arts General B.A.

To fulfill the requirements for a general degree in Fine Arts students must take 12 half courses in Fine Arts, including 110*, 111*, 120*, 121*. Of the eight remaining half courses at least four must be on the third year level. Courses in music and dance will be considered as electives and not as part of the regular Art programme in Fine Arts. Students from any faculty may take courses in Fine Arts on an elective basis with the consent of their departments, or as part of their regular programme where their departments so direct.

Undergraduate Courses

110* Introduction to World Art 1
A comparative survey of Western art, from prehistoric times to the Renaissance, emphasizing visual form as an expression of its historical and cultural context.
No prerequisites. Fall term.

111* Introduction to World Art 2
A comparative study of non-Western art, including the Orient, and the development of modern art from the Baroque to the Twentieth Century, emphasizing visual form as an expression of its historical and cultural context.
Prerequisite: Fine Arts 110*. Winter term.

120* Fundamentals of Visual Art
An introduction to the fundamental principles and concepts of visual art, through a series of experimental studio problems in two and three dimensional materials and media.
Lab fee. Fall term.

121* Fundamentals of Visual Art 2
A series of studio projects designed to develop basic skills and apply principles of visual dynamics in the various media of visual art. Lab fee.
Prerequisite: Fine Arts 120*. Winter term.

180* (Kinesiology 160*): History of Dance Since 1900
Consideration is given to the study of folk forms of dance and their eventual development to ethnic forms, theatre dance, and neo-classics dance. Particular attention is paid to the simultaneous development of classic dance forms of the nineteenth century.
181* (Kinesiology 161*): History of Dance Since 1900
The emergence of modern dance in North America is examined in detail. The conditions leading to this new dance form as well as past and future developments are analyzed.
Winter term.

210* Modern Art 1
A survey of the history of modern art, examining its origins in the eighteenth century and the romantic and realistic art of the nineteenth century, showing how the late nineteenth century developed the basic characteristics of the twentieth century art.
Prerequisite: Fine Arts 110*-111*. Fall term.

211* Modern Art 2
A survey of modern art examining the development of twentieth century art from the Post-Impressionists through the multiple trends of the present decade. Both movements and individual artists will be studied.
Prerequisite: Fine Arts 210*. Winter term.

212* Italian Renaissance Art 1
A survey of painting, sculpture, and architecture, especially in Florence and Siena, starting with Giotto and his contemporaries and covering innovations in perspective, anatomy, and iconography through the end of the 15th century.
Prerequisite: Fine 110*/111*, or consent of Instructor. Fall term.

213* Italian Renaissance Art 2
A continuation of Fine 212* starting with the masters of the High Renaissance, Leonardo, Raphael, and Michelangelo, and proceeding through Mannerism, Baroque, and Rococo in Florence, Venice and Rome.
Prerequisite: Fine 212* or consent of Instructor. Winter term.

16* (Anthro. 230*) Primitive Art
A study of prehistoric world art (Paleolithic, Mesolithic, and Neolithic), the art of Africa, the Americas, and Oceania, and European folk art (both continental and colonial).
Fall term. This course may be taken on an individual basis with approval of the specific instructor involved.

218* Western Religious Art
An introductory survey of the visual art and architecture of Judaism and Christianity in the Common era. The development and subsequent changes of style in places of worship and ceremonial objects and ornaments, and the changing forms of religious expression through visual art, will be studied.
Winter term. This course may be taken on an individual basis with approval of the specific instructor involved.

220* Fundamentals of Painting 1
Exploration of painting problems in various media as vehicles for serious creative expression: the fundamentals of composition and painting techniques (paints, materials, and preparation of painting surfaces) will be presented through studio projects. Lab fee.
Prerequisite: Fine Arts 120*-121*. Fall term.

221* Fundamentals of Painting 2
A continuation of Fine Arts 220* with an emphasis on independent problems. Lab fee.
Prerequisite: Fine Arts 220*.
Will not be offered in 1972/73.

22* Fundamentals of Sculpture 1
Exploration of sculpture problems in various media as vehicles for serious creative expression: emphasis will be given to developing understanding and mastery of three dimensional forms and the preparation and handling of sculptural materials and tools. Lab fee.
223* Fundamentals of Sculpture 2: A continuation of Fine Arts 222* with an emphasis on independent problems. Lab fee.

Prerequisite: Fine Arts 222*.

Will not be offered in 1972/73.

224* Introductory Graphics 1 (General Drawing): Students will make analytical and expressive drawings in a variety of media, in order to develop accurate observation and understanding of form. Lab fee.

Prerequisite: Fine Arts 120*.-121*. Fall term.

226* Introductory Graphics 2 (General Printmaking): An introductory course in materials and methods of printmaking with emphasis on relief and intaglio techniques.

Lab fee. Prerequisite: Fine Arts 224*. Winter term.

227* Scientific Drawing: Through studio experiences, students will learn techniques for making accurate scale drawing of biological subjects in line and value, using various media. Methods of preparing drawings for reproduction will be included.

No prerequisite. Winter term.

234* Introduction to Film Making 1: Basic introduction to the field of audio visual media: principle techniques and methods; creative ideas; scripting, production and directing; camera, sound and editing techniques; film forms.

Photo supplies, film stock and processing at student expense. Possession of photo and film camera (Super 8mm) by students desirable. Lab fee.

Prerequisite: Fine Arts 120*.-121* or consent of instructor. Fall term.

235* Introduction to Film Making 2: Practical introduction to film techniques. Theory, experiments and assignments in script writing, production planning, directing, editing and camera work. Further differentiation in film forms. Lab fees.

Prerequisite: Fine Arts 234*. Winter term.

244* History of Film 1 (Silent Film): The historic development of world cinematography in its silent era (1895-1929), including a short mention of the prehistory of film (before 1895), covering the most important artistic movements, works by outstanding directors and their contribution to the film as an independent form of art. Regular screenings will accompany discussion of historic and aesthetic aspects of film.

Prerequisite: Fine Arts 110*.-111* or consent of instructor. Fall term.

245* History of Film 2 (Sound Film): A continuation of Fine 244*: the extension of film history into the sound era (since 1929) including the most recent period.

Prerequisite: Fine Arts 244*. Winter term.

280* (Kinesiology 260*): Modern Dance Theories and Composition 1: Historical survey and study and movement theories of late 19th century and early 20th century – Delsarte, Dalcroze, Wigman. Studio sessions involve the study of the elements of dance composition – space, time dynamics.

2 lectures, 2 hours studio.

281* (Kinesiology 261*): Modern Dance Theories and Composition 2: A study of the basic theories and techniques in Modern Dance emerging in the early 20th century – Martha Graham, Doris Humphrey. Study sessions involve a study of the rhythmic components of movement and a manipulation of the elements of dance through creative expression in the medium of movement.

2 lectures, 2 hours studio.
0* (C. Civ. 351*) Greek Art and Architecture
A survey of the art and architecture of the ancient Greek world from the Minoan to the Hellenistic periods.
3 lectures. Consult Classics listing.

311* (C. Civ. 352*) Roman Art and Architecture
A survey of the art and architecture of the Roman world from Etruscan to Imperial times.
3 lectures. Consult Classics listing.

312* Renaissance Art Outside Italy 1
A survey of painting, and related developments in sculpture and architecture, from the late Gothic period through the High Renaissance. Emphasis will be on the Flemish and German schools.
Prerequisite: Fine 110*-111* or consent of instructor.

313* Renaissance Art Outside Italy 2
Mannerism, Baroque, and Rococo in Northern Europe and Spain. The contributions of such masters as Brueghel, Rembrandt, Rubens and Velasquez will be studied as well as the emergence of genre and landscape painting and the development of national schools.
Prerequisite: Fine Arts 312* or consent of instructor. Winter term.

316* Canadian Art
An examination of Canadian art beginning with the aboriginal arts of Indians and Eskimos, extending through the imported styles of settlers, especially from Britain and France, in the seventeenth, eighteenth and nineteenth centuries, to the development of the nationalist styles of the early twentieth century, culminating in contemporary Canadian art.
No prerequisites. Fall term.

317* Canadian Art
A continuation of Fine Arts 316*.
Prerequisite: Fine Arts 316*. Winter term.

320* Advanced Painting 1
Exploration and organization of colour in a three dimensional environment. Lab fee.
Prerequisite: Fine 220*. Fall term.

321* Advanced Painting 2
A continuation of Fine Arts 320* with emphasis on independent problems. Lab fee.
Prerequisite: Fine 320*.
Will not be offered in 1972/73.

322* Advanced Sculpture 1
Exploration of sculpture problems, specifically the organization and integration of three dimensional objects in a real environment. Lab fee.
Prerequisite: Fine 222*. Winter term.

323* Advanced Sculpture 2
A continuation of Fine 322* with emphasis on independent problems. Lab fee.
Prerequisite: Fine Arts 222*.
Will not be offered in 1972/73.

324* Advanced Drawing 1
A course in which drawing is investigated as a means of expression and communication. An understanding of the human figure – its structure, its movement, and its connotation – will be a central goal of the work. Objects and the landscape will also be studied as sources of artistic possibility. The student will be encouraged to experiment with imagery, to develop personal vision, and to devise individual formal modes of expression.
Fall term.
325* Advanced Drawing 2
A continuation of Fine 324*.
Winter term.

326* Advanced Printmaking 1
The practice and study of various graphic techniques with emphasis on
coloured intaglio, silk screen, and photographic processes. Lab fee.
Prerequisite: Fine 226*. Fall term.

327* Advanced Printmaking 2
A continuation of Fine 326* with emphasis on independent problems.
Lab fee.
Prerequisite: Fine 326*. Winter term.

328* Calligraphy 1
A study of the art of written forms, combining studio projects with slide
lectures on the history of writing, illuminating, and lettering. Students
will strive for mastery in various calligraphic forms including Roman,
Uncial, Gothic, Italic and Contemporary free scripts. Lab fee.
No prerequisites. Fall term.

329* Calligraphy 2
Studio work in techniques of preparation of graphic material for
reproduction, using illustration and typography as well as calligraphic
forms, together with slide lectures on the history of printed forms.
Lab fee.
Prerequisite: Fine 328*. Winter term.

334* Advanced Film Making 1
A critical examination of film as a medium: film as art; film and
literature, visual art, music; film and audience; experimental film forms;
film and television; film time and film space. Extended study and
practice of film forms and techniques. Production of short film sequences
by groups.
Film stock and processing paid by students.
Prerequisite: Fine 234* and 235*. Fall term.

335* Advanced Film Making 2
Examination of production methods in film and TV industry. Production
of films. Lab fee.
Prerequisite: Fine 334*. Winter term.

370* Film Theory 1 (Anatomy of Film)
A development of ideas gained in Fine Arts 244* and 245*. Provided
with the basic historical knowledge, the student will analyse the aesthetic
aspects of a cinematographic work (principles known as “film
language”).
Milestones of the history of film will be discussed. Screenings of film
will accompany the course.
Prerequisites: Fine 244*-245* or Fine 234*-235* or Permission. Fall term.

371* Film Theory 2 (Film Aesthetics and Criticism)
An extension of Fine 370*. The main accent will be placed upon major
theories of cinematography, such as those of Kracauer, Bulaz, and
Eisenstein, and upon the development of the students own judgment in
the form of critical essays.
Some problems of television, as a new film medium will also be
discussed.
Prerequisite: Fine 370*. Winter term.

380* (Kinesiology 360*) Ballet History and Theory 1
Historical survey, including the use of film of the development of ballet
from the preclassic dance of the French courts to beginning of the 20th
2 lectures, 2 hours studio.
381* (Kinesiology 361*) Ballet History and Theory 2
Historical developments in the ballet since 1900 with particular reference to change in thematic content of significant choreographers and changing attitude toward the theatre.
2 lectures, 2 hours studio.

390* Selected Subjects in Fine Arts
Research and reading courses under the direction of individual instructors.
Admission by consent of the instructor. Fall term.

391* Selected Subjects in Fine Arts
Research and reading courses under the direction of individual instructors.
Admission by consent of the Instructor. Winter term.

490* Senior Honours Presentation 1
Each student will work under the direction of a Fine Arts faculty member on an advanced creative project; the result of this endeavour will be presented in the form of an exhibition or its equivalent (i.e.: a film, illustrated book, portfolio, or essay), which will be examined by faculty members of Fine Arts and also where pertinent, by members of other departments.
Required of all students in Honours Fine Arts.

491* Senior Honours Presentation 2
A continuation of Fine 490*.
Winter term.

20* Senior Seminar in Graphics Techniques 1
Admission by consent of Instructor.
Fall term.

21* Senior Seminar in Graphics Techniques 2
Admission by consent of Instructor.
Winter term.

434* Senior Seminar in Film Techniques 1
Admission by consent of Instructor.
Fall term.

435* Senior Seminar in Film Techniques 2
Admission by consent of Instructor.
Winter term.

470* Senior Seminar in Film Concepts 1
Admission by consent of Instructor.
Fall term.

471* Senior Seminar in Film Concepts 2
Admission by consent of Instructor.
Winter term.

72* Senior Seminar in Graphics Concepts 1
Admission by consent of Instructor.
Fall term.

73* Senior Seminar in Graphics Concepts 2
Admission by consent of Instructor.
Winter term.
The following courses are administered by Conrad Grebel College

102*G/104*G Introduction to the Fine Arts

An integrated study of works of art and musical compositions, and their relationship to the time period in which they were created. The emphasis is on actual experiences of the arts.

No prerequisites.

150*G Introduction to Music 1

Examination by means of listening and analysis, of styles of music ranging from early Christian Chant to electronic and computer music. Composition to be studied included major forms such as sonata, symphony, opera, mass, etc., as well as smaller forms.

3 lectures. Fall term.

151*G Introduction to Music 2

Continuation of 150*G.

3 lectures. Winter term.

Prerequisite: 150*G or consent of Instructor.

250*G The History of Music 1

From its earliest beginnings to 1750.

251*G The History of Music 2

From 1750 to the present.

252*G Music and Literature 1

A study of music which is related to literary works from the various periods and genres, including Greek drama and mythology, the Bible, Goethe, Heine, Shakespeare, etc., and which have taken form in a variety of musical genres, such as lied, opera, oratorio and symphonic music.

Not offered in 1972-73.

253*G Music and Literature 2

A study of music which is related to literature concentrating on one or several writers, and which has taken form in one or several of the musical genres, such as lied, opera, oratorio and symphonic music.

Not offered in 1972-73.

260*G Choral Literature

Study of choral and ensemble music of all styles, sacred and secular, from the middle ages to the present. Laboratory sessions will consist of actual singing of choral works, leading to public performance.

Prerequisite 150/151 G or consent of Instructor.

261*G Choral Literature

Continuation of 260*G.

3 Lectures. Winter term.

272*G The Folk Music of Europe and North America

Countries to be discussed: British Isles, France, Germany, the Balkans and Eastern Europe, including the Ukraine and Russia; Canada and the USA through Library of Congress record albums, Folkways and other records, field recordings from Bulgaria, Yugoslavia, Czechoslovakia, Greece, Hungary, Rumania.

3 lectures.
An interdisciplinary course intended for students interested in English, Music, Drama, and Speech. The focus of the seminar is centered in the dramatic and musical productions at Stratford Festival theatres plus performances at the Shaw Festival Theatre at Niagara-on-the-Lake and selected productions at Toronto and London, Ontario. 
Offered summer only.
Prerequisite: An introductory course in Music, Drama, or Speech, or consent of instructor.

Continuation of Fine Arts 300*G.

Music from around 1700 to 1827, the Baroque and Classical periods of Music. Major composers studied Bach, Haydn, Mozart and Beethoven. Listening to music is an integral part of the course.
3 lectures.

Included among the many musical compositions studied are operas Wagner, Verdi and Mussorgsky, the Lieder of Schubert, Schumann and Wolf, symphonic music of Brahms, Mendelssohn, Tchaikowsky, and piano music of Chopin.
3 lectures.

A study of representative musical compositions of the twentieth century and their relationship to social, literary and political movements.
Prerequisites: Fine 150*G and 151*G, or consent of instructor.
General Engineering

000 Tutorial

Students will meet with a faculty member designated as their class professor. Performance in problem assignments and conceptual difficulties with other courses will be discussed, along with interrelation of present coursework, later work and engineering practice.

1 hour per week, both terms. (Consultation periods with teaching assistants regarding specific course problems and if required at the initiative of the student or his class professor, will be available.)

061 History and Philosophy of Science

The nature of science; science and technology in Egypt and Babylon. The development of science in Greece; the Orphic mysteries and the Ionian philosophers. Plato and Aristotle; Archimedes. The Alexandrian school and the separation of science and philosophy. Technology under the Roman Empire. The mediaeval attitude toward science. The Renaissance. Copernicus and Galileo. Sir Isaac Newton. The physical and biological sciences during the 18th century. Developments during the 19th century in physics, chemistry, technology, geology, evolution, and the rise of modern genetics. The 20th century revolution in pure science and technology.

3 lectures, 1 hour tutorial.

062 Introduction to Human Communication Systems

Broadly, the processes involved in man-man, man-machine and mass communications will be discussed. Models of communication systems. The contributions and points of view of the various disciplines which make up the spectrum of communication studies today. Necessary fundamental concepts from these disciplines. Applications of the theories in fields relevant to the student.

3 hours per week, lectures and seminars.

101 Topics from Scientific Thought

A variety of topics selected from modern science are treated in the lectures at a conceptual level and then used as a base for discussion. Certain aspects of historical, philosophical and particularly social significance are included according to the inclinations of the students and discussion leaders.

1 hour lecture and 1 seminar per week.

102 Fundamentals of Social-Political Thought

The central question of the course is: What reasons can I have for acting on the issues which will face me as a member of society? Such problems as divorce, democracy, socialism, the Bomb, and international politics will be critically discussed in the light of readings from both classical and contemporary philosophers.

2 hours per week (Engineering K divisions only).

103 Topics from the Arts and Humanities

The course will explore some of the major movements of thought which are still shaping modern affairs and modern consciousness - including Christianity, Marxism, Racism, Imperialism, Freudianism, Existentialism, and Humanism. Lectures, readings and seminars together should offer an entertaining and stimulating, if glancing, acquaintance with a few of the major strands of the present intellectual environment.

1 lecture and 1 seminar per week.
111 Graphics (A Term)  A course in the fundamentals of graphical projections of all types – orthographic, isometric, oblique and true perspective. Introduction to spatial co-ordinate plotting. Fundamentals of free hand sketching for communication of concept. 
3 hours per week.

111 Graphics (B Term)  The application of graphics to the solution of vector problems, both coplanar and non-coplanar. Graphic calculus, both integration and differentiation, design of all types of nomographs: design of special slide rules: continuation of free hand sketching. 
3 hours per week.

3 hours lecture, term project.

120 Engineering Synthesis  Principles of problem statement, analysis, and concept creation in the design process. Discussion of planning, the flow of information, physical, economic and financial feasibility, and concept selection as related to project design. Discussion of social and economic conditions affecting value and utility, and their relationship with the design process in the solution of engineering problems. The application of simulation, modelling and optimization to the above: three term projects.
2 hours lecture, 1 hour tutorial.

121 Digital Computation  Introduction to electronic digital computers, hardware and software organization; basic features of FORTRAN IV; examples of efficient numerical algorithms for basic scientific computations.
2 hour lecture, 2 hour tutorial, one term.

122 Electricity and Magnetism  Introduction to fundamentals of electromagnetics, circuits, wave motion and propagation. Electromagnetics: Coulomb's Law, electric field and potential, capacitor; resistivity and Ohm's Law; Ampere's Law, magnetic fields and forces, inductor. Circuits: series and parallel circuits, Kirchhoff's laws; ohmic dissipation of energy, stored energies in capacitors and inductors. Wave motion: graphical representation, rotating vectors, superposition. Wave propagation: (i) sound: velocity, wavelength, energy, frequency and resonance. (ii) optics: plane, concave and convex mirrors and lens; reflection and refraction; interference and diffraction, polarization; electricity and light.
3 hour lectures, 2 hours lab, 1 hour tutorial.
Department of Geography

Professor and Chairman of the Department
L.H. Russwurm, B.A., M.A. (Western), Ph.D. (Illinois)

Associate Professor and Acting Chairman, 1972-73
R.R. Krueger, B.A., M.A. (Western), Ph.D. (Indiana)

†Professor and Associate Dean (Environmental Studies Graduate Affairs)
B.C. Matthews, B.S.A. (Toronto), A.M. (Missouri), Ph.D. (Cornell)
G.R. McBoyle, B.Sc., Ph.D. (Aberdeen)

Professor and President of the University
A.G. McLellan, B.Sc., Ph.D. (Glasgow)

†Professor and Dean of Environmental Studies
R.E. Preston, B.A., M.A. (Washington), Ph.D. (Clark)
H.D. Steiner, M.Sc., Ph.D. (Zurich)

Associate Professor and Deputy Chairman

Visiting Professor (fall term)
R.A. Bullock, B.A., M.A. (Belfast), Ph.D. (London)
M.G. George, B.Sc. (Mysore), M.Sc. (Bombay), Ph.D. (Delhi)
A.B. Kesik, M.A., Ph.D. (UMCS – Lublin, Poland)
G.B. Priddle, B.A. (Western), M.A., Ph.D. (Clark)

Visiting Associate Professor (winter term)
R.J.C. Munton, B.A., Ph.D. (Birmingham)

Professors
A. Diem, B.A. (Wayne State), M.A. (Clark), Ph.D. (Michigan)
D.K. Erb, B.Sc. (Western), M.A. (Toronto), Ph.D. (McGill)
R.E. Preston, B.A., M.A. (Washington), Ph.D. (Clark)
H.D. Steiner, M.Sc., Ph.D. (Zurich)

Associate Professors
R.A. Bullock, B.A., M.A. (Belfast), Ph.D. (London)
M.G. George, B.Sc. (Mysore), M.Sc. (Bombay), Ph.D. (Delhi)

†Assistant Professors
C.R. Bryant, B.A., Ph.D. (London School of Economics)
T.E. Bunting, B.A. (York), M.A. (Western)
B. Hyma, B.S., M.S. (Madras), M.S. (Sheffield), Ph.D. (Pittsburgh)
W.B. Mitchell, B.A., M.A. (U.B.C.), Ph.D. (Liverpool)
E.R. Officer, B.A. (U.B.C.), M.A. (Wisconsin)
R.A. Patrick, B.A., M.A. (Queen’s)
D.F. Walker, B.Sc. (London), M.A., Ph.D. (Toronto)

Lecturer
E. Sommerville, B.Sc. (Glasgow)

Lecturer and Cartographer
A.E. Hildebrand, B.A. (Toronto)

†Faculty members appointed also in other Schools or Departments of the Division of Environmental Studies
101* Introduction to Human Geography
An introduction to the nature of geography through a survey of some of the central problems, concepts, methods, techniques and applications of contemporary geographic analysis of man's cultural environment. Two overriding themes are emphasized: the man-land theme, which focuses on the study of the impact of man through time on the landscape, and the locational analysis theme, which focuses on the study of spatial structure and dynamics of socio-economic systems. 
No prerequisite.
3 hours lecture/discussion (fall and winter terms)
Instructors: Preston, Sommerville

102* Introduction to Physical Geography
An ecosystem approach to physical geography is employed which emphasizes that man's natural environment is an integrated system of which man is a part. A systems approach is used to study selected aspects of weather and climate, soils, biogeography, and landforms. Stress is placed on the flows of energy, water and matter and the resultant effects on the subsystems of the natural environment. 
No prerequisite.
2 hours lectures, 2 hours lab-discussion (fall and winter terms)
Instructors: Russwurm, Sommerville

110* Tutorial in Geography
A tutorial for first year geography majors designed to promote close contact with a faculty member. Students will follow a personalized programme within the realm of geography. Times and meetings will be arranged individually.
(fall and winter terms)
Instructors: Faculty

125R* Introduction to the Developing World
An introduction to problems of population growth, resource development, cultural diversity, and of industrial and urban growth in developing areas of the world. Contemporary problems of economic, cultural and demographic differences will be examined in selected regions of Asia and Africa.
No prerequisite.
3 hours (fall term)
Instructor: Hyma

126R* The Emerging “Third World”
The emergence of the “Third World” in international relationships. Background factors: the impact of occidental culture in colonial and post-colonial times; changes in technology, economic organization, rapid population growth, resource development problems, political unrest. The challenge to the wealthy, industrialized countries posed by the needs of the populations of Africa and Asia.
No prerequisite.
3 hours (winter term)
Instructor: Hyma

127* Regional Problems of Europe
An introduction to the geography of Europe which examines agricultural, industrial and urban problems. Lectures, discussions and visual presentations based on field experience of instructors.
One two hour seminar (winter term)
Instructor: Diem
## 201* Some Basic Topics of Physical Geography
Further study of energy and matter flows in the atmosphere and on the land (begun in Geography 102*). Specific topics of study include global radiation balances, energy flux at the land-air interface, weather modification, urban climates, climate classification systems, the physical processes in the pollution of land, air and water, the dynamics and morphology of stream systems and glacial landform systems.

*Prerequisite: Geography 102*.

2 hours lectures, 2 hour lab (winter term)

Instructors: McBoyle, McLellan

## 202* Some Basic Topics of Economic and Urban Geography
Locational analysis of settlement patterns and economic activity. The location theory approach to the problem of rational, spatial allocation of economic activity is compared to the more all-inclusive viewpoint of resource management specialists.

*Prerequisite: A first-year human geography course.

2 hours lectures, 1 hour discussion (fall term)

Instructors: Bryant, Walker

## 203* Some Basic Topics of Cultural and Regional Geography
The approach of the regional geographer is illustrated by reference to one or more world regions. Political, social and historical processes are studied as they affect man’s perceptions of his environment and the identification of culture regions.

*Prerequisite: A first year human geography course.

2 hours lectures, 1 hour discussion (winter term)

Instructors: Bater, Bullock

## 225R* Urbanization in Newly Developing Countries
An analysis of the factors behind the rapid urbanization of selected areas in Asia, Africa and Latin America, with an examination of related problems of urban planning and development control policies.

No prerequisite.

3 hours lectures (fall term)

Instructor: Hyma

## 226R* Population Growth and Resource Development in “Third World” Countries
A discussion of some major problems of population explosion, food supply and economic development faced by the developing countries of the World. Emphasis will be placed on case studies of selected countries like India, China, Indonesia, Egypt, Brazil, Ghana and Nigeria.

No prerequisite.

3 hours lectures (winter term)

Instructor: Hyma

## 232* Geography of Population

No prerequisite.

3 hours lectures (fall term)

Instructor: Hyma

## 251* Urban Areas in North America
An introduction to some basic concepts in urban geography with specific reference to processes and problems of urban development in North America, particularly in Canada.

No prerequisite.

3 hours lectures (fall and winter terms)

Instructors: Bunting, Preston
260* Cartography  Geodetic, surveying and photogrammetric principles as related to mapping. Techniques and materials used in the compilation, design, production and reproduction of thematic maps.  
Prerequisite: Geography 102* and a first year human geography course.  
2 hours lectures, 2 hours lab (fall and winter terms)  
Instructor: Hildebrand

70* Introduction to Cartography and Air Photo Interpretation  Principles of the presentation of the earth’s surface on maps and air photographs. Basic techniques of map compilation and reproduction. Interpretation of air photographs primarily in the field of resource inventory.  
No prerequisite  
2 hours lectures, 2 hours lab (fall and winter terms)  
Instructors: Erb, Hildebrand, Kesik

71* Introduction to Quantitative Research Methods  An introduction to scientific method; descriptive and inferential statistics; computer programmes. This course is the same as Plan. 271* and M. Env. 271*.  
Prerequisite: Only for students in General or Honours Geography, Planning, Man-Environment or Architecture.  
2 hours lecture, 1 hour practical (fall term)  
Instructors: Bryant, Mitchell, Semple, Steiner

72* Computer Programming and Selected Terminal Systems  The course will emphasize programming skills as applied to environmental problems.  
Prerequisite: Geography 271* or consent of instructor.  
3 hours (winter term)  
Same as Plan 272* and M. Env. 272*  
Instructor: Semple

275* Introductory Air Photo Interpretation  Principles of air photography and air photo interpretation. Analysis of different features (bed rocks, land forms, soils, vegetation, rural and urban land use) presented on the air photographs.  
Prerequisite: Geography 102* and a first year human geography course.  
2 hours lectures, 2 hours lab (fall and winter terms)  
Instructors: Erb, Kesik

300* Geomorphology  An evaluation of past and contemporary positions of this subdiscipline. The basic geomorphological processes are critically examined in relation to climate, vegetation, soils, geology, and man. Emphasis will be placed on the geomorphological problems of Southern Ontario.  
Prerequisite: Env. S. 200* and Geography 201* or consent of instructor.  
2 hours lectures, 2 hour lab (fall term)  
Instructor: McLellan

Prerequisite: Geography 201* or consent of instructor.  
2 hours lectures, 2 hours lab. (winter term)  
Instructor: McBoyle
307* Social Survey Techniques

Social research and the planning process; interview and self administered surveys; questionnaire design; profile data; sampling; data processing; non-survey data collection techniques; practical applications. This course is the same as Plan. 307*.

Prerequisite: Geography 271*; may be taken in 2nd or 3rd year.
2 hours lectures, 1 hour practical or discussion (winter term)
Instructor: Burton

310* Advanced Econ. Geog. 1 Resources Management

Theoretical and conceptual approaches to resources studies; evaluation of management practices in fisheries, forestry, petroleum, minerals and water; research techniques.
Prerequisite: Geography 202* or consent of instructor.
3 hours (fall term)
Instructor: Mitchell

311* Advanced Econ. Geog. 2 Manufacturing and Transportation

Studies in the geography of manufacturing and transportation: further development of theory and empirical studies of Canada and the United Kingdom.
Prerequisite: Geography 202* or consent of instructor.
3 hours (fall term)
Instructor: Walker

315* Agricultural Geography

An introduction to and analysis of agricultural concepts and systems.
Prerequisite: Geography 102* and a first year human geography course
3 hours (fall term)
Instructor: Coppock

316* Multivariate Statistics

The theory and application of multivariate statistics, with particular emphasis upon use of the computer. Same as Plan. 316*.
Prerequisite: Geography 271* or consent of instructor
3 hours seminar and/or tutorial (fall term)
Instructor: Steiner

317* Nonparametric Statistics

The theory and application of nonparametric statistics, with particular emphasis upon social science problems. Same as Plan. 317*.
Prerequisite: Geography 271* or consent of instructor.
2 hours lectures, 1 hour practical (winter term)
Instructor: Mitchell

318* Spatial Analysis

Advanced quantitative analysis applied to spatial patterns and interactions. The course will focus on a selection of techniques from gravity models, linear programming, nearest neighbour analysis, Markov chain analysis, graph theory, simulations, and trend surface analysis. This course is the same as Plan. 318*.
Prerequisite: Geography 271* or consent of instructor.
3 hours (winter term)
Instructors: Bryant, Walker

319* Regional Planning Techniques

Application of economic and social measurement techniques in regional planning; includes discussion of input-output analysis; regional accounting techniques; cost-benefit analysis; planning, programming and budgeting systems; the multiplier and accelerator concepts; and balance of payments. This course is the same as Plan. 319*
Prerequisite: Geography 271* or consent of instructor.
3 hours seminar and/or tutorial (fall term)
Instructor: Burton
320 World Regional Geography  
Study in depth of selected areas of the world's climatic regions, emphasizing characteristic problems as well as their physical, cultural and economic interrelationships. Utilization of natural resources, the effects of increasing population density, the occupation and utilization of urban and rural lands, and the effects of man's tools, techniques, and institutions on the earth's surface.

*No prerequisite.*

2 hours lectures, 2 hour lab (year)

Instructor: Diem

321* Geographic Perspectives on Contemporary Problems of the American Environment 
Focus on three critical problem areas of contemporary life in America: the cities, regional economic disparities, and the natural environment. Student participation through individual and collective project-seminar work makes liberal use of audio-visual materials to generate interest, to spark discussion and to serve as a substitute for the field experience.

*Prerequisite: Any half course in human geography or consent of instructor.*

3 hours (winter term)

Instructor: Sommerville

322* Geographical Study of Canada 
Geographical basis of Canada and Canadian issues. Selected problems relating to environmental quality, urbanization, regional and resource development. Students may not take both Geography 322* and Planning 222*.

*No prerequisite.*

3 hours (fall term)

Instructor: Krueger

323* Geographical Study of a Selected Region 
A geographical analysis of a selected region and its current problems. The region chosen in any given year will depend on the specialized knowledge of faculty available and student demand.

*No prerequisite.*

3 hours

Not offered 1972-73

324* Soviet Geography 
Introduction to the geography of the Soviet Union, with a focus on selected problems in urbanization, industrialization, resource use and regional economic development in a planned economy.

*No prerequisite*

3 hours (fall term)

Instructor: Boter

325* Africa 
The geography of modern Africa south of the Sahara in the context of changing attitudes to the continent on the part of the "developed" countries.

*No prerequisite*

3 lectures (fall term)

Instructor: Bullock

330* Cultural Geography 
Problems in the delimitation of cultural regions. A study of the diversity of man in his relations with his environment.

*Prerequisite: Geography 203* or consent of instructor.

3 hours (fall term)

Instructor: Bullock
331* Special Topics in Cultural Geography
A detailed investigation of selected issues in man's relations with the natural environment. Given as a seminar. Issues will be partially selected on the basis of the interests of participants.
Prerequisite: Geography 330* or consent of instructor.
3 hours (winter term)
Instructor: Bullock

332* Special Topic In The Geography of Population
Detailed study of selected topics of population geography.
Prerequisite: Geography 232* or consent of instructor.
3 hours (winter term)
Instructor: Hyma

341* Historical Geography of Canada 1
The changing geographies of settlement and resource use from the Discoveries to the early nineteenth century.
Prerequisite: Geography 203* or consent of instructor.
3 hours (fall term)
Instructor: Officer

342* Historical Geography of Canada 2
The changing geographies of settlement and resource use in the nineteenth and early twentieth centuries.
Prerequisite: Geography 341* or consent of instructor.
3 hours (winter term)
Instructor: Officer

345* Political Geography
A study of differences from place to place in political phenomena. Subjects covered include the interrelationships of states and nations, centripetal and centrifugal "forces" within states, electoral geography, boundary and frontier problems, the location of capital cities, internal organization of states, external relations, and geopolitics.
Prerequisite: Geography 203* or consent of instructor.
3 hours
Instructor: Patrick

350* Advanced Urban Geography 1
The external structure and function of urban centres and their role in the spatial economy. Studies of the growth and support of urban centres and city systems, of the outward growth of cities, and of analytical techniques available for such studies are emphasized.
Prerequisite: Geography 202* or 251* or consent of instructor.
3 hours (fall term)
Instructors: Preston, Russwurm

351* Advanced Urban Geography 2
An examination of theories, models and research procedures appropriate to the study of internal urban structure.
Prerequisite: One of Geography 202*, 251*, 351* or consent of instructor.
3 hours (winter term)
Instructor: Bunting

357* Conservation and Resource Management
History of the conservation movement; ecological principles of conservation and resource management and the development of resources. Analysis, use and planning of recreational resources. The course is the same as Plan. 357* and M. Env. 357*.
Prerequisite: Env. S. 200*
3 hours (winter term)
Instructors: Dorney, George, Kitchen, Theberge
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Prerequisites</th>
<th>Instructor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>381*</td>
<td>The Nature of Geography</td>
<td>The past traditions in geography. Modern trends in geographical research and teaching.</td>
<td>*Prerequisite: Any three full geography credits or consent of instructor. 2 hours seminar (fall and winter terms)</td>
<td>McBoyle, Munton</td>
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<tr>
<td>391*</td>
<td>Field Research</td>
<td>One week field camp session during which a specific area will be analysed from a geographic point of view. Students will be expected to undertake individual or group analysis of specific problems and must present the results in a written report.</td>
<td>*Prerequisite: Third Year Honours Geography students only or consent of instructor. 2 hours seminar (fall term) Estimated cost to student: $45.00</td>
<td>McLellan, Priddle</td>
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<tr>
<td>400*</td>
<td>Climatic and Periglacial Morphology and Geomorphological Surveying</td>
<td>Characteristics of the main principles of climatic and climato-genetic geomorphology. Examination of processes and forms related to the periglacial environment. Principles of morphological surveying: morphology, geomorphological mapping, basic laboratory techniques.</td>
<td><em>Prerequisite: Geography 300</em> or Earth Science 342* or consent of instructor. 3 hour seminar/lab (fall term)</td>
<td>Kesik</td>
</tr>
<tr>
<td>401*</td>
<td>Glacial Geomorphology and some Contemporary Applications</td>
<td>Advanced study of the total effect of glaciation. Glacial and fluvio-glacial deposits and depositional conditions will be analysed. Special attention on the environmental influence of glaciation and on practical applications of the glacial geomorphologists’ techniques and information.</td>
<td><em>Prerequisite: Geography 300</em> or Earth Science 342* or consent of instructor. 3 hour seminar/lab. Not offered 1972-73</td>
<td>Kesik</td>
</tr>
<tr>
<td>402*</td>
<td>Physical and Chemical Processes in Geomorphology</td>
<td>Applications of the principles of soil and rock mechanics, hydrology, and geochemistry in the analysis of geomorphic processes; watershed behaviour, fluvial processes, sediment transport, dynamics of shoreline behaviour, evolution of natural slopes, chemical processes in weathering and applications to various geologic conditions, hydrologic and chemical interactions in karst phenomena, role of ice in river and frozen ground systems. Cross listed as Earth Science 445*.</td>
<td><em>Prerequisite: Geography 300</em> or Earth Science 342* or consent of instructor. 2 hours lectures, 1 lab (winter term)</td>
<td>Cherry</td>
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<tr>
<td>403*</td>
<td>Advanced Cartography</td>
<td>Advanced study of numerical map analysis and computer mapping techniques.</td>
<td><em>Prerequisite: Geography 260</em>, 271* or consent of instructor. 2 hours seminar and/or tutorial (winter term)</td>
<td>Steiner</td>
</tr>
</tbody>
</table>
406* Tropical Geomorphology  
Basic geomorphological concepts and their application in a tropical environment. Special emphasis on morphology and processes as related to the geological foundation.
*Prerequisite: Geography 300* or Earth Science 342* or consent of instructor.
3 hour seminar/lab (winter term)
Instructor: Erb

407* Field and Lab Techniques in Geomorphology  
An analysis of the range of techniques used by geomorphologists. This course will involve intensive field and laboratory work with the possibility of a weekend field trip.
*Prerequisite: Geography 300* or Earth Science 342*. or consent of instructor.
3 hour seminar/lab
Not offered 1972-73

408* Special Topics in Climatology  
Special studies in economic aspects of climate; atmospheric pollution potential; perception of urban climate and air pollution; weather modification; the atmosphere as a natural resource system.
*Prerequisite: Geography 301*.
3 hours seminar (fall term)
Instructor: McBoyle

410* Recreation Geography  
The environmental implications of existing and potential recreational demands. Recreational travel, site capability, economic and ecological impact models will be considered as well as the normative behavioural aspects of amenity resources.
*Prerequisite: Geography 310* or consent of instructor.
3 hours (fall term)
Instructor: Priddle

411* Resource Studies  
Study of natural resource problems, with particular attention upon the role of foreign investment and the global corporations in developing resources in Canada and other selected countries.
*Prerequisite: Geography 310* or Geography 410*.
3 hours (winter term)
Instructors: Mitchell, Priddle

412* Industrial Geography  
Industrial location theory will be assessed through empirical analysis of the spatial organization of the workshop factory continuum at both urban and regional scales. Some attention will also be given to industrial location theory and problems in a planned economy.
*Prerequisites: Geography 311* or consent of instructor.
3 hours (winter term)
Instructors: Bater, Walker

413* Behavioural Studies  
Studies of the behaviour of individuals, groups and organizations in interaction with their environment. Emphasis will be placed on environmental perception and decision-making.
*Prerequisite: One of Geography 310*, 311*, or 351* or consent of instructor.
3 lectures (winter term)
Instructor: Priddle
415* Special Topics in Urban Geography 1
Detailed examination of selected aspects of urban geography with emphasis on research methodology. Special attention is paid to applied studies based on geographic theory.
Prerequisite: Geography 350*/351* or consent of instructor.
2 hour seminar (fall term)
Instructor: Bunting

416* Special Topics in Urban Geography 2
Continuation of Geography 415* but with emphasis on behavioural studies and systems theory.
Prerequisite: Geography 415*.
2 hour seminar (winter term)
Instructors: Bunting, Russwurm

421 Europe and the Mediterranean
Detailed study of physical, cultural, economic, and political geography of non-communist Europe. Geographical aspects of the development of cities, problems of agriculture, changing industrial patterns, distribution of trade, regional disparities, and planning on the city, regional and national levels.
No prerequisite.
3 hours (year)
Instructor: Diem

422* Canada
Seminar on the geographical analysis of selected Canadian development problems. Emphasis on topics of continuing Canadian concern and methods of teaching Canadian geography.
Prerequisite: Geography 322* or equivalent.
2 hours seminar (winter term)
Instructor: Krueger

423* Eastern Europe
Detailed study of physical, cultural, economic, and political geography of Eastern Europe. Geographical aspects of agricultural problems, industrialization, distribution of trade, economic planning, and relations with the Soviet Union and the West.
No prerequisite.
Not offered 1972-73

424* Soviet Geography
Advanced study of selected aspects of the geography of the Soviet Union. A degree of flexibility in the course allows some emphasis on topics of particular interest to the students registered in it.
Prerequisite: Geography 324* or consent of instructor.
2 hours seminar (winter term)
Instructor: Bater

425* East Africa
Examination of selected aspects of the geography of a major region in Africa with particular reference to problems of development. The region will normally be East Africa; a degree of flexibility will facilitate the selection of topics related to the interests of participants.
Prerequisite: Geography 325* or consent of instructor.
2 hours seminar (winter term)
Instructor: Bullock

426-432
In this group of courses other selected world regions will be analysed. The areas chosen will depend on faculty availability and student demand, e.g. Middle East, Latin America, U.S.A, Asia, Polar Lands, & Oceania.
Not offered 1972-73
<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
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</table>
| 430         | Field Research in Regional Geography            | A detailed analysis of a selected region with major emphasis upon a field examination of the region (2-3 weeks duration) in spring. **Prerequisite:** Fourth year honours geography students or consent of instructor. 2 hours seminar  
Not offered 1972-73                                                                                             |
| 451*        | Soils Geography                                 | An analysis of the factors affecting soil development and classification. Techniques of soil survey and land classification. **Prerequisite:** Env. S. 200* and Geography 201* or consent of instructor. 2 hours seminar (fall term)  
*Instructor: Matthews*                                                                                             |
| 452*        | Problems of Rural Land Use                      | An analysis of the nature of rural land use problems, and a critical evaluation of the methods of rural land use planning. **Prerequisite:** Consent of instructor. 2 hours seminar (winter term)  
*Instructor: Bryant*                                                                                              |
| 460         | Land Dereliction and Rehabilitation             | The course will examine the reasons for land dereliction, its processes, and its effects. Analysis of techniques to rehabilitate such areas will range from principles of landscape architecture to complementing needs of local communities, to optimizing ecological considerations and use of post operation areas. Students examine an area and gather data necessary to prepare an objective and acceptable proposal in the form of a report on methods of operations and post operation rehabilitation. **Prerequisite:** Consent of instructor. 2 hour seminar (year)  
*Instructors: Kitchen, McLellan*                                                                                   |
| 470*        | Advanced Air Photo Interpretation 1             | Advanced studies in air photo interpretation and its application in geomorphology, geology, terrain analysis, geography and resources survey. **Prerequisite:** Geography 275* or 300* or consent of instructor. 3 hours seminar and/or lab. (fall term)  
*Instructor: Erb*                                                                                                  |
| 471*        | Advanced Air Photo Interpretation 2             | Data gathering from air photos by interpretation and measurement with emphasis on agricultural and urban geography. Recent advances in remote sensing (satellite photography, thermal infrared and radar imagery, multiband imagery). Spectral analysis, image quality, image processing. **Prerequisite:** Geography 275* and 300* or consent of instructor. 3 hours seminar and/or lab (winter term)  
*Instructor: Steiner*                                                                                             |
| 475*        | Special Readings and Seminar on Selected Topics | **Prerequisite:** Honours Geography students and consent of instructor. 2 hours seminar and/or tutorial (fall and winter terms)  
*Instructors: Faculty*                                                                                             |
| 476         | Special Readings and Seminar on Selected Topics | **Prerequisite:** Honours Geography students and consent of instructor. 2 hours seminar and/or tutorial (year)  
*Instructors: Faculty*                                                                                             |
### 480* Development of Geographical Thought

Historical development of the discipline of geography; contributions of the German, French, British and American geographers in the nineteenth and twentieth centuries.  
*Prerequisite: 3 full credits in geography or consent of instructor.*  
2 hours seminar (fall term)  
Not offered 1972-73

### 481* Frontiers in Geography

*Prerequisite: 3 full credits in geography or consent of instructor.*  
2 hours seminar (winter term)  
Instructor: McBoyle

### 490 Senior Honours Research

**Essay**  
*Prerequisite: Honours Geography students only.*  
3 hours seminar (year)  
Instructors: Faculty
Professor, Chairman of the Department
J.W. Dyck, A.B. (Bethel), M.A. (Missouri), Ph.D. (Michigan)

Associate Professor, Deputy Chairman
M. Richter, Staatsexamen (Berlin and Bonn), M.A., Ph.D. (Toronto)

Professors
E. Heier, B.A., M.A. (British Columbia), Ph.D. (Michigan)
S. Hoefert, B.A., M.A., Ph.D (Toronto)
I. Levitsky, A.B. (Rochester), M.A. (Buffalo), Ph.D. (Duke)

Visiting Professors
H. Boeschenstein, Ph.D. (Rostock), F.R.S.C.
R.C. Paulin, B.A., M.A. (N.Z.), Ph.D. (Heidelberg)

Associate Professors
W. Shelest, Diploma (Munich), M.A. (Ottawa), Ph.D (Munich)
J. Whiton, B.A., M.A., Ph.D. (Minnesota)

Assistant Professors
A. Donskov, B.A., M.A. (British Columbia), Ph.D. (Helsinki)
G. Firnau (MRS.), Staatsexamen (Berlin), Ph.D. (Yale)
M. Kuxdorf, B.A., M.A. (Waterloo), Ph.D. (Alberta)
H.W. Panthel, B.A. (Waterloo), M.A. (Cincinnati), Ph.D. (Waterloo)
A. Zweers, Doctorandus (Amsterdam), litt. Dr. (Groningen)

Lecturers
F. Jakobsh, B.A., M.A. (Manitoba), Ph.D. (Waterloo)
T. Sommer (Miss), B.A., M.A. (Waterloo)

(Part-time) H. Marsden (Mrs.) B.A. (Randolph-Macon), M.A. (Waterloo)

Dean of Women

Undergraduate Courses

German

Note 1 All courses with the exception of German 10 are one term (half) courses.
Note 2 Half courses are designed for the convenience of students (Engineering and other Co-operative) who are enrolled in term-programmes. Nevertheless, to obtain credit Arts students must follow up—though not necessarily in the same year—101 with 102 or 112: 111 with 112 or 102: 121 with 122; 201 with 202; 241 with 242; 251 with 252; 271 with 272; 351 with 352; 451 with 452.
Note 3 Any other two term (half) courses constitute one full course.
Note 4 Except for German 10, all the following courses are Honours courses, but are also open to students enrolled in General programmes.
Note 5  The Department offers a programme in German language and literature at the University of Mannheim on the Rhine. The programme is open to 3rd and 4th-year students normally qualified to enrol in German courses at this level. In exceptional cases, 2nd-year students will also be considered. Students who would like to being their studies in Mannheim in the Winter Semester (Oct. 15 to Feb. 15) must apply by April 1. The application deadline for those who would like to begin their studies in the Summer Semester (April 15 to July 15) is Feb. 1. Applications should be submitted to: “Waterloo in Germany” Department of Germanic and Slavic Languages and Literatures, University of Waterloo, Waterloo/Ontario.

10 Reading and Translation  This course is designed to assist graduate students in acquiring a reading knowledge of German. Usage and structure of German scientific writings. Translation in fields of specialization.  
Two terms. Lectures arranged.  
Open to graduate students of all departments.

101* First Year German  (Arts Oriented) For students with little or no knowledge of German.  
(Not open to students with Ontario High School Grade 13 German or equivalent, and for students who have credit for German 111/112.) The basic elements of German grammar with an emphasis on oral practice and pronunciation. Language laboratory. Introduction to aspects of German culture and reading of appropriate graded texts.  
Open to all university students.  
One term. 4 hours.

102* First Year German  (Arts Oriented) Course description as in German 101.  
Prerequisite: German 101, or German 111, or equivalent.

111* First Year German  (Science Oriented) For students with little or no knowledge of German.  
(Not open to students with Ontario High School Grade 13 German or equivalent, and for students who have credit for German 101/102). The basic elements of German grammar with an emphasis on reading and translation of elementary scientific literature from various fields. The basic elements of German pronunciation. Introduction to aspects of German culture.  
Open to all university students.  
One term. 3 hours

112* First Year German  (Science Oriented) Course description as in German 111.  
Prerequisite: German 111, or German 101, or equivalent.

121* Introduction to German Literary Movements  Reading and interpretation of selected works by major German authors. Oral practice, composition, grammar.  
One term. 3 hours (lectures and language lab.).  
Prerequisite: This course is normally for students with at least two years of high school German. Other students with equivalent knowledge of German should obtain the permission of the instructor.

122* Introduction to German Literary Movements  Course description as in German 121.
201* Scientific German
A review of the fundamentals of grammar is followed by a more advanced study of language structure and idiom. Readings and translation from contemporary scientific writing in the Physical Sciences with the aim of helping the student to acquire a greater vocabulary and to master the stylistic difficulties peculiar to technical writing. The reading material will be selected in accordance with the field of study of the individual student.
One term. 3 lectures.
Prerequisite: German 102, 112 or equivalent.

202* Intermediate Scientific German
Course description as in 201.
One term. 3 lectures.
Prerequisite: German 201 or equivalent.

221* Development of the German Theatre
A historical study of the major developments of German theatre from the beginnings to Storm and Stress. The development of dramatic criticism, acting and stage design will also be discussed. The production of a play of the time covered in this course is envisaged. This course is taught in English.
One term. 3 lectures.
Prerequisite: None.

222* Development of the German Theatre
A historical study of the major developments of German theatre from the Classical period to the present. The development of dramatic criticism, acting and stage design will also be discussed. The production of a play of the time covered in this course is envisaged. This course is taught in English.
One term. 3 lectures.
Prerequisite: None.

241* German Conversation and Composition
This course offers extensive practice in both the spoken and written language. It provides vocabulary building, grammar review, and exercises in pronunciation and comprehension.
One term. 3 hours (lectures and language lab.).
Prerequisite: German 102, 112, or permission of instructor.
Not open for students who have credit for German 251/252.

242* German Conversation and Composition
Course description as in German 241.
One term. 3 hours (lectures and language lab.).
Prerequisite: German 241 or equivalent.

251* German Conversation and Composition
This course offers extensive practice in both the spoken and written language. It provides vocabulary building, grammar review, and exercises in pronunciation and comprehension.
One term. 3 hours (lectures and language lab.).
Prerequisite: German 122 or permission of instructor.
Not open for students who have credit for German 241/242.

252* German Conversation and Composition
Course description as in German 251.
One term. 3 hours (lectures and language lab.).
Prerequisite: German 251 or equivalent.

261* German Classicism
Reading, interpretation, and critical analysis of representative works (Goethe, Schiller, Kleist, Hölderlin, etc.).
One term. 3 lectures.
Prerequisite: German 102, 122 or permission of instructor.
262* German Romanticism  
Reading, interpretation, and critical analysis of representative works (Novalis, Brentano, Tieck, Eichendorff, etc).
One term. 3 lectures.
Prerequisite: German 102, 122 or permission of instructor.

271* German Thought and Culture  
A survey of cultural currents to the time of Enlightenment. Lectures will focus on major developments in literature, philosophy, religion, art, architecture, and music as seen against the historical background of the German speaking peoples. This course is taught in English.
One term. 3 lectures. Prerequisite: none.

Note: Arts students can take this course in their second or subsequent years, students of other faculties in any year (p. 97 for course requirements in the Faculty of Arts).

272* German Thought and Culture  
A survey of cultural currents from Goethe to the present. Lectures will focus on major developments in literature, philosophy, religion, art, architecture, and music as seen against the historical background of the German speaking peoples.
This course is taught in English.
One term. 3 lectures.

351* Intermediate Conversation  
Written reports on prescribed themes and topics. Oral drill.
One term. 3 lectures (language lab.).
Prerequisite: German 242, 252 or equivalent.

352* Intermediate Conversation and Composition  
Course description as in German 351.
One term. 3 lectures.
Prerequisite: German 351.

361* Young Germany and Biedermeier  
Reading, interpretation, and critical analysis of prescribed prose, drama and poetry.
One term. 3 lectures.
Prerequisite: German 102 or 122.

362* Poetic Realism  
Reading, interpretation, and critical analysis of prescribed prose, drama and poetry.
One term. 3 lectures.
Prerequisite: German 102 or 122.

371* Modern German Literature  
Reading and interpretation of prescribed works from early Naturalism to the Twenties.
One term. 3 lectures.
Prerequisite: German 102 or 122.

372* Modern German Literature  
Reading and interpretation of prescribed works from the Twenties to the present.
One term. 3 lectures.
Prerequisite: German 102 or 122.

381* Enlightenment  
Reading, interpretation, and critical analysis of prescribed prose, drama and poetry (Brokes, Haller, Gellert, Klopstock, Lessing, Wieland, etc.).
One term. 3 lectures.
Prerequisite: German 102 or 122.
382* Storm and Stress
Reading, interpretation, and critical analysis of prescribed prose, drama and poetry (Herder, Goethe, Lenz, Klinger, Schiller, etc.).
One term. 3 lectures.
Prerequisite: German 102 or 122.

391* Masterpieces of German Literature
A study of significant prose and dramatic works of German literature from 1770 to the present. These works will be studied in groups according to themes such as: political freedom and tyranny, personal responsibility and egoism, flesh and spirit, man in society. The works studied will include titles such as: Prinz von Homburg (Kleist), Wayzeck (Büchner), Thus Spake Zarathustra (Nietzsche), Death in Venice (Thomas Mann), Steppenwolf (Hesse), Metamorphosis. The Trial (Kafka), plays by Brecht, Hochhuth, Weiss, and others.
This course is taught in English.
One term. 3 lectures.
Open to all students.

392* Masterpieces in German Literature
Course description as in German 391.
One term. 3 lectures.
Open to all students.

451* Advanced Conversation, Grammar and Composition
This course is conducted in German and provides intensive practice in spoken and written German on the advanced level.
One term. 3 lectures.
Prerequisite: German 352 or equivalent.

452* Advanced Conversation, Grammar and Composition
As 451.
Prerequisite: German 451.

461* Introduction to the History of the German Language with Readings in Middle High German
One term. 3 lectures.
Prerequisite: German 102 or 122.

462* Middle High German Literature
Reading and interpretation of prescribed works of the first “Bluetezeit” in German literature. (Walther von der Vogelweide, Reinmar der Alte, Heinrich von Morungen, Wolfram von Eschenbach, Gottfried von Strassburg, Nibelungenlied, etc.).
One term. 3 lectures.
Prerequisite: German 461.

471* German Poetry
A study of the main thoughts, themes, forms, and schools in German poetry from the beginnings to Goethe.
One term. 3 lectures.
Prerequisite: German 102 or 122.

472 German Poetry
A study of the main thoughts, themes, forms, and schools in German poetry from German Romanticism to the present.
One term. 3 lectures.
Prerequisite: German 102 or 122.

481* Renaissance/Humanism
Reading, interpretation, and critical analysis of prescribed texts (Tepl, Brant, Erasmus, Luther, Sachs, Bidermann, etc.).
One term. 3 lectures.
Prerequisite: German 102 or 122.
482* Baroque  Reading, interpretation, and critical analysis of prescribed texts (Opitz, Gryphius, Grimmelshausen, Reuter, Fleming, Hofmannswalda, Angelus Silesius, Guenther, etc.).
One term. 3 lectures.
Prerequisite: German 102 or 122.

495*-498* Reading Course in Approved Topics  One term each, 3 lectures.
Open to fourth year students only.

Russian

Note 1  All courses with the exception of Russian 10 are one term (half) courses.
Note 2  Half courses are designed for the convenience of students (Engineering and other Co-operative) who are enrolled in term-programmes.
Nevertheless, to obtain credit Arts students must follow up — though not necessarily in the same year — 101 with 102; 111 with 112; 201 with 202; 251 with 252; 271 with 272; 351 with 352; 381 with 382; 451 with 452.
Note 3  Any other two term (half) courses constitute one full course.
Note 4  Except for Russian 10, all the following courses are Honours courses, but are also open to students enrolled in General programmes.

10 Reading and Translation  This course is designed to assist graduate students in acquiring a reading knowledge of Russian. Usage and structure of Russian scientific writings. Translation in fields of specialization.
Two terms. Lectures arranged.
Open to graduate students of all departments.

101* First Year Russian  (Arts Oriented) For students with little or no knowledge of Russian. The elements of Russian grammar and composition, with emphasis on oral practice and pronunciation. Language Laboratory and Visual aids. Selected readings of major Russian authors.
Open to all university students, except those who have credit for Russian 111/112.
One term. 4 hours.

102* First Year Russian  (Arts Oriented) Course description as in Russian 101.
One term. 4 hours.
Prerequisite: Russian 101 or equivalent.

111* First Year Russian  (Science Oriented) For students with little or no knowledge of Russian. Essential grammar, sentence structure. Reading and translation of scientific, literature according to the students' fields of interest.
Open to all university students, except those who have credit for Russian 101/102.
One term. 3 hours.

112* First Year Russian  (Science Oriented) Course description as in Russian 111.
One term. 3 hours.
Prerequisite: Russian 111, Russian 101, or equivalent.
201* Scientific Russian  
A review of the fundamentals of grammar is followed by a more advanced study of the language structure and idiom. Readings and translation from contemporary scientific writing in the Physical Sciences with the aim of helping the student to acquire a greater vocabulary and to master the stylistic difficulties peculiar to technical writing. The reading material will be selected in accordance with the field of study of the individual student.  
Prerequisite: Russian 102, 112 or equivalent.  
One term. 3 lectures.

202* Intermediate Scientific Russian  
Course description as 201.  
Prerequisite: Russian 201 or equivalent.  
One term. 3 lectures.

251* Conversation, Composition, Grammar and Phonetics  
This course is conducted largely in Russian and provides intensive practice in spoken Russian. Vocabulary building, comprehension, pronunciation and intonation are stressed.  
Prerequisite: Russian 102, 112 or equivalent.  
One term. 3 hours (lectures and language lab.).

252* Conversation, Composition, Grammar and Phonetics  
As 251.  
Prerequisite: Russian 251 or equivalent.  
One term. 3 hours (lectures and language lab.).

261* Introduction to Russian Literary Movements  
Reading of representative works from Russian Classicism, Romanticism, 19th Century Realism, and various periods of 20th century Russian literature.  
Prerequisite: Russian 102 or permission of instructor.  
One term. 3 lectures.

262* Introduction to Russian Literary Movements  
As 261.  
Prerequisite: Russian 261.  
One term. 3 lectures.

271* Russian Thought and Culture  
A survey of cultural history from 862 to 1861. Lectures will focus on major developments in literature, religion, philosophy, art, architecture, and music as seen against the background of Russia's historical past. This course is taught in English.  
Note  
Arts students can take this course in their second or subsequent years, students of other faculties in any year (p. 97 for course requirements in the Faculty of Arts).

272* Russian Thought and Culture  
A survey of cultural history from 1861 to the present. Lectures will focus on major developments in literature, philosophy, art, and music as seen against the background of Russia's historical past. Discussions will be devoted primarily to works of Russian literature. This course is taught in English.  
One term, 2 lectures, 1 discussion.

351* Intermediate Conversation and Composition  
Written reports on prescribed themes and topics. Oral drill and translation.  
Prerequisite: Russian 252 or equivalent.  
One term. 3 lectures.
352* Intermediate Conversation and Composition  
As 351.  
Prerequisite: Russian 351.  
One term. 3 lectures.

361* Russian Realism  
(Aksakov, Gogol, Goncharov, Turgenev, Tolstoy, Ostrovsky). Reading, interpretation, and critical analysis of selected fiction and drama.  
Prerequisite: Russian 102.  
One term. 3 lectures.

362* Russian Realism  
(Chernyshevsky, Leskov, Dostoevsky, Saltykov-Shchedrin, Chekhov). Reading, interpretation, and critical analysis of selected fiction and drama.  
Prerequisite: Russian 102.  
One term. 3 lectures.

71* The Golden Age of Russian Literature  
Reading and interpretation of prescribed prose, drama and poetry from Lomonosov to Pushkin.  
Prerequisite: Russian 102.  
One term. 3 lectures.

72* The Golden Age of Russian Literature  
Reading and interpretation of prescribed prose, drama and poetry from Pushkin to the 1860's.  
Prerequisite: Russian 102.  
One term. 3 lectures.

381* The Peoples of the Soviet Union  
Especially emphasized will be the study of non-Slav peoples of the Caucasus and Central Asia, European Russia and Siberia. Czarist and Soviet policy towards national minorities, assimilation and integration problems in the light of linguistic divisions; development of literary languages. Some achievements of Soviet anthropology  
One term. 3 lectures.

382* The Peoples of the Soviet Union  
As 381.  
Prerequisite: Russian 381.  
One term. 3 lectures.

391* Great Russian Novels  
Themes especially emphasized will be: the complex society, its merits, responsibility or guilt in relation to the individual; East-West confrontation; reform ideas; Nihilism; the superfluous man; tears behind laughter, etc.  
This course is taught in English.  
One term. 3 lectures.  
Open to all students.

392* Great Russian Novels  
Themes as in Russian 391.  
This course is taught in English.  
One term. 3 lectures.  
Open to all students.
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
</table>
| 451*        | Advanced Conversation, Grammar and Composition | This course is conducted in Russian and provides intensive practice in spoken and written Russian on the advanced level.  
Prerequisite: Russian 352 or equivalent.  
One term. 3 lectures. |
| 452*        | Advanced Conversation, Grammar and Composition | As 451.  
One term. 3 lectures. |
| 451*        | Advanced Conversation, Grammar and Composition | As 451.  
One term. 3 lectures. |
| 461*        | Twentieth Century Russian Literature | (Andreev, Bunin, Gorky, Kataev, Sholokhov, A.N. Tolstoy). Reading, interpretation, and critical analysis of selected fiction and drama.  
Prerequisite: Russian 102.  
One term. 3 lectures. |
| 462*        | Twentieth Century Russian Literature | (Arbusov, Bulgakov, Erenburg, Nabokov, Pasternak, Solzhenitsyn). Reading, interpretation, and critical analysis of selected fiction and drama.  
One term. 3 lectures. |
| 471*        | The Image of Russia and the Russians in Western Thought and Writings | This is a critical appraisal of the changing image of the Russian and Russia as presented by West European writers, poets and thinkers.  
Consideration will also be given to the image of western man in Russian literature.  
One term. 3 lectures. |
| 472*        | The Image of Russia and the Russians in Western Thought and Writings | As 471.  
One term. 3 lectures. |
| 481*        | Russian Poetry | A study of themes and forms of representative authors of Classicism, Romanticism (Lomonosov, Derzhavin, Pushkin, Lermontov, Nekrasov, Fet, Tiutchev, etc.).  
Prerequisite: Russian 102.  
One term. 3 lectures. |
| 482*        | Russian Poetry | A study of themes and forms of representative authors from Symbolism to the present (Blok, Esenin, Mayakovsky, Akhmatova, etc.).  
Prerequisite: Russian 102.  
One term. 3 lectures. |
| 495*-498*   | Reading Course in Approved Topics | Open to fourth year students only.  
One term each. 3 lectures. |
Ukrainian

101* Beginners' Ukrainian
Intensive language study. Basic grammar, reading, oral practice in language lab, translation, and writing exercises.
One term. 3 hours.
Open to undergraduate students of all departments; recommended to graduate students of Russian as a second Slavic language.

102* Intermediate Ukrainian
Reading from selected texts, oral practice, translation, grammar with the aim of helping to master pronunciation and syntax. Intensive exercises in composition.
One term. 3 hours.
Prerequisite: Ukrainian 101 or equivalent.

201* Introduction to Ukrainian Literature
The place of Ukrainian in the Slavic family of languages, review of grammar; reading of texts chosen from the works of Ukrainian authors (Skovoroda, Kotliarevsky, Franko, L. Ukrainka, Rylsky and others).
Prerequisite: Admission by consent of the instructor.
One term. 3 lectures.

202* Introduction to Ukrainian Literature
A critical survey of Ukrainian literature from Kotliarevsky to the present.
Prerequisite: Ukrainian 201 or admission by consent of the instructor.
One term. 3 lectures.

301* Ukrainian Romanticism
Taras Shevchenko and his Time. Kharkov and Kiev as literary centers; the Brotherhood of SS. Cyril and Methodius; reading and critical interpretation of prescribed prose, drama, and poetry. (Shevchenko, Kostomariv, Kulish, and others).
Prerequisite: Ukrainian 202 or admission by consent of the instructor.
One term. 3 lectures.

302* Ukrainian Romanticism
The literary revival in Western Ukraine. A critical study of the literary movement with special emphasis on the major authors (Shashkevych, Walievych, Holavats'ky and others).
Prerequisite: Ukrainian 301 or admission by consent of the instructor.
One term. 3 lectures.
Department of History

Associate Professor, Acting Chairman of the Department
D. N. Baker, B.A. (U.B.C.), A.M., Ph.D. (Stanford)

Professor, Acting Vice-President, Academic
P. G. Cornell, E.D., M.A., Ph.D. (Toronto)

Professor, Acting Dean, Faculty of Arts
J. F. H. New, B.A., M.A. (Melbourne), Ph.D. (Toronto)

Professors
R. W. Beachey, B.A. (Queen’s), Ph.D. (Edinburgh)
H. MacKinnon, B.A. (Montreal), Ph.L., S.T.L. (Gregorian), M.A. (Toronto), D.Phil. (Oxford)

(Department of Religion and Culture; W.L.U.)

(Dept. of Religion and Culture; W.L.U.)

Adjunct Professor
A. J. Siirala, Th.Cand. (Helsinki), Th.Lic. (Lund.), Th.D. (Helsinki)

Associate Professors
M. T. Cherniavsky, M.A. (Oxford)
D. A. Davies, B.A., Ph.D. (Washington)
K. R. Davis, B.A. (Toronto), M.A. (Wheaton), Ph.D. (Michigan)
F. H. Epp, B. Th. (Canadian Mennonite Col.), B.A. (Bethel College), M.A., Ph.D. (Minnesota)
L. A. Johnson, B.A. (Waterloo), M.A., M.Phil. (Toronto)

(Classics and History)

P. Keresztes, M.A. (Toronto), Ph.D. (Graz)
W. Klaassen, B.A. (McMaster), D.Phil. (Oxford)

D. N. Lammers, A.B. (Cornell), M.A. Ph.D. (Stanford)
A. Lentin, B.A., M.A., Ph.D. (Cambridge)
R. C. MacGillivray, B.A. (Queen’s), A.M., Ph.D. (Harvard)
E. P. Patterson, B.A. (Baylor), M.A. (Kansas), Ph.D. (Washington)

Assistant Professors
J. A. Barbier, M.A., Ph.D. (Connecticut)
J. P. E. Dembski, B.A., M.A. (Toronto)
P. J. Harrigan, B.A. (Detroit), A.M., Ph.D. (Michigan)
D. J. Horton, B.A. (Waterloo Lu.), M.A. (Waterloo), Ph.D. (McGill)
P. S. Smith, M.A. (Toronto), Ph.D. (New Mexico)
J. A. Wahl, C.R., B.A. (Western), M.A., Ph.D. (St. Louis)
D. E. Wright, B.A., M.A. (Cambridge), M.A., Ph.D. (McMaster)

Lecturers
(London), DIP. Ed. (Oxford), M.L.S. (Western)

(Part-time)
L. W. Grady, B.A. (St. Elizabeth College), M.A. (McMaster)
R. W. Guiso, B.A. (Toronto)
S. K. Johannesen, B.A. (Evangel College), M.A. (Missouri)
K. M. McLaughlin, B.A. (Waterloo), M.A. (Dalhousie)
J. W. Walker, B.A. (Toronto), M.A. (Waterloo)

Liaison Librarians
Senior B.A. Bailey, B.A. (London), DIP. Ed. (Oxford), M.L.S. (Western)
Assistant J. M. Campbell, B.A. (Waterloo)
Bachelor of Arts

a) General Programme

Students majoring in history should consult the General Programme requirements described on page 97. They will normally choose one course from the Introductory and three courses from the Survey listings below. In their third year they must also take at least two courses from the Depth Study listings (or from the Senior Seminar listings, if permitted by the instructor). The exact programme for each student will be worked out in consultation with a departmental advisor.

b) Honours Programme

Students taking the Honours programme in History should consult the Honours Programme requirements on page 100. The exact programme for each student will be worked out in consultation with a departmental advisor.

Undergraduate Courses

Note 1 Courses offered by the History Department are divided into four basic categories to allow for sequential development. The four categories are as follows:

<table>
<thead>
<tr>
<th>Level</th>
<th>Category</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Introductory Courses</td>
<td>(For General and Honours credit)</td>
</tr>
<tr>
<td>200</td>
<td>Survey Courses</td>
<td>Group 1 (For General credit only)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Group 2 (For General or Honours credit)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Group 3 (For Honours History Students only)</td>
</tr>
<tr>
<td>300</td>
<td>Depth Courses</td>
<td>(For Honours credit only)</td>
</tr>
<tr>
<td>400</td>
<td>Senior Seminars</td>
<td>(For Honours credit only and intended primarily for Honours students)</td>
</tr>
</tbody>
</table>

Note 2 General students are reminded that they must take at least two Depth Courses — or Senior Seminars, if granted permission — for Honours credit in order to complete their major. A student cannot take both a General and a corresponding Honours course for credit: e.g., 203* and 204*; 213 and 277; 222* and 383B*; 223* and 224* and 265.

Note 3 Half courses (meeting for one term only) are designated by an asterisk (*) after the course number. To simplify bookkeeping procedures, the Department is attempting an experiment with three courses, 265, 383, and 399. Students registering for the full year should enroll in 265, 383 or 399. Students registering for a half-term only should enroll in either 265A* (Fall) or 265B* (Winter), 383A* (Fall) or 383B* (Winter), or 399A* or 399B*. 
Note 4  In both undergraduate and graduate courses an instructor may grant a grade of Incomplete for a certain time in special cases, such as illness. If all the required work is not completed in the specific period, a grade is allotted. Unless a major portion of this work has been submitted this grade is normally an F. All incomplete grades are automatically turned into Fs at the end of an eleven month lapse.

Introductory Courses

100 The Historian's Craft This course examines a number of topics with the aim of introducing students to the nature of historical explanations. Participants will examine how and why history has been studied, and perhaps come to some conclusion about how and why it should be studied.
  Barbier, Smith

101 Major Themes of Western Civilization A study for freshmen of several distinct but related themes which have been of central importance in the evolution of Western Civilization. Students will be introduced to historical controversy, historical methodology, techniques of theme writing and research, and source analysis.
  MacKinnon, Davis, Harrigan, Lammers

103* The Emergence of the Third World Surveys the history of the social, political and economic changes which have led to the creation of new nations and the resurgence of old nations and peoples in Asia, Africa and the New World.
  Fall
  Walker, Guisso

104* The Emergence of the Third World Surveys the history of the social, political and economic changes which have led to the creation of new nations and the resurgence of old nations and peoples in Asia, Africa and the New World.
  Winter
  Walker, Beachey

105* The Meaning of Civilization This course is structured around the series of films, Civilization, narrated by Kenneth Clark, and has two objectives. One is to offer an introduction to some of the masterworks of Western art and architecture, with an eye to processes of change in form and sensibility. The films will constitute the core of this aspect of the course, supplemented by prints and brief documentary readings. The other is to consider classics of modern thought by Weber, Freud, Lévi-Strauss, and others that implicitly challenge suppositions of the films in regard to the definition, motifs, purposes and costs of civilization.
  Winter
  Johannesen

10 An Introduction to Historical Method This course is designated for able students with a special interest in history. The aim is to provide an introduction to the techniques of historical enquiry through the study of one period in some depth.
  MacGillivray
120 An Introduction to Western Intellectual History

This course is a foray into intellectual history which will explore some of the seminal visions of the human predicament and some of the solutions posed by thinkers of the Western world over the past 2,500 years. The work is tailored especially for students who want to be challenged intellectually and who are willing to opt for more, and more stimulating reading than is usual in introductory subjects. This is a course of continuous readings and discussions, meeting twice a week in small seminars. Written work will be required and a high level of participation in seminars; but there are no lectures.

_Baker_

Survey Courses

**Group 1**

* 3 hours. _No prerequisite. The following courses may not be taken for Honours History credit._

201* Expansion of Europe from the 15th to the 18th Century

Surveys the major explorations, conquests and settlements of the Portuguese, Dutch, French and English empires. The eighteenth-century decline of the French, Spanish, and English empires in the new world is outlined.

_Fall_

_Patterson_

202* Expansion of Europe in the 19th and 20th Centuries

Surveys European expansion especially in Africa and Asia and traces the rise of the nationalist-independence movements which culminate in the end of empire in the mid-twentieth century.

_Winter_

_Patterson_

203* Twentieth Century History, 1900-39

Surveys the historical evolution of the present century to the beginning of World War 2, with emphasis on those issues which have posed the greatest problems and dilemmas in a rapidly changing world.

_Fall_

_Davies_

204* Twentieth Century History, 1939-70

Recent social, economic and political trends in Europe, Asia, Africa and the Americas will be set in a longer historical perspective.

_Winter_

_Eagles_

211* British History to 1603

A survey of the main stages in the transition of Britain from a remote province of the Roman Empire to a preeminent, independent state of post-Reformation Europe. Within the chronological framework, cultural and social as well as political and institutional developments will be examined.

_Fall_

_Cherniavsky_

212* British History since 1603

A survey of the shaping of British society and the British experience from the time of Shakespeare to the present: constitutional conflict and compromise, rise and fall of empire, industrial and urban revolution, world wars and welfare state.

_Winter_

_Wright_
213 British Empire and Commonwealth History
A topical survey rather than the usual chronological treatment, divided into halves on the broad themes "The British Influence" and "The Colonial Identity". In the first term there will be sections on the institutional framework, imperial biographies and development of communications; in the second, sections on native peoples, colonial economics and the history of the commonwealth ideal.
Not offered in 1972-73.
Caton

222* Modern French Canada
A survey of the development of French-speaking peoples in Canada since Confederation. This course will investigate, in depth, such issues as the social and economic development of the francophone population in Quebec as well as in the other provinces, changes in English-French racial relations and the resulting political and constitutional strategies, and the development of national identity and nationalist movements both in Quebec and other provinces. A knowledge of French is not required.
Winter
Johnson

223* Canadian History to 1867
An analysis of selected issues: New France, Atlantic outlook, Loyalism and the crisis of Empire, rebellion and reconstruction, regional loyalties and the strategy of Confederation.
Not offered in 1972-73

224* Canadian History since 1867
An analysis of selected issues: westward expansion, regionalism and the crisis of Canadian federalism, framing a foreign policy, French-Canadian Nationalism, urbanization and the New Society.
Fall
Johnson

227* The History of Selected Racial and Regional Minorities in North America
An examination of the formative years of the Afro-Canadian, Afro-American and Native Indian communities in Canada and the United States.
Fall
Walker

228* The History of Selected Racial and Regional Minorities in North America
An examination of the emergence of minority assertiveness and the position of minorities in modern Canadian society.
Winter
Walker

133 Men, Women and Families in Modern History
A survey of sexual relations and the family in European culture since the sixteenth century with special attention to the role of sex related ideologies to larger processes of economic and political change. The course will also provide an introduction to research methods in the field of demography and vital statistics, as they may be useful to historians.
Johannesen

Group 2 3 hours. Lectures and seminars. The following courses have as a prerequisite an Introductory history course or the permission of the instructor. These courses are for both Honours and General credit.

255 Ancient Civilization
A survey of the social, political and economic history of Greece and Rome with an introduction to the civilization of the Ancient Near East.
Wahl
260 Europe in Renaissance and Revolution

This course will focus on Europe in transition (1300-1600) and emphasize those political, intellectual, social and economic changes most significant to the emergence of modern Europe.

Davis

261* Europe in the Eighteenth Century

This course hopes to bring out the characteristics of European civilization between 1680 and 1789. The first term will survey international relations; religion, politics and society in France, the Empire and Russia; the origins and impact of the Enlightenment, and the concept of Enlightened Absolutism.

Fall
Lentin

262* Europe in the Eighteenth Century

The second term will attempt to define 18th-century man in his cultural setting and changing attitude to the human condition, by sampling his art, architecture, music and belles lettres. These will be studied under three headings: (a) heroic striving in the age of the baroque (b) aristocratic culture and the rococo (c) neo-classicism, sentimentalism and the search for lost innocence.

Winter
Lentin

263* Europe in the Nineteenth Century

A study of Europe from the French Revolution to approximately 1900 with particular emphasis on the social and intellectual forces that affected European society and the historical role of institutions in European society.

Fall
Harrigan

264* Europe in the Twentieth Century

The course will stress a close examination of those issues both domestic and international, which constitute the distinctive features and trends of twentieth century Europe.

Not offered in 1972-73
Wynne

267G* Canadian Non-Indigenous Minorities

A study of the 200 year history of the Mennonite minority in Canada with emphasis on their changing way of life, relations to the state and interactions with the larger society.

Fall
Epp

268G* Canadian Non-Indigenous Minorities 2

An examination of selected ethnic and religious minorities including Hutterites, Doukhobors, Ukrainians, Germans and Jews.

Winter
Epp

281 South Asian History

Economic, social and political repercussions of contact with Europe since 1600. Emphasis will be on events in the Indian sub-continent.

Not offered in 1972-73.

282 East Asian History

A study of the development of East Asia to the Opium War (China) and the Meiji Restoration (Japan), with emphasis on the distinctively oriental societal characteristics, institutions and viewpoints.

Guisso
284* Latin America, Colonial Period
A survey of the period 1492-1821 (discovery to the winning of independence), focussing on the evolution of Latin American Society.
_Fall_
Barbier

285* Latin America, National Period
A survey of the period 1821 to the present, focussing on the conflict of old and new: the response of existing semi-feudal Colonial civilization to the demands of industrialization.
_Winter_
Smith

291* Ancient and Pre-Colonial Africa
A survey of the societies, cultures and civilizations produced by the peoples of sub-Saharan Africa from ancient times to the colonial period.
_Fall_
Walker

292* Colonial and Independent Africa
A study of sub-Saharan Africa from the establishment of colonial rule to the present. Particular attention will be given to the African response to European control and to contemporary issues in independent Africa.
_Winter_
Walker

295* History of the United States to 1865
A survey of American society, politics and thought, and of the relations of the United States with the outside world from 1776 to 1865.
_Fall_
Johannesen

296* History of the United States since 1865
A survey of American society, politics and thought and of the relations of the United States with the outside world from 1865 to the present.
_Winter_
Eagles

Group 3
3 hours. Lectures and seminars. The following courses have as a prerequisite an Introductory course or the permission of the instructor. They are for Honours History students only.

258 History of Medieval Europe
The political, cultural, economic and ecclesiastical development of Europe from 300 to 1300.
_MacKinnon_

265 Canadian History
Selected topics in Canadian History. The course will be thematic rather than strictly chronological. Considerable emphasis will be placed on historiography: how historians have interpreted major social, political and economic themes. _For additional detail, see 265A* and 265B*_.
_McLaughlin_

265A* Canadian History 1
In the pre-Confederation period the course will examine the effect of the Metropolitan centres of Paris and London on the colonies and contrast their influence with that of the Canadian frontier. We shall also be concerned with the conquest theory, the development of French Canadian nationalism, the Loyalist tradition, the effects of the American Revolution on Canada and the achievement of Confederation. _The first half of 265 for students taking only the Fall half-term._
_Fall_
McLaughlin
265B* Canadian History 2
In the post-Confederation period the course will study Canada's development from Colony to Nation – (to Colony?). Such themes as sectionalism, economic nationalism, continentalism and imperialism, Anglo-Saxon Racism and French Canadian Nationalism, Rural and Urban Protest will constitute areas of discussion.
(The second half of 265 for students taking only the Winter half-term.)
Winter
McLaughlin

277 British Empire and Commonwealth History
A topical survey rather than the usual chronological treatment, divided into halves on the broad themes "The British Influence" and "The Colonial Identity". In the first term there will be sections on the evolution of the institutional framework, imperial biographies and the development of communications; in the second, sections on native peoples, colonial economics and the history of the commonwealth ideal.
Not offered in 1972-73.
Craton

Depth Courses

3 hours. Lectures and seminars. The following courses are open to students above the First Year level. In every case the prerequisite is an Introductory or Survey course appropriate to the subject, or the permission of the instructor. In some cases there are specific additional prerequisites. These courses may only be taken for Honours credit. General students taking these courses will therefore be expected to work at Honours-level standard.

345* Roman History, 287 to 27 B.C.
A study of the middle and late republic, with particular emphasis on the social and constitutional crises which shaped them.
Fall
Wahl

346* Roman History, 27 B.C. to 337 A.D.
A study of imperial Rome, with particular emphasis on those institutions of law and government which were the great achievement of the Roman empire.
Winter
Wahl

347G* Radical Reformation 1
(also RS 321G*)
A study of radical reform spokesmen Andreas Carlstadt, Thomas Muntzer and others, and of the violent revolt of the peasants, 1524-1526.
Fall
Klaassen

348G* Radical Reformation 2
(also RS 322G*)
A study of Anabaptism, a socio-religious movement committed to change through nonviolence, and of other dissenters like Sebastian Franck, Caspar Schwenkfeld, and Michael Servetus.
Winter
Klaassen

350 Theory and Practice of Historical Writing
A course consisting of seminars on problems of historical enquiry and explanation, including individual guidance in the preparation of a research essay. Primarily for third year Honours students.
Baker, New
Department of History

351* Special Subject
Seminars and public lectures in special fields.
*Not offered in 1972-73.

352A* Special Subject: The United States in World Affairs
An analysis of American foreign policy in the twentieth century.
Winter
Eagles

353 Medieval Church History From 312-1449
A study of the evolution of the dogmatic approach. Topics will include dogmatic moral and political questions which affected the teaching of the church.
Winter
Wahl

355* Russian History 1613-1825
The course will focus on selected themes in the development of the Russian state and society from the beginning of Romanov rule to the middle of the nineteenth century.
Fall
Davies

356* Russian History Since 1825
The course will focus on selected themes in Russia's development in the nineteenth and twentieth centuries, including the Soviet Period.
Winter
Davies

357* German History 1648-1848
The course will cover in some depth selected topics of political, social and economic history of the Germanic lands from the Peace of Westphalia to the revolution of 1848.
Fall
Wynne

358* German History 1848-1933
The course will cover briefly the Unification of Germany; the empire under William I and William II; the Revolution of 1918 and some aspects of the Weimar Republic to Hitler. German nationalism will analysed in both courses.
Winter
Wynne

359* French History 1760-1870
A study of France from the Ancien Regime to the revolution of 1848 with particular emphasis on the social and intellectual forces that affected French society and the historical role of institutions in French society.
Fall
Harrigan

360* French History Since 1870
A study of France from 1848 to the Fifth Republic with particular emphasis on the social and intellectual forces that affected French society and the historical role of institutions in French society.
Winter
Baker

361 English History 1485-1660
A study of achievements and crises in the Tudor and early Stuart periods.
MacGillivray

362 English History Since 1760
A study of the development of the world's first industrialized state.
Wright
363 Medieval English History
A study of government, church and society.
*Not offered in 1972-73.*

Cherniavsky

364 Iberian History
History of Spain and Portugal from ancient times to present. The course will deal primarily with the emergence of a medieval society and the persistence of such a society—despite developments elsewhere in Europe—to the present day.
*Not offered in 1972-73.*

Bat-bier

366 European Intellectual History
Major themes in European thought and culture since the 17th century, with an emphasis on the emergence, transformation and decline of Enlightenment perspectives and the contemporary search for alternatives.

Baker

8 The International Relations of the European States, from the Congress of Vienna to the Cold War
A study of the international relations of the European states during the periods of European ascendancy, paramountcy and decline, with attention to the nature of the “state system”, the workings of the “balance of power”, the causes and nature of war, and the conditions of peace in modern times.

Lammers

370 Comparative Studies in Imperialism and Colonization
A comparison of colonial empires, mostly European, since the sixteenth century, in which a general study in the first term is followed by the examination of particular examples in the Caribbean region, Latin American and Southern Africa in the second term.
*Not offered in 1972-73.*

Cration

372 East African History
An examination of the historical development of East Africa from its partition among the European powers in the late nineteenth century to the present day. Special attention will be given to the slave trade, colonial administration, emergence of nationalism, and the basic problems faced by the territories of Uganda, Kenya, Tanzania and Zanzibar since attaining their independence.

Beachey

374G* The Middle East Conflict
A survey of regional, religious and imperial rivalries from ancient to modern times, with emphasis on the 20th century and the Arab-Israeli conflict.

Fall

Epp

375 History of China
The continuation of History 282. Particular attention will be devoted to responses to the technically sophisticated cultures of the West; modernization; reform and revolution; modifications of Communism and democracy; the development of the People’s Republic.

Guisso, Grady

377 History of Modern India
Selected issues in the development of India since 1526, centering primarily on traditional Hindu society, the Muslim and Western impact on that society and the emergence of independent India.
*Not offered in 1972-73.*
380* Canada 1867-1914 This course will examine the development of a “national concensus” in British North America after Confederation. Continentalism, Imperialism, Bi-culturalism and Economic nationalism will be major themes.  
*Fall*  
Johnson

381* Canada Since 1914 This course will examine Canada’s emergence as a twentieth century nation. Emphasis will be placed on economic and social change, regional unrest, and the development of Canadian nationalism.  
*Winter*  
Johnson

382 Canadian Intellectual History An historical analysis of Canadian culture, both nationally and regionally.  
*Not offered in 1972-73.*  
*English*

383 History of French Canada The course will emphasize social and economic issues in the development of French Canada and the emergence of modern Quebec.  
Horton

383A* History of French Canada to 1867 The course will emphasize social and economic issues in the development of French Canada to Confederation.  
(The first half of 383 for students taking only the Fall half-term.)  
*Fall*  
Horton

383B* History of French Canada Since 1867 The course will treat the emergence of modern Quebec, with special emphasis on social and economic issues.  
(The second half of 383 for students taking only the Winter half-term.)  
*Winter*  
Horton

386* Ontario History to Confederation The course will examine the growth of Ontario from a pioneer settlement, with particular emphasis on economic, social, political and cultural aspects of change. An emphasis will be placed on the sources and method of local historical research.  
*Fall*  
*English, McLaughlin*

387* Ontario History Since Confederation The course will examine the emergence of Ontario as an industrial giant and the development of its hegemony in Canada. An emphasis will be placed on the sources and methods of local historical research.  
*Winter*  
*English, McLaughlin*

388 History of Canadian-American Relations Mainly, but not exclusively the history of diplomatic relations. In addition, selected topics of a political, economic, social and cultural nature will be studied in comparative terms.  
*Not offered in 1972-73.*  
Dembski
Canada in World Affairs: The Twentieth Century

An analytical and historical examination of Canadian foreign policy in the international system: domestic sources of Canadian foreign policy; the international sources of Canadian foreign policy; the international system as a source of Canadian diplomacy; the instruments of foreign policy; the "linch-pin" thesis and pre-1939 policy; and the influence of public opinion and the bureaucratic apparatus in the making of foreign policy.

English

History of North American Indians

An examination of the main themes in the history of the Indians of Canada since 1600. Some attention will also be given to the Indians of the United States comparing their history with that of the Canadian Indians.

Patterson

Colonial American History

The development of an American civilization with emphasis on colonial and Revolutionary origins. Selected topics in social and intellectual history will be explored in depth.

Not offered in 1972-73.

Johannesen

Nineteenth Century United States History

Selected topics in intellectual and cultural history in depth.

Ostrander

Latin America

Depth study of selected topics in Latin American history. Depending upon the instructor in the particular year, emphasis will be placed upon the Colonial or the National periods. In either case, the course will deal primarily with the development of societies and institutions.

Smith

History of Science

A survey of scientific developments in Western Civilization from its roots in the ancient world to the present, with emphasis on the scientific revolutions of the 17th and 20th centuries and on the relation of science to society, government, religions, industry and technology, and the arts.

Not offered in 1972-73.

Wahl

The History of Public and Private Law to 1500

An historical study of the evolution of law and the legal approach. Topics in the history of Roman, Canon, and Common Law will be discussed to provide the student with an appreciation of law as it exists today.

Not offered in 1972-73.

Wahl

Directed Studies in Special Topics

Study in a limited field under tutorial guidance. A high standard of written work will be expected.

Directed Studies in Special Topics

Study in a limited field under tutorial guidance. A high standard of written work will be expected.

Fall

Directed Studies in Special Topics

Study in a limited field under tutorial guidance. A high standard of written work will be expected.

Winter
Senior Seminars

3 hours. Seminars and consultations. These seminars are limited to students who have taken relevant Survey or Depth courses, their equivalent elsewhere, or related courses in other disciplines. In all cases the instructor's permission is required. These courses are designed for senior Honours students. Outstanding General students or Third-Year Honours students may be admitted with the approval of the instructor.

401 Medieval History
405 The Intellectual History of the Renaissance and Reformation
406 Europe and Russia in the 18th Century
410 Early Modern English History
411 English History from the 17th to the 19th Century
412 19th and 20th Century British History
413 Modern French History
414 Modern European Intellectual History
415 Modern German History
418 Russian History since 1861
420 Canada in the 19th Century
421 Ontario History
422 France and Its Atlantic Empire in the 18th Century
423 Modern Quebec
424 Canadian Labour History
425 Canadian Cultural History
426 Colonial American History
427 19th Century United States History
428 Modern American History
429 Latin American History
430 British Imperial and Colonial History
432 African History
435 The History of Native Response to Colonial Rule
440 Far East Asian History
442 Indian History
452 The History of Science
453 Modern International Relations

Other Senior Courses

These courses are limited to senior Honours students.

456 Literature and History of the Victorian Age

A literary and historical survey of Victorian England through authors and works that have major significance in both fields. The student will be encouraged to use several approaches and forms of evaluation of this material. He will be obliged to register in English 456 or History 456 and will direct and concentrate his study accordingly.

Not offered in 1972-73.
465 The History and Theory of Historical Writing
3 hours. Lectures and seminars.
Cherniavsky, Lentin

66* The History and Theory of Historical Writing
This half course will be offered in conjunction with a half course in the philosophy of history offered by the philosophy Department.
Winter
Lentin

491 Directed Studies in Special Topics
Senior students only.
Faculty

The following courses are administered by Renison College.

100R Western Civilization.
Problems in the historical development of European civilization from Graeco-Roman and Judaeo-Christian origins to the computer age.

229R* History of China and Japan.
The historical development of China and Japan to modern times.
(Fall Term)

230R* History of China and Japan.
The transformation of China and Japan in modern times.
(Spring Term)

367R Contemporary History.
War and revolution in the 20th century. The 1914-1918 War; the Russian Revolutions; peacemaking 1919; the Chinese nationalist revolution; fascism and nazism; The Second World War; peacemaking 1945; the Chinese Communist revolution; the Korean War; international communism and the West; revolution in the “third” world.
Human Relations & Counselling Studies is a newly organized department that has evolved successively from the Counselling and Human Relations Division of the Department of Psychology and the Committee on Human Relations Studies of the Department of Psychology. For several years doctoral and master's programmes have been offered in this area within the Department of Psychology.

The department and its programme are interdisciplinary in staff and scope. The interdisciplinary effort is centered about the concepts of development and change, individual change in dyadic and group situations, change and organizational processes in groups, and in social change. The concern with development and change cuts across the boundaries of disciplines and professions such as psychology, sociology, anthropology, law, medicine, and others.

The department emphasizes efforts to understand the person as such, and the person in the context of group, institutional, and social structures. It has, therefore, a humanistic perspective aspiring to illuminate and contribute to the quality of human living. Personal development and humanistically oriented institutional and social development constitute a major axis of concern in the programme. These aspects of the orientation of the department are reflected in its educational and research components, and in the developing involvement of programme members in activities and projects in the larger community.
The department seeks to achieve a fusion of scholarly, scientific, humanistic, and social values and activities. Integration of knowledge and values is seen as an essential condition for adequate response to human and social problems. These problems include damaging and often dangerous communication difficulties, and institutional structures unresponsive to human needs and destructive to individuals. The complex patterning of influences and relationships among these phenomena call for advances in methodology in which naturalistic and ecological emphases are prominent, and for massive extension of systematic and functional knowledge in the human relations field.

The department does not yet offer an undergraduate programme although it does offer undergraduate courses. For further information, inquiry may be made at the departmental office.

Undergraduate Courses

IR 334 Counselling Process and Personal Facilitation

An introduction to theory, method, and resource development in personal counselling.
Department of Kinesiology

Professor and Chairman of the Department
N.J. Ashton, B.Sc. (P.E.) (McGill), M.S. (Michigan)

Professor and Dean of the School of Physical Education and Recreation
G.S. Kenyon, B.P.E. (UBC), M.S. (Indiana), Ph.D. (N.Y.U.)

Associate Professor and Undergraduate Officer
D. Hayes, B.Sc., B.P.E., M.Sc., D.P.E. (Springfield)

Assistant Professor, Assistant Director, Women's Athletics
P. Davis, (Miss) B.P.H.E. (Toronto), M.Ed. (North Carolina)

Associate Professor
J.C. Nash, B.A. (Western), M.S. (Illinois), Ph.D. (Ohio State)

Assistant Professors
P.J. Bishop, B.Sc., B.P.E. (Waterloo), M.Sc. (Western Illinois)
H.J. Green, B.A., B.P.H.E. (Queen's), M.A. (Alberta)
M.E. Houston, B.Sc. (Toronto), Ph.D. (Waterloo)
F. King, B.P.E. (UNB), M.Sc., Ph.D. (Alberta)
B. McPherson, B.A., M.A. (Western Ontario), Ph.D. (Wisconsin)
R.W. Norman, B.A., B.P.E. (McMaster), M.Sc. (Alberta)
C.H. Pierce, B.A. (Grinnell), M.A. (De Pauw), Ph.D. (Kansas)
R.E. Priddle, (Mrs.), B.P.H.E. (Toronto), M.A. (Springfield)
R.P. Schlegel, B.A. (Western Ontario), M.Sc. (Illinois)
J.P. Stothart, B.P.E., M.Sc. (Alberta), Ph.D. (Penn State)
L.M. Wankel, B.P.E., B.Ed. (Saskatchewan), M.Sc., Ph.D. (Alberta)
W.N. Widmeyer, B.A. (Western), B.P.E. (McMaster), M.A. (California)
I. Williams, M.S., Ph.D. (Illinois)

Lecturers
G. H. Baycroft, B.P.E., M.Sc. (Alberta)
R.D. Graham, B.A. (Western)
J. Officer, (Mrs.)

Course Descriptions

Courses in Kinesiology, Health Studies and Dance are offered within the Department of Kinesiology. Descriptions of Health Studies and Dance courses follow those for the Kinesiology courses below. For details of programs in all three areas see pages 215 - 219.

102* Bio-physical Basis of Kinesiology
The study of human physical movement from mechanical, anatomical and physiological viewpoints is discussed. The course provides a general orientation to the study of Kinesiology.
2 lectures, 1 tutorial. (Fall Term)

103* Psycho-social Basis of Kinesiology
The study of human physical activity, from psychological, sociological and aesthetic perspectives is examined.
2 lectures, 1 tutorial. (Winter term)

116* Organic Chemistry
An introduction to organic chemistry.
3 lectures. (Winter Term)

171* History of Sport and Physical Activity
A cultural historical review of the development of sport and physical activity from the early Greek period to modern times. Special emphasis is placed on the development of sport in Canada since 1900 and the role of physical activity of all kinds in today's society.
3 lectures. (Winter Term)
200* Human Anatomy  A study of the human anatomical systems and their integration. Particular emphasis is placed on the skeletal, articular and muscular systems. 
Prerequisite: Kinesiology students or permission of instructor. 
3 lectures, 2 hours lab. (Fall Term)

222* Statistical Techniques Applied to Kinesiology  An introduction to descriptive and inferential statistics and the interpretation of data. A major consideration of the course is the use of statistics in the solution of problems in Kinesiology. 
Prerequisite: Kinesiology students only. 
2 hours lecture, 2 hours laboratory. (Fall Term)

280* Administration  A study of the principles underlying general administrative behaviour with an emphasis upon understanding the role and mechanics of decision making. Case study analysis and practical project work are utilized to foster the development of the student's administrative technique. 
3 lectures. (Winter and Spring Terms)

300* Physiology of Physical Activity (Part 1)  A study of the effects of physical activity on the muscular, circulatory and respiratory systems and the mechanisms through which the body adapts to activity and environment. 
Prerequisites: Biology 303, 304. 
3 lectures, 2 hour lab. (Fall Term)

317* Biochemistry  Carbohydrates, lipids, proteins, hormones and vitamins. Metabolism of these groups of compounds in humans. 
Prerequisite: Kinesiology 116 or equivalent or, Grade 13 Chemistry. 
3 lectures. (Fall Term)

1* Introduction to the Analysis of Human Movement  Anatomical, neural and mechanical considerations of human physical activity are examined. 
Prerequisites: Physics 103, Kinesiology 200 and 222. 
3 lectures, 2 hours lab. (Winter and Spring Terms)

330* Research Design  An introduction to the basic principles of scientific inquiry in Kinesiology. A systematic treatment of the logic and practice of methods and techniques employed in research related to physical activity with an examination of design, sampling, data gathering and analysis. 
Prerequisite: Kinesiology students only. 
3 lectures. (Fall and Winter Terms)

1* Evaluation of Human Motor Performance  Methods and procedures used in evaluating human physical performance are studied and practiced. Measurements of strength, motor performance, work capacity, reaction time and others, are included. 
Prerequisite: Kinesiology 222 
3 lectures, 2 hours lab. (Winter and Spring Terms)

340* Care and Prevention of Athletic Injuries  Prevention and correction of accidents in athletic activities. The use of proper personal and field equipment, support methods, conditioning exercises, the medical examination and therapeutic aids. 
Prerequisite: Kinesiology 200 
3 lectures, 2 hours lab. (Fall and Winter Terms)
346* Nutrition (Health Studies 346*)
An elementary course in nutrition with special emphasis on diet for sport and certain physiological conditions.
Prerequisite: Kinesiology 317 or equivalent.
3 lectures. (Winter Term)

352* Aging, the Aged and Leisure: A Sociological and Social Psychological Perspective (Recreation 361*)
Employing a sociological and psychological frame of reference, the process and problems of aging will be analysed. Special emphasis will be given to the problem of leisure time in the later years of life.
Prerequisites: Sociology 101 and one other Sociology course.
3 lectures. (Fall and Spring Terms)

355* Motor Learning
An introduction to the theories of learning motor activity, individual differences, retention, transfer and other topics. Laboratory sessions enable the student to reproduce some of the standard experiments in this field.
Prerequisite: Kinesiology students only or permission of instructor.
3 Lectures, 2 hours lab. (Winter Term)

401* Physiology of Physical Activity (Part 2)
A study of the metabolic and environmental aspects of exercise, fatigue, training, and physical fitness. Work capacity in relation to age and sex will be examined.
Prerequisites: Kinesiology 300 and 317.
3 lectures, 2 hour lab. (Winter and Spring Terms)

405* Applied Kinesiology
Principles of physiology and movement analysis as they apply to the development of maximal human motor performance are examined. Consideration is given to the effects of environmental, psychological and social factors on such developments. Intended for students not electing Kinesiology 401*, Physiology of Physical Activity, Part 2.
Prerequisites: Kinesiology 300 and 321.
3 lectures, 2 hours lab. (Winter Term)

410* Growth, Development and Aging (Health Studies 410*)
The changing capacities and interests of man are studied as he grows and develops. The contribution of physical activity to growth, and physical, psychological and sociological development is examined.
Prerequisites: Kinesiology 200 and Biology 303.
3 lectures. (Fall and Spring Terms)

420* Kinesiological Determinants of Facility and Equipment Design
A study of the interrelationship between the environment which man structures and human motor abilities. Currently available facilities and equipment will be studied as to suitability of design with reference to the size, strength, work capacity and other limitations of the user.
Prerequisites: Kinesiology 200, 321.
3 hours lecture. (Fall and Spring Terms)

422* Administration of Facilities
A study of the problems involved in the planning and maintenance of various athletic plants used by schools and recreation agencies and the selection and care of the equipment and supplies used with these facilities.
3 lectures. (Fall and Winter Terms)
425* Kinesiology of Sport and Dance  A detailed analysis, from a mechanical and anatomical perspective, of skilled and unskilled performance in dance and selected sports activities. Cinematography and electromyography laboratory sessions will be emphasized to investigate changes which occur during skill acquisition. “Normal” and “abnormal” movement patterns will be studied for insight into central nervous system mechanisms involved in skilled movement.  
Prerequisite: Kinesiology 321.  
3 lectures, 2 hours lab. (Winter and Spring Terms)

430* Research Project  Each student will work under the direction of a member of the department on an approved research topic in Kinesiology, Health Studies or Dance. The results of the investigation will be presented in thesis form.  
Prerequisite: Kinesiology students only.

2* Adapted Physical Activities  The study of individual problems and their implications for the Kinesiologist. Body mechanic problems, orthopaedic disabilities, neurological disabilities, psychologic disorders, heart disturbances and nutritional problems will be discussed in depth.  
Prerequisite: Kinesiology 200.  
2 lectures, 2 hours lab. (Winter Term)

1* Personality and Motivation in Physical Activity  An application of major psychological theories to the central problems of sport and physical activity. Current research in the area will be examined. Major emphasis will be placed upon gaining an insight into those psychological factors influencing performance and behaviour of the sport participant.  
Prerequisites: Psychology 101, 355 or consent of instructor.  
3 lectures. (Fall and Spring Terms)

452* Sport in Society  An introduction to the sociology of sport. Utilizing the major frames of reference of the social sciences, the function of sport in contemporary society is examined.  
Prerequisite: Sociology 101 and one other Sociology course.  
3 lectures. (Winter and Spring Terms)

455* The Individual in Sport Situations (Recreation 307*)  An introduction to the social psychology of sport and physical activity, including sport involvement and personality, attitude, and beliefs; the team as a small group; and social influence and facilitation in sport situations.  
Prerequisite: Two term courses in psychology or social psychology.  
3 lectures. (Winter and Spring Terms)

470* Seminar in Kinesiology  An examination of the current major issues in Kinesiology. Included will be discussion of trends in applied kinesiology.  
Prerequisite: Kinesiology students only.  
3 hours.
480* Coaching Foundations  A study of the basic principles and philosophies of coaching today. An examination of the qualifications and responsibilities of the coach, resource materials and problems pertinent to coaching.  
Prerequisite: Kinesiology students only.  
3 lectures.

Physical Activities Courses

Instructional courses at basic and advanced levels for over twenty sports are available to all Kinesiology students. Detailed listings are available at the time of pre-registration. In addition, outdoor camping and ski schools are offered to upper year students. A nominal charge will be made to cover the extra costs of these two schools.

All activity courses are elective and non-credit.

Students should consult with a faculty advisor concerning requirements in this area for entry into careers such as teaching.

Health Studies

140* Introduction to Health 1  Emphasis is placed on the problems of youth. The course is designed to foster understanding and attitudes essential for making decisions related to present and future health practices.  
3 lectures. (Fall Term)

141* Introduction to Health 2  An overview of marriage and family life. Also discussed are problems of environmental health and an examination of health agencies.  
3 lectures. (Winter Term)

240* Man Adapting  An analysis of the physiochemical determinants of life essential for the understanding of man's nature. Views man from two points of view: an organic entity and a responding being.  
3 lectures. (Fall Term)

241* Epidemiology  An investigation of the communicable and non-communicable diseases of man. The etiology, duration, and severity of selected diseases are studied, along with resistance and immunity: natural and artificial.  
3 lectures. (Winter Term)

345* Community Health  A course designed to help students investigate the concept and functioning of community health.  
Prerequisites: Kinesiology 140, 141 or consent of instructor.  
3 lectures. (Fall Term)

346* Nutrition (Kinesiology 346*)  An elementary course in nutrition with special emphasis on diet for sport and certain physiological conditions.  
Prerequisite: Kinesiology 317 or equivalent.  
3 lectures. (Winter Term)
347* Mental Health
A survey course providing a general overview of the mental health field. The experimental literature from behavioural and cognitive perspectives will be discussed concerning normal problems of adjustment within the home, school and community. Strategies of prevention and treatment of mental health problems will be discussed.
Prerequisites: Kinesiology 140, 141, Psychology 101 or consent of instructor.
3 lectures. (Fall and Spring Terms)

410* Growth, Development and Aging (Kinesiology 410*)
The changing capacities and interests of man are studied as he grows and develops. The contribution of physical activity to growth, and physical, psychological and sociological development is examined.
Prerequisites: Kinesiology 200 and Biology 303.
3 lectures. (Fall and Spring Terms)

440* Marriage and Family
The analysis of contemporary trends in Canadian family life. Topics include mate selection, family planning, family life cycle, family dissolution, and the impact of contemporary culture and values on the modern family.
Prerequisite: Consent of instructor.
3 lectures. (Winter Term)

445* Seminar in Health
A study of current issues pertaining to health and health education. Topics include pertinent research in the field of health which have significant value to the individual, family and community, as well as a complete study of the problem areas in health education.
Prerequisite: Consent of instructor.
3 lectures. (Winter Term)

Dance

160* History of Dance to 1900 (Fine Arts 180*)
Consideration is given to folk forms of dance and their eventual development to ethnic forms, theatre dance and neoclassic dance. Particular attention is paid to the simultaneous development of social folk and social ballroom dance with emphasis on the latter's development to the classic dance of the 19th century.
3 lectures. (Fall Term)

1* History of Dance since 1900 (Fine Arts 181*)
The emergence of modern dance in North America is examined in detail. The conditions leading to this new dance form, as well as past and future developments, are analyzed.
3 lectures. (Winter Term)

6* Modern Dance Theories and Composition 1 (Fine Arts 280*)
Historical survey and study and movement theories of late 19th and early 20th century Delsarte, Dalcroze, Wigman. Studio sessions involve the study of the elements of dance composition space, time, dynamics.
2 lectures, 2 hours studio. (Fall Term)

1* Modern Dance Theories and Composition 2 (Fine Arts 281*)
A study of the basic theories and techniques in Modern Dance emerging in the early 20th century Martha Graham, Doris Humphrey. Study sessions involve a study of the rhythmic components of movement and a manipulation of the elements of dance through creative expression in the medium of movement.
2 lectures, 2 hours studio. (Winter Term)
360* Ballet History and Theory 1  
(Fine Arts 380*)  
Historical survey, including the use of film of the development of ballet from the preclassic dance of the French courts to the beginning of the 20th century. Studio involves study of classic technique in R.A.D. Syllabus.  
3 lectures, 2 hours studio. (Fall Term)

361* Ballet History and Theory 2  
(Fine Arts 381*)  
Historical Developments in the ballet since 1900 with particular reference to change in thematic content of significant choreographers and changing attitude toward the theatre.  
3 lectures, 2 hours studio. (Winter Term)
Department of Management Sciences

Professor, Chairman of the Department
Donald J. Clough, B.A.Sc. (Toronto), M.B.A. (Toronto)

Professor and Associate Chairman
S.D. Saleh, B.A. (Cairo), M.A., Ph.D. (Case Western Reserve)

Professor and Graduate Officer
E.A. Silver, B.Eng. (McGill), Sc.D. (M.I.T.)

Professors
K.D. Mackenzie, A.B. (U.C. at Berkeley), Ph.D. (U.C. at Berkeley)
S.S. Sengupta, M.A., D.Phil. (Calcutta)

Associate Professors
Irwin Bernhardt, B.A. (N.Y.U.), Ph.D. (U.C. at Berkeley)
F.E. Burke, B.A. (London)
W.P. McReynolds, B.A.Sc. (Toronto), M.Sc. (U.B.C.), Ph.D. (Toronto)
K.J. Radford, M.A. (Cantab), FSS (UK)

Assistant Professor
J.B. Moore, B.A.Sc. (Toronto), M.Math., Ph.D. (Waterloo)

Special Lecturer
M. Saltsman, M.P.

Research Associates
N. Bernhardt, A.B. (Reed)
L.G. Fisher, B.Math (Waterloo)

Activities and Scope

The Department of Management Sciences, Faculty of Engineering was established in 1969, as a graduate department and has recently extended its activities to undergraduate programmes.

The present activities of the department are: (1) the pursuit of advanced research in selected fields of the management sciences, (2) the provision of post-graduate courses of instruction for people who want to achieve high professional qualifications, and (3) the provision of undergraduate courses in the management sciences for students registered in the Faculty of Engineering.

Active faculty engagement in advanced research as well as experience in professional practice is considered essential to the development of adequate courses of instruction. The boundaries between pure research, applied research and professional practice become indistinct when the aim is to discover imaginative new ways to solve complex management problems. The research activities of the faculty members fall into three major categories: operations research, applied economics, and organizational behaviour. A major aim of the Department is to strengthen and develop these major fields of study.

Undergraduate Programmes

At the present time, the Department offers a minor programme consisting of a package of four MS courses for students registered in any undergraduate programme in the Faculty of Engineering. The main objectives of this minor programme are to provide an awareness of the nature of managerial problems, to present some of the issues, concepts, and techniques related to these problems and to motivate the students to
learn the scientific approaches to management. Although the courses emphasize practical problems, rigorous theoretical and conceptual approaches are presented.

The structure of the four course package is based on the appreciation of the complexity of management problems and the importance of being introduced to the different principles, considerations, and approaches of tackling them. In a programme of this nature, it is considered advantageous to have an overall appreciation of the nature of the problems rather than dealing, in some depth, with only a few of them. Therefore, the minor programme is intended to introduce several approaches and different considerations in relation to managerial decision making.

Enrolment in these courses will start in term 3B and will be primarily for students who will take all four courses offered.

**Course Descriptions**

*(2 hours lecture and one hour lab per week)*

- **406 Managerial Decision Making 1**  
  The nature and context of managerial decision making. Elementary introduction to utility theory. Basic probability theory; review of important concepts. Strategies for decision. Criteria for decisions, including multiple objectives. Brief introduction to optimization. Examples from management problems.

- **407 Managerial Decision Making 2**  

- **405 Managerial Economics**  
  The course is designed to give the student an appreciation of the usefulness of basic concepts from economics in managerial decision making. Topics considered will include costs, costs as foregone opportunities, accounting definition of cost, production as a process in time relating costs to benefits.

- **404 Organizational Behaviour**  
  The course presents a systematic approach to the study of human behaviour in organizations. It synthesizes different concepts and findings from the behavioural sciences and shows their applications to business. More specifically the course deals with some manpower problems, i.e., selection, training, control, and motivation problems; with interpersonal and small group behaviour, norms and values, leadership and authority, and with organizational structure and change.
Department of Man-Environment Studies

**Professor and Chairman**  

**Professor, and Dean of Environmental Studies**  

**Associate Professors**  
D.W. Fischer, B.S. (Trinity), M.S. (Michigan State), Ph.D. (Colorado State)
† J.T. Horton, B.A. (Wheaton), M.A. (Northwestern)
† W. Shalinsky, B.A., B.S.W. (McGill), M.Sc., D.S.W. (Western Reserve)

**Assistant Professors**  
G.S. Davies, B.P.E., B.Sc., M.Sc. (U.B.C.), Ph.D. (California)
C.E. De'ath, B.A. (Auckland), ASOPA Cert. (Sydney), M.Ed., Ph.D (Pittsburgh)
† S.K. Gupta, B.Sc., M.Sc. (Punjab), M.A., Ph.D. (Toronto)
† R.F. Keith, B.S.A. (Guelph), M.A., Ph.D. (Michigan State)
(M-Env. and Earth Sciences)
A.V. Morgan, B.A. (Leicester), M.A. (Calgary), Ph.D. (Birmingham)
† E.M. Pallet, B.A.Sc., M.Music (Oregon), Ph.D. (Michigan State)
† T.McL. Semple, B.A. (Western Ontario), M.A. (Waterloo)
† J.B. Theberge, B.Sc.A. (Guelph), M.Sc. (Toronto), Ph.D. (British Columbia)

†Lecturer (Part time)  
S.C. Lerner, B.A. (Ohio State), M.A. (Columbia)

† Faculty members appointed also in other Schools or Departments of the Division of Environmental Studies

**Course Descriptions**

**120* Environmental Issues and the Natural Sciences**  
Analysis of selected environmental issues using concepts and theories from the natural and life sciences.
*Prerequisite: Honours Man-Environment or consent of instructor*
3 hours (Fall term)

**121* Environmental Issues and the Natural Sciences**  
Continuation of M-Env 120*.
*Prerequisite: M-Env 120*  
3 hours (Winter term)

**130* Environmental Issues and the Social Sciences**  
Analysis of selected environmental issues using concepts and theories from the social sciences including economics, sociology, anthropology, psychology, political science, social welfare and communication.
*Prerequisite: Honours Man-Environment or consent of instructor*
3 hours (Fall term)

**131* Environmental Issues and the Social Sciences**  
Continuation of M-Env 130*.
*Prerequisite: M-Env 130*  
3 hours (Winter term)

Prerequisite: Honours Man-Environment or consent of instructor

3 hours (Fall term)

151* Environmental Issues: Continuation of M-Env 150*.

Prerequisite: M-Env 150*

3 hours (Winter term)

190* Seminar-Workshop An overview of major environmental problems and issues including population growth, impact of urbanization, environmental pollution, resource management, conservation and environmental planning. Group and individual learning approaches through modular learning units.

Prerequisite: Honours Man-Environment

6 hours (Fall term)

191* Seminar-Workshop A problem and issue-oriented course stressing interdisciplinary treatment of environmental problems including small group projects, discussion, field work as appropriate.

Prerequisite: M-Env 190*

6 hours (Winter term)

240* Small Groups in the Environment Small group dynamics will be examined through class participation as a small group. Decisions will be made as a group about course direction and structure and goals, forms of communication and the environment around and within the group.

No prerequisite

3 hours (Fall term)

Instructor: Shalinsky

241* Social Change An analysis of major theories of social change, the sources and patterns of change and change processes, with emphasis on the environmental context.

No prerequisite

3 hours (Winter term)

Instructor: De' Ath

260* Visual Perception and Communication A study of the various physio-psychological factors in visual perception and communication, including personal space, territoriality, and time. The approach to subject-matter is largely 'gestalt' rather than 'analytical'.

No prerequisite

3 hours (Fall and Winter terms)

Instructor: Gupta

271* Quantitative Techniques for Environmental Problems An introduction to scientific method, statistical techniques, experimental design and statistical tests as applied to selected environmental issues. Cross-listed as Geog 271* and Planning 271*.

Prerequisite: Only for students in Man-Environment, Planning, General or Honours Geography or Architecture

2 hours lectures, 1 hour practical (Fall term)

Instructor: Semple
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Prerequisite/Comments</th>
</tr>
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<tbody>
<tr>
<td>72*</td>
<td>Computer Programming and Selected Terminal Systems</td>
<td>The course will emphasize programming skills as applied to environmental problems. Cross-listed as Planning 272* and Geog 272*. Prerequisite: 271* or consent of instructor 3 hours (Winter term)</td>
<td>Instructor: Semple</td>
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<tr>
<td>275*</td>
<td>Special Readings</td>
<td>Prerequisite: Consent of the instructor 2 hours or equivalent (Fall and Winter terms)</td>
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<tr>
<td>290*</td>
<td>Seminar-Workshop</td>
<td>A problem and issue-oriented seminar or workshop; special emphasis on interdisciplinary treatment of environmental problems. Prerequisite: Honours Man-Environment or consent of instructor 6 hours (Fall term)</td>
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<tr>
<td>291*</td>
<td>Seminar-Workshop Continuation of M-Env 290*</td>
<td>Continuation of M-Env 290*. Prerequisite: M-Env 290* 6 hours (Winter term)</td>
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<tr>
<td>310*</td>
<td>Psychological Man</td>
<td>The psychological correlates of the differing environments in which man develops and continues in adult life. The emphasis will be on individual differences assessed by empirical techniques and objective criteria derived from the physical and cultural environment. No prerequisite 3 hours (Fall term)</td>
<td>Instructor: Semple</td>
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<tr>
<td>320*</td>
<td>Environmental Economics</td>
<td>Principal economic forces that affect the environment. Examination of macro and micro concepts of economic welfare including scarcity, leisure externalities, growth and property. Introduction to social benefit-cost analysis as applied to environmental problems. Cross-listed as Economics 348*. Prerequisite: Honours Man-Environment or introductory economics course or consent of instructor 3 hours (Fall term)</td>
<td>Instructor: Fischer</td>
</tr>
<tr>
<td>330*</td>
<td>Psycho-Social Aspects of Environmental Design</td>
<td>Introduction to environmental psychology and sociology to improve conceptions of environmental designers of natural and urban man-environment systems. A comprehensive theory of human needs is used to organize the growing research literature. Evaluation of existing activity systems, such as housing and transportation, emphasizing individual differences. Prerequisite: An introductory social science course or consent of instructor 1 hour lecture and 2 hours studio per week (Fall term)</td>
<td>Instructor: Pallett</td>
</tr>
<tr>
<td>331*</td>
<td>Psycho-Social Aspects of Environmental Design</td>
<td>The programming and design of natural and environment components, such as housing and transportation, primarily in terms of environmental psychology and sociology rather than economic and bio-physical criteria. Emphasis on new activity theory and methodology to obtain better inferences about space requirements. Design problems will be selected from the programs. Prerequisite: M-Env 330* 1 hour lecture and 2 hours studio per week (Winter term)</td>
<td>Instructor: Pallett</td>
</tr>
</tbody>
</table>
334* Comparative Development of Northern Regions
A comparative study of social and cultural change in Arctic and sub-Arctic areas brought about by political and economic development of those lands, with specific reference to northern Canada, the Soviet far north, and Siberia.
Cross listed as Sociology 334*.
No prerequisite
2 hours (Fall term)
$45.00 fee to cover field trip

350* Community Action on Environmental Problems
The citizen's role in the solution of environmental problems. The work of various community groups is examined and evaluated. Students take part in one group project to experience the process at first hand.
2 hours (Fall term)
Not offered in 1972-73.

351* Organizations and Environmental Management
Analysis of selected governmental or other organizations performing important functions relating to environment. Their perceptions of policy issues and goals. Programme planning, budgeting, and delivery processes. Role of different specialists and "generalists"; nature and extent of public participation.
No prerequisite
2 hours seminar (Winter term)
Instructor: Francis

357* Man and Resource Use
Review of the main physical, organizational and institutional factors governing Man's decisions to use natural resources. Appraisal of such resources as land, water, food, forests, wildlife, energy, oceans and air with special attention to contemporary conflicts of use, and main issues in resource policy and management. Reference to global and North American situations.
Cross-listed as Geog. 357* and Planning 357*.
Prerequisite: Env. S. 200*
3 hours (Winter term)
Instructors: Davies, Fischer

360* Science, Technology, Art and Environment
An interdisciplinary exploration of concepts and themes which unify many aspects of nature and human artifacts. Such themes as "time" and "communication" in biophysical environment and in psychology, films and literature; "natural order" in man and nature and human artifacts are presented.
Prerequisite: Consent of the instructor
3 hours (Fall term)
Instructor: Gupta

361* Contemporary Media of Communication and Human Environment
Contemporary media of human communication and their relevance to the understanding of human environment. Special emphasis placed upon the "new wave" movements since the 1950's in cinema, music, and theatre of the absurd.
Prerequisite: Senior students with the consent of instructor
3 hours (Winter term)
Instructor: Gupta
62* Environments of the Future
A study of the various physical and cultural environments of the future in different parts of the world, and their psycho-social influences. A special emphasis will be on the role of mass communication in the environments of the future.
Prerequisite: Consent of the instructor
3 hours (Winter term)
Instructor: Gupta

75* Special Reading or Seminar on Selected Topic
Prerequisite: Consent of the Instructor
2 hours or equivalent (Fall and Winter terms)

390 Seminar-Workshop
A problem and issue-oriented seminar or workshop; special emphasis on interdisciplinary treatment of environmental problems. Variable credit by consent of faculty.
Prerequisite: Honours Man-Environment students, or consent of instructor
6 hours (Fall term)

391 Seminar-Workshop
Continuation of M-Env 390.
Variable credit by consent of faculty.
Prerequisite: M-Env 390
6 hours (Winter term)

410 Honours Seminar: Environmental Management
Major problems and issues in the management of environmental impacts stemming from development projects. Synthesis of ecological, economic and institutional aspects. Integrating environmental management with social and economic development policies and programs.
Prerequisite: Honours Man-Environment or consent of the instructor
2 hours seminar

30 Honours Seminar: Community Environments
Prerequisite: Honours Man-Environment or consent of instructor
2 hours seminar
Not offered in 1972-73

10* International Cooperation on Environmental Problems
The response of international organizations to environmental problems recognized to be of international or global importance. Constraints on ability of international organization to facilitate mutual cooperation among countries. Special attention to environment in the context of socio-economic development. Illustrative examples from the United Nations systems, OECD, and other governmental international organizations.
Prerequisite: Honours Man-Environment or consent of the instructor
2 hours seminar (Fall term)

431* Comparative Approaches to Environmental Management
Environmental programmes of other nation-states compared to Canadian approaches. Case studies from U.S., British and European situations, and other countries.
Prerequisite: Honours Man-Environment or consent of instructor
2 hours seminar (Winter term)

440 Honours seminar: Environmental Communication and Education
A study of communication, innovation and educational processes in the context of environmental issues. Approaches to environmental education and communication for primary and secondary school programs and adult education.
2 hours seminar
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Description</th>
<th>Prerequisites</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>450</td>
<td>Honours Seminar: Environmental Design</td>
<td>Major psycho-social problems related to design and use of urban, rural and wilderness environments. Integration of psycho-social information with economics and environmental information in the design process.</td>
<td>Honours Man-Environment or consent of instructor</td>
<td>2 hours</td>
</tr>
<tr>
<td>470</td>
<td>Environmental Teaching</td>
<td>Practical training in project development, leadership, group facilitation processes, and project coordination.</td>
<td>Honours Man-Environment students; prior approved training in group problem solving techniques; by consent of faculty.</td>
<td></td>
</tr>
<tr>
<td>475*</td>
<td>Special Readings or Seminar on Selected Topics</td>
<td></td>
<td>Consent of instructor</td>
<td>2 hours</td>
</tr>
<tr>
<td>476</td>
<td>Special Readings or Seminar on Selected Topics</td>
<td></td>
<td>Consent of instructor</td>
<td></td>
</tr>
<tr>
<td>490</td>
<td>Seminar-Workshop</td>
<td>A series of seminars and workshop periods over which a student will be expected to develop and present an analysis of a major environmental problem in the form of a thesis essay. Group or individual work as appropriate. Variable credit by consent of faculty.</td>
<td>Honours Man-Environment</td>
<td></td>
</tr>
<tr>
<td>490A</td>
<td>(0.5 credit)</td>
<td>Variable credit by consent of faculty.</td>
<td></td>
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</tr>
<tr>
<td>490B</td>
<td>(1.0 credit)</td>
<td></td>
<td>M-Env 490*</td>
<td></td>
</tr>
<tr>
<td>490C</td>
<td>(1.5 credit)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>491</td>
<td>Seminar-Workshop</td>
<td>Continuation of M-Env 490.</td>
<td>M-Env 490*</td>
<td></td>
</tr>
<tr>
<td>491A</td>
<td>(0.5 credit)</td>
<td>Variable credit by consent of faculty.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>491B</td>
<td>(1.0 credit)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>491C</td>
<td>(1.5 credit)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Faculty of Mathematics

Department of Applied Analysis and Computer Science

Professor and Chairman of the Department
P.C. Fischer, M.B.A. (Michigan), Ph.D (M.I.T.), F.S.A.

Professor and Director of Computing Centre
J.W. Graham, M.A. (Toronto)

Associate Professor, Associate Chairman of the Department
E.G. Manning, M.Sc. (Waterloo), Ph.D (Illinois)

Assistant Professor, Director of First Year Studies in the Faculty of Mathematics
P.C. Brillinger, B.A. (McMaster), M.A. (Waterloo)

Assistant Professor, Associate Director of Computing Centre
C.E. Kohn, B.Eng.Sc. (Western), M.Sc. (Birmingham)

Distinguished Professor
J. Aczel, Ph.D. (Budapest), Habil.D.Sc. (Hung. Academy of Sciences), F.R.S.C.

Professors
J.A. Brzozowski, M.A.Sc. (Toronto), Ph.D. (Princeton)
C. Froese Fischer (Mrs.), M.A. (U.B.C.), Ph.D. (Cantab.)
H. Haruki, Ph.D. (Osaka)

Associate Professors
J.A. Baker, M.A. (Saskatchewan), Ph.D. (Waterloo)
D.D. Cowan, B.A.Sc. (Toronto), Ph.D. (Waterloo) [On Sabbatical Leave, 1972-73]
K. Culik, M.Sc., R.N.Dr. (Charles University, Prague), Ph.D. (Czechoslovak Academy of Sciences, Prague)
W.M. Gentleman, B.Sc. (McGill), PhD. (Princeton)
P.B. Hansen, M.Sc. (Technical University of Denmark)
P.L. Kannappan, B.Sc. (Annamalai), Ph.D. (Washington)
J.D. Lawson, B.A.Sc. (Toronto), Ph.D. (Waterloo)

Assistant Professors
E.A. Ashcroft, B.A. (Cantab.), Ph.D. (Imperial College)
R. Benesch, M.Sc. (Alberta), Ph.D. (Queen's)
J.A. George, M.Sc. (Alberta), Ph.D. (Stanford)
J.G. Linders, M.A.Sc. (Toronto), Ph.D. (Imperial College)
D.E. Morgan, B.S. (Rose Polytechnic Institute), M.S. (Michigan), Ph.D. (Waterloo)
C.T. Ng, (Chinese University, Hong Kong), Ph.D. (Waterloo)
R.W. Peebles, B.Sc. (McGill), Ph.D. (Witwatersrand)
G.T. Sande, B.Sc. (Alberta), Ph.D. (Princeton)
R.B. Simpson, M.A.Sc. (Toronto), Ph.D. (Maryland)
W.W. Wadge, B.A. (U.B.C.), Ph.D. (University of California at Berkeley)
R.V.M. Zahar, M.A. (U.B.C.), Ph.D. (Purdue)

(part-time) J.H. Vellinga, B.A. (Western), M.A. (Waterloo)
Faculty of Mathematics

Lecturers
V.A. Dyck, M.Math. (Waterloo)
W.F. Finden, M.Sc. (Waterloo)
L.G. Rogers. B.Sc. (McGill)
(part-time) T.C. Wilson, B.A. (Iowa), M.Sc. (Chicago)

Instructor (Statistics, and Applied Analysis and Computer Science)
J.F. Gentleman (Mrs.), B.S.Math., M.S.Stat. (Chicago)

Postdoctoral Fellows
D.C. Jensen, A.B. (Fresno), Ph.D. (U.C.L.A.)
P. Kritzinger, M.Sc. Eng. (Witwatersrand), Ph.D. (Waterloo)
K.M.S. Saxena, M.Sc. (Lucknow), Ph.D. (Indian Institute of Technology, Kanpur, India)

Department of Applied Mathematics

Professor, Chairman of the Department
D.G. Wertheim, B.A. (McMaster), Ph.D. (Toronto) [On Sabbatical Leave, 1972-73]

Associate Professor, Associate Dean of the Faculty of Mathematics
C.F.A. Beaumont, B.A. (McMaster), M.A. (Toronto)

Associate Professor, Acting Chairman of the Department
I.J. McGee, B.A.Sc (Toronto), M.Sc. (Waterloo), Ph.D. (Yale)

Professors
E.T. Davies, M.Sc. (Wales), Dottore in Matematica (Rome), Ph.D., D.Sc. (London)
C. Froese Fischer (Mrs.), M.A. (U.B.C.), Ph.D. (Cantab.)

(Applied Analysis and Computer Science, and Applied Mathematics)
B. Forte, Ph.D. (Pisa), Habil. D.Sc. (Rome)

(Applied Analysis and Computer Science, and Applied Mathematics)
M.A. McKiernan, (Loyola), Ph.D. (I.I.T.)

Associate Professors
J. Cizek, R.N.Dr. (Charles University, Prague), C.Sc. (Czechoslovak Academy of Sciences, Prague)
J. Froese, B.A. (Manitoba), M.A. (Queen's), Ph.D. (U.B.C.)
G.J. Lastman, M.A. (U.B.C.), Ph.D. (Texas)
D. Lovelock, Ph.D. (Natal, Durban)
J. Paldus, R.N.Dr. (Charles University, Prague), C.Sc. (Czechoslovak Academy of Sciences, Prague)
R.A. Wentzell, B.Sc. (Acadia), Ph.D. (Western)

Assistant Professors
Z. Dvoracek, M.S., R.N.Dr. (Charles University, Prague), Ph.D. (Czechoslovak Academy of Sciences, Prague)
W.H. Hui, B.Sc. (Peking), Ph.D. (Southampton)
S.P. Lipshitz, B.Sc. Hons. (Natal), M.Sc. (South Africa), Ph.D. (Witwatersrand)
B.J. Marshman, (Mrs.), Ph.D. (Waterloo)
R.G. McLenaghan, M.Sc. (Queen's), Ph.D. (Cambridge)
M.E. Snyder B.Sc. (Western), M.Sc. (Waterloo)
J. Wainwright, B.Sc. (Natal), Ph.D. (South Africa)

Adjunct Professors
D.J. Henderson, B.A. (U.B.C.), Ph.D. (Utah), F. Inst. P.
H. Rund, Ph.D. (Cape Town), Habilitation (Freiburg)
Department of Combinatorics and Optimization

Professor, Chairman of the Department  G. Berman, M.A., Ph.D. (Toronto)
Professor, Associate Dean of the Faculty of Mathematics  K.D. Fryer, B.A. (Western), Ph.D. (Toronto)
Professor, Associate Dean of Mathematics Graduate Studies  R.C. Mullin, B.A. (Western), Ph.D. (Waterloo)

Assistant Professor, (part-time), Associate Director of Computing Centre  J.W. Dodd, B.A.Sc. (Toronto), M.Sc. (Waterloo)

Instructor, Administrative Assistants  E. Anderson, B.A. (McMaster)
R.G. Dunkley, B.A. (Western)
W.I. Miller, B.A. (Queen's)

Distinguished Professor  W.T. Tutte, Ph.D. (Cantab.), F.R.S.C.

Professors  H.F. Davis, Ph.D. (M.I.T.)
J. Edmonds, B.A. (Geo. Washington), M.S. (Maryland)
P.L. Hammer, Ph.D. Math. (University of Bucharest, Romania)
R.C. Read, M.A. (Cambridge), Ph.D. (London)

Associate Professors  C.E. Haff, B.S. (Stanford), Ph.D. (Waterloo)
R.A. Honsberger, B.A. (Toronto), M.A. (Waterloo)
U.S.R. Murty, M.A. (Osmania), Ph.D. (Indian Statistical Institute)
H. Shank, M.Sc. (Chicago), Ph.D. (Cornell)
D.H. Younger, Ph.D. (Columbia)

Assistant Professors  M. Best, M.Math. (Waterloo), Ph.D. (University of California at Berkeley)
J.A. Bondy, D. Phil. (Oxon.)
R.N. Burns, B.Sc. (Toronto), Ph.D. (Waterloo)
A.R. Conn, B.Sc. (Imperial College), M.Sc. (Manitoba), Ph.D. (Waterloo)
G.B. Faulkner, B.A.Sc. (Toronto), Ph.D. (Waterloo)
D.M. Jackson, Ph.D. (Cambridge)
P. Schellenberg, Ph.D. (Waterloo)

Instructor  P. Zima, M.Sc. Physics (Charles University, Prague)

Adjunct Professors  F.I. Johnson, B.S. (Georgia Tech), Ph.D. (University of California at Berkeley)
C.St. J.A. Nash-Williams, Ph.D. (Cantab.), F.R.S.E.
Department of Pure Mathematics

**Professor, Chairman of the Department**
A. Kerr-Lawson, B.A. (Toronto), M.A. (Chicago), Ph.D. (McMaster)

**Associate Professor of Foundations of Mathematics**

**Professors**
- G.E. Cross, M.A. (Dalhousie), Ph.D. (U.B.C.)
- D.Z. Djokovic, Ph.D. (Belgrad)
- R.A. Staal, Ph.D. (Toronto)
- D.B. Summer, M.Sc. (Canab.), D.Phil. (Witwatersrand)

(Philosophy and Pure Mathematics)
- J.W. Tucker, B.Sc. (King's College, London), Ph.D. (Birbeck College, University of London)

**Associate Professors**
- S. Burris, Ph.D. (Oklahoma)
- Y. Chen, M.Ph. (Frankfurt), Ph.D. (Bochum)
- G. Dankert, Dip. Math (T.U. Hanover), Ph.D. (Cologne)
- P. Hoffman, B.A. (Toronto), Ph.D. (Manchester)
- F.C.Y. Tang, B.Sc. (Hong Kong), M.S. (South Carolina), Ph.D. (Illinois)

(St. Jerome's and Pure Mathematics)
- J.G. Anderson, M.Sc. (Durham), Ph.D. (Newcastle upon Tyne)
- L.J. Cummings, Ph.D. (U.B.C.)
- L.J. Dickey, M.A. (Arizona), Ph.D. (Wisconsin)
- W.J. Gilbert, M.A. (Canab.), D. Phil. (Oxon.)
- J. Malzan, Ph.D. (Toronto)
- E.M. Moskal, B.A. (Toronto), Ph.D. (Illinois)
- D. Mowat, Ph.D. (Waterloo)
- K.A. Rowe, B.A. (Toronto), M.S. (Wisconsin), Ph.D. (Illinois)

Department of Statistics

**Professor, Chairman of the Department**
D.A. Sprott, Ph.D. (Toronto)

**Professor, Dean of the Faculty of Mathematics**
W.F. Forbes, Ph.D., D.Sc. (London), D.I.C.

**Professor, Associate Chairman of the Department**
J.G. Kalbfleisch, B.Sc. (Toronto), Ph.D. (Waterloo)

**Lecturer, Administrative Assistant**
C. Springer, M.Sc. (McGill)

**Professors (Economics and Statistics)**
- S.N. Afriat, M.A. (Cambridge), Ph.D. (Oxford)
- V.P. Godambe, M.Sc. (Bombay), Ph.D. (London)
- J.S. Minas, B.A. (Wayne), Ph.D. (Illinois)
- P.M. Reilly, B.A.Sc. (Toronto), D.I.C., Ph.D. (London), F.S.S.
- G. Tintner, Ph.D. (Vienna)
- M.D. Vogel-Sprott, B.A. (McMaster), Ph.D. (Toronto)

**Associate Professors**
- M.A. Bennett, B.A. (Nottingham), F.S.A., F.C.I.A.
- W.H. Cherry, Ph.D. (Melbourne)
- K.R. Shah, M.A. (Bombay), Ph.D. (Indian Statistical Institute)
Faculty of Mathematics

(Psychology and Statistics) R.V. Thysell, B.S. (Montana), Ph.D. (Iowa)
J.C. Young, B.A.Sc. (Toronto), M.Sc. (Waterloo), Ph.D. (Edinburgh)
(part-time) G.W. Bennett, Ph.D. (Adelaide)

Assistant Professors L. Billard, Ph.D. (New South Wales)
J.F. Lawless, Ph.D. (Waterloo)
R.L. Prentice, B.Sc. (Waterloo), Ph.D. (Toronto)
W.S. Rickert, Ph.D. (Waterloo)
J.C. Robinson, M.A.Sc., P.Eng., Ph.D. (Waterloo)
V. Taht, M.A. (Toronto), A.S.A.

(Psychology and Statistics) T.G. Waller, M.S. (Southern Mississippi), Ph.D. (Vanderbilt)
J.B. Whitney, M.A. (Western), Ph.D. (Toronto)
(part-time) R.C. Frecker, B.Sc. (Memorial), M.D. (Dalhousie)
(part-time) M.E. Thompson (Mrs.), B.Sc. (Toronto), Ph.D. (Illinois)

Lecturer F. Reynolds, M.Sc. (Manitoba), F.S.A., F.C.I.A.

Instructors R.L. Brown, B.Math. (Waterloo)


Postdoctoral Fellows N.T. Ison, M.A. (University of the Philippines), Ph.D. (Kansas State)
J. Jackson, M.A. (Cambridge), M.B., B.Chir. (Cambridge)
H. Moraal, Nat.Phil.Cand.; Doctorandus (Leiden), Ph.D. (Waterloo)
J.R.S. Wallis (Mrs.), B.Sc. (University of N.S.W.), Ph.D. (La Trobe University, Bundoora, Australia)

Adjunct Professors P. Robinson, Dip. Math. Stat. (Cantab.), Ph.D. (Cape Town)

Adjunct Associate Professor J.G. Spiro, P.Eng. (Budapest), M.Sc. (Carnegie-Mellon University), Ph.D. (McGill)
Faculty of Mathematics

Visiting Professors with Faculty of Mathematics 1971-72

<table>
<thead>
<tr>
<th>Name</th>
<th>On Leave From</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.P. Anisimov</td>
<td>U.S.S.R. Academy of Sciences, Moscow, U.S.S.R.</td>
<td>Statistics</td>
</tr>
<tr>
<td>M. Barner</td>
<td>Mathematisches Forschungsinstitut, Oberwolfach, West Germany</td>
<td>Pure Mathematics</td>
</tr>
<tr>
<td>P.L. Bhatnagar</td>
<td>Himachal Pradesh University, Simla, India</td>
<td>Applied Mathematics</td>
</tr>
<tr>
<td>L. Billard</td>
<td>University of New South Wales, Kensington, N.S.W., Australia</td>
<td>Statistics</td>
</tr>
<tr>
<td>P. Erdős</td>
<td>Math. Inst. of the Hungarian Academy of Sciences, Budapest, Hungary</td>
<td>Combinatorics and Optimization</td>
</tr>
<tr>
<td>P.W. Kasteleyn</td>
<td>Instituut-Lorenz, Leiden, The Netherlands</td>
<td>Combinatorics and Optimization</td>
</tr>
<tr>
<td>W. Laidlaw</td>
<td>University of Calgary, Calgary, Alberta</td>
<td>Applied Mathematics</td>
</tr>
<tr>
<td>H.T. Loh</td>
<td>University of Malaya, Kuala Lumpur, Malaysia</td>
<td>Combinatorics and Optimization</td>
</tr>
<tr>
<td>R. Rado</td>
<td>University of Reading, Reading, Berkshire, England</td>
<td>Combinatorics and Optimization</td>
</tr>
<tr>
<td>B.H. Worsley</td>
<td>Queen's University, Kingston, Ontario</td>
<td>Applied Analysis and Computer Science</td>
</tr>
</tbody>
</table>

Undergraduate Course Descriptions

Note  The number of hours or lectures shown after the course description is an attempt to indicate the “normal”; each instructor determines how often his particular class will meet.

2 hours lectures, 1 1/2 hours problems.

2 hours lectures, 1 1/2 hours problems.
22 Calculus 2 (for Chemical Engineers)  
Partial differentiation, the gradient, multiple integrals with applications, line and surface integrals, divergence and curl, Theorems of Green and Stokes. Applications to physical problems.  
3 hours lectures, one term.

23 Introduction to Computer Programming  
Concept and properties of an algorithm, language and notation for describing algorithms. An analysis of computational problems and development of algorithms for their solution. An introduction to the Fortran 4 programming language for use in implementing algorithms on the computer.  
2 hours lectures, 1 hour problems, one term.  
No prerequisite.

25 Calculus 2 (for Electrical Engineers)  
Differential calculus of functions of several variables. Differential Equations. Multiple integrals.  
2 hours lectures, 2 hours tutorial; one term.  
Prerequisite: Math 12 or equivalent.

31 Differential Equations  
3 hours lectures.

32 Numerical Analysis  
A survey of numerical procedures with emphasis upon computer implementation using the Fortran 4 programming language. In particular the following topics are covered: interpolation, curve fitting, solution of non-linear equations, numerical integration, numerical solution of Ordinary Differential Equations, matrix algebra and solution of systems of linear equations, and problems in the solution of partial differential equations.  
Prerequisite: Mathematics 23 or equivalent.  
2 hours lectures, 2 hours problems, one term.

33 Differential Calculus  
Real numbers, sequences, limits, continuity. The derivative. General Theorem of Mean Value. Functions of several variables. Implicit functions, Jacobians, Power series with complex terms, the Taylor series for functions of several variables, constrained extrema. The elementary functions for a complex variable.  
Prerequisite: Math 22, 31.  
3 lectures, one term.

34 Integral Calculus  
Prerequisites: Math. 21, 31.  
3 lectures, one term.

35 Advanced Calculus (for Electrical Engineers)  

41 Applied Analysis  
3 lectures, one term.
Faculty of Mathematics

44 Complex Variable
Cauchy-Riemann equation, the Cauchy intergral theorems, conformal mapping, the Taylor and Laurent series, contour integration.
2 lectures, 1 hour problems, one term.

51 Probability and Statistics
3 lectures, 2 hours problems, one term.

Note 1  The following two courses, Mathematics 81 and 82, have been designed primarily for elementary school teachers taking a degree at the University of Waterloo

Note 2  These two courses should be open only to persons who have not completed Grade 13 Mathematics and/or equivalent and are not to be counted as credits towards a B.Math. degree.

81 An Introduction to Functions, Analytic Geometry, and Calculus
2 hours lectures.

82 Introduction to Algebra
2 hours lectures.

100 Fundamental Concepts of Modern Mathematics
A course for non-mathematicians to provide some insight into the many aspects of modern mathematics. The “human interest” point of view will be stressed in order to reveal mathematics as an endeavor holding a strong place in man’s culture. Emphasis will be on twentieth century ideas. To integrate the traditional with the modern, material will be organized on a conceptual rather than a chronological manner.

101 Applications of Mathematics in the Sciences
(a) First term: Formulation of problems from biology, information theory and economics in terms of difference equations; techniques of solution and interpretation of results. The emphasis will be on formulation, interpretation and the similarities between problems in apparently separate disciplines – techniques are relatively simple. Typical problems: predator prey; host parasitoid; economic dynamics. inventory analysis, national income: transmission of information; learning models.

101 (b) Second term: Simple probability theory with applications to biology and economics; simpler parts of vector and matrix theory, ideas of Stochastic process and Markov chains with application.
Prerequisite: Grade 13 Mathematics.
Faculty of Mathematics

119 Algebra and Geometry
Functions and permutations. Elementary number theory. Real and complex number systems. Polynomial functions. Linear geometry and algebra in 2 and 3 space.
3 hours lectures, 1 hour tutorial.

Note 119 is not a course for Honours Mathematics students.

120 Calculus
3 hours lectures, 1 hour tutorial.

Note 120 is not a course for Honours Mathematics students.

125 Algebra Geometry and Calculus for Optometry Students
A conventional course for freshmen. Calculus but with more time spent on concepts of algebra and analytic geometry intimately connected with the Calculus.
4 hours lectures.

129 Algebra and Geometry
Functions and permutations. Elementary number theory. Real and complex number systems. Polynomial functions. Linear geometry and algebra in 2 and 3 space. Algebraic systems.
3 hours lectures, 1 hour tutorial.

130 Calculus
3 hours lectures, 1 hour tutorial.

131 Algebra and Solid Geometry
2 lectures, 1 hour problems.

132 Introduction to Computer Science
A thorough introduction to algorithms, stored-programme computers and programming languages. Concept and properties of an algorithm, language and notation for describing algorithms. Analysis of computational problems and development of algorithms for their solution. A procedure-oriented language (FORTRAN IV) and machine and assembly languages are used to implement algorithms on the computer. Introductory ideas from Boolean Algebra switching theory and hardware design.
3 hours lectures, 2 hour problems.
Prerequisite: Grade 13 Mathematics recommended.
201 (a) Applications of Mathematics to the Physical Sciences

Mathematics 201 (a and b) is the first of three courses (201, 301, 401), designed to show the interplay between mathematics and science; each course is a study of the application of mathematical ideas and techniques to the sciences and the influence of physical problems on the formulation of mathematical concepts.

In Mathematics 201 (a) calculus is applied to an examination of the basic concepts of Newtonian mechanics, planetary motion, rocket flight and related topics; vectors, tensors and groups are given added meaning through a discussion of various physical laws and crystalline structure.

2 hours lectures. Fall term.
Prerequisite: M. 130, Phys. 131 or equivalents.

Note 201 may not be counted as Mathematics credit but may be counted as an elective credit.

201(b) Applications of Mathematics to the Physical Sciences

The concepts of probability and statistics are exemplified in discussions of some of the following topics: Kinetic theory of gases, Maxwell’s distribution of velocities, statistical meaning of entropy, random numbers and random walk, Brownian motion, Monte Carlo method, design and evaluation of experiments, Markov chains and notion of information.

2 hours lectures. Winter term.
Prerequisite: Phys. 131 or equivalent.

217 Advanced Calculus

Differential calculus of functions of several variables. Multiple integrals. Line and Surface integrals; Green’s Theorem, Divergence Theorem, Stokes’ Theorem. Infinite Series.

3 hours lectures.

Note 217 is not a course for Honours Mathematics students.

219 Linear Algebra


3 hours lectures.

Note 219 is not a course for Honours Mathematics students.

228 Introduction to Pure Mathematics

Examples and results in modern geometry, number theory, and algebra. Logical foundations of Mathematics (Hilbert’s proof theory and Brouwer’s intuitionism).

2 hours lectures.

229 Linear Algebra


3 hours lectures.
Prerequisite: 129 or 131.

233 Probability and Statistics

An introduction to probability theory and statistics, with emphasis on applications to practical problems, and on the logical principles involved. Several examples to be discussed require use of the computer. Topics from probability theory include the laws of probability; discrete and continuous random variables; expectation; and the central limit theorem. Topics from statistics include the use of relative likelihood in estimation; sufficiency; exact and approximate tests of significance, tests of fit, contingency tables.

3 hours lectures.
Prerequisite: 130, 132 (may be taken concurrently).
234 Introduction to Applied Mathematics

234 (a) Differential Equations
First order equations; second order equations with constant coefficients. Applications to problems in the physical sciences. Solution of differential equations by series.
2 hours lectures, one term.
Prerequisite: 237 (may be taken concurrently).

234 (b) Introduction to Mechanics
2 hours lectures, one term.
Prerequisites: First year Physics or consent of instructor.
31 or 234 (a) or 236.

Note 234 (a) and 236 may not both be taken for credit.

235 (a) Actuarial Mathematics
The theory of rates of interest and discount, annuities and sinking funds; application to financial problems, including the determination of mortgage payments and the price and yield of bonds.
2 hours lectures, Fall Term.

235 (b) Basic Life Insurance Mathematics
Applications of probability to problems of life and death. The determination of single and annual premiums for assurances and annuities. Reserves. Company expenses and their incorporation into premium and cash value calculations.
2 hours lectures, Winter term.

236 Elementary Differential Equations
2 hour lectures.

Note 236 is not a course for Honours Mathematics Students.

237 Advanced Calculus
Differential calculus of functions of several variables. Multiple integrals. Line and Surface integrals; Green's Theorem, Divergence Theorem, Stokes' Theorem, Infinite Series. Uniform Convergence.
3 hours lectures.
Prerequisite 130.

239 Introduction to Combinatorics and Optimization

239a An Introduction to Combinatorics
Recommended for students wishing an introduction to discrete mathematics, and for students intending to pursue a course of study in combinatorics and optimization.
2 hours lectures, one term.
Prerequisites: 1st year algebra (129).
239b An Introduction to Optimization
Recommended for students wishing an introduction to optimization, and for students intending to pursue a course of study in combinatorics and optimization.
2 hours lectures, one term.
Prerequisites: 1st year algebra (129); Note that 239a is Not a prerequisite but is highly recommended.

240 (a) Numerical Applications in Computer Science
An introduction to Numerical Procedures with emphasis upon computer implementation using the FORTRAN IV programming language. In particular, the following topics are introduced: concept of numerical errors, interpolation, curve fitting, solution of non-linear equations, numerical integration, matrix operations and solution of systems of linear equations, numerical solution of ordinary differential equations.
2 hours lectures, one term.
Prerequisites: 119 or 129, and 120 or 130, and 132.
There is a special section for non-Mathematics students.

240 (b) Non-Numeric Applications in Computer Science
Primitive Numerical Data Representation; character strings: representation, manipulation, and applications; logical operations; introduction to data structures; processing linearly linked lists, multi-linked lists; searching and sorting routines; program as an object for manipulation; syntactic analysis, generation of object code – macros.
2 hours lectures, one term.
Prerequisite: Mathematics 132 or equivalent.

243 Statistics for the Sciences
The topics of Mathematics 233 with particular emphasis on the analysis and interpretation of experimental data and the design of experiments in the Sciences. The more difficult mathematical techniques associated with these problems will be omitted and many examples from Physics, Chemistry, Biology and other natural Sciences will be considered.
2 hours lectures, 1 hour laboratory.

Note This course is not for Honours Mathematics students.

300 Discovery and Invention in Mathematics
A study of about 100 challenging problems taken from many areas of elementary mathematics – number theory, combinatorics, geometry, probability, logic. Emphasis is placed on student participation.
This course was designed for those planning to go into high school teaching. However, the problems have universal appeal to all who like mathematics. This is a “do” course, and is not recommended for passive students.
2 hours lectures, one term.
Prerequisites: No formal prerequisites are demanded. However, the broader and deeper one's mathematical experience the better. This course focusses on APPLYING one's knowledge and ingenuity.
30 Mathematical Discovery and Invention-B  

A study of about 100 challenging problems taken from many areas of elementary mathematics – number theory, combinatorics, geometry, probability, logic. Emphasis is placed on student participation.  

This course was designed for those planning to go into high school teaching. However, the problems have universal appeal to all who like mathematics. This is a "do" course, and is not recommended for passive students.  

2 hours lectures, one term.  

Prerequisites: No formal prerequisites are demanded. However, the broader and deeper one's mathematical experience the better. This course focuses on APPLYING one's knowledge and ingenuity.  

Note 300a is Not a prerequisite to 300b.

301 (a) Applications of Mathematics to the Physical Sciences  

See the preamble to Mathematics 201. Partial differential equations are applied to classical wave problems.  

2 hours lectures. Fall term.  

Prerequisites: 201 and 237 or equivalent.  

Note 301 may not be counted as a mathematics credit, but may be counted as elective credit.

301 (b) Applications of Mathematics to the Physical Sciences  

Vector and tensor analysis are related to problems in continuum mechanics.  

2 hours lectures. Winter term.  

Prerequisite: 201 and 237 or equivalent.

302 Applications of Mathematics to the Biological Sciences  

The aim of Mathematics 302 is mainly to acquaint Mathematics students with the fundamentals of the Biological Sciences, so that the student can see how his discipline can interact with the Biological Sciences. Subject areas such as probability, design of experiments, distributions, data processing, differential equations, and their applications in the Biological Sciences, will form part of the course.  

Two lectures per week for two terms.

307 Combinatorial Geometry  

A study of combinatorial properties of plane figures, with particular attention to convex figures, covering problems, addition of figures, maxima and minima problems, curves of constant breadth and delta-curves.  

This course is designed for the student who particularly likes geometry and for the serious student of combinatorics. Occasionally brief contact is made with the subject of analysis. Thus a concurrent course in real variables is helpful, but is certainly not necessary.  

2 hours lectures.  

Prerequisites: First year calculus (130).

12 (a) Elements of Real Variable Theory  

Metric properties of $\mathbb{R}^n$, functions from $\mathbb{R}^n$ to $\mathbb{R}$; differentials; Riemann integrals; and one of  

a) and introduction to the Lebesgue integral:  

b) an introduction to metric spaces;  

c) orthogonal systems.  

3 hours lectures.  

Note Emphasis will be on applications rather than theory.

Note 312 (a) is not a course for Honours Mathematics students.
312 (b) An Introduction to Complex Variable Theory
Complex numbers; continuity, differentiability, analyticity of functions; the Cauchy-Riemann equations; solutions of Laplace’s equation; conformal mapping by elementary functions, and applications; the Cauchy and allied theorems; Taylor and Laurent expansions; uniform convergence and power series; the residue calculus, and applications.

3 hours lectures.

Note Emphasis will be on applications rather than theory.

Note 312 (b) is not a course for Honours Mathematics students.

319 Abstract Algebra
Rings, integral domains, fields, groups. Quotient groups and quotient rings.

Note Emphasis will be on examples rather than proofs of theorems.

Note 319 is not a course for Honours Mathematics students.

329 Abstract Algebra
Relations and operations in sets. Rings, integral domains, fields, groups. Quotient structures. Linear maps of inner-product spaces.
2 hours lectures.

330 (a) Projective Geometry
Projective spaces over fields, collineations and correlations, quadric curves and surfaces. References to non-euclidean geometries.

3 hours lectures, one term.
Prerequisite: 229.

330 (b) Geometry of the Complex Numbers
The plane of complex numbers. The group of circle preserving mappings and its subgroups. Connections with non-euclidean geometrics. Other number systems and their geometries. (Laguerre, Minkowski).

3 hours lectures, one term.
Prerequisite: 229.

330 (c) Euclidean Geometry
Concurrent lines, collinear points, the Euler line, the Simson line, the nine point circle. Cross ratio, projection, Harmonic range, the quadrilateral and the quadrangle. Properties of circles.

3 hours lectures, one term.

332 (a) Elements of Real Variable Theory
Metric properties of $\mathbb{R}^n$, to $\mathbb{R}$; differentials; Riemann integrals; and one of:
a) an introduction to the Lebesgue integral;
b) an introduction to metric spaces;
c) orthogonal systems.

3 hours lectures.

332 (b) An Introduction to Complex Variable Theory
Complex numbers; continuity, differentiability, analyticity of functions; the Cauchy Riemann equations: solutions of Laplace’s equation; conformal mapping by elementary functions, and applications; the Cauchy and allied theorems; Taylor and Laurent expansions; uniform convergence and power series; the residue calculus, and applications.

3 hours lectures.
334 (a) Numerical Algebra
2 hours lectures. 2 hours problems, one term.
Prerequisite: 240 (a). Also recommended are 219 or 229 and 217 or 237.

34 (b) Numerical Approximation
2 hours lectures. 2 hours problems, one term.
Prerequisite: 240 (a). Also recommended are 219 or 229 and 217 or 237.

335 (a) Finite Differences
A course in the calculus of finite differences, to include: summation, differences of zero, numerical integration, relation between integration and summation.
2 hours lectures.

335 (b) Graduation of Tables
Applications of finite differences to actuarial problems in graduation of statistical tables.
2 hours lectures.

336 Life Contingencies
336 (a) An advanced course on problems with single lives.
3 hours lectures, one term.

336 (b) An advanced course on problems with multiple lives; population and multiple decrement theory.
3 hours lectures, one term.

338 Mathematical Statistics
Derivation and applications of statistical theory for normally distributed measurements. Part (a) may be taken separately for half credit.

338 (a) Continuous random variables; moments and moment generating function; distribution of t, chi-squared, and F, and their applications. Simple analysis of variance and regression.
2 hours lectures.
Prerequisites: 233, 237.

338 (b) The multivariate normal distribution, its properties and uses; quadratic forms and Cochran’s theorem; regression and auto-regression with K independent variables.
2 hours lectures.
Prerequisites: 229, 338(a).

339 Probability and Stochastic Processes
339 (a) Probability distributions, joint variation, central limit theorem. Introduction to continuous time stochastic processes. Poisson process and application to simple congestion situations.
2 hours lectures. Fall or Spring term.
Prerequisite: 233 or 243.
2 hours lectures. Winter term.
Prerequisite: 233 or 243.

340 (a) Machine, Data and Program Structures
3 hours lectures, 2 hours problems, one term.
Prerequisite: 240 (b).

340 (b) Implementation Schemes for Programming Structures
3 hours lectures, 2 hours problems, one term.
Prerequisite: 240 (b).

341 Algebra
Fundamentals of group, ring, and field theory.
3 hours lectures.
Prerequisite: 229.

342 Real Analysis 1
Theory of functions of real variables. The notions of compactness, connectedness, and uniformity are used in a study of continuity, differentiation, and integration.
2 hours lectures.
Prerequisite: 237.

343 Complex Analysis 1
Analysis of complex numbers: fundamental theorems of holomorphic functions; meromorphic functions.
2 hours lectures.
Prerequisite: 237.

344 Topology (a)
Intuitive set theory, metric spaces, point set topology.
3 hours lectures, one term.
Consent of instructor.

345 Topics in Pure Mathematics for Combinatorial Mathematicians
Elementary introduction to cardinal and ordinal numbers; convexity and its applications to optimization; introduction to the main concepts of projective geometry, metric and topological spaces.
2 hours lectures.

349 Applied Statistical Analysis
Review of Normal, t, Chi-squared and F distributions and their applications. Introduction to the design of experiments and surveys. Analysis of variance. Multiple regression.
3 hours lectures, Winter term.
Prerequisite: 233 or 243

351 Introduction to Graph Theory and Combinatorial Analysis

351a Introduction to Graph Theory
Basic concepts; Konigsberg bridge problem, Euler trails and Hamiltonian cycles; marriage problem, maximum matchings, Hall's theorem; planar graphs, four colour problem, chromatic number; Ramsey's theorem.
Stress will be on problem solving. Recommended for students interested in learning the basics of graph theory and for those intending to take higher level courses in graph theory.
2 hours lectures, one term.
Prerequisites: No formal prerequisites, 239 recommended.
351b Applied Graph Theory

Applications of graph theory to communication networks, timetabling, ranking, and other combinatorial problems.

This course supplements the material covered in Math 352, but with greater emphasis on combinatorial aspects.

2 hours lectures, one term.

Prerequisites: 351a.

351c Topological Graph Theory

Planar graphs, Euler's formula, Kuratowski's theorem, five colour theorem; orientable and non-orientable surfaces, embedding of graphs, genus, crossing number, Heawood's conjecture.

For students interested in theoretical aspects of combinatorics and graph theory.

2 hours lectures, one term.

(not offered in 1972-73).

Prerequisites: 351a.

351d Introduction to Combinatorial Designs and Coding Theory

Latin squares, finite fields, orthogonal Latin squares; balanced incomplete block designs, difference sets, finite geometries, steiner triple systems; Coding theory, linear codes, hamming codes.

Recommended for students interested in applications of algebra and statistical theory of design and analysis of experiments, and for those wishing background for advanced courses in this area of combinatorics.

2 hours lectures, one term.

Prerequisites: No formal prerequisite, 239 recommended.

352a Fundamentals of Optimization-A

Introductory study of optimization techniques common to a wide variety of operations research and engineering problems, and of fundamental theoretical interest. Linear programming, simplex method, duality; integer and non-linear programming; convexity; branch and bound, network programming, optimal paths and trees, transportation problems, flows, PERT, replacement Policies Knapsack problems.

Recommended for students desiring mathematical background for operations research, industrial engiineering, computer science and for those wishing to pursue advanced courses in mathematical programming and combinatorics.

2 hours lectures, one term.

Prerequisites: Linear algebra (Math 219/229) or consent of instructor.

352b Fundamentals of Optimization-B

Introductory study of optimization techniques complementary to those covered in 352a. Extrema of functions of n-variables, implicit functions and Lagrange multipliers, inventory problems; difference methods; queuing, recurrent events and replacement policies; games; job-sequencing problems; dynamic programming.

Recommended for students desiring mathematical background for operations research and industrial engineering and for those wishing to pursue advanced courses in mathematical programming and queuing theory.

2 hours lectures, one term.

Prerequisites: Differential calculus (Math 217/237), some knowledge of probibility and statistics, or consent of instructor.

Note 352a is Not a prerequisite for 352b.
360 (a) Tensor Analysis  
Elementary introduction to classical differential geometry and tensor analysis. Curves and surfaces in Euclidean spaces, coordinate transformation, invariance of length, introduction of tensors and metric, Riemannian spaces, covariant differentiation, geodesics, curvature and Einstein tensors.  
2 hours lectures + 1 hour tutorial, Fall term.  
Prerequisites: 237, Consent of instructor.

360 (b) Differential Geometry  
Intermediate level course on Riemannian spaces (continuation of 360 (a). Conformal spaces, spaces with corresponding geodesics, theory of subspaces.  
2 hours lectures + 1 hour tutorial, Winter term.  
Prerequisites: 237, 360 (a) or Consent of instructor.

361 (a) Calculus of Variations  
Euler-Lagrange Equations, Legendre and Jacobi condition, the E-function. Fields of extremals and sufficient conditions; Hilbert’s invariant integral. Parameter invariant single and multiple integral problems; Hamilton-Jacobi theory. Introduction to optimal control problems; introduction to direct methods and partial differential equations.  
2 hours lectures, 1 hour tutorial. Fall Term.  
Prerequisites: 237, Consent of instructor.

361 (b) Mechanics  
2 hours lectures, 1 hour tutorial. Winter Term.  
Prerequisites: 237, Consent of instructor.

362 (a) Introduction to Continuum Mechanics  
Ordinary differential equations applied to the motion of a system of particles; stability theory applied to the motion of a system of particles, applications to celestial mechanics; the stress tensor; partial differential equations in continuum mechanics; collisions between particles; from ordinary mechanics to impulsive mechanics by distribution theory; introduction to statistical mechanics.  
2 hours lectures, Fall term.  
Prerequisites: 234, 237 or consent of instructor.

362 (b) Partial Differential Equations of Applied Mathematics  
Derivation of the equations of heat flow, the vibrating membrane and the electro-magnetic field equations by various elementary techniques and illustrations of the use of the calculus of variations in the derivation of equations; solutions of the above equations by separation of variables; Fourier analysis and Fourier Integral.  
2 hours lectures, Winter term.  
Prerequisites: 234, 237 or consent of instructor.

363 Differential Equations  
2 hours lectures.  
Prerequisites: 234, 237 or equivalent 332 (real variables) or equivalent may be taken concurrently.

398 Undergraduate Seminar  
Two hours lectures.

399 Reading in Mathematics
Applications of Mathematics to the Physical Sciences
See the preamble to Mathematics 201. The concepts and techniques of group theory, special functions and theory of distributions are illustrated by the problems of quantum physics.
2 hours lectures.
Prerequisite: Consent of instructor.

Note
Math. 401 may not be counted as a Mathematics credit, but may be counted as an elective credit.

Topics in Mathematical Aspects of Chemistry, Biology, and the Medical Sciences
Subjects will be selected from areas such as introductory wave mechanics, spectroscopy, molecular biology, and mathematical models of disease processes.
2 hours lectures.

Note
402 may not be counted as a Mathematics credit, but may be counted as an elective credit.

Linear Algebra 2
Continuation of linear algebra. Main topics; representations of endomorphisms, structures of bilinear forms, multilinear products.
2 hours lectures.
Prerequisite: 239 or 341.

Algebraic Geometry
An introduction to the theory of algebraic varieties. Special topics such as the Theorem of Riemann-Roch.
2 hours lectures.
Prerequisite: 329 or 341.

Mathematical Logic
First order languages and theories. A treatment of at least one of the following: set theory, model theory, undecidability.
2 hours lectures.

Foundations of Geometry
An axiomatic treatment of geometry. Geometrical structures, such as projective planes and inversive planes.
2 hours lectures.

Ring Theory
Continuation of the theory of rings and modules.
2 hours lectures.
Prerequisite: 329 or 341.

Group Theory
Continuation of group theory.
2 hours lectures.
Corequisite: 329 or 341.

Field Theory
Field extensions and Galois theory.
2 hours lectures.
Prerequisite: 329 or 341.

Non-linear Differential Equations
2 hours lectures.
Prerequisites: 363 (may be taken concurrently), Consent of instructor.

Algebraic Graph Theory
(not offered in 1972-73)
418 Combinatorial Applications of Computers

418a Combinatorial Applications of Computers-A
General topics: methods of data storage for combinatorial problems, representation of sets, etc. Algorithms for permutations, combinations, partitions, etc. The use of generating functions, and methods of handling them on a computer. Enumeration problems: Polya's theorem and variations. Applications.
Useful for students wishing to specialize in the more computationally-oriented aspects of graph theory or operations research.
2 hours lectures, one term.
Prerequisites: Practical knowledge of at least one computer programming language. 329-algebra.

418b Combinatorial Applications of Computers-B
Useful for students wishing to specialize in the more computationally-oriented aspects of graph theory or operations research.
2 hours lectures, one term.
Prerequisites: Practical knowledge of at least one computer programming language. 329-Algebra. 418a is a prerequisite for 418b.

419 Applications of Graph Theory (not offered in 1972-73)

420 Combinatorial Methods and Probability Methods (not offered in 1972-73)

425 Theory of Numbers
Multiplicative-algebraic theory of numbers. Foundations of natural number theory. Elements of additive-combinatorial number theory.
2 hours lectures.
Corequisite: 329 or 341.

426 Topology
Continuation of general topology; selected topics from other branches of topology.
2 hours lectures.
Prerequisite: 344.

428 Lattice Theory
Ordered sets, lattices, and Galois connections. Applications in algebra, geometry and logic.
2 hours lectures.
Consent of instructor.

429 Combinatorial Topology
Homology theory of complexes. Theorems of invariance, covering, and duality.
2 hours lectures.

430 Finite Geometries
2 hours lectures.
Corequisite: 330 (a) (Projective Geometry).
432 Complex Analysis 2 Further properties of holomorphic and meromorphic functions. Riemann surfaces.

2 hours lectures.
Prerequisite: 332 (b) or 343.

433 Real Analysis An introduction to integration and measure theory with emphasis on the real line.

2 hours lectures.
Prerequisite: 332 (a) or 342.


2 hours lectures.
Prerequisite: 363 or equivalent, or consent of instructor.

435 Laboratory Numerical problems arising in actuarial science and statistics.

2 hours laboratory.

436 Introduction to Logic An introduction to the logic of sentences and predicates with some emphasis on familiar algebraic structures. At first informal, then leading to a formal axiomatic treatment with proofs of consistency and completeness.

2 hours lectures.
Prerequisite: consent of instructor.

7 (a) Measurement of Mortality Methods of analysis of data to produce raw rates for mortality and other tables.

2 hours lectures, one term.

(b) Risk Theory Individual and collective risk theory. Ruin theory. Stop loss reinsurance premiums, Monte Carlo methods.

2 hours lectures, one term.

438 Statistical Inference Several approaches to the controversial problems of statistical inference are compared. Likelihood, fiducial probability, Bayes' theorem, confidence intervals. Sufficiency and ancillarity. Consistency and efficiency of estimates. Information. Maximum likelihood and large sample theory.

3 hours lectures.
Prerequisite: 338 (a).

439 Theory of Experimental Design The logic of experimental design. The design and analysis of sample surveys. The course covers the theory of the construction and analysis of various kinds of designs with emphasis on the important basic principles (e.g. randomization, replication) and the application of the designs to practical problems.

3 hours lectures.
Prerequisite: 338A or consent of instructor.


2 hours lectures.
2 hours lectures. Winter term.
Prerequisite: 360(a) Consent of instructor.

443 Electromagnetism  Applications of the Maxwell equations. Reflection and refraction. Introduction to wave guides and antennae.
2 hours lectures. Fall term.
Consent of instructor.

444 Elasticity  Basic equations of elasticity for homogeneous isotropic bodies; bending of beams; plane elastic waves; Rayleigh surface waves, Love waves. Solution of problems by potentials, variational methods and Saint Venants' principle.
2 hours lectures + 1 hour tutorial. Winter term.
Prerequisite: 445(a).

445 (a) Continuum Mechanics  Stress and strain tensors, rate of strain tensor, generalized Hookes' law, conservation laws, equations of motion; thermodynamic and energy considerations.
2 hours lectures + 1 hour tutorial. Fall term.

445 (b) Hydrodynamics  Viscosity, compressibility, vorticity, circulation; Stokes and Kelvin's theorems, boundary conditions; two and three dimensional irrotational, incompressible flow, elements of compressible flow, Navier-Stokes equations.
2 hours lectures. 1 hour tutorial. Winter term.
Prerequisite: 445 (a).

446 History of Mathematics

446a History of Mathematics-A  A study of selected topics from Greek geometry. Some related work of post-renaissance scholars is included. Topics include: famous construction problems, pythagorean arithmetic, regular solids, four discoveries of Archimedes the problem of Apollonius; taken from the work of such men as Archimedes, Euclid, Apollonius, Euler, Steiner, and many others. Emphasis is placed on the mathematics, with little attention to non-technical historical aspects.
This course was designed as a final-year course for those planning to go into high school teaching. However, it may appeal to anyone interested in mathematics.
2 hours lectures, one term.
Prerequisites: No formal prerequisites are demanded. However, it is recommended that a student have a Working knowledge of elementary geometry (e.g. the material contained in "A Modern Geometry For High Schools" by Lougheed and Workman).
446b History of Mathematics-B  A study of selected topics from post-renaissance mathematics. Topics include material on prime numbers, Fermat's Last Theorem, the Gaussian Integers, the Fibonacci Sequence, other topics from elementary number theory, a collection of outstanding problems in geometry (Fagnano, Steiner-Lehrus, Morley, ----), and several miscellaneous items such as the Cantor ternary set and Ramanujan's Highly Composite Numbers. Emphasis is placed on the mathematics, with little attention to non-technical historical aspects. This course was designed as a final-year course for those planning to go into high school teaching. However, it may appeal to anyone interested in mathematics.

2 hours lectures, one term.

Prerequisites: No formal prerequisites are demanded. However, it is recommended that the student possess a reasonable mathematical maturity.

447 Statistical Mechanics  Applications of probability theory to theoretical Physics.

2 lectures, Fall term.

448 Differential Geometry  Differentiable manifolds, Tensors and Forms, Connexions, Riemannian manifolds.

2 hours lectures.

Prerequisite: 229 and 237.

449 Experimental Design  Similar to Mathematics 439 but with more accent on the logic and methods than on the mathematics.

2 hours lectures.


2 hours lectures.

(This course is not for Honours Mathematics students)

451 Nonlinear Optimization

451a Nonlinear Optimization-A  A study of recent algorithms for minimizing nonlinear differentiable functions subject to nonlinear constraints. Extentions of classical calculus methods to semidefinite quadratic forms. Unconstrained univariate optimization with examples of the four basic approaches. Unconstrained multivariate optimization including first and second order Newton methods, quasi-Newton methods, and conjugate gradient directions. Constrained optimization including first and second order Newton methods, quasi-Newton methods, and conjugate gradient directions. Constrained optimization including nonlinear transformations, feasible direction methods, projection algorithms and penalty functions. Recommended for graduate level nonlinear programming.

2 hours lectures, one term.

Prerequisites: Differential Calculus (237); Elementary Fortran.
451b Nonlinear Optimization-B A study of recent mathematical programming algorithms that do not require differentiability. Unicyclic methods such as Simplex, and Complex; Simple Cyclic algorithms; conjugate directions of Powell; pattern search; lattice minimization with constraints, difference approximations to differentiable methods. Applications of optimization to linear and nonlinear least squares problems. Special topics and extensions.

Recommended for graduate level nonlinear programming.

2 hours lectures.

Prerequisites: Differential Calculus (237); Elementary Fortran.

452 Linear Programming (Theory, Applications, and Related Topics) Linear Programming (Theory, Applications, and Related Topics)


Comments: Throughout this course an attempt will be made to indicate the various areas in which the techniques mentioned above may be applied. These areas include: inventory control, production scheduling, optimal product mix problems, blending problems, game theory, economic input-output models, project scheduling (Critical Path, Decision C.P.M., etc.), bottleneck problems, cost-benefit analysis, cutting stock problem, etc.

Students will be required to use the computer to solve "semi-practical" problems, and some knowledge of computer programming is a definite asset.

Prerequisites: 229 (or equivalent). Students will be required to use the computer on occasion and 132 (or its equivalent) would be a definite asset.

453 Queuing Theory

453a Queuing Theory-A Introductory study of queuing models from simple queues with Poisson arrival and Exponential service distributions to multi-server queuing models including: homogeneous and heterogeneous parallel servers; servers in series; and phase type service. Methods of analysis introduced include differential-difference equations, probability generating functions and simulation.

Recommended as a pre-requisite for Math 453b. Recommended for operations research and computer science students.

2 hours lectures, one term.

Prerequisites: Introductory Probability.
453b Queuing Theory-B  Study of advanced queuing models including single server models with balking and reneging; jockeying between queues; pre-emptive and non-pre-emptive priority queues; queuing models with batch arrival or service processes. Also included: advanced simulation models and the algebraic analysis of complex queuing systems.
   Recommended as a pre-requisite course for Math 885.
   Recommended for students interested in modelling techniques.
   2 hours lectures, one term.
   Prerequisites: Math 453a.

454 Game Theory

454a Game Theory  A mathematically-oriented course on the basics of game theory, with applications to economics, bargaining, and strategy.
   Classification of games; solution of matrix games and their relationship to linear programming; infinite zero sum games; utility theory; bimatrix games and the bargaining problem; n-person games; Shapley value; metagames.
   2 hours lectures, one term.
   Prerequisites: Formal Second year linear algebra (Math 229); fundamentals of linear programming and probability theory.

454b Selected Topics in Graph Theory  (Not offered in 1972-73)

455 Mathematical Programming

455a Nonlinear Programming  Nonlinear programming convex sets and convex functions; convergence conditions and convergence rates for some unconstrained optimization methods; introduction to Kuhn-Tucker theory and duality theory for nonlinear programmes; economic interpretation of dual variables.
   2 hours lectures, one term.
   Prerequisites: Math 352a.

55b Dynamic Programming and Quadratic Programming  Quadratic Programming: Lemke's complementary pivot scheme to solve a quadratic programme.
   Dynamic Programming: deterministic decision process problems; monotomic path problems; equipment replacement; resource allocation; reduction of dimension by use of Lagrange multipliers; shortest path problems; the travelling salesman problem; introduction to optimal control theory.
   2 hours lectures, one term.
   Prerequisites: Math 455a.

456 Combinatorial Methods in Operations Research

456a Combinatorial Systems  (Not offered in 1972-73)

456b Boolean Methods  (Not offered in 1972-73)
457 Applied Combinatorial Mathematics

457a Applied Combinatorial Mathematics-A
A selection of combinatorial problems from the applied sciences. Topics which might be included are: Markov chains, random walk, the Polya problem, the dimer (and monomer-dimer) problem, the Ising problem, percolation processes, probabilistic graphs, electrical network theory.
2 hours lectures, one term.
Prerequisites: Math 351a and Math 233.

457b Selected Topics in Applied Combinatorics
(not offered in 1972-73)

458 Graph Theory
Topics in graph theory. These may include symmetry in graphs, planarity, bipartite graphs, minimax theorems, directed graphs, enumeration, algorithms, colouring problems, matrices and graphs.
Recommended for students who have taken a course in graph theory and wish to study additional topics not normally covered in an introductory course.
2 hours lectures.
Prerequisites: Math 351a or consent of instructor.

459 Optimizational Combinatorics

459a Optimizational Combinatorics-A
Recommended for students interested in theoretically advanced study in Combinatorics and Optimization or Computer Science.
2 hours lectures, one term.
Prerequisites: Math 352a or consent of instructor.

459b Optimizational Combinatorics-B
Recommended for students interested in theoretically advanced study in Combinatorics and Optimization or Computer Science.
2 hours lectures, one term.
Prerequisites: Math 459a or consent of instructor.

460 Combinatorics

460a Combinatorics-A
Enumerative Mathematics Combinatorial identities, generating functions, counting of labelled and unlabelled objects, theorems of Polya, Redfield-Fead, and de Bruijn.
Recommended as a useful preliminary for Math 785 "Planar graphs".
2 hours lectures, one term.
Prerequisites: A knowledge of elementary group theory (Math 329).
460b Combinatorics-B  The existence and construction of error correcting codes, projective geometrics, orthogonal Latin squares, balanced incomplete block designs and other combinatorial configurations. 
*Recommended for Math 780, Combinatorial Analysis.*
*Prerequisites: Theory of finite groups rings and fields (Math 329).*

*2 hours lectures, one term.*
*Prerequisite or Corequisite: M336.*

461 (b) Actuarial Laboratory  A tutorial course for the advanced actuarial student.
*2 hours lectures, one term.*

62 (a) Measure and Integration  The theory of measure and the Lebesgue integral.
*2 hours lectures, Fall term.*

462 (b) Linear Operators  Linear operators in Hilbert spaces. Compact operators. Introduction to functional analysis.
*2 hours lectures, Winter term.*

*2 hours lectures, Fall term.*
*Consent of instructor.*

464 Topics in Mathematical Physics  A selection of topics given by members of the Applied Mathematics Department. Topics covered in previous years have included continuum mechanics (elasticity, fluid mechanics), electromagnetic theory, statistical mechanics.
*2 hours lectures, two terms.*
*Consent of instructor.*

66 (a) Statistical Data Analysis  Summary Statistics (mean, median, midmean, hinge, trimean, etc.). Transformation of data (to increase symmetry, remove strays, equalize spread). Residuals (from various measures of centrality, plottings, etc.). Outliers (effect on summary statistics and residuals, identification and removal). Plotting techniques (dot plots, histograms, stem-and-leaf box plots, schematic plots, probability plots - normal, half-normal, other - Q-Q plots, rootagrams, etc.).
*Prerequisite: (1) A course in Fortran Programming or equivalent (2) Mathematics 338.*

470 (a) Ordinary Differential Equations and Integral Equations

**Initial Value Problems**  Existence and uniqueness of solutions, one step methods, multistep methods, stability, error analysis.

**Boundary Value Problems**  Shooting and discretizations methods, implementation problems especially for non-linear equations.

**Integral Equations**  Correspondence to ODE initial value and boundary value problems, solution techniques.
*2 hours lectures, one term.*
*Prerequisite: M334 (b) or consent of instructor.*
Faculty of Mathematics

470 (b) Partial Differential Equations
Discretization methods for PDE's, convergence and stability, grid and characteristic methods for hyperbolic equations; iterative methods of solution for parabolic and elliptic equations, rate of convergence estimates.

2 hours lectures, one term.
Prerequisite: Math. 334 (a) or consent of instructor.

471 (a) Switching Circuits

2 hours lectures, Fall term.

471 (b) Computer System Organization and Logic Design
Part I. Logic Design: Brief review of basic switching theory; Number systems; logic circuits, storage elements; standard computer subsystems; overall logical design of a conventional processor; automated design of processors – computer compilers.

Part 2. System Organization: Definition of total system requirements for batch processing, time-sharing, real-time processing and other applications; hardware-software tradeoffs and the impact of large-scale integration; unorthodox hardware organizations evaluation of solutions. Some attention will be paid to design for reliability and fault diagnosis as additional system requirements.

2 hours lectures, Winter term.
Prerequisite: M 471 (a) or consent of instructor.

472a Introduction to Automata Theory

2 hours lectures, Fall term.
Prerequisite: 132 and 329, or consent of instructor.

472b Introduction to Turing Machines and Computability Theory

2 hours lectures, Winter term.
Prerequisite: 436 or 472 (a) or consent of instructor.

473 (a) and 473 (b)
Mathematics 340(a) and Mathematics 340(b) will be available under the numbers Mathematics 473(a) and Mathematics 473(b) for students who started Mathematics 340 before September, 1971. (i.e. had the earlier version of this course).
480 Functional Equations Cauchy’s, Pexider’s and similar equations. Equations for polynomials and for trigonometric functions. Reduction to differential equations. General methods and theorems. Iteration. Applications. Further topics, as equations for functions of several variables, or equations for analytic functions, or equations on algebraic structures.

499 Reading in Mathematics

Topics in Computer Science

This course will be offered on an experimental basis during the Fall/1972 and Winter/1973 academic terms. Enrolment will normally be restricted to students in fourth year. Topics available will include:
1) Advanced Applications Programming
2) Advanced Systems Programming
3) Systems Analysis
4) Simulation

499 Reading in Mathematics
Department of Mechanical Engineering

Professor, Chairman of the Department
E. Brundrett, B.S.A. (O.A.C), B.A.Sc., M.A.Sc., Ph.D. (Toronto)

Professor, Associate Dean for Engineering Graduate Studies
T.A. Brzustowski, B.A.Sc. (Toronto), A.M., Ph.D. (Toronto)

Professor, Associate Chairman for Graduate Studies
D.J. Burns, B.Sc., Ph.D. (Bristol)

Professor, Associate Dean for Engineering Undergraduate Studies
E.L. Holmes, B.Sc. (Bristol), M.A.Sc., Ph.D. (London)

Professor, Associate Chairman for Undergraduate Studies
G.F. Pearce, B.A.Sc. (British Columbia), M.A.Sc. (Toronto)

Professors
S.A. Alpay, Dipl. Ing., Dr. Ing. (Berlin)
G.T. Csanady, Dipl. Ing. (Munich), Ph.D. (New South Wales)
M.B. Danard, B.A.Sc. (British Columbia), M.A. (Toronto), Ph.D. (Chicago)
H.I. Evans, B.Sc., M.Sc. (Wales), D.I.C., Ph.D. (London)
J.H.G. Howard, B.Sc. (Queen's), M.Sc., Ph.D. (Birmingham)
W.B. Nicoll, S.M. (M.I.T.), Engineer (Stanford), Ph.D. (London)
P. Niessen, B.Sc. (McMaster), M.A.Sc., Ph.D. (Toronto)
M.M. Yovanovich, B.Sc. (Queens), M.S. (Bufl.), M.E., Sc.D. (M.I.T.)

Associate Professors
G.M. Bragg, B.S.Sc. (Toronto), Ph.D. (Cambridge)
R.N. Dubey, B.Sc. (Hons) (Patna), B.Sc. (Eng.) (Bihar), Ph.D. (Waterloo)
D. French, B.Sc., C. Eng.
A.M. Hale, B.Sc., M.A. (New Brunswick), B.A.Sc. (Toronto), M.A.Sc., Ph.D. (Waterloo)
K.G.T. Hollands, B.A.Sc. (Toronto), Ph.D. (McGill)
C.E. Hermance, B.E. (Yale), M.A.A., M.SE., Ph.D. (Princeton)
H.W. Kerr, B.A.Sc., Ph.D. (Toronto)
W.M. Mansour, B.Sc. (Cairo), M.A.Sc., Ph.D. (Toronto)
H.R. Martin, B.Sc., M.Sc. (Queen's Belfast), Ph.D. (Nottingham)
K.R. Pickarski, Dipl. Ing. (London), Ph.D. (Cambridge)
A. Plumtree, B.Sc., Ph.D. (Nottingham)
G.D. Raithby, B.E.Sc., M.E.Sc. (Western), Ph.D. (Minnesota)
R.F. Scrutton, B.Sc., M.Sc. (Melbourne)
P.R. Slawson, B.A.Sc., M.A.Sc., Ph.D. (Waterloo)
A.B. Strong, B.A.Sc. (Waterloo), M.Sc. (Imperial College, London), Ph.D. (Waterloo)

Assistant Professors
K.G. Adams, B.Sc. (Queen's), M.A.Sc., Ph.D. (Waterloo)
G.C. Andrews, B.A.Sc., M.A.Sc. (British Columbia), Ph.D. (Waterloo)
T.A. Ledwell, B.Eng., M.Eng. (Nova Scotia), Ph.D. (Waterloo)
W.K. Luk, D.I.C. (London), Dipl. of Hong Kong Tech. College, Ph.D. (Waterloo)
J. Moss, B.Sc. (Western), Ph.D. (McMaster)
R.J. Pick, B.A.Sc. (British Columbia), M.S. (Imperial College, London), Ph.D. (Waterloo)

Lecturers
J.D. Malcolm, B.A.Sc., M.A.Sc. (Waterloo)

Special Lecturers
C.J. Beingessner, B.Sc., M.A.Sc., Ph.D. (Toronto)
R.G.R. Lawrence, Q.C.
U.H. Mohaupt, B.A.Sc. (Waterloo)
Undergraduate Programmes

Details of the undergraduate programme in Mechanical Engineering are to be found on page 140. All courses extend over one term only, and consist of 3 hours of lectures per week unless otherwise specified. The hours of the core courses are listed on page 142. In general, the only prerequisites are the core courses, unless otherwise specified.

Undergraduate Course Descriptions

1 Advanced Calculus

Infinite series: Tests for absolute, conditional, uniform convergence; power series; series expansions; differentiation and integration. Partial differentiation: total derivatives; estimation of errors; chain rule; geometry; maxima and minima; taylor series; jacobians. Multiple integration: areas, centroids, moments of inertia, centres of gravity. Vector analysis: gradient, divergence, curl, Laplacian; integral theorems.

2 Statistics for Engineers


Ordinary Differential Equations


4 Numerical Analysis

A survey of numerical procedures with emphasis upon computer implementation using the Fortran 4 programming language. In particular, the following topics are covered: Interpolation, curve fitting, solution of non-linear equations, numerical integration, numerical solution of Ordinary Differential Equations, matrix algebra and solution of systems of linear equations, and problems in the solution of partial differential equations.

10 System Dynamics

Generalized and unified dynamic concepts, physical laws governing dynamic systems. Laplace transform review and the transfer functions. Mathematical models and block diagrams for physical systems. Dynamics of first and second order systems due to deterministic inputs. Analogies among mechanical, electrical, fluid and thermal systems. Linear flow graph and Mason's rule. Analog computer simulation. Stability from the pole zero configuration.
12 Dynamics

15 Structure and Properties of Materials 1
Interatomic bonding, crystal and amorphous structures, structural defects, phase equilibria, diffusion, non-equilibria, transformations, corrosion.

16 Modern Physics

19 Mechanics of Deformable Solids 1

20 Mechanics of Deformable Solids
A general treatment of the behaviour of structural components from the study of stress and strain in solids. Topics include super-position, energy theorems, theories of failure, elastic and inelastic analysis of unsymmetrical bending, torsion of circular members, columns and stability, and virtual work.

21 Kinematics and Dynamics of Machines

22 Mechanical Design 1

30 Structure and Properties of Materials 2
Elasticity, inelasticity, plasticity, fracture, creep, fatigue, strengthening mechanisms, electrical, magnetic and optical properties.

32 Physical Metallurgy 2

33 Experimental Materials Science
This course is designed to acquaint students with experimental techniques in Materials Science. For the initial part, the students will be required to perform assigned experiments which demonstrate common physical phenomena. For the remainder of the course, each student will work on a small experimental project.

35 Industrial Metallurgy
This course is intended for those students interested in acquiring a working knowledge of metallurgy. It will cover: Metals and alloy systems, iron-carbon alloys, heat treatment and the function of alloying elements in steel, corrosion and scale resistant alloys, copper and nickel base alloys, light metals and their alloys; casting, hot and cold working of metals; soldering, brazing and welding; corrosion and oxidation; metal failure analysis.


46 Manufacturing Science 7 Introduction to polymer processing for mechanical engineers. Elements of polymer science; plastics as a design material. Screw extrusion; elements of non-Newtonian flow and viscometry. Injection moulding. Parameters of polymer conversion operations and their estimation.


48 Analysis and Design of Manufacturing Systems 2 Analysis and design of the plant layout and materials handling systems as basic components of a manufacturing facility and system. Product range and mix and their effect on these systems. Proven systematic analysis and synthesis and evaluation techniques for efficient and effective plant design. Prerequisite: ME 45.

49 Metrology Theory and practice of high precision mechanic measurements under strict control conditions—super micrometry; measurements by comparators; profilometry; surface profilography; environmental effects on measurements accuracy; theodolite techniques in the measurements of large structures; collimator applications in machine installation. Tolerances and quality control.

51 Fluid Mechanics 1  Physical properties of fluids and fundamental concepts in fluid mechanics. Hydrostatics. Conservation laws for mass, momentum and energy. Flow similarity and dimensional analysis as applied to engineering problems in fluid mechanics. Laminar and turbulent flow. Engineering applications such as flow measurement, flow in pipes and fluid forces on moving bodies.

52 Air Conditioning  Thermodynamic properties of moist air; psychrometric charts; humidity measurements; direct water contact processes; heating and cooling of moist air by extended surface coils; solar radiation; heating and cooling of loads on buildings; effects of the thermal environment; air conditioning calculations; air flow in and around buildings, diffusers. 

Prerequisite: ME 54.

53 Heat Transfer 1  Introduction to heat transfer mechanisms. The formulation and solution of steady and transient heat conduction. Radiant heat transfer including exchange laws and view factors. Introductory convective heat transfer.

54 Thermodynamics 2  Emphasis on applications of thermodynamics to flow processes, real fluids, evaluation of state functions of real fluids. Thermodynamic analysis of selected devices.

55 Refrigeration Engineering  Methods of refrigeration, refrigerants and their thermodynamic properties, vapour compression systems; actual cycles, simple and complex; survey of refrigeration applications such as preservation of food by quick freeze and long term deep freeze techniques; cooling load calculations; calculation of thermal capacities of components such as evaporators, compressors and condensers; refrigerant controls; piping and accessories; defrost methods; miscellaneous processes, cryogenics. 

Prerequisite: ME 54.

56 Heat Transfer 2  Forced and free laminar and turbulent convection heat transfer in internal and external flows. Special topics selected from current applications.

58 Internal Combustion Engines  Reciprocating SI and CI engines, gas turbines, jets, rockets. 

Prerequisite: ME 54.

59 Energy Conversion  Applications of fundamental principles of thermodynamics, fluid mechanics, combustion and heat transfer to the design of power plants using fossil and nuclear fuel heat sources. Economic and pollution problems associated with power equipment. Other energy conversion devices such as batteries, fuel cells, solar cells, thermionic and thermoelectric devices and MHD generators. 

Prerequisite: ME 54.


63 Lubrication Mechanics
A) Lubrication Principles: dry friction, boundary lubrication, hydrodynamic lubrication, rolling elements, squeeefilms, metal working lubrication, wear, failure modes.
B) Lubrication applications: sources and types of lubricants, their composition and selection; sliding bearings, rolling bearings, gears, wire rope, hydraulic fluids, metalworking.
C) Project: related to a specific topic in Parts A and B. Lab or theoretical evaluations will be involved in the design of a suitable lubrication system for a specified industrial application.
To be offered in Fall and Spring Terms.

64 Industrial Fluid Mechanics
Flow in ducts, furnaces, heat exchangers, scrubbers, reactors, etc.; gas cleaning by removal of gaseous and particulate constituents; gas handling equipment; atmospheric dispersion of pollutants; wind loading on buildings and structures; wind tunnel modelling.
Prerequisite: ME 62.

69 Introduction to the Environmental Sciences
Composition and structure of the atmosphere and oceans.

82 Mechanical Engineering Projects
Engineering assignments requiring the student to demonstrate initiative and assume responsibility. Student activity is guided and co-ordinated by faculty supervisor. In selecting projects, particular account is taken of the students' field of specialization. Projects, in general, involve technical disciplines beyond the strictly mechanical engineering field.
9 hours laboratory.

90 Engineering Physics
Physical optics; waves as energy carriers, interference and diffraction. Quantum theory of radiation; photons, empirical spectroscopy, de Broglie waves, atomic structure, energy quantization, absorption and radiation by atoms and molecules. Nuclear physics; nuclear structure, binding energy, nuclear reactions. Solid state physics; statistical distribution laws, molecular binding, band theory.

100 Introductory Survey of Law
The rights and responsibilities of the engineer as a citizen of Ontario and Canada under the law; brief history of Canadian law differentiating between Civil and Criminal Law, the rights and duties of citizens and police, a review of Domestic Law, Real Estate Law, Landlord and Tenant Law. The law as it may pertain to the engineer in his profession, brief reviews of the Law of Contracts, Patents, Trade marks, industrial design, and copy-right, Bills of Exchange, Company Law, incorporation of companies, Common and Preferred shares, the Law of Master and Servant, surveying law, Constitutional Law, Private International Law, and other topics.

200 Introduction to Mechanical Engineering 1
Discussion of structure of Mechanical Engineering curriculum, operation of Department, Faculty, University, technical societies.
1 hour, non-credit.

300 Introduction to Mechanical Engineering 2
Technical specialities in Mechanical Engineering, discussion of options in Mechanical Engineering curriculum, seminars and technical topics in the various options.
1 hour, non-credit.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>Introduction to Mechanical Engineering 3</td>
<td>Research frontiers in Mechanical Engineering, specific discussion of research done at Waterloo, seminars by members of research groups. 1 hour, non-credit.</td>
</tr>
<tr>
<td>503</td>
<td>Advanced Vectors, Tensors and Matrices</td>
<td>Advanced topics in vector analysis and matrix algebra. Cartesian tensors for engineers. Curvilinear coordinates. Introduction to general tensors.</td>
</tr>
<tr>
<td>504</td>
<td>Numerical analysis 2</td>
<td>Advanced numerical techniques specifically designed to solve engineering problems in heat transfer, solid and fluid mechanics and systems dynamics.</td>
</tr>
<tr>
<td>523</td>
<td>Mechanical Design 2</td>
<td>Principles of optimum design of machine elements; minimum cost, minimum weight, maximum power, etc. Statistical considerations in factors of safety and tolerances. Effect of manufacturing errors on product performance. Introduction to value engineering and reliability. Prerequisite: ME 22.</td>
</tr>
<tr>
<td>524</td>
<td>Advanced Dynamics</td>
<td>A second course in engineering dynamics, inertia tensor and Euler’s Equations, energy methods, gyroscopic motion, generalized co-ordinates and Lagrange Equations, vibrations.</td>
</tr>
<tr>
<td>528</td>
<td>Experimental Mechanics</td>
<td>Experimental methods of static and dynamic stress analysis; strain gauges, brittle coatings, photo-elasticity, moire fringes, analogues. Selected related topics: flaw detection, vibration measurement, use of statistical methods, error analysis and curve fitting.</td>
</tr>
</tbody>
</table>
534 Properties of Polymers

537 Ceramics
The crystallography of ionic and co-valent compounds. A study of the mechanical properties of single crystals and polycrystals. Properties of special ceramic materials.

544 Manufacturing Science 5

547 Statistical Quality Control and Reliability Engineering

548 Numerical Control of Machine Tools 1

549 Analysis of Design of Machine Tools
This subject presents to the students both static and dynamic problems associated with machine tools and their effect on the accuracy and efficiency of manufacture.


Factors affecting the stiffness of machine tool structures, effects of relative stiffness on accuracy, friction characteristics of slideways. Hydrostatic bearings.

550 Experimental Numerical Control and Automation
The course is designed to enable the student to study the fundamental concepts of the application of Numerical Control and Automation to Manufacture. The students will perform a series of experiments which demonstrate the basic concepts, in addition each student will undertake a project.

Prerequisite: ME 548.

555 Thermodynamics 3
Chemical equilibrium, multiconstituent fluid phases, additional topics in statistical thermodynamics, introduction to thermodynamics of irreversible processes.
557 Combustion 1 Phenomenological description of flames of various types, flashback, blow off, inflammability limits, premixed flames, diffusion flames, burner design, flame holding, laminar flame theory, quasisteady droplet burning theory.


562 Control Theory 2 Introduction to nonlinear system: phase plane and describing functions. State space analysis. Introduction to systems with random inputs. Auto and cross-correlations, and the optimum filter theory.


564 Dynamics of Biomedical Systems Sensors and instrumentation used in monitoring body parameters. Response of the body to various actions. Transfer functions and reaction times. Characteristics of blood flow. Mathematical models of pulmonary, cardiovascular and optical systems. Use of computers in modelling and data analysis. Application of automatic control principles to artificial limbs and other aids. Use of fluidics and fluid power devices to aid body functions.

565 Gas Dynamics Basic laws of compressible fluid flow. Wave propagation in compressible fluids, isentropic flow of a perfect gas, normal and oblique shock waves, Prandtl-Meyer flow. Flow in ducts and over bodies, flow with frictions (Fanno) and heat transfer (Rayleigh). Imperfect gas effects, measurement of compressible flows, use of formulae, charts and tables.

567 Aerodynamics of Flight  
Kinematics and dynamics of fluid flow; vorticity and circulation; vortex dynamics; theorems of Kelvin and Helmholtz and Biot-Savart law. Potential theory with circulation; Kutta-Joukowski theorem. Theory of infinite wing; effects of angle of attack, camber and profile shape on lift. Thin airfoil theory; aerodynamic devices for improving performance. Finite subsonic wing; downwash and induced drag. Stability and control of airplanes. Theory of supersonic wing; aerodynamic problems of supersonic flight.

568 Acoustics  

569 Industrial Fluid Mechanics  
A study of industrial aspects of fluid Mechanics. Unsteady flow, pipe and duct systems, two and three-dimensional flow techniques, practical calculation of boundary layers, separation, base pressures, jets, wakes and shear layers, diffusers and flow distribution devices, flow control, two-phase flow, instrumentation, wind tunnel modelling, wind loading. The course will be oriented to practical design techniques for flow systems, reactors, air pollution control equipment, etc.

570 Geophysical Fluid Dynamics  
Hydrodynamic equations of motion on a rotating earth. Geostrophic balance in the atmosphere and oceans, vertical variation of wind and pressure fields in the atmosphere, mechanisms of pressure change, vorticity equation.

571 Air Pollution  
Nature and sources of air pollution, chemical and biological aspects, effects on health and environment. Physical aspects of the atmosphere, thermodynamics, vertical variation of wind and temperature, stability, convection, atmospheric turbulence, diffusion equations, plumes, thermals, jets in stratified flow, radioactive plumes, particulate dispersion, instrumentation (micrometeorological), air pollution control techniques and equipment monitoring instrumentation.

572 Ocean Engineering  
This course will deal with a number of topics from the broad spectrum of engineering problems in the aquatic environment. Subjects discussed may include: structures (open, solid, floating, submerged), vehicles (surface, substructure, bottom) and shore processes. Treatment of the phenomena and the particular properties of the medium which make its solution of engineering problems in this area more challenging will be treated (mainly from the descriptive point of view). Usually a seminar and/or essay will be an important part of the course work-load.

576 Control System Design  
A study of available components, their specifications, use and limitations. A number of industrial design projects will be carried out by limited number of students. Guest speakers from industry are invited to this course.
School of Optometry

Professor and Director of School  E. J. Fisher, B.A., M.A. (Toronto), D.Sc. (Hon. Penn. College of Optometry)

Professors  C. W. Bobier, O.D. (College of Optometry of Ontario), B.A. (Toronto), M.S. (Ohio State)
           T. P. Grosvenor, B.Sc., Ph.D. (Ohio State)
           W. S. Long, O.D. (College of Optometry of Ontario), B.A. (Toronto)
           W.M. Lyle, O.D. (College of Optometry of Ontario), M.S., Ph.D. (Indiana)
           M. E. Woodruff, O.D. (College of Optometry of Ontario), M.S., Ph.D. (Indiana)

Associate Professors  J. D. Moreland, B.Sc. (London), D.I.C., Ph.D. (Imperial College)

Assistant Professors  R. D. Beauchamp, B.A. (McMaster), M.A., Ph.D. (Brown)
                    A. Remole, O.D. (College of Optometry of Ontario), B.F.A. (Manitoba), M.S., Ph.D. (Indiana)
                    T. D. Williams, O.D. (College of Optometry of Ontario), M.S. (Indiana)
                    G. C. S. Woo, O.D. (College of Optometry of Ontario), M.S., Ph.D. (Indiana)

Lecturer  M. G. E. Callender, O.D. (College of Optometry of Ontario), B.Sc. (S.G.W.U.)

Adjunct Professors  D. E. Andrew, B.A., M.D. (Toronto)
                   I. Baker, O.D. (College of Optometry of Ontario)
                   D. H. Lamont, B.A. (Toronto), Q.C.
                   C. W. Schwenger, M.D., D.P.H. (Toronto)
                   G. W. Wyszecki, Dipl. Ing., (Tech. Univ., Berlin)

Clinical Associates  W. R. Andrews, O.D. (College of Optometry of Ontario)
                     R.R. Bock, O.D. (College of Optometry of Ontario)
                     R. R. Chen, O.D. (College of Optometry of Ontario)
                     R. E. Coles, O.D. (College of Optometry of Ontario)
                     B. Garnett, O.D. (College of Optometry of Ontario)
                     G. A. Grant, O.D. (College of Optometry of Ontario)
                     R. R. Hansford, O.D. (College of Optometry of Ontario)
                     J. E. Longstaff, Dip. Opt. (College of Optometry of Ontario)
                     K. J. Mackenzie, O.D. (College of Optometry of Ontario)
                     A. J. MacKinnon, O.D. (College of Optometry of Ontario)
                     G. N. Miller, O.D. (College of Optometry of Ontario)
                     M. S. Munn, Dip. Opt. (College of Optometry of Ontario)
                     H. Naftolin, O.D. (College of Optometry of Ontario)
                     C. G. Nicol, O.D. (College of Optometry of Ontario)
                     M. L. Osler, O.D. (College of Optometry of Ontario)
                     R. D. Pellowe, O.D. (College of Optometry of Ontario)
                     S. A. Salsberg, O.D. (College of Optometry of Ontario)
                     M. J. Samek, O.D. (College of Optometry of Ontario)
                     J. R. Shankman, O.D. (College of Optometry of Ontario)
                     W. Shilman, O.D. (College of Optometry of Ontario)
                     H. Thompson, B.A. (Toronto), O.D. (College of Optometry of Ontario)
                     G. R. Virgin, O.D. (College of Optometry of Ontario)
                     G. A. Williams, O.D. (College of Optometry of Ontario)
                     E. J. Wylie, O.D. (College of Optometry of Ontario)
Course Descriptions

Students in other disciplines may register for Optometry courses only upon the approval of the Director of the School of Optometry.

200* History and Orientation
A brief history of the profession; a review of the development of visual science; a consideration of legal and organizational development of optometry; the role of professional associations. The scope and nature of optometrical practice and the relationship of the profession to other professions and the community.
2 lectures. Fall term.

211* Physiological Optics
The eye as an optical instrument. The refracting mechanism; accommodation, pupil action and lid action; the passage of light in the eye; stray light in the eye; analysis of the retinal stimulus pattern.
3 lectures, 3 hours laboratory. Winter term.
Prerequisite: Physics 236*.

216* Advanced Geometrical Optics
An extension of geometrical optics given in Physics 236 dealing with the optics of surfaces, prisms, thin and thick lens systems including the eye, aberrations of such systems and their correction; optical and ophthalmic instruments.
4 lectures, 3 hours laboratory. Winter term.
Prerequisite: Physics 236*.

224* Anatomy of the Eye and Associated Structures
The gross, microscopic and ultra structure of ocular tissues will be examined in detail. Extensive dissection of various eyes will be completed. Bone and other supportive structure will be studied in the laboratory with emphasis directed toward application of anatomical knowledge to related courses in pathology and clinical optometry. Embryology and Comparative Anatomy are included.
3 lectures, 2 hours laboratory. Fall term.
Corequisite: Biology 201.

234* Anatomy of the Eye and Associated Structures
A continuation of Optometry 224*.
3 lectures, 2 hours laboratory. Winter term.
Prerequisite: Optometry 224*.

301* Physiological Optics
Ocular motility: description and analysis of eye movements, measurement of eye movements, the innervational systems of the extraocular and intraocular musculature.
3 lectures, 3 hours laboratory.
Prerequisite: Optometry 211*.

302* Clinical Optometry
Lectures on clinical techniques for examination of the optical properties of the eye. Included will be:—measurement of the visual acuity, theory and practice of retinoscopy, ophthalmoscopy, keratometry, subjective sight testing, measurement of amplitude of accommodation, and calculation of reading addition. A laboratory course in which these techniques will be demonstrated and practised will run concurrently.
3 lectures, 3 hours laboratory. Fall term.
Prerequisite: Optometry 211*.
305* General Pathology  A study of the basic disease processes including inflammation, degeneration, neoplasia. The properties of pathogenic microorganisms and the specific diseases with which they are associated. Resistance, immunity, hypersensitivity. Diseases caused by physical agents other than microorganisms. Principal diseases affecting each organ system.
3 lectures, 1 hour tutorial, Fall term.
Prerequisite: Biology 201, Optometry 224*-234*.

306* Optometrical Optics  The history and manufacture of optical glass, ophthalmic lens surfacing and design, classification and performance of single vision ophthalmic lenses, prismatic effects, transposition, absorptive lenses and lens coating, problems and solutions in fitting ophthalmic lenses to the eyes. The laboratory course deals with processing all types of ophthalmic material, as well as optical bench experiments.
3 lectures, 2 hours laboratory, Fall term.
Prerequisite: Optometry 216*.

311* Physiological Optics  The visual process: retinal structure; photopigments; photoreception; electrophysiology of the retina and higher centres.
3 lectures, 3 hours laboratory.
Prerequisite: Optometry 301*.

312* Clinical Optometry  Clinical techniques for the examination of the binocular relations of the non-strabismic patient, with particular emphasis on the study of the relationship between accommodation and convergence; techniques of phorometry, prism vergence tests, relative accommodation tests, dynamic retinoscopy, and monocular and binocular cross cylinder tests.
3 lectures, 3 hours laboratory, Winter term.
Prerequisite: Optometry 301*, 302*.

315* General Pathology  A continuation of 305*.
4 lectures, 1 hour tutorial, Winter term.
Prerequisite: Optometry 305*.

316* Optometrical Optics  A continuation of 306*, dealing with problems peculiar to bifocal and multifocal lenses. Aberrations of thin lenses and the design of lenses for ophthalmic use.
3 lectures, 2 hours laboratory, Winter term.
Prerequisite: Optometry 306*.

401* Physiological Optics  Psychophysics of vision: light and dark adaptation; spatial and temporal light discrimination; normal and defective colour vision.
3 lectures, 3 hours laboratory.
Prerequisites: Optometry 301*, 311*.

402* Clinical Optometry  The sequence of testing in the clinical examination will be outlined. Stress will be on case history, tests of the integrity of the visual system, tests of the refractive properties, and tests of binocular relations. The integration of these tests into a satisfactory clinical analysis and modes of treatment will constitute a large part of the course.
3 lectures, 1 hour laboratory, Fall term.
Prerequisites: Optometry 302*, 312*. 
404* Physiology of the Visual Systems
Vacuolar supply; physiology of the cornea and lids; formation, supply and drainage of the ocular fluids; intraocular pressure, metabolism of cornea, lens, vitreous and retina; effects of drugs producing miosis, mydriasis, cycloplegia, spasm of accommodation and anaesthesia of the ocular surfaces; neurophysiology of the retina, sensory and motor pathways and the brain centres of the visual system.
2 lectures, 2 hours laboratory. Fall term.
Prerequisite: Optometry 224*.

405* Ocular Pathology
2 lectures, 1 hour tutorial. Fall term.
Prerequisites: Optometry 305*, 315*.

406* Optometrical Optics
The lecture course will deal with the problems involved in the selecting, cosmetic and comfort requirements. The laboratory course will give the student experience in working with lenses and frames as he prepares ophthalmic materials for clinic patients.
2 lectures, 4 hours laboratory. Fall term.
Prerequisites: Optometry 306*, 316*.

408* Optometry Clinic
The student is assigned to the Visual Analysis Clinic and under the direct supervision of optometrists of the clinic staff, carries out routine clinical investigations of patients who attend the public clinic.
7 hours clinic. Fall term.
Prerequisite: Permission of Clinic Director.

409* Light and Illumination
Light sources, transmitting and reflecting surfaces; principles of radiometry and photometry; illumination and related factors involved in the control of the visual environment.
2 lectures, 2 hours laboratory. Fall term.

411* Physiological Optics
Binocular vision and perception: The binocular system; binocular integration and interaction; effects of disparate stimulation; perceived size, shape, direction, distance, motion, colour, illusions.
3 lectures, 3 hours laboratory.
Prerequisite: Optometry 401*.

412* Clinical Optometry
A continuation of 402*. The detection of strabismus and techniques for testing the sensory and motor characteristics of the strabismic patient. The aim will be to allow the student to evaluate the likelihood of achieving a cure by non-surgical means. The techniques of orthoptics and visual training by which a rehabilitation of vision can be attempted will be described and demonstrated.
2 lectures, 2 hours laboratory. Winter term.
Prerequisites: Optometry 302*, 312*, 402*.

414* Physiology of the Visual Systems
A continuation of 404*.
2 lectures, 2 hours laboratory. Winter term.
Prerequisite: Optometry 404*.

415* Ocular Pathology
A continuation of 405*.
2 lectures, 1 hour tutorial. Winter term.
Prerequisite: Optometry 405*.
417* Optometrical Specialties  
A series of lectures and laboratories on the handling of patients in specialized areas of optometric practice. These include contact lens fitting, the fitting of aids for subnormal vision, and the correction of aniseikonia.  
3 lectures, 2 hours laboratory, Winter term.  
Prerequisites: Optometry 401*, 402*, 408*.  

418* Optometry Clinic  
A continuation of 408*.  
7 hours clinic, Winter term.  
Prerequisite: Optometry 408*.  

428* Summer Clinic  
Each student is required to complete 60 hours of clinical practice during the summer term. Times will be arranged by the student with the approval of the clinic staff.  
Prerequisite: Permission of Clinic Director.  

500* Optometrical Jurisprudence and Praxis  
Lectures on laws governing the practice of Optometry in Canada and laws relating to the rights and responsibilities of the optometrist in his relations with his patients; the establishment and management of optometric practice; economics, taxes, insurance, accounting, office design, mode of practice, professional organization and societies.  
2 lectures, Fall term.  

501* Physiological Optics  
Assignments will include preparing for seminars on topics of interest, reviews, library and laboratory researches by individuals or small groups. Consideration will be given to the individual student's special interests. Students who have demonstrated a particular interest in research in this area may elect this course as an alternative to Psychology 357*; Optometry 513*.  
3 hours, Fall term.  
Prerequisites: Optometry 401*, 411*.  

502* Advanced Clinical Optometry  
The lecture portion of this course will deal with special techniques of clinical optometry for examination of refractive properties and binocular relations; techniques of binocular refraction, prism adaptation; etiology of refractive errors and change of refraction with age; seminars and the presentation of clinical case reports by the student for defense and criticism will constitute a part of the course.  
3 lectures, Fall term.  
Prerequisites: Optometry 302*, 312*, 402*, 412*.  

504* Ocular Pharmacology  
Neurohumoral theory, responses to drugs, sterile techniques, disinfectants. Drugs used in contact lens practice, drugs used topically on the eye, drugs used as diagnostic aids. Side effects of all drugs on the eye and vision.  
2 lectures, 1 hour laboratory, Fall term.  
Prerequisites: Optometry 404*, 405*, 415*.  

508* Optometry Clinic  
The clinic is the culmination of the optometry student's educational career. Emphasis will be placed on vision care to patients of all ages and walks of life. The clinical intern performs the total work of an optometrist under the supervision and counsel of clinical faculty. Specialty clinic will be operated within the clinic organization to obtain facility of application of appropriate skill in pathology detection, orthoptics and vision training, contact lens application, the detection and rehabilitation of perpetual-motor problems, the problems associated with the low-vision patient.
509* Public Health Optometry  
The role of optometry in providing vision care to society and the community. Optometrical services to industry, in schools, the role of vision in the safe operation of highway vehicles and airplanes as well as the role of optometry in private and government programs of vision care and health insurance. Epidemiology.  
2 lectures, 2 hours laboratory, Fall term.

510* Optometrical Jurisprudence and Praxis  
A continuation of 500*.  
2 lectures, Winter term.  
Prerequisite: Optometry 500.

511* Physiological Optics  
A continuation of 501*.  
3 hours, Winter term.  
Prerequisite: Optometry 501.

513* Optometric Communication  
This course deals with aspects of communication, control and motivation in optometric clinical practice. Verbal communication with the patient during and at the conclusion of the visual examination will be emphasized along with intra- and inter-professional referral methods. Special problems arising with elderly patients and children will be reviewed. The student will be asked to evaluate his own aims and skills in these matters.  
2 lectures, Winter term.

514* Genetics For Optometrists  
A brief review of Mendelian genetics, and the molecular basis of modern genetics. Inherited conditions of particular interest, e.g., colour vision, albinism, aniridia, refractive error, retinoblastoma, etc. Genetic counseling, and the detection of carriers.  
2 lectures, Winter term.  
Prerequisites: Optometry 405*, 415*

518* Optometry Clinic  
A continuation of 508*.  
24 hours clinic, Winter term.  
Prerequisite: Optometry 508*.

519* Public Health Optometry  
A continuation of 509*.  
2 lectures, 2 hours laboratory, Winter term.
Department of Philosophy

Professor and Chairman of the Department  B.H. Suits, B.A., M.A. (Chicago), Ph.D. (Illinois)

Professors
R.A. George, M.A., Ph.D. (Michigan State)
L.L. Haworth, B.A. (Rollins), M.A., Ph.D. (Illinois)
J.S. Minas, B.A. (Wayne), Ph.D. (Illinois)
P. Seligman, B.A., Ph.D. (London)
J.W. Tucker, B.Sc., B.A., Ph.D. (London)

Associate Professors
W.R. Abbott, B.A. (Kenyon), Ph.D. (Ohio State)
E.J. Ashworth (Miss), B.A., M.A. (Cambridge), Ph.D. (Bryn Mawr)
B.P. Hendley, B.A. (Marquette), M.A., Ph.D. (Yale)
J.R. Horne, B.A., M.A. (Western Ontario), B.Th. (Huron), Ph.D. (Columbia)
J. Huertas-Jourda, B.A. (Florida), M.A., Ph.D. (New York)
A.C. Minas (Mrs.), B.A. (Radcliffe), M.A., Ph.D. (Harvard)
D.D. Roberts, B.A. (Roosevelt), M.A., Ph.D. (Illinois)
J.W. Van Evra, B.A. (Valparaiso), M.A., Ph.D. (Michigan State)

Assistant Professors
J F. Centore, B.Sc. (Canisius), M.A. (Maryland), Ph.D. (St. John's)
J D.T. DeMarco, B.S. (Stonehill, Mass.), Ph.D. (St. John's, N.Y.)
J A. Dobos, B.A. (Western), M.A., Ph.D. (St. Louis)
W.M. Pfeiffer, B.A. (Bishop's), M.A. (Duke), Ph.D. (Toronto) [Visiting 1972-73]
J. Wubnig (Miss), B.A. (Swarthmore), M.A., Ph.D. (Yale)

Lecturer
M.F. McDonald, B.A. (Toronto), M.A. (Pittsburgh)

Note 1  Unless otherwise noted in the course listing, all courses offered by the Department may be taken by any student in the University, subject only to his meeting the specific prerequisites listed in the individual course descriptions.

Note 2  Some of the advanced courses (those numbered 300 or above) will not be available every year. Each Spring, the Department will publish a list of the courses to be offered for the following academic year. This list will include descriptions of courses whose content is not specified below and names of instructors for each course.

Note 3  The attention of all first-year students is called to the fact that several courses in addition to Philosophy 100 or 110 are open to them, any full courses or two half courses of which can be used to satisfy part of the University requirement under group A(i). These are the courses numbered 125*, 135*, 140*, and 150* as well as 221*/222*, 240, and 280*/281*.
Of these, the courses numbered 221*/222*, 240, and 280*/281* are especially recommended for the student contemplating further study in Philosophy. (See recommended Honours Programmes, page 100)

Note 4  The number of hours shown after the courses merely indicates the weight of courses relative to one another and does not determine the number of hours the course meets. The number of class meetings per week is determined by the instructor. Half courses (courses which meet for one term only) are designated by an asterisk (*) after the course number.

Note 5  Courses suffixed with 'J' are administered by St. Jerome's College; those suffixed with a 'P' are administered by St. Paul's College.
Note to General Philosophy Students
6 full course equivalents in Philosophy are required for the General Degree in Philosophy, including 140* or 240, 221*/222*, 280*/281*, 282*/283*.

Minor
A minor in Philosophy consists of any five full courses (or equivalent) in Philosophy.

Note to Honours Philosophy Students
The attention of students in Honours Philosophy programmes is drawn to the following list of recommended electives: Classical Civilization 251, Classical Civilization 260, History 260, English 350 and Political Science 320.

Note
Any of the following courses is especially recommended for the consideration of honours students who intend to pursue graduate studies in Philosophy: Philosophy 340, 350, 363, 455, 465, and one of either 380*-389* or 480*-489*.

Undergraduate Courses

Note Concerning Introductory Courses
Normally all first year courses provide opportunity for weekly discussions in small groups.

100 Introduction to Philosophy
A broad selection of the main problems in philosophy will be considered. For example: How can we know whether anything is right or wrong? How can we know about things we cannot directly observe? Can we know whether there is a God? Is mind in any sense distinct from matter? Original texts of both classical and contemporary thinkers are employed.
No prerequisite.
3 hours.

110 Problems
An introduction to philosophical thinking through an examination of problems that concern the student. The course will begin with a general discussion of problematic aspects of contemporary life. We will then focus in on specific topics and consider them in light of relevant philosophical approaches. Readings to be used will depend on the topics emerging from the discussion.
No prerequisite.
3 hours.

125* Fundamentals of Social and Political Philosophy
The central question of the course is: What reasons can I have for acting on the issues which will face me as a member of society? Such problems as divorce, democracy, socialism, the Bomb, and international politics will be critically discussed in the light of readings from both classical and contemporary philosophers.
No prerequisite.
3 hours.

135* Fundamentals of the Philosophy of Religion
A philosophical consideration of problematic aspects of religious belief. Topics to be discussed will include: attempts to prove the existence of God, the problem of evil, faith and reason, religious experience, and religious language. Classical and contemporary readings will be used.
No prerequisite.
3 hours.
140* Fundamentals of Logic  
Basic types of reasoning will be analyzed. The reasons for using symbols in logic will be explored, and some simple systems considered. Attention will also be devoted to informal arguments and scientific method.  
No prerequisite.  
3 hours.

150* Knowledge and Reality  
Discussion of the nature of reality. Rival theories concerning mind, matter, freedom, the existence of God, and the place of experience and reason in human knowledge.  
No prerequisite.  
3 hours.

201* Love  
A philosophical analysis of different forms and functions of love. Among the topics to be considered: love and sexuality, religious love, love and knowledge. Classical and contemporary sources will be treated.  
No prerequisite.  
3 hours.

221* Ethics 1  
The classic literature of ethics will be analyzed, and the principal problems brought to light.  
No prerequisite.  
3 hours.

222* Ethics 2  
Contemporary theories will be explored, and recent philosophical methods applied in the discussion of the principal problems of ethical theory.  
Prerequisite: Philosophy 221* or consent of instructor.  
3 hours.

223 Moral and Social Philosophy  
An examination of theories for evaluating personal conduct and political, social, and economic systems and policies. Such concepts as right and wrong, justice, individual rights, and the ends of political organization form the principal subject-matter of the course. Both classical and contemporary readings are employed.  
Prerequisite: Philosophy 100 or equivalent, or Honours status in any Social Science department, or consent of instructor.  
3 hours.

225* Problems in Social and Political Philosophy in Canada  
This course is a philosophical study of various Canadian social and political problems using the theory developed in Philosophy 125*. Among the problems discussed will be the Criminal Code's regulation of moral matters; the provision of public support for the promotion of religious ideals; the right of self-determination in Confederation; foreign control of Canada's economy and culture; and the proper distribution of wealth to various citizens. Students also will be encouraged to discuss arguments of particular interest to them.  
Prerequisite: Philosophy 125* or consent of the instructor.  
3 hours.

235* Philosophy and Mysticism  
A critical examination of mystical writings, with regard to the nature of the experience reported, their typology, and their implications for epistemology, ethics, and philosophy of religion.  
Prerequisite: Consent of instructor.  
2 hours.
240 Logic A systematic development of the propositional calculus and of the first-order functional calculus. Some attention will be devoted to extensions to, and interpretations of, such formal systems. 
Prerequisite: None for second-year students and above; consent of instructor for others.
3 hours.

250* Knowledge and Reality (French) As 150*, but this course will be taught in French. (Cross-numbered as French 385*)
Prerequisite: Consent of instructor.
3 hours.

280* History of Ancient Philosophy 1 From the beginnings to Plato.
Prerequisite: Consent of instructor for students not taking philosophy as their main subject.
3 hours.

281* History of Ancient Philosophy 2 From Aristotle to the close of classical antiquity.
Prerequisite: Philosophy 280*.
3 hours.

282* History of Modern Philosophy 1 Earlier period beginning with Descartes.
Prerequisite: One full or two half Philosophy courses, preferably 280*/281*, or consent of instructor.
3 hours.

283* History of Modern Philosophy 2 Later period including Kant.
Prerequisite: Philosophy 282*.
3 hours.

311* Philosophy of Education 1 A philosophical analysis of classical and contemporary Theories of education, with a view to formulating a clear workable concept of education, its aims and methods.
Prerequisite: One full or two half Philosophy courses, or consent of instructor.
3 hours.

312* Philosophy of Education 2 Critical evaluation of selected problems of education in an attempt to relate theory to practice. Recent studies, such as the Hall-Dennis Report, will be among those considered.
Prerequisite: Philosophy 311*, or consent of instructor.
3 hours.

321*/324* Studies in Ethics Various half courses dealing with special topics; one or more of these will be offered each year as announced by the Department.
Prerequisite: Philosophy 221*/222*.
3 hours.

325* Political Philosophy 1 Philosophical analysis of central concepts in political theory and its relation to moral and metaphysical problems of various periods.
Prerequisite: One full or two half Philosophy courses.
3 hours.

326* Political Philosophy 2 A detailed discussion of contemporary theories.
Prerequisite: Philosophy 325*, or consent of instructor.
3 hours.
327* Philosophy of Law
Analysis of legal notions; the bearing of philosophical systems on theories of law. Historical and contemporary examples will be used.
Prerequisite: One full or two half Philosophy courses.
3 hours.

331 Aesthetics
Philosophical consideration of works of art and the problems of beauty using selected readings to enable the student to recognize and formulate his own views in a philosophic manner.
Prerequisite: One full or two half Philosophy courses.
3 hours.

335* Philosophy of Religion
A critical examination of the methods and substantive arguments found in selected major works of religious philosophy. The writings chosen for consideration will be announced in advance each year.
Prerequisite: One full or two half Philosophy courses.
3 hours.

340 Logical Theory
A rigorous development of the propositional and predicate calculus in a general framework in terms of which various alternative calculi may be examined. Particular attention is given to such concepts as completeness, consistency, extensionality, modality, etc., from both formal and philosophical points of view. Intended primarily for those interested in the philosophical issues connected with logic.
Prerequisite: Philosophy 140*, or (preferably) Philosophy 240, or consent of instructor.
3 hours.

341* Decision and Value Theory
A systematic study of the basic concepts in decision-making theories and their associated value theories. Special emphasis will be devoted to the definition and measurement of utility functions and to the various criteria employed in models of decision-making under uncertainty and under risk. Extensive use will be made of literature from Economics, Political Science, Psychology, and Mathematical Statistics.
Prerequisite: Consent of instructor.
3 hours.

350 Epistemology
A systematic course in the analysis of human knowledge. Phenomenalism and various kinds of realism will be considered, as well as other main topics such as the a priori, our knowledge of other minds, and our knowledge of abstract entities.
Prerequisite: One full or two half courses in Philosophy. Students not taking Philosophy as their main subject should consult the instructor.
3 hours.

358* Introduction to the Philosophy of Science
A discussion of various methodological and substantive topics common to many sciences. These topics include the logical structure of scientific laws, the nature of scientific theories, and the structure of scientific explanation.
Prerequisite: One full or two half courses in Philosophy, or consent of instructor.
3 hours.

359* Philosophy of the Formal Sciences
A study of philosophical problems concerning mathematics. Topics discussed include formalism, intuitionism, logicism, the mathematical paradoxes, and other topics in foundations and metamathematics.
Prerequisite: Philosophy 358* or consent of instructor.
3 hours.
2* Philosophy of Social Science
Problems about the fundamental methods and aims of the social sciences generally, and problems specific to Psychology, Sociology, Political Science, etc., and their relations to one another will be considered.
Prerequisite: Some previous work in a social science or in Philosophy.
3 hours.

363 Analytic Philosophy
Contemporary philosophical literature is employed in the exploration of both formal and "ordinary language" analysis. This course should be especially useful for persons contemplating graduate study in Philosophy.
Prerequisite: Consent of instructor, or honours status in Philosophy.
3 hours.

365*-366* Oriental Philosophy
Studies of a selected area of non-western Philosophy (e.g. Indian or Chinese). Parallels will be drawn between modes of Eastern thinking and European conceptions with emphasis on essential differences as well as similarities.
Prerequisite: Consent of instructor.
3 hours.

370*-372* Special Subjects
One or more half courses will be offered at different times as announced by the Department.
Prerequisite: Consent of instructor.
3 hours.

380*-389* Studies in the History of Philosophy
Various half courses dealing with a particular philosopher, a selected work or period; one or more of these will be offered each year as announced by the Department.
Prerequisite: Philosophy 280*/281* and 282*/283*.
3 hours.

390* Medieval Philosophy 1
The early period to the 13th century. Among those considered will be: Augustine, Boethius, Anselm, and Abailard.
Prerequisite: Philosophy 280*/281*.
3 hours.

391* Medieval Philosophy 2
The later period, from the 13th century. Among those considered will be: Bonaventure, Aquinas, Scotus, and Ockham.
Prerequisite: Philosophy 390*.
3 hours.

398(a-b)* Directed Reading in Special Areas
Prerequisite: Consent of instructor.

399 Tutorial for Honours Students
Students wishing to enrol in 399 should consult the Department.

401* Philosophical Literature
The study of specific philosophic problems as illustrated in appropriate literary works. Choice of selections will be determined by their relevance to the philosophical theme or themes under consideration. Themes such as free will and determinism, the nature of the universe, the problem of knowledge, the nature of justice, the state and the individual, the nature of man, and the problem of beauty may be studied singly or in combination.
Prerequisite: Third or Fourth Year Standing or consent of instructor.
3 hours.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Description</th>
<th>Prerequisites</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>425*</td>
<td>Philosophy of the City</td>
<td>Analysis and evaluation of the philosophical points of view that underlie current criticism of urban life and prevalent schemes for its reconstruction.</td>
<td>Prerequisite: One half Philosophy course.</td>
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<tr>
<td>435*-439*</td>
<td>Studies in Philosophy of Religion</td>
<td>A study of a particular philosopher or problem. The topic will be announced in advance each year.</td>
<td>Prerequisite: Consent of instructor.</td>
<td>3</td>
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<tr>
<td>440*-444*</td>
<td>Studies in Logic</td>
<td>Various half courses dealing with specific topics; one or more of these will be offered each year as announced by the Department.</td>
<td>Prerequisite: Philosophy 240 or Mathematics 436.</td>
<td>3</td>
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<tr>
<td>446*</td>
<td>Philosophy of History</td>
<td>Consideration of various possible views about the ultimate nature of history and historical knowledge. Offered in sequence with History 466*.</td>
<td>Prerequisite: One full course equivalent in Philosophy, or consent of instructor.</td>
<td>3</td>
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<tr>
<td>455</td>
<td>Metaphysics</td>
<td>Theories of reality, historical and contemporary, with emphasis on metaphysical problems in the light of recent studies.</td>
<td>Prerequisite: Two full courses (or equivalent) in Philosophy.</td>
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<td>465</td>
<td>Existential Philosophy</td>
<td>A study of the thought of such authors as Kierkegaard, Nietzsche, Unamuno, Camus, Heidegger, and Sartre with special emphasis on the problems of truth and philosophical, literary and artistic expression.</td>
<td>Prerequisite: Consent of instructor.</td>
<td>3</td>
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<tr>
<td>470</td>
<td>Phenomenology</td>
<td>A critical examination of the issues and methods of phenomenology. The basic writings of phenomenologists such as Husserl and Merleau-Ponty will be the main texts. Such a critique will include the attempt to understand the uses and ramifications of phenomenological methods through the working out of particular analyses.</td>
<td>Prerequisite: One full or two half courses in Philosophy, or consent of instructor.</td>
<td>3</td>
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<tr>
<td>471*-473*</td>
<td>Problems</td>
<td>One or more half courses will be offered at different times, as announced by the Department.</td>
<td>Prerequisite: Consent of instructor.</td>
<td>3</td>
</tr>
<tr>
<td>480*-489</td>
<td>Advanced Studies in the History of Philosophy</td>
<td>Various half courses dealing with a particular philosopher, a selected work or period; one or more of these will be offered each year as announced by the Department.</td>
<td>Prerequisite: Consent of instructor.</td>
<td>3</td>
</tr>
<tr>
<td>498(a-b)*</td>
<td>Directed Reading in Special Areas</td>
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<td>Prerequisite: Consent of instructor.</td>
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<tr>
<td>499</td>
<td>Tutorial and Honours Essay</td>
<td>Students wishing to enrol in 499 should consult the Department.</td>
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</tr>
</tbody>
</table>
The following courses are administered by St. Jerome's College.

100J Invitation to Philosophize
An attempt to see philosophy as the heart of a liberal arts education. Also, there will be discussion of the nature of philosophy relative to other disciplines. Is philosophy a science? How is philosophy different from theology? etc. A discussion of the different views of philosophy as illustrated by their handling of the traditional areas of nature, man, and God. Questions such as what is right and what is wrong? Is seeing believing? Does man have a soul distinct from matter? etc., will be asked.

3 hours.

200J Intentional Logic
This course regards logic as a tool in guiding our penetration of various substantive issues in philosophy. It will systematically cover the common logical fallacies, term logic, propositional logic, some logical paradoxes, syllogistic (categorical and compound) logic, variations on the syllogism, and reasoning by example, induction, etc. The differences between intentional logic and mathematical logic will be discussed.

No prerequisite.
3 hours, half course, Fall term.

205J General Science of Nature
An examination through conceptual analysis and historical reference of the explanatory principles underlying the material world. Various main doctrines (e.g. pythagoreanism, atomism, hylomorphism) will be compared and contrasted. Germane discoveries in physics (especially the work of Planck, Einstein, de Broglie, Heisenberg) and chemistry will be brought in.

No prerequisite.
3 hours, half course, Fall term.

206J Special Problems in the Philosophy of Nature
This course will take up various key topics with respect to the constitution and operation of the natural universe. Issues such as the definition of change, space and place, time, purpose in nature, the infinity of the universe, anti-matter, action-at-a-distance, etc., will be discussed.

No prerequisite.
3 hours, half course, Winter term.

210J Philosophy of Man
A discussion of the peculiarities of living creatures; what it means to be alive. The various main types of living things compared and contrasted. The place of man in nature, his intellectual and volitional powers, his evolution, the nature of love, and the possibility of life after death will be discussed. The latest relevant discoveries in biology, psychology, and anthropology, as well as the insights of existentialism and phenomenology will be utilized.

No prerequisite.
3 hours, half course, Winter term.

18J Philosophy of Human Acts
A normative approach, employing several of the classic Western traditions of rational thought, to general ethics. The various schools of ethical thought will be discussed.

No prerequisite.
3 hours, half course, Fall term.
219J* Practical Ethics
This course will discuss the applications of general ethics to the more specific areas of human endeavour, e.g., family, government, warfare, work, recreation, education and religion.

*No prerequisite.*

3 hours, half course, Winter term.

(1972-73 Sections of the above two half courses will be offered in the evening.)

300J* The Western Philosophical Tradition (to 1600)
An intensive overview of the major recurring themes in Western intellectual history from both an historical and a philosophical viewpoint.

*Prerequisite: Second year standing.*

3 hours, half course, Fall term.

301J* The Western Philosophical Tradition (1600-present)
A continuation of 300J*.

*Prerequisite: Second year standing.*

3 hours, half course, Winter term.

(1972-73 Sections of the above two half courses will be offered in the evening.)

333J Contemporary Philosophical Problems in Art
An examination and discussion of some problems, especially in the areas of music, painting, and poetry, with which today's artist as well as his audience are confronted. Information Theory, computerized techniques, mass art, "Pop Art," the psychology of creative invention, art as an expression of reality, the morality of art, the responsibility of the artist, and art's function as a reflection of society or as a symbol of human integration are possible topics for discussion.

*Prerequisite: One other philosophy course or consent of instructor.*

3 hours.

349J Philosophy of Human Cognition
The problems of human knowledge have been in the foreground of philosophical discussions for three centuries. This course will cover such topics as the principles of all human knowledge, types and degrees of probability and certitude, Realism and Idealism, the problem of universal predication, various meanings of truth, criteria of truth, historiography.

*Prerequisite: One other philosophy course or consent of instructor.*

3 hours.

395J Special Topics/Directed Readings
A series of readings and/or seminars on one or two topics or thinkers, with periodic reports and discussion.

*Prerequisite: Consent of instructor.*

3 hours.

(Not offered in 1972-73)

399J Philosophy Tutorial
Students wishing to enroll must first consult the department.

450J Philosophy of Being
An advanced course for the serious student, delving into the notions of reality, being, essence, existence, analogy, etc. The existence and nature of God, as far as can be determined without any kind of revelation, will be examined. The techniques of linguistic analysis to be employed. Also, the very possibility of any kind of metaphysics will be thoroughly discussed.

*Prerequisite: Third year standing or consent of instructor.*

3 hours.
495J Special Topics/Directed Readings A series of readings and/or seminars on one or two topics or thinkers, with periodic reports and discussions.

*Prerequisite: Consent of instructor.*

3 hours.

*(Not offered in 1972-73)*

499J Philosophy Tutorial Students wishing to enroll must first consult the department.

The following course is administered by Renison College

400R Introduction to Philosophy A broad selection of the main problems in philosophy. How can we know whether anything is right or wrong? How can we know about things we cannot directly observe? Can we know whether there is a God? Is mind in any sense distinct from matter? Original texts of classical and contemporary thinkers will be considered.
Department of Physics

Professor and Chairman of the Department

Professor and Associate Dean
F.W. Boswell, B.A., M.A., Ph.D. (McMaster)

Graduate Affairs, Faculty of Science

Professor (Chemistry and Physics) and Dean of the Faculty of Science
H.E. Petch, B.Sc. (McMaster), M.Sc., Ph.D. (U.B.C.), F.R.S.C.

Professors
R.A. Aziz, B.A., M.A., Ph.D. (Toronto)
G.A. Bakos, B.A. (Trnava), M.A. (Bratislava), M.A., Ph.D. (Toronto)
D.E. Brodie, B.Sc., M.Sc., Ph.D. (McMaster)
J.A. Cowan, B.Sc. (Manitoba), M.A., Ph.D. (Toronto)
I.R. Dagg, B.Sc. (Manitoba), B.S. (Penn State), Ph.D. (Toronto)
J. Grindlay, B.Sc. (Glasgow), D.Phil. (Oxon)
J.L. Ord, B.A.Sc. (Toronto), M.S., Ph.D. (Illinois)
G.E. Reesor, B.A., M.A. (McMaster), Ph.D. (Toronto)

(Chemistry and Physics)
G. Scoles, B.Sc., Ph.D. (Genova)
R.A. Snyder, B.Sc., Ph.D. (Western)
S.F. Wang, B.E. (Port Arthur, China), D.Sc. (Nagoya)

Adjunct Professors
J.A. Barker, D.Sc. (Melbourne), F.A.A.S.
P.A. Egelstaff, B.Sc., Ph.D. (London)
D.J. Henderson, B.A. (U.B.C.), Ph.D. (Utah), F. Inst P.
J.D. Poll, Cand, Doc Leiden, Ph.D. (Toronto)

Associate Professors
A. Anderson, M.A., D.Phil. (Oxon)
P.C. Eastman, B.Sc., M.Sc. (McMaster), Ph.D. (U.B.C.)
H.K. Ellenton, B.Sc. (Western), M.A. (Toronto)
N.R. Isenor, B.Sc. (Acadia), M.Sc., Ph.D. (McMaster)
J. Kruuv, B.A.Sc., M.Sc. (Waterloo), Ph.D. (Western)
J.D. Leslie, B.A.Sc. (Toronto), M.S., Ph.D. (Illinois)
C.C. Lim, B.A. (DePauw), M.A. (Nebraska), Ph.D. (Toronto)
R.A. Moore, B.Sc., M.Sc. (McMaster), Ph.D. (Alberta)
H.M. Morrison, B.Sc., Ph.D. (Edinburgh)
R.K. Pathria, B.Sc., M.Sc. (Panjab), Ph.D. (Delhi)
M.M. Pintar, B.Sc., M.Sc., Ph.D. (Ljubljana)
A.D. Singh Nagi, B.A., B.Sc. (Panjab), Ph.D. (Delhi)
H.J.T. Smith, B.Sc., Ph.D. (London)
B.H. Torrie, B.A.Sc. (Toronto), Ph.D. (McMaster)
K.A. Woolner, B.Sc. (London)

Assistant Professors
J.K. Brandon, B.Sc., Ph.D. (McMaster), M.A. (Cantab.)
J.M. Corbett, B.A.Sc. (Toronto), M.Sc., Ph.D. (Waterloo)
A.E. Dixon, B.Sc. (Mt. Allison), M.Sc. (Dalhousie), Ph.D. (McMaster)
M.P. FitzGerald, B.Sc., M.Sc. (Toronto), Ph.D. (Case)
H.E. Frey, B.S., M.S., Ph.D. (Penn State)
D. Hemming, B.Sc., Ph.D. (Bristol)
T.K. Mitra, B.Sc., M.Sc. (Calcutta), Ph.D. (Liverpool)
D.L. Roberts, A.B. (Bowdoin College), Ph.D. (Case)
J. Vanderkooy, B. Eng., Ph.D. (McMaster)

Instructors
A.B. Haner, B.Sc., M.Sc. (Waterloo)
D.S. McVicar, B.Sc. (Waterloo)
Undergraduate Course Descriptions

Note 1 Details of the undergraduate programmes offered by the Faculty of Science are to be found on page 231.

Note 2 All courses described are one-term courses unless otherwise designated. Such one-term courses are marked* and are .50 course credit unless otherwise specified.

Note 3 Prerequisites are given as a guide to the student and may be waived with the consent of the instructor.

1* Mechanics and Wave Motion Vectors, rectilinear motion, plane motion, dynamics of particles, work and energy, linear momentum, rotational motion, statics, angular momentum, harmonic motion, gravitation, wave motion, sound waves. For students registered in the Year I Engineering Programme. 3 lectures, 1 hour tutorial, fall term.


102* General Physics Electric fields and potential, D.C. circuits, magnetic fields, A.C. generators and circuits, elementary electronics. The thin lens equations, diffraction, resolution of optical instruments, the eye, camera, telescope and microscope, coherent light, colour, polarization, birefringence and photometry. 3 lectures, winter term.

Note The one year-sequence Physics 101*–102* is not normally followed by upper year Physics courses and is intended for students registered in the Year 1 Science programme who intend to proceed in Biology, Biology and Chemistry, or Earth Sciences. (It may be used as a prerequisite for Physics 301*–302*)

103* Mechanics in Human Movement An introduction to the physical principles required for the analysis of the mechanics of athletics. A course for Kinesiology students. 3 lectures, 3 hours laboratory alternate weeks, tutorials to be arranged.

121* Introductory Physics 1 Introduction to mechanics, motion of particles, conservation of energy and momentum, fluid statics and dynamics, rotational kinetics. Prerequisites: Grade 13 Mathematics – Functions and Relations, Calculus. Grade 13 Physics recommended. 3 lectures, 3 hours laboratory or 2 hours tutorial, fall term.

122* Introductory Physics 2 This course is a continuation of Physics 121*. Rotational dynamics, vibrations, waves, gravitation, heat and thermodynamics, properties of materials. Prerequisite: Physics 121*. 3 lectures, 3 hours laboratory or 2 hours tutorial, offered in winter and spring terms.
Note The one-year sequence Physics 121*-122* is intended for students registered in the Year 1 Science programme or the Year 1 Mathematics programme, and gives adequate preparation for upper year Physics courses.

162* Mechanics, Wave Motion and Heat 1 Vectors, rectilinear motion, plane motion, dynamics of particles, work and energy, linear momentum, rotational motion, angular momentum, statics, additional enrichment topics such as special relativity.
Prerequisites: At least 75% average in Grade 13 Physics, Mathematics — Functions and Relations, and Calculus.
3 lectures, 3 hours laboratory or 2 hours tutorial, fall term.

163* Mechanics, Wave Motion and Heat 2 This course is a continuation of Physics 162*. Harmonic motion, gravitation, wave motion, sound waves, temperature, heat, first and second laws of thermodynamics, kinetic theory of gases, additional enrichment topics such as quantum concepts.
Prerequisite: Physics 162*.
3 lectures, 3 hours laboratory or 2 hours tutorial, offered in winter and spring term.

Note The one-year sequence Physics 162*-163* is an enriched version of the Physics 121*-122* sequence intended for students registered in the Year 1 Science programme or the Year 1 Mathematics programme, and is normally followed by upper year Physics courses.

222* Electricity and Magnetism 1 Coulomb's law, electric field, Gauss's law, potential, capacitance, properties of dielectrics, current, resistance, electromotive force, D.C. circuits and instruments.
Prerequisites: Physics 121*-122* or equivalent, Mathematics 130.
2 lectures, 1 hour tutorial, fall term.
Physics Majors must take 222L* with this course.

222L* Electricity and Magnetism 1 Laboratory For students taking Physics 222*.
3 hours alternate weeks, 0.25 course credit, full term.

223* Electricity and Magnetism 2 Magnetic fields, induced electromotive forces, magnetic properties of matter, alternating currents, electromagnetic waves.
Prerequisite: Physics 222*.
2 lectures, 1 hour tutorial, winter and spring terms.
Physics Majors must take 223L* with this course.

223L* Electricity and Magnetism 2 Laboratory For students taking Physics 223*.
3 hours alternate weeks, 0.25 course credit, winter and spring terms.

226* Optics 1 Reflection and refraction at plane and curved surfaces, thin and thick lenses, optical instruments.
Prerequisites: Physics 121*-122* or equivalent and Mathematics 130.
2 lectures, fall term.
Physics Majors must take Physics 226L* with this course.

226L* Optics 1 Laboratory For students taking Physics 226*.
3 hours alternate weeks, 0.25 course credit, fall term.
**227* Optics 2**
The wave nature of light, interference, diffraction, slits and gratings, resolution, polarization, photometry.

*Prerequisite: Physics 226*.

2 lectures, winter term.

*Physics Majors must take Physics 227L* with this course.

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**227L* Optics 2 Laboratory**
For students taking Physics 227*.

3 hours alternate weeks, 0.25 course credit, winter term.

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**236* Optics**

*Prerequisites: Physics 121*-122* or equivalent and Mathematics 123 or 130.

*Corequisite: Physics 236L*.

This course is primarily intended for students registered in the Optometry programme.

3 lectures, fall term.

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**236L* Optics Laboratory**
For students taking Physics 236*.

3 hours alternate weeks, 0.25 course credit, full term.

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**237 Astronomy 1**
This is a two term course consisting of the courses Physics 250* and 251* for Summer School students only.

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**243* Electricity and Magnetism**
Electrostatics, D.C. circuits, magnetic fields, electromagnetic induction, A.C. circuits, electrical measurements.

*Prerequisites: Physics 121*-122* or equivalent, Mathematics 130.

3 lectures, 3 hours laboratory alternate weeks, offered in fall and spring terms if sufficient demand.

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**243L* Electricity and Magnetism Laboratory**
For students taking Physics 243*.

3 hours alternate weeks, 0.25 course credit, offered in fall and spring terms if sufficient demand.

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**244 Quantum Physics**

*(Not for General Students).*

2 lectures, for 2 terms.

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**250* The Solar System**
An introduction to the astronomy and astrophysics of the solar system for students with a background in elementary (University) physics and Mathematics. Astronomical coordinate systems, gravitational astronomy, astronomical measurements and instruments, physical nature of the planets, satellites, etc. which comprise the solar system.

*Prerequisites: First year courses in physics and mathematics, or consent of instructor.*

3 lectures, fall term.
251* The Stellar System  
An introduction to the astronomy and astrophysics of objects beyond the solar system for students with a background in elementary (University) physics and mathematics. The Sun, a typical star, observational methods and interpretation in stellar astronomy, structure of stars, distribution and motion of stars, structure of the Milky Way galaxy, external galaxies, cosmology.  
Prerequisites: First year courses in physics and mathematics, or consent of instructor.  
3 lectures, offered in winter and spring terms.

252* Electricity and Magnetism 1  
Electrostatic fields, potential, steady currents, magnetic fields.  
Physics Majors must take Physics 252L* with this course.  
Prerequisites: Physics 121*-122* or 162*-163*, Mathematics 130.  
Corequisite: Mathematics 237.  
2 lectures, 1 hour of problems, offered in fall term.  
Recommended for students registered in Honours programmes.

252L* Electricity and Magnetism  
For students taking Physics 252*.  
1 Laboratory  
3 hours alternate weeks, 0.25 course credit, fall term.

253* Electricity and Magnetism 2  
Induced electromotive forces, magnetic properties of materials, time-varying currents, electromagnetic waves.  
Physics Majors must take Physics 253L* with this course. Prerequisites: Physics 252*, Mathematics 31*.  
2 lectures, 1 hour of problems, offered in winter and spring terms.  
Recommended for students registered in Honours programmes.

253L* Electricity and Magnetism  
For students taking Physics 253*.  
2 Laboratory  
3 hours, alternate weeks, 0.25 course credit, offered in winter and spring terms.

255* Quantum Physics  
Background of quantum physics: special relativity, Bohr atom, wave-particle properties, uncertainty and wave packets. Introduction to quantum mechanics: equation for travelling wave, Schrödinger equation, solutions with potentials, correspondence principle, brief description of transitions and radiation processes.  
Prerequisites: Physics 121*-122* or Physics 162*-163* and Mathematics 130.  
3 lectures, offered in winter and spring terms.  
Recommended for students registered in Honours programmes.

256* Optics  
Reflection and refraction at plane and curved surfaces using the matrix method, thin and thick lenses, optical instruments. The wave nature of light, interference, diffraction, slits and gratings, resolution. Polarization, optical activity, photometry.  
Prerequisites: Physics 121*-122* or 162*-163*, Mathematics 130.  
3 lectures, offered in fall term.  
Physics Majors must take Physics 256L* with this course.  
Recommended for students registered in Honours programmes.

256L* Optics Laboratory  
For students taking Physics 256*.  
3 hours, alternate weeks, 0.25 course credit, offered in fall term.
259* Structure of Solids 1
Electronic structure of atoms and atomic bonding, crystal structure and space lattices, symmetry, crystal geometry, stereographic projections, theory of X-ray diffraction, X-ray methods, crystal formation, crystal defects, physical properties of crystals.
Prerequisites: Physics 121*-122* or 162*-163*, Mathematics 130.
Corequisite: Physics 259L*.
3 lectures, offered in winter and spring terms.

259L* Structure of Solids 1 Laboratory
For students taking Physics 259*.
3 hours, alternate weeks, 0.25 course credit, offered in winter and spring terms.

265* Introduction to Physical Mathematics
Some mathematical techniques used in solving problems in the areas of physics familiar to second-year students i.e. mechanics, thermodynamics and electromagnetism. The use of differential equations, partial derivatives, vectors, polar coordinates and matrices. Elementary statistics for the analysis of experimental data.
Prerequisites: Physics 121*-122* or Physics 162*-163*, Mathematics 130, Mathematics 31*.
3 lectures, offered in winter and spring terms.

270* Laboratory
Further experiments in optics for students taking Physics 256L*.
3 hours, alternate weeks, offered in fall term, 0.25 course credit.

271* Laboratory
Further experiments in electricity and magnetism for students taking Physics 253L*.
3 hours, alternate weeks, offered in winter and spring terms, 0.25 course credit.

301* Physical Instrumentation for Biologists 1
Ultra-centrifugation, spectroscopy, microscopy, use of radioactive tracers.
Prerequisites: a first year physics course, Mathematics 130.
2 lectures, fall term.

302* Physical Instrumentation for Biologists 2
Detection and measurement of ionizing radiation, read-out devices, transducers and other techniques.
Prerequisite: Physics 301*
2 lectures, winter term.

24* Atomic and Nuclear Physics 1
Fundamentals of modern physics, special theory of relativity, quantization of electromagnetic radiation, wave properties of particles, the hydrogen atom.
Prerequisites: Physics 222*, 223*, 226* and 227*.
3 lectures, offered in fall and spring terms.
Recommended for students registered in General programmes.

25* Atomic and Nuclear Physics 2
Many electron atoms, atomic and X-ray spectra, nuclear structure, nuclear reactions, molecular and solid state physics.
Prerequisite: Physics 324*.
3 lectures, winter term.
Recommended for students registered in General programmes.

335 Thermodynamics, Statistical physics
This is a course for Summer School students consisting of Physics 358* and Physics 359*.
Prerequisites: none, however, familiarity with the contents of Physics 250*-251* will be assumed.
3 lectures, offered in the fall term of odd-numbered years to third and fourth year students.

Prerequisites: none, however, familiarity with the contents of Physics 250*-251* will be assumed.
3 lectures, offered in the winter and spring terms of even-numbered years to third and fourth year students.

Note Physics 450*, Astrophysics 3, and Physics 451*, Astrophysics 4, are also open to third and fourth year students. Physics 350* alternates with Physics 450* and Physics 351* alternates with Physics 451*.

352* Electronics 1 Basic A.C. circuit theory. A survey of tubes, transistors and solid state devices, equivalent circuits, power supplies, amplifiers and feedback. 
Prerequisites: Physics 222*-223* or equivalent and Mathematics 31*.
Corequisite: Physics 352L*.
3 lectures, offered in fall, winter and spring terms.

352L* Electronics 1 Laboratory For students taking Physics 352*.
3 hours, alternate weeks. 0.25 course credit, offered in fall, winter and spring terms.

353* Electronics 2 Applications of feedback to oscillators, operational amplifiers, analogue computers and multi-vibrators. Introduction to digital circuits. 
Prerequisite: Physics 352*
Corequisite: Physics 353L*.
2 lectures, winter term.

353L* Electronics 2 Laboratory For students taking Physics 353*.
3 hours, alternate weeks. 0.25 course credit, offered in winter term.

354* Atomic and Molecular Physics The Schrödinger equation applied to simple one- and three-dimensional potentials. Hydrogen atoms, angular momentum and spin, molecular vibrations and rotations, many electron atoms, radiation processes. 
Prerequisite: Physics 255*.
2 lectures, offered in fall and spring terms.

355* Nuclear and Particle Physics Nuclear structure, interactions of nuclear radiations with matter, radioactive decay, nuclear reactions, nuclear force, elementary particles. 
Prerequisite: Physics 255*.
3 lectures, winter term.
358* Thermodynamics
Thermodynamic systems, equations of state, the laws of thermodynamics with applications. Change of phase.
Prerequisites: Mathematics 237 and Physics 121*-122* or equivalent.
3 lectures, offered in fall and spring terms.

359* Statistical Mechanics
Prerequisite: Physics 358*.
3 lectures, winter term.

360A* Intermediate Laboratory
Selected experiments in mechanics, atomic physics, solid state physics, optics and electronics.
18 hours of experiments, offered in fall and spring terms.
0.25 course credit.

360B* Intermediate Laboratory
Continuation of 360A*.
18 hours of experiments, offered in winter term.
0.25 course credit.

362* Classical Mechanics 1
Prerequisites: Physics 121*-122* or equivalent, Mathematics 130, 237 and 31*.
3 lectures, offered in fall and spring terms.

363* Classical Mechanics 2
Prerequisite: Physics 362* or Mathematics 234.
3 lectures, winter term.

364* Physical Mathematics 1
Vector and tensor analysis with applications.
Prerequisites: Mathematics 237 and 31*.
3 lectures, offered in fall and spring terms.

365* Physical Mathematics 2
Prerequisites: Mathematics 237 and Mathematics 31*.
3 lectures, winter term.

368* Geophysics 1
Introductory topics on the physics of the earth. Seismology and the earth's interior. Thermal history of the earth, gravity and isostasy. Origin of the continents and continental drift. (Identical to Earth Sciences 368*).
Prerequisite: Mathematics 130, Physics 121*-122* or equivalent.
2 lectures, fall term.

369* Geophysics 2
The geology of the ocean basins. Topics in physical oceanography. Physical properties of ocean water, heat budget of the world oceans. Oceanic circulations. Coriolis effects. Some idealized current regimes. (Identical to Earth Sciences 369*).
Prerequisite: Physics 368*.
2 lectures, winter term.
371A* Intermediate Laboratory  Further experiments in atomic, nuclear and solid state physics, optics and electronics. For honours students who are taking Physics 360A*. 18 hours of experiments, offered in fall and spring terms. 0.25 course credit.

371B* Intermediate Laboratory  Continuation of 371A*. For honours students who are taking Physics 360B*. 18 hours of experiments, offered in winter term. 0.25 course credit.

380* Molecular Biophysics  Energy production, transport and release in cells, structure of large molecules and their replication, genetic code, control of intracellular processes.  
Prerequisites: First year Chemistry, Mathematics 31*, Physics 252* and 253* or consent of instructor.  
3 lectures, fall term.

381* Cell Biophysics  Structure and behaviour of cell membranes, diffusion problems, selective ion transport, electrical activity and nerve conduction, cilia and flagella, muscle cells, sensory receptor cells, synthesis of cell components and cell division.  
Prerequisite: Physics 380*.  
3 lectures, winter term.

Prerequisite: Physics 362*, 363*, 364* and 365*.  
2 lectures and 1 tutorial hour for two terms, fall and winter.

432* Physics of Solid State Devices  The theories of solid state physics are applied to explain the operation and use of several modern electronic devices, including the p-n junction, transistors, thyristors, tunnel diodes, field effect devices, optical devices, etc.  
Prerequisite: Physics 435*.  
3 lectures, winter term.

433 Advanced Laboratory  An experimental research project. This course is designed for students in the Honours Physics Programme and in the Cooperative Applied Physics Programme.  
Enrolment may be limited. Two terms, fall and winter, 1.00 course credit.

Prerequisite: Physics 354*.  
2 lectures and 1 tutorial hour, fall term.
434B* Quantum Mechanics


Prerequisite: Physics 434A*.

2 lectures and 1 tutorial hour, winter term.

435* Solid State Physics

Crystal structure, crystal diffraction and the reciprocal lattice, crystal binding, phonons, thermal properties of insulators, free electron theory of metals, band theory.

Prerequisite: Physics 255* or equivalent.

3 lectures, fall term.

436 Physical Mathematics

Functions of a complex variable. Integral transforms (Fourier, Laplace) Integral equations, Green's functions.

Prerequisites: Physics 364*-365*.

2 lectures and 1 tutorial hour for two terms, fall and winter.

437* Topics in Theoretical Physics

Selected subjects for advanced study by theoretically inclined students, topics in relativistic, quantum, and statistical physics.

Enrolment may be limited. 3 hours per week, winter term.

438 Geophysics 3

A more advanced discussion of seismology and the internal constitution of the Earth, mechanical properties of the Earth's interior, figure of the Earth and its gravitational field, temperature and thermal history of the Earth, internal magnetic field of the Earth and its electrical properties at depth, the rotation of the Earth and its geophysical effects.

2 lectures for two terms, fall and winter.

441 Electromagnetic Theory

A generalized treatment of the basic laws of electricity and magnetism, mathematical techniques for the problems of electrostatics, solutions of Maxwell's equation in free space and the study of plane waves, theory of waveguides and introduction to radiation.

Prerequisites: Physics 222*-223* or Physics 252*-253*, Physics 364*-365* or equivalent, 2 lectures and 1 tutorial hour for two terms, fall and winter.

442* Structure of Solids

A survey with emphasis on the physical properties and behaviour of metals and alloys. Elastic and plastic deformations of crystals. Solidification, structure of alloys, free energy of alloy systems, equilibrium diagrams, diffusion, solid state phase transformations.

Prerequisite: Physics 435*.

3 lectures, winter term.

443* Classical Field Theory

An introduction, with applications in the areas of elasticity and hydrodynamics. (The electromagnetic field is discussed in Physics 441). Topics covered are the conservation laws, field equations, boundary conditions. Equations of state, invariance, material symmetry. Methods of solution, application to fluid and elastic systems with simple geometries.

Prerequisites: Physics 364*-365* or equivalent.

3 lectures, winter term.
444* Nuclear Physics  Elements of nuclear structure and systematics. Alpha emission, beta decay, gamma emission, two-body systems and nuclear forces, nuclear reactions. Neutron physics. Sub-nuclear particles.  
Prerequisite: Physics 355.*  
3 lectures, winter term.

445* Modern Optics  Optical coherence, spontaneous and stimulated radiation processes. Particular attention will be given to lasers.  
Prerequisites: Physics 256*, Physics 354*.  
3 lectures, fall term.

Prerequisites: none, however, familiarity with the contents of Physics 250*-251* will be assumed.  
3 lectures, offered in the fall term of even-numbered years to third and fourth year students.

450* Astrophysics 3  Solar system astrophysics. The application of the observational and theoretical techniques of physics to the study of the solar system (excluding the sun). The physical nature of planetary (and satellite) surfaces, atmospheres and interiors. Asteroids, meteoroids and comets. The interplanetary medium (solar wind). Solar interactions with the interplanetary medium and the earth's magnetosphere.  
Prerequisites: none, however, familiarity with the contents of Physics 250*-251* will be assumed.  
3 lectures, offered in the fall term of even-numbered years to third and fourth year students.

451* Astrophysics 4  The structure of stellar interiors, nuclear reactions and energy sources in the stars of the main sequence, early evolution of stars from the main sequence. Lifetimes of the stars.  
Prerequisites: none, however, familiarity with the contents of Physics 250*-251* will be assumed.  
3 lectures, offered in the winter and spring terms of odd-numbered years to third and fourth year students.

452* Digital Electronics  Fundamental and advanced concepts of digital logic stressing practical uses of modern integrated circuit technology.  
Prerequisites: Physics 352*-353*.  
3 lectures, fall term.

453* Analogue Circuits  A variety of topics in connection with the operation of linear systems. Noise, stability under feedback, radio frequency components, cables, specialized amplifiers, modern circuit techniques, integrated circuits, operational amplifiers, transformers and high frequency device behaviour.  
Prerequisites: Physics 352*-353*.  
3 lectures, winter term.
480* Radiation Biophysics  The effect of radiation of various kinds on cells and tissues, exposure calculations, mechanism of damage, repair theories, genetic effects, target theory, isotopic tracers in biophysical research. 
*Prerequisites: Physics 222*-223* and Mathematics 236 or equivalent, or consent of instructor.
3 lectures, fall term.

481* Biophysics of Organ Systems  Physics of homeostasis, interactions with the environment, circulation of blood, temperature regulation, respiration, transport problems and special organ systems.
*Prerequisites: Physics 222*-223* and Mathematics 236 or equivalent, or consent of instructor.
3 lectures, winter term.
Department of Political Science

Professor and Chairman of the Department
T.H. Qualter, B.A. (New Zealand), Ph.D. (London)

Professor and Deputy Chairman of the Department
J.E. Kersell, B.A., M.A., (Queen’s), Ph.D. (London)

Associate Professors
- C.H. Grant, B.A., M.A. (Leicester), Ph.D. (Edinburgh)
- J.M. Wilson, B.A., M.A. (Toronto)

Assistant Professors
- K.H. Cabatoff, B.A., M.A., (McGill), Ph.D. (Sussex)
- J.D. Fraser, B.A. (Cantab.), Ph.D. (Leicester)
- R.P. Woolstencroft, B.A. (Alberta)

Lecturers
- R.F. Freeman, B.A., M.A. (Waterloo)
- J.E. Surich, B.A., M.A. (Waterloo)
- R.J. Williams, B.A., M.A. (McMaster)

Undergraduate Programmes

The Department of Political Science offers a series of undergraduate programmes designed to meet the needs of students with varying interests. Requirements for each programme are restricted to the completion of a specified number of courses in different fields of the discipline before graduation. For these purposes Political Science courses above the 100 level are numbered according to the field within which they fall. The key to this scheme is the second digit of the course number, as follows:

2 - theory and methodology
3 - public administration, public law, and public policy
4 - local and regional politics
5 - comparative politics (more than one country)
6 - comparative politics (specific countries)
7 - the political process
8 - international politics
9 - special courses which are not regarded as dealing with a particular field of the discipline

1 General Programme
Students choosing a three-year General programme in Political Science (see the University's requirements for the General Programme on p. 99) will normally complete, before graduation, the equivalent of five full courses in Political Science beyond the 100 level, of which three must be from three different fields of the discipline as defined above.

2 Honours Programme
Students choosing an Honours programme in Political Science (see p. 100) must complete, before graduation, the equivalent of nine full courses in Political Science beyond the 100 level, of which four must be from four different fields of the discipline as defined above. Honours students may elect to pursue a series of connected courses as a minor programme in a related discipline such as Anthropology, Economics, Geography, History, Philosophy, or Sociology in consultation with the departments involved.
3 Joint Honours Programme

A number of joint Honours programmes have been arranged for students who wish to obtain a broad training in a related discipline. These are:

a) Honours Anthropology and Political Science (page 100)
b) Honours Economics and Political Science (page 102)
c) Honours English and Political Science (page 104)
d) Honours French and Political Science (page 106)
e) Honours Geography and Political Science (page 107)
f) Honours History and Political Science (page 108)
g) Honours Philosophy and Political Science (page 112)
h) Honours Political Science and Psychology (page 112)
i) Honours Political Science and Sociology (page 114)

Students choosing a joint Honours programme involving Political Science must complete, before graduation, the equivalent of six full courses in Political Science beyond the 100 level of which three must be from three different fields of the discipline as defined above. Joint Honours programmes other than those already approved may be arranged by consultation with Political Science and the department concerned.

4 Minor Programme

The Department will be glad to recommend a connected series of courses in Political Science beyond the 100 level for students majoring in related disciplines.

Graduate Programme

The Department of Political Science offers a programme leading to the degree of Master of Arts. The Department's graduate brochure provides details of the requirements for this degree, and other relevant information. The Department cooperates with the Departments at Brock University, the University of Guelph, McMaster University and Waterloo Lutheran University in a broad range of activities at the graduate level.

Undergraduate Courses

Note  Very extensive descriptions of the content of Political Science courses are available in the Department at the time of pre-registration.

115* Introduction to Politics 1

An introduction to the major political ideologies of the present world: socialism, communism, liberalism, capitalism, conservatism, and fascism. 3 hours, fall term.

116* Introduction to Politics 2

A study of selected aspects of government and politics.  
Prerequisite: Political Science 115* or consent of instructor.  
3 hours, winter term.

221* The History of Political Theory 1: The Classical Period

The first part of a history of the development of western political theory from the time of Socrates to the present day.  
No Prerequisite for students in their second year and above.  
3 hours, fall term.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Prerequisite</th>
<th>Credits, Term</th>
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</thead>
<tbody>
<tr>
<td>222*</td>
<td>The History of Political Theory 2: The Modern Period</td>
<td>The second part of a history of the development of western political theory from the time of Socrates to the present day.</td>
<td>Political Science 221.</td>
<td>3 hours, winter term</td>
</tr>
<tr>
<td>223*</td>
<td>Quantitative Analysis 1</td>
<td>An introduction to the methodology of empirical enquiry with emphasis on a discussion of concepts, description, indicators, and the structure and processes of explanation.</td>
<td></td>
<td>3 hours, fall term</td>
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<tr>
<td>224*</td>
<td>Quantitative Analysis 2</td>
<td>The application of concepts discussed in Political Science 223 to actual quantitative analysis. Only a rudimentary understanding of mathematics is required.</td>
<td>Pol. Sci. 223.</td>
<td>3 hours, winter term</td>
</tr>
<tr>
<td>250</td>
<td>Comparative Politics</td>
<td>An introduction to comparative methods of analysis in political science with special reference to Canada, Europe and the U.S.A.</td>
<td>No prerequisite for students in the second year and above.</td>
<td>3 hours</td>
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<tr>
<td>260</td>
<td>Canadian Government and Politics</td>
<td>A critical examination of the institutions and practices of the Canadian political system.</td>
<td>No prerequisite for students in the second year and above.</td>
<td>3 hours</td>
</tr>
<tr>
<td>264*</td>
<td>American Government and Politics</td>
<td>The theory and practice of the American political system as revealed by the institutions and operations of American national government.</td>
<td>No prerequisite for students in the second year and above.</td>
<td>3 hours, winter term</td>
</tr>
<tr>
<td>265*</td>
<td>Soviet Government and Politics</td>
<td>A survey of the development of Soviet political structures with and analysis of the relative influence of ideological goals on the one hand and social forces on the other;</td>
<td>No prerequisite for students in the second year and above.</td>
<td>3 hours, fall term</td>
</tr>
<tr>
<td>266*</td>
<td>Problems in Soviet Politics</td>
<td>A study of the sources and formulation of selected Soviet politics including an analysis of Soviet foreign policy.</td>
<td>Political Science 265*.</td>
<td>3 hours, winter term</td>
</tr>
<tr>
<td>268*</td>
<td>British Government and Politics</td>
<td>An examination of the uniquely British characteristics of the British political system.</td>
<td>No prerequisite for students in the second year and above.</td>
<td>3 hours, winter term</td>
</tr>
<tr>
<td>281*</td>
<td>International Politics 1</td>
<td>Sovereignty and interdependence. The concept of the International System. Political change in the contemporary world.</td>
<td>An introductory course in Political science or consent of instructor.</td>
<td>3 hours, fall term</td>
</tr>
</tbody>
</table>
282* International Politics 2 Institutional framework of international co-operation in economic and social fields. The functional pattern and the regional pattern. Economic underdevelopment and international politics.
Prerequisite: Political Science 281* or consent of instructor.
3 hours, winter term.

22* Aspects of Canadian Politics
An overview of some aspects of Canadian Politics. This course is open to cooperative students only.
No prerequisite.
3 hours, winter term.

321* Socialism: Marxist and Non-Marxist 1
A comparative study of the thought of the founders of anarchism and of "utopian" and Marxian socialism.
No prerequisite for students in the third year and above.
3 hours, fall term.

322* Socialism: Marxist and Non-Marxist 2
A comparative study of the thought of Russian Marxists (both Bolshevik and anti-Bolshevik) and of contemporary "revisionist" Marxist.
Prerequisite: Political Science 321*
3 hours, winter term.

33* Ancient Political Philosophy
A selective examination of political philosophy during the classical period in Greece.
Fall term.

4* Modern Political Philosophy
A selective examination of political philosophy in the modern period.
Winter term.

327* Political Science and Political Values
An examination of the relationship of "values" to a proper science of politics.
Admission by the consent of the instructor.
3 hours, fall term.

330 Public Administration
A study of selected public institutions and policies interpreted in the light of empirical and normative theory.
Prerequisite: At least one previous course in Political Science.
3 hours.

341* Provincial Politics
A comparative study of government and politics in the ten Canadian provinces.
Prerequisite: Political Science 260.
3 hours, fall term.

343* Urban Politics
An analytical study of the responses of various urban political systems to contemporary metropolitan problems with special reference to Canada.
Prerequisite: At least one previous course in Political Science.
3 hours, fall term.

350 The Politics of the Developing Areas
An analysis of political systems and processes in ten developing societies of Africa, Asia, the Caribbean and Latin America.
Fall and winter terms.
372* The Political System
An examination of the concept of system as applied to the study of politics.
*Admission by consent of instructor.
3 hours, winter term.

373* Political Parties
An analytical and comparative study of the development, organization, activity and function of political parties, and the nature of contemporary party systems.
Prerequisite: At least one of Political Science 250*, 260, 264*, 265*, or 268*.
3 hours, fall term.

374* Interest Group Politics
A study of interest group theory and comparative analysis of the internal politics of interest groups and their role in the political process.
Prerequisite: At least one of Political Science 250*, 260, 264*, 265*, or 268*.
3 hours, winter term.

375* Theories of Integration and Disintegration
A study of the requirements for the development of an adequate conceptual framework for the analysis of political movements relative to societal integration.
Prerequisite: Political Science 250 or consent of instructor.
3 hours, fall term.

377* Political Socialization
A study of the processes and agents of political socialization and their effect on political stability or change in liberal-democratic societies.
*Admission by consent of the instructor.
3 hours, fall term. (Offered in 1971-72 as Pol. Sci. 378).

380 Theory and Practice of International Politics
Various theories and analytical approaches used in the study of international politics will be examined, and their application to the practice of foreign policy and international politics will be studied through consideration of specific important problems facing regimes as they interact.
Open only to students in the third year and above.
3 hours.

422* Liberalism, Socialism
An analysis of the development of western radicalism based on a study of the principles of the liberal tradition and the main elements of modern democratic socialism.
Prerequisite: Political Science 221 or 222, or consent of instructor.
3 hours, winter term. (May not be offered in 1972-73).

423* The Federalist Papers
An examination of the political thought expressed by Hamilton, Madison and Jay in the Federalist Papers.
*Admission by consent of instructor.
3 hours, fall term. (Not offered in 1972-73).

425* English Political Theory of the Nineteenth Century
A survey of the development of English liberal thought from the philosophic radicals through J. S. Mill to T. H. Green.
No prerequisite for students in the third year and above.
3 hours, fall term.
427* Special Topics in Political Philosophy
A selective examination of basic problems in political philosophy in the modern and pre-modern periods.
Prerequisite: Political Science 221, 222, 323 or 324.
3 hours, fall term.

428* State and Economic Life
An analytical and comparative study of the growth of government intervention in the economic process, and of the development of the welfare state.
Admission by consent of instructor.
3 hours, winter term.

55* Canadian Constitutional Law
An introduction to the nature and basic principles of constitutional law. The course will deal especially with the distribution of powers in the Canadian federation, and its evolution, notably by judicial decision. It will consider leading cases and the writings of leading authorities.
Prerequisite: Political Science 260
3 hours, fall term (Not offered in 1972-73).

442* Politics in Ontario
A critical examination of the distinctive elements of government and politics in the province of Ontario.
Prerequisite: Political Science 260 or 341* or consent of instructor.
3 hours, winter term.

446* Politics in Western Canada
A critical examination of the distinctive elements of government and politics in the provinces of Manitoba, Saskatchewan, Alberta, and British Columbia.
Prerequisite: Political Science 260 or 341* or consent of instructor.
3 hours, winter term.

447* The Politics of French Canada
A study of the principles, practices and personalities of French Canadian politics.
Admission by consent of instructor.
3 hours, fall term.

453* The Politics of Parochial Societies
The course will deal with some of the main characteristics of "parochial societies" by which are meant the peasant societies of Asia, Latin America, and Southern Europe. The problems of power in these societies will be treated by reference to certain characteristics which are found with remarkable frequency in peasant societies such as the intensity of religious and family sentiments, the illicit nature of commerce and usury, and the frequent limitation of metropolitan goods and fashions. Open to all students in third year and above.
3 hours, fall term.

455* Comparative politics in the Old Commonwealth
An analytical comparison of institutions and processes as they have developed in various systems of the "old" Commonwealth such as Britain, Canada and Australia.
Admission by consent of instructor.
3 hours, fall term.

458* The Third World
This course deals with the Third World primarily in the international context. As the problems of this group of countries are on a very large scale and very diverse, they will be examined on a comparative basis.
Prerequisite: Political Science 350 or consent of instructor.
3 hours, winter term.
470 Political Behaviour An examination of the objectives, characteristics and problems of contemporary research on political behaviour, with emphasis on democratic electoral behaviour.

*No prerequisite for students in the third year and above.*

*3 hours.*


*Prerequisite: Political Science 224* or 373* or consent of instructor.

*3 hours, winter term.*

481* International Law A survey of the principles and rules of international law with special emphasis on the element of change.

*Admission by consent of instructor.*

*3 hours, fall term. (Not offered in 1972-73).*

487* Theories of International Politics A critical examination of alternative approaches to the study of international politics.

*Admission by consent of instructor.*

*3 hours, fall term.*

488* International Organizations A study of the nature and functions of international organizations, and an evaluation of League of Nations and the United Nations systems.

*Admission by consent of instructor.*

*3 hours, winter term. (Not offered in 1972-73).*

490 Senior Research Seminar Admission by consent of instructor.

*3 hours.*

491*-498* Special Subjects In any year one or more subjects may be offered as special seminars. *Course descriptions will be announced at the time of registration.*

499 Senior Honours Essay Students wishing to register in Political Science 499 should consult the Department.

**Senior Undergraduate and Graduate Courses**

*Note* Courses at the 500 level are open to senior undergraduates and to students in qualifying programme as well as to those in graduate programmes. Admission is in all cases by consent of the instructor.

521* Classical Democratic Theory An examination of recent and contemporary theories of democratic government.

*3 hours, fall term.*

522* Contemporary Political Philosophy The course will examine the nature of classical political science and philosophy in order both to clarify our own way of understanding political things through an investigation of that original kind of understanding, and to contrast the classical and modern versions of that understanding. One or more Platonic dialogues and/or one of Aristotle’s works will be studied.

*3 hours, winter term. (Not offered in 1972-73).*
523* Empirical Theory  This course will consist of (i) a philosophical analysis of sociological theories of system and of behaviour, and (ii) the application of these theories to the field of politics.
3 hours, fall term.

126* Contemporary Socialist and Communist Thought  This course will survey some contemporary problems in socialist and communist thought, with special emphasis on recent developments in European Marxism.
3 hours, winter term.

532* Canadian Foreign Policy  A critical examination of the sources, challenges and methods of Canadian foreign policy together with case studies of major contemporary issues.
3 hours, winter term (Not offered in 1972-73).

134* Comparative Foreign Policy  The course will explore the problem of the connections between types of regimes and types of foreign policy. Besides considering this problem from a theoretical perspective, a comparative analysis will be made of aspects of several foreign policies.
3 hours, winter term.

561* Problems in Canadian Politics  A critical examination of various problems of Canadian politics, with an emphasis on political integration, federalism and political parties.
3 hours, fall term.

572* Public Opinion and Propaganda  A detailed study of the nature of public opinion and the attempt to control it through propaganda.
3 hours, winter term.

591*-598* Special Subjects  In any year one or more subjects may be offered as special seminars. Course descriptions will be announced at the time of registration.
Department of Psychology

Professor, Chairman of the Department
R.K. Banks, B.A., M.A., Ph.D. (Toronto)

Professor, (Deputy Chairman)
M.P. Byrden, B.S. (Massachusetts Institute of Technology), M.Sc., Ph.D. (McGill)

Associate Professor, (Associate Chairman Undergraduate Affairs)
P.M. Merikle, B.A. (Knox), M.A., Ph.D. (Virginia)

Associate Professor, (Associate Chairman Graduate Affairs)
R.A. Steffy, B.A. (Albright), M.A., Ph.D. (Illinois)

Professor and Associate Dean, Arts Graduate Affairs
M.D. Vogel-Sprott, B.A. (McMaster), M.A., Ph.D. (Toronto)

Professors
W.C. Corning, B.A. (Heidelberg), Ph.D. (Rochester)
J.M. Butler, B.S., Ph.D. (Minnesota)
D.P. Crowne, B.A. (Antioch College), Ed.M. (Rochester), Ph.D. (Purdue)
J.A. Dyal, B.A. (Oklahoma), Ph.D. (Illinois)
W.D. Fenz, B.A. (Southern Missionary), M.A., B.D. (St. Andrew's), M.Sc. (Hawaii), Ph.D. (Massachusetts)
H.M. Lefcourt, B.A. (Antioch), M.A., Ph.D. (Ohio State)
M. Lerner, B.A., M.A. (Ohio State University), Ph.D. (New York University)
R.K. Penney, B.Sc. (Wayne State), Ph.D. (Iowa)
S.D. Saleh, B.A. (Cairo), M.A., Ph.D. (Case Western Reserve)

Professors (Human Relations and Psychology)
J.M. Cornell, B.A., M.A., Ph.D. (Washington)
G.R. Engel, B.A., M.A., Ph.D. (Queen's)
G.A. Griffin, B.A. (Colgate), M.A., Ph.D. (Wisconsin)
W.J. Hudspeth, B.A., M.A. (San Jose State) Ph.D. (Claremont)

Professors (Management Sciences and Psychology)
D.A. Sprott, B.A., M.A., Ph.D. (Toronto), F.S.S.

Associate Professors
K.S. Bowers, B.A., Ph.D. (Illinois)
M. Breidenbaugh (Mrs.), B.A. (Wittenburg), Ph.D. (Vienna)
M. Brown, B.Sc., M.Sc. (McGill), Ph.D. (Michigan)
T.E. Cadell, B.A. (British Columbia), M.A. (Massachusetts), Ph.D. (Wisconsin)
J.M. Cornell, B.A., M.S., Ph.D. (Washington)
G.R. Engel, B.A., M.A., Ph.D. (Queen's)
G.A. Griffin, R.A. (Colgate), M.A., Ph.D. (Wisconsin)
W.J. Hudspeth, B.A., M.A. (San Jose State) Ph.D. (Claremont)

Associate Professors (Sociology and Psychology)
R.D. Lambert, B.A., M.A. (McMaster), Ph.D. (Michigan)

Associate Professors (part-time)
G.E. MacKinnon, B.A. (Queen's), Ph.D. (Johns Hopkins)
D. Meichenbaum, A.B. (City College of New York) M.A., Ph.D. (Illinois)

Associate Professors (part-time)
R.R. Ross, B.A., M.A., Ph.D. (Toronto)
P.M. Rowe, B.A. (Toronto), M.A. (Dalhousie), Ph.D. (McGill)
R.V. Thysell, B.A. (Montana), M.A., Ph.D. (Iowa)
T.G. Wailer, B.S., M.S. (Southern Mississippi), Ph.D. (Vanderbilt)
E.E. Ware, B.A., M.A. (Richmond), Ph.D. (Illinois)
Assistant Professors

(St. Jerome's and Psychology) R.J. Alapack, B.A. (Scranton), M.A., Ph.D. (Duquesne)
D.M. Amoroso, B.A., M.A. (Toronto), Ph.D. (Waterloo)

(Part-time) P.E. Bowers, (Mrs.), B.A. (Rosemont), M.A., Ph.D. (Illinois)
J.A. Cheyne, B.A. (Waterloo Lutheran), M.A., Ph.D. (Waterloo)
R.A. Cole, B.A. (Rochester), M.A., Ph.D. (Univ. of California)

(St. Jerome's and Psychology) A.C. Firetto, C.R., B.A. (Western), M.A. (St. Louis), Ph.D. (Loyola)
F.D. Kemp, B.A. (Texas Christian), Ph.D. (Harvard)

(St. Jerome's and Psychology) J.E. Orlando, B.A. (Western Ontario), M.A. (Detroit), M.A., Ph.D. (Michigan)

(Renison and Psychology) R.W. Robinson, B.A. (Rutgers Univ.), M.A., Ph.D. (Temple Univ.)
H. Ross (Mrs.), B.A. (Toronto), Ph.D. (North Carolina)
M.A. Ross, B.A. (Toronto), M.A., Ph.D. (North Carolina)
R.D. Seim, B.A. (Queen's), Ph.D. (Waterloo)
D.L. Wahlsten, B.A. (Alma College), Ph.D. (California, Irvine)

Adjunct Professors

J.R. Amdur, B.S. (Portland State College), M.A., Ph.D. (Denver)
M.G. Pruesse, B.S., M.A. (British Columbia), Ph.D. (Waterloo)
G. Summer-Smith, M.R.C.V.S., B.V.Sc. (Univ. of Liverpool), F.R.-C.V.S., M.Sc. (Guelph)
C.R. Van Eysinga, F.A.Sc. (Chauverre College)
D.E. Hill, B.S., M.D. (British Columbia)

Undergraduate Programmes

Introductory Psychology Psychology 101* is a prerequisite for all subsequent courses in Psychology. To achieve a better understanding of experimentation in Psychology, all students in introductory courses are required to participate in two hours of appropriate psychological research.

General Programme Students choosing a three-year General programme in Psychology must complete Psychology 101*, 102*, 275, a minimum of three additional full-year Psychology courses or equivalent, and a minimum of eight full-year courses or equivalent in Departments other than Psychology (see also the Arts Faculty General Programme requirements).

Honours Programme Students choosing the Honours programme in Psychology must complete, before graduation, the equivalent of nine full courses in Psychology. Before entering the fourth year of the programme, all students must complete Psychology 283*, 284*, 285*, 331* and one research half course from each of the following groups.

Group 1: 293*, 295*, 297*
Group 2: 393*, 395*, 397*

In the fourth year, all students must complete Psychology 499.
Joint Honours Programme

Students choosing a joint Honours programme involving Psychology must complete the equivalent of seven full courses in Psychology and an Honours thesis course. Unless other arrangements are approved by the Department, all students in joint Honours programmes must complete, before entering the fourth year, Psychology 283*, 284*, 285*, 331*, and one research half course from each of the following groups:

Group 1: 293*, 295*, 297*
Group 2: 393*, 395*, 397*

In the fourth year, all students must complete Psychology 499 or the Honours Thesis course in the related discipline.

Joint Honours programmes other than those already approved may be arranged by consultation with the Psychology Department and the Department concerned.

Minor Programme

The Department offers a minor programme in Psychology. Any student interested in planning a sequence of five courses to complement their major field of study is encouraged to consult the Undergraduate Officer. All minor programmes must be approved by the Department.

Undergraduate Course

The number of hours of lectures shown after the course descriptions is an attempt to indicate the "normal"; each instructor determines how often his particular class will meet.

101* Introductory Psychology

A general survey course designed to provide the student with an understanding of the basic concepts and techniques of modern psychology as a behavioural science.

3 hours.

102* Introductory Psychology

A more in depth study of selected topics introduced in Psychology 101*.

Special Topics

Prerequisite: Psychology 101*.

3 hours.

203* Learning and Motivation

This course is designed to introduce the student to theories in Learning and Motivation and to provide the student with an understanding of the experimental techniques in these areas.

3 hours.

205* Sensory Processes

A consideration of data and theory concerning sensory processes. Topics will include psycho-physical methodology, sensory mechanisms and the neuropsychological basis of perception.

3 hours.

206* Perceptual Processes

An examination of data and theory concerning perceptual processes. Topics will include the perception of form and space, perceptual learning and a consideration of the effect of personality variables in perception.

3 hours.
207* Cognitive Processes
An examination and evaluation of selected topics dealing with human learning, thinking, concept formation, memory and language.
3 hours.

211* Developmental Psychology
An examination of the process and factors of human development.
3 hours.

214* Psychology of Adolescence
A study of the psychological processes occurring in the second decade of human development. Consideration is given such areas as intellectual development, emotional and social growth, and identity formation. Current concepts, issues, and research are stressed.
Prerequisite: Psychology 211*.
3 hours.

1* Educational Psychology: The Psychology of Classroom Learning
A consideration of the main variables affecting learning in the classroom with special focus upon the conditions essential to efficient learning.
3 hours.

242* Educational Psychology: Learning Disabilities
Analyses of learning disabilities associated with various categories of exceptionality including mental retardation, emotional problems, and receptive and expressive handicaps.
3 hours.

253* (Sociology 210*) Social Psychology
The relation between psychological processes and social interaction. Topics to be considered include (1) how we evaluate others' personalities, (2) determinants of friendship, (3) formation and change of attitudes, (4) conformity and independence, (5) the self-concept.
3 hours.

254* (Sociology 212*) Interpersonal Relations
The contribution of social organization to the interpersonal processes. Consideration of some "theories" of social interaction. The social system approach to the problem of personal and interpersonal control.
Prerequisite: Psychology 253*.
3 hours.

261* Physiological Psychology
The structure and function of the nervous system and their relation to behaviour.
3 hours.

271* Animal Behaviour
An in depth study of the behaviour of animals emphasizing both observational and experimental research.
3 hours.

283* Statistical Methods in Psychology
An introduction to the logical and theoretical base for the application of statistical methods to the solution of problems in the social sciences. Consideration will be given to descriptive statistics, to sampling statistics and to an introduction to inferential statistics. Required of all students in Honours Psychology.
3 hours.
**284* Experimental Design**
An examination of the effective use and interpretation of statistics in the design and understanding of experiments in the social sciences. Required of all students in Honours Psychology.

*Prerequisite: Psychology 283*.
3 hours.

**285* Tests and Measurements**
An introduction to the theory and use of psychological tests. Special emphasis is placed on the assessment of personality, intelligence, aptitudes and interests.

*Prerequisite: Psychology 283*.
3 hours.

**293* Research in Learning and Motivation**
Open only to students in Honours Psychology (and Joint Honours programmes with Psychology) and to those students in the General programme who are majoring in Psychology. Open to students in other programmes by permission of instructor only.

*Prerequisite: Psychology 283* and one of Psychology 203*, 207* or 271*.
2 hours lecture, 2 hours laboratory.

**295* Research in Perceptual and Cognitive Processes**
Open only to students in Honours Psychology (and Joint Honours programmes with Psychology) and to those students in the General Programme who are majoring in Psychology. Open to students in other programmes by permission of instructor only.

*Prerequisite: Psychology 283* and one of Psychology 205*, 206* or 207*.
2 hours lecture, 2 hours laboratory.

**297* Research in Biopsychology**
Open only to students in Honours Psychology (and Joint Honours programmes with Psychology) and to those students in the General programme who are majoring in Psychology. Open to students in other programmes by permission of instructor only.

*Prerequisite: Psychology 283* and one of Psychology 261* or 271*.
2 hours lecture, 2 hours laboratory.

**331* Individual Differences**
An analysis of individual and group differences in behaviour, with emphasis on studies of intelligence.

*Prerequisite: Psychology 285*.

**333* Industrial Psychology**
An introduction to the methods and problems in Industrial Psychology.

3 hours.

**334* Counselling Psychology**
An introduction to the methods and problems in Counselling Psychology.

3 hours.

**336* (Sociology 310*) – Group Dynamics**
An analysis of natural and experimental groups from a social structural view. The study of processes of differentiation, integration, power etc., internally; and of nesting of small groups in larger collectives.

*Prerequisite: 3rd or 4th year standing in a social science or by permission.
Facilitative human relations within the context of education, guidance and interpersonal exchanges are treated in terms of current psychological theories and research. The demonstration and development of these concepts are aided by personal participation, observation and taped sessions. Application to both individual and group interaction.

Prerequisite: Psychology, 355*, 357* or suitable alternative.

3 hours.

An examination and evaluation of some of the outstanding theories of personality.

3 hours.

The nature and origin of deviant behaviour.

3 hours.

One or more half courses will be offered at different times as announced by the Department.

Prerequisite: Consent of instructor.

Open only to students in Honours Psychology (and Joint Honours programmes with Psychology) and to those students in the General programme who are majoring in Psychology.

Prerequisite: Psychology 283* and Psychology 211* or 331*.

2 hours lecture, 2 hours laboratory.

Open only to students in Honours Psychology (and Joint Honours programmes with Psychology) and to those students in the General programme who are majoring in Psychology.

Prerequisite: Psychology 283* and 253*.

2 hours lecture, 2 hours laboratory.

Open only to students in Honours Psychology (and Joint Honours programmes with Psychology) and to those students in the General programme who are majoring in Psychology.

Prerequisite: Psychology 283* and one of Psychology 331*, 355* or 357*.

2 hours lecture, 2 hours laboratory.

An examination of current theoretical approaches to psychological problems present in a historical context.

2 hours.

Logic and experimental designs. Randomization. Experimental and sampling errors. Designs applied to biological sciences. Methods of analysis for factorial designs. Latin squares, etc.

2 hours.
Seminars

451* Senior seminar in Learning.
Admission by consent of instructor.
2 hours.

452* Senior seminar in Perception.
Admission by consent of instructor.
2 hours.

453* Senior seminar in Developmental Psychology.
Admission by consent of instructor.
2 hours.

454* Senior seminar in Educational Psychology.
Admission by consent of instructor.
2 hours.

455* Senior seminar in Social Psychology.
Admission by consent of instructor.
2 hours.

456* Senior seminar in Personality.
Admission by consent of instructor.
2 hours.

457* Senior seminar in Clinical Psychology.
Admission by consent of instructor.
2 hours.

458* Senior seminar in Cognitive Processes.
Admission by consent of instructor.
2 hours.

459* Senior seminar in Motivation.
Admission by consent of instructor.
2 hours.

461* Senior seminar in Physiological Psychology.
Admission by consent of instructor.
2 hours.

462* Senior seminar in Animal Behaviour.
Admission by consent of instructor.
2 hours.

463* Senior seminar in Special Topics.
Admission by consent of instructor.
2 hours.

464* Senior seminar in Special Topics.
Admission by consent of instructor.
2 hours.
465* Senior seminar in Special Topics.
Admission by consent of instructor.
2 hours.

466* Senior seminar in Special Topics.
Admission by consent of instructor.
2 hours.

480 Directed Studies in Special Topics
For the student who desires to pursue a particular topic in depth through independent experimental research and/or extensive reading. A faculty member must approve a student’s project prior to registration for this course. Open to exceptional students with permission of the instructor and the Department.
3 hours.

499 Senior Honours Essay
Each student will work under the direction of a member of the department on an experimental study. The result of this investigation will be presented in the form of a thesis, which will be critically examined by members of the department and also, where pertinent, by members of other departments. Required of all students in Honours Psychology.

3 hours.

The following courses are administered by Renison College

120R Introductory Psychology
Basic concepts and techniques of modern psychology as a behavioural science, with special emphasis on social aspects of behaviour, learning and remembering, motivation, values and attitudes, personality, sensation and perception, and small group processes will be studied with reference to physiological correlates and environmental factors.

220R Social Psychology
An examination of the psychological principles involved in the interaction between the individual and society. Emphasis on social attraction, socialization of the child, language and social communication, interpersonal perception, attitude formation, personality and society, status and roles, social control, group dynamics and leadership.

330R Social Functioning and Human Behavior
Selected aspects of social responses to growth, health, disease and disability. The course will also examine abnormal behaviour as a social problem and as a manifestation of culture. There will also be a brief survey of modern diagnostic and treatment procedures.
Department of Recreation

Associate Professor, Chairman of the Department
C.A. Griffith, B.A. (Sir George Williams), M.S., Re.D. (Indiana)

Dean, School of Physical Education and Recreation
G.S. Kenyon, B.P.E. (British Columbia), M.S. (Indiana), Ph.D. (New York)

Professor
E.M. Avedon, B.S.S. (William and Mary), M.A., Ed.D. (Columbia)

Associate Professors
D.M. Crapo, B.P.E. (Alberta), M.S., Ph.D. (Michigan State)
D. Ng, B.A. (Lingnan), M.A. (Carver), M.S., Re.D. (Indiana)

Assistant Professors
D.J. Arnold, B.P.E. (British Columbia), M.Sc. (San Francisco), Re.D. (Indiana)
D.C. Godbey, B.S. (New York), M.S., Ph.D. (Penn State)
F.W. Martin, B.S. (City College, New York), M.S., Ed.D. (Columbia)
J.D. Pearse, B.A. (Toronto)
C. Pierce, B.A. (Grennell), M.A. (DePauw), Ph.D. (Kansas)

Lecturer
J. Levy, B.A. (Waterloo Lutheran), B.P. E. (Waterloo), M.S.W. (Waterloo Lutheran)

Course Descriptions

100* Introduction To The Study of Leisure and Recreation
A course designed to develop an overview of the total field of recreation and an understanding of the leisure phenomena and the implications for contemporary society.
3 lectures (Fall term)

101* Introduction to Leisure Services
An introduction to various leisure service agencies and the services provided. Field trips to municipalities, specialized institutions, and voluntary agencies.
For Departmental students only.
3 lectures (Winter term)

106* Orientation To The Fine and Performing Arts
The place of music, drama and creative activity in recreation and opportunity to become aware of the techniques and organization of the fine and performing arts through direct experience.
Students will be involved in acting, directing, stage managing, costumes, set design, props, make-up in drama; vocal, instrumental and choral work in music; arts, crafts, and handicraft in creative activity.
2 hours lab.
Non-credit course, for Departmental students only. (Fall and Winter terms)

107* Orientation To Sport
The place of sport in recreation. An opportunity to become aware of the techniques and organization of various sports through direct experience.
Students will be involved in aquatics, team sports such as volleyball, soccer and baseball and individual sports such as tennis, golf, and skiing.
2 hours lab.
Non-credit course, for Departmental students only. (Fall and Winter terms)
108* Orientation To The Outdoors
The place of outdoor living in recreation. An opportunity to become aware of the techniques and organization of outdoor camping activity through direct experience.
Students will be involved in canoeing, outtripping, orienteering, campcraft, nature lore, conservation, survival, outdoor recreation. 1 week field trip to a resident camp.
Non-credit course, for Departmental students only. (Fall term)

109* Orientation To Communication Media and Technology
The place of the communication media and technology in recreation. An opportunity to become aware of the techniques of communication through direct experience.
Students will be involved in radio, television, newspaper, committees and councils, use of microphone, movie projector and other technical equipment, public speaking, chairing meetings, writing minutes and reports.
2 hours lab.
Non-credit course, for Departmental students only. (Winter term)

200* Theories Of Play
A critical analysis of definitions, concepts and assumptions of classical, recent and modern theories of play with implications for research strategies, programming and planning for play.
2 lectures, 2 hours lab in community play environments. (Spring term)

210* Organization and Administration of Recreation Services
The organization and administration of recreation on federal, provincial, and municipal levels; legislation, financing, budgeting, personnel management, public relations, administrative practices and departmental organization with particular emphasis on the municipal level.
3 lectures (Fall and Winter terms)

211* Specialized Institutions In Recreation
A course designed to examine different organized recreation settings in detail. Included will be municipal recreation, industrial recreation, Y.M.C.A.’s, therapeutic programs, correctional programs, and armed forces programs.
Prerequisite: Recreation 210.
3 lectures (Winter term)

220* Recreation Program Planning
A study of the scope of community recreation programs and the factors involved in program planning. Emphasis will be placed on the approaches, hazards, misconceptions, creativity, values and evaluation in program planning. Specific reference will be given to the techniques of organizing recreation programs in music, drama, dance and social recreation.
2 lectures, 2 hours lab.
Prerequisite: Recreation 210. (Fall term)

230* Introduction To Outdoor Education and Recreation
A survey of outdoor education, camping, and outdoor recreation in relation to natural resource systems. Emphasizes a basic network of interaction between governmental and nongovernmental agencies, departments, and associations as they relate to and integrate with resource and program management process for outdoor living.
3 lectures (Fall and Winter terms)
241* Administration Of Camping and Outdoor Education
The philosophy and objectives of camping and outdoor education; administration, organization, planning, staff relationships, leadership training, trends in camping and outdoor education. The emphasis in this course will be the place of the resident camp in education and recreation with particular reference to administrative policies and procedures.
3 lectures, 1 week-end field trip to a resident camp. Lab fee, approximately $15.00.
Prerequisite: Recreation 230. (Winter term)

250* Introduction To Therapeutic Recreation
Examines the philosophical, theoretical and empirical frameworks of recreation as a therapeutic service and process to individuals with physical, emotional and intellectual disabilities.
2 lectures, 2 hours lab in community agencies.
Prerequisite: Psychology 101 and Science 351 or equivalent.
(Fall, Winter and Spring terms)

252* Recreation And Mental Retardation
An analysis of the motoric and psycho-social behavioral dimensions specific to the retarded with direct and obvious applicability to the planning, implementing and evaluating of recreational programs.
2 lectures, 2 hours lab in community agencies.
Prerequisite: Recreation 250 and Psychology 242.
(Fall and Spring terms)

253* Recreation And Physical Disabilities
The psycho-social concomitants of physical disabilities will be analysed, with special focus given to the planning, implementing and evaluating of leisure time activities.
2 lectures, 2 hours lab in community agencies.
Prerequisite: Recreation 250. (Winter term)

254* Recreation And Mental Illness
A psycho-social analysis of the determinants and consequences of recreative behavior as related to positive and negative mental health, discussing in detail, structure, semiotic factors and interaction patterns.
2 lectures, 2 hours lab in community agencies.
Prerequisite: Recreation 250. (Winter term)

270* Statistical Techniques Applied To Leisure Studies
An introduction to descriptive and inferential statistics and the interpretation of data. A major consideration of the course is the use of statistics in the solution of problems in recreation and leisure.
3 lectures, 2 hours lab (Fall and Spring terms)

271* Research Designs Applicable To Leisure Studies
An introduction to the methods and techniques of research as applied to leisure studies and services. General consideration will be given to the technical problems involved in various stages of research methodology with emphasis on the logic underlying the research process.
Prerequisite: Recreation 270.
3 lectures (Winter term)

300* Philosophy Of Leisure
Examination of major philosophical themes through the ages with reference to contemporary viability and effect upon social behavior.
Prerequisite: Consent of the instructor.
3 lectures (Fall and Winter terms)
301* Sociology Of Leisure  Nature and extent of leisure phenomena in contemporary society.
Examination of institutional and formal organizational aspects, social role, social research strategies employed in the study of leisure. (Same as Sociology 375).
Prerequisite: Two term courses in Sociology, i.e., Sociology 101 and 341.
3 lectures (Winter term)

302* Travel and Tourism  The scope and nature of travel and tourism as contemporary leisure experiences. Economic, political, and social ramifications, research strategies employed, implications for the future.
Prerequisite: Recreation 301.
3 lectures (Fall term)

303* Sport in Society  An introduction to the sociology of sport. Utilizing the major frames of reference of the social sciences, the function of sport in contemporary society is examined.
Prerequisite: Sociology 101 and one other Sociology course.
3 lectures (Winter and Spring Terms)

306* Leisure And Psychopathology  Examination of the psychodynamics of popular leisure experiences, e.g. —sport, gambling, fashion, and the like, and their relationship to psychopathology. Examination of the use of leisure experience to resolve emotional conflict and cope with stress.
Prerequisite: Recreation 301, Psychology 357, and advanced standing.
3 lectures (Winter term)

307* The Individual In Sport Situations  An introduction to the social psychology of sport and physical activity, including sport involvement and personality, attitude and beliefs; the team as a small group; and social influence and facilitation in sport situations.
Prerequisite: Recreation 301, Recreation 303.
3 lectures (Winter and Spring terms)

311* School Recreation  An analysis of the relationship between recreation and education with particular emphasis on the sponsorship of community recreation programs by education authorities including leisure education and co-curriculum activities.
Prerequisite: Recreation 210.
3 lectures (Winter term)

320* Evaluation of Recreational Programs  Evaluation procedures and techniques applicable to recreation programs are examined in detail. Specification of objectives, development of practical recording procedures and experimental analysis are stressed. Students conduct field evaluations in local community agencies.
2 lectures, 2 hours lab in community agencies.
Prerequisite: Recreation 220. (Winter and Spring terms)

330* Outdoor Recreation  The present status of outdoor recreation in modern society; government functions and policies related to outdoor recreation services; the planning and administration of outdoor recreation activities. Current problems.
2 lectures, 2 hours lab.
Prerequisite: Recreation 230, lab fee approximately $15.00. (Winter term)
332* Theory And Practice In Outdoor Education
Emphasis on methods and techniques for the selection, development, and implementation of programs and projects through the utilization of diverse and unique natural settings and environments. The status of current governmental and nongovernmental projects will be explored.
2 lectures, 2 hours lab.
Prerequisite: Recreation 230 - 241 (Fall term)

334* Park Management
An overview of park systems in Canada with an emphasis on municipal parks; general policies of acquisition, operation and development; basic administrative procedures in park management.
Prerequisite: Recreation 210, Recreation 230, or equivalent.
3 lectures (Fall term)

360* Growth, Development And Aging
The changing capacities and interests of man as related to leisure. The relationship of developmental processes to social gerontology is examined.
2 lectures, 2 hours lab.
Prerequisite: Psychology 211, Recreation 250. (Spring term)

361* Aging And Leisure
Social parameters of the aging process with particular reference to the Leisure Service Industry.
Prerequisite: Recreation 301, Recreation 360
3 lectures (Fall and Spring terms)

370* Directed Study In Special Topics
For the student who desires to pursue a particular topic in depth through guided independent research and/or reading. A faculty member must approve a student’s project prior to registration. May be repeated in subsequent terms.
Prerequisite: Faculty approval. (Fall and Winter terms)

400* Seminar In Recreation And Leisure
An in depth analysis of the current major issues and trends.
Fourth year Departmental students only.
3 hours (Fall and Spring terms)

402* Colloquium On Religion And Leisure
Theological notions as they relate to theories of leisure. Contemporary trends and behavior which affect organized religion, and other leisure-related institutions. Issues for possible consideration, e.g. - public ritual as a leisure and religious phenomenon, leisure forms and liturgy, leisure as prayer, the church and a leisure ethic, ministering in 'mass leisure', the Sabbath and leisure.
Prerequisite: A course in philosophy and theology, or consent of the instructor.
3 lectures (Fall term)

406 Comparative Recreation Systems
A study of multi-national recreation systems. Course meets on Campus and in the field in other countries. Full term study over a period of 6-8 weeks. Laboratory fee varies with field observation.
(Spring term)

410* Planning Of Recreation Facilities
A course to introduce the student to the planning, design and layout of recreation areas and facilities.
Prerequisite: Recreation 210.
3 lectures (Fall term)
### 432* Theory And Practice In Outdoor Education

Concepts, philosophy and practices relative to the enrichment of school and community curricula through the use of the natural environment. Emphasis on the role of the school, the community, the provincial and federal government relative to a systems approach toward an integrated design for leadership program, areas, facilities and management.

*2 lectures, 2 hours lab. Lab fee approximately $15.00.*

*Prerequisite: Recreation 332 or consent of the instructor. (Winter term)*

### 434* Park Management

A study of policies, procedures, and practices relative to the management of natural resources. Emphasis is placed on a systems approach to management as it relates to park management at all levels of government.

*Prerequisite: Recreation 334.*

*3 lectures (Winter term)*

### 470 Research Project

Directed research in recreation and leisure studies. Students are required to complete a research project in their honours option.

*Prerequisite: Completion of an honours optional course sequence.*

*1 lecture, 4 hours lab (Fall, Winter and Spring terms)*
Religious Studies

Associate Professor and Convenor J.W. Miller, B.A. (Goshen), M.A. (N.Y.U.), B.D. (Princeton), Th.D. (Basel)

Associate Professors
G W. Klaassen, B.A. (McMaster), B.D. (McMaster Divinity School), D.Phil. (Oxford)
P A.M. McLachlin, M.A. (Toronto), B.D. (Emmanuel), Th.D. (Emmanuel)
P A.F. Thompson, B.A. (Toronto), B.Th. (Huron), M.A. (Western), S.T.M., Ph.D. (McGill)

Assistant Professors
J W.J. Bildstein, B.A. (Western), S.T.B. (Gregorian), M.A. (Windsor), S.T.D. (Angelicum)
P R. M. Bird, B.A., M.A. (Iowa)
J M.D. Coogan, B.A. (Fordham), Ph.D. (Harvard)
J B.J. Hubbard, B.A. (Seattle), M.A. (Marquette), Ph.D. (Iowa)
G D. Sahas, B.D. (Athens), S.T.M. (Christian Theological Seminary), Ph.D. (Hartford Seminary Foundation)
P G J.E. Toews, B.A. (Tabor), M.A. (Wichita)

Lecturers
J W.H. Hall, B.A. (Loyola), B.Th., S.T.L. (Montreal)
P D.R. Newman, B.A. (Toronto), B.D. (Emmanuel), M.A. (Toronto)

Note 1 Purposes of the Programme in Religious Studies:
a) to expose the student to the issues and problems involved in, and to the nature of the questions raised by, the study of religious phenomena and ideas;
b) to enable him to approach, in a methodical way, the study of the major religious traditions living today, for the purpose of encountering and understanding the life and the expression of religion through the various religions of the world;
c) to introduce him to the distinctive features of one or more religious traditions and to the methods for their systematic study.

Note 2 Students majoring in Religious Studies must have their programmes approved by the undergraduate officer. Each student is required to take any 100-level R.S. course in the first year and two R.S. courses in each of the two subsequent years. These courses should be selected from at least two of the following four main categories of approaches to religious phenomena (the decade grouping of the numbering scheme will guide the student in making this selection):

Course Categories and Numbering Scheme
1) Studies in Religious Texts
   00-90

2) Studies in the History of Religions
   10-19 A) History of Religions
   20-29 B) History of the Christian Church

3) Theological – Philosophical Studies
   30-39 A) Theological
   40-49 B) Philosophical
   50-59 C) Ethics
4) Cultural Studies
60-69 A) Religion and Culture
70-79 B) Religion and the Social Sciences

Note 3 The honours programme in Religious Studies can be found in Section 8 of this Calendar.

Note 4 Students at the University of Waterloo and Waterloo Lutheran University may, with the permission of their adviser, take courses in Religious Studies at either university. For details regarding registration procedures, and courses available at Waterloo Lutheran University, consult the undergraduate officer, Religious Studies.

Undergraduate Courses

103G* Origins of the Judaeo-Christian Tradition 1
A study of the history, literature and basic concepts of the religion of ancient Israel in the pre-Christian era, against the background of the religions of the ancient Near East.
3 lectures, fall term.

104G* Origins of the Judaeo-Christian Tradition 2
A study of the origins of the Christian community and faith, with special focus on the church's relation to Jesus and the emergence of Christian literature, theologies, and life styles.
3 lectures, winter term

105P Introductory Hebrew
An introduction to Hebrew grammar. Translation and exegesis of selected passages from the Old Testament.
Not offered 1972-73.

106P New Testament Greek
This course will consist of two parts:
a) An introduction to Greek grammar with appropriate grammatical exercises and development of vocabulary.
b) An exegetical study of the Greek text of the Synoptic Gospels, with Mark as the basis.
3 lectures

110* Religions of Mankind 1
An introduction to the religious traditions of the East: history, religious beliefs and practices of Hinduism, Buddhism, Shinto, Zen Buddhism, and Confucianism.
3 lectures, fall and winter terms

111* Religions of Mankind 2
Encounter with Judaism, Christianity and Islam: the history and interaction of the three major religious traditions which have shaped the image of the Western World.
3 lectures, fall and winter term

130P* Introduction to Theology
A study of the nature of the Christian faith with consideration of questions such as these: How do you speak of God in a secular age? What significance have the Bible and Church doctrines for history and faith? Who is Jesus? the Cross and Resurrection; the question of Salvation.
3 lectures, fall term
131P* Introduction to Theology
Further study of the Christian faith to include the questions and issues: What is man? What is freedom? Is there a Christian life-style? the new morality; Man and Nature; the Church: Mission and Worship; the Future.
3 lectures, winter term

145* (Philosophy 135*)
Fundamentals of the Philosophy of Religion
A philosophical consideration of problematic aspects of religious belief. Topics to be discussed will include: attempts to prove the existence of God, the problem of evil, faith and reason, religious experience, and religious language. Classical and contemporary reading will be used.
3 lectures

160R* Introduction to Religion and Culture 1
An exploration of the interrelationships of religion and culture through the medium of the arts. An effort to understand the religious dimension of man's literary and artistic achievement, as well as to comprehend the ultimate questions implied in culture East and West.
3 lectures, fall term

161R* Introduction to Religion and Culture 2
A consideration of the "soul of culture" in East and West in terms of the quest for meaning in various aspects of culture: art, science, cinema, drama, fiction and music.
3 lectures, winter term

201J* Introduction to the Old Testament
A survey of the literature of the Old Testament as viewed in its historical and cultural setting in the ancient Near East and as interpreted by modern scholarship; the literature as an expression of the religious thought of ancient Israel, one of the formative influences in Western civilization.
3 lectures, fall term

202J* Introduction to the New Testament
A survey of the literature of the New Testament as viewed in its historical and cultural setting in the Greco-Roman world and as interpreted by modern scholarship; the literature as an expression of the religious thought and experiences of the early Christian communities, the origin of the Church.
3 lectures, winter term

203G* Wisdom Literature in the Old Testament
A study of Proverbs, Job, Ecclesiastes and other wisdom writings in ancient Israel, against their Near Eastern background.
3 lectures, fall term

204G* Worship Life in Ancient Israel
A study of the festivals, prayers and liturgies of the Old Testament against the background of worship practices in the ancient Near East.
3 lectures, winter term

205G The Hebrew Prophets
A study of the writings of Amos, Hosea, First Isaiah, Second Isaiah, Micah, Jeremiah, and Ezekiel in the historical, social, and religious context of the ancient world, and of their influence upon the development of religious life and thought.
Not offered in 1972-73.

206G* Modern Study of Jesus
An examination of recent approaches to the study of Jesus of Nazareth to determine his significance for the beginnings of the Christian Church and for modern man.
3 lectures, winter term
207G* The Gospel of John
An interpretation of the Fourth Gospel in the light of the problems facing the Christian Church at the end of the first century A.D.
Not offered in 1972-73.

208P* Myth and the Modern Consciousness
The role of the apocalyptic imagination. Interpretations of the Book of Revelation. Apocalyptic motifs in the literature of radicalism, and secular versions of millenial hopes. The presence of the apocalyptic myth in major works of modern fiction.
3 lectures, fall term

209G* Cultural Conflict in Early Christianity
A study of the conflict within the early church over the nature of the Christian message and community, with special consideration of the writings of Paul, one of the leading missionaries and theologians of the church.
Not offered in 1972-73.

212J* Ancient Near Eastern Religions
An analysis of the myths, epics, legends, rituals, incantation, prayers and festival texts of ancient Near Eastern peoples, with special emphasis on the religions of Egypt, Mesopotamia and Canaan-Phoenicia.
To be offered 1973-74.

213* Hinduism
A study of the development of religious thought in India from the Vedic Peiod to the present. The course will combine a historical survey with a study of representative texts from the religious, philosophical social, and political thought of the Hindus.
3 lectures, fall term

214* Buddhism in India, China and Japan
This course will consist of a historical survey of the essential doctrines and practices of Buddhism in India, China and Japan, along with a study of representative texts from the various schools of thought.
3 lectures, fall term

215* Chinese Religions
A historical survey of the various expressions of Chinese spirituality from the classical period to the present. Special attention will be given to the dynamics between the indigenous traditions (e.g., Taoism) and those imported into China (e.g., Buddhism).
3 lectures, winter term

216* Islam
The religion of the Muslims throught fourteen centuries of its existence. An introduction to the life and the personality of Muhammad the Prophet, the Qur'an, the Muslim Tradition, the development of the Muslim Theology and Philosophy, Sufism, Muslim expansion and civilization, Muslim life and piety, and present condition of the religion in the Muslim world.
3 lectures, fall term

217* Judaism
The religion of Israel throught its 4000-year of existence. An introduction to the history, Scriptures, intellectual life, practice and modern situation of the religion.
3 lectures, fall term

19* Islam in the Modern World
The state of the Muslim community in the twentieth century with reference to the trends of thought and movements of action which are emerging in its midst, as it confronts itself and the non-Muslim world, especially the West.
Not offered 1972-73.
220 (History 258) History of Mediaeval Europe
The political, cultural, economic and ecclesiastical development of Europe from 300 to 1300.
3 hours, lectures and seminars

223G* History of the Ancient Church (A.D. 33-450). A study of the history of the ancient church, with special emphasis on developments in form and doctrine and on the church’s relation to the culture and thought of the time.
3 lectures, fall term

224G* History of the Late Medieval and Reformation Church (A.D. 1200-1560). Especially emphasized are parish life and belief and the causes of the reformation. The Anabaptist movement is studied as a significant part of the reformation in addition to the traditional concern with Lutheran, Reformed and Anglican Christianity.
3 lectures, winter term

226G* Jewish-Christian Dialogue
An analysis of the relations between the Jewish and Christian communities from the first century to the present. Special attention will be given to the problem of anti-Semitism.
Not offered in 1972-73.

231J Revelation, Religion and Doctrine
An examination of the meaning of revelation and its significance for the study of religion. An investigation of the move in the early Church from Kerygma to dogma and the need for theology. A survey of the development of the fundamental truths of the Christian Faith: The meaning of God; The Mystery of the Incarnation; The role of the Spirit; The Church and the Sacraments; The development of Mariology; The problem of Evil.
Prerequisite: 2nd Year Standing.
3 lectures

232J Christ and Contemporary Man
A systematic reflection on the revolution in contemporary consciousness and its meaning for the understanding of Jesus in a secular and pluralistic world. The significance of Trinitarian doctrine for our time. The Christ of Faith and the Jesus of history. The presence of the Risen Christ in time.
Prerequisite: 2nd Year standing, 2 hours

233P*/234P* Contemporary Atheism and Faith in God
3 lectures, fall and winter terms.
Not offered in 1972-73.

238J The Ecumenical Movement
An examination of the origin and history of the modern ecumenical movement through a study of its important leaders and events. Documents of the different Christian Churches will be examined and major doctrines in the Christian understanding of the Church will be analysed: Word, Authority, and Sacrament.
Prerequisite: 2nd Year Standing
3 lectures
239* Islamic Theology, Philosophy and Mysticism
A survey of the development of the Islamic Theology and Philosophy from the beginning of sectarianism to the dawn of the twentieth century, along with a study of the contribution of the mystics (sufis) to the Islamic thought. The course will introduce for study various texts from representative figures and schools of thought.
Prerequisite: Consent of the instructor.
3 lectures, winter term

246* Philosophy and Mysticism
A critical examination of mystical writings, with regard to the nature of the experience reported, their typology, and their implications for epistemology, ethics, and philosophy of religion.
Prerequisite: Consent of instructor.
2 hours

49P* Philosophies of Education
A study of religious and secular theories of the nature and purpose of education. The thought of classical Greek and Biblical writers. Reformation and Renaissance thinkers, and selected educators of the present day.
Not offered 1972-73.

260* (Fine Arts 218*) Western Religious Art
An introductory survey of the visual art and architecture of Judaism and Christianity in the Common Era. The development and subsequent changes of style in places of worship and ceremonial objects and ornaments, and the changing forms of religious expression through visual art, will be studied.

262P* Religion, Ethics and Politics 1
A historical overview of several religious traditions in terms of their stance with respect to selected socio-political issues. A consideration of the problems and possibilities presented by religious factors in the choice of ethical responses to political problems
Fall term

263R* Religion, Ethics and Politics 2
A consideration of varied religious responses to 20th century political realities. An examination of theological and/or ethical reflections within various religious standpoints on the static ideologies of nationalism, statism, racism, fascism, the revolutionary movements of Marxism and Utopianism, and the problems of war and revolution, force and nonviolence.
Winter term

266R*/267R* Religion and the Film
A theological approach to the study of the film as a world-transforming phenomenon for man. The religious outlook of selected film-makers (i.e. Bunuel, Bergman, Pasolini and others) as well as religious themes central to films generally, such as the nature and destiny of man and various modes of human estrangement and reconciliation (a fee of $5-10 a term will be asked in order to permit greater use of feature films).
3 lectures

270P* Psychology of Religion
A study of theories of the psychological nature of religious experience, the sources of religious belief and religious significance of psychological phenomena. Special attention to such questions as faith and doubt, mass evangelism, conversion, faith healing, mysticism, 'Jesus freaks', drugs and religious experience, and parapsychology.
3 lectures, winter term
275G* Religion and Psychotherapy
A review and analysis of the dialogue between theistic religion in the west and the personality sciences since Freud: their respective views of God, man, sin, sickness and the therapeutic process. Clinicians and theorists in psychotherapy and religion from the surrounding community will contribute to the exploration.
3 lectures, winter term

298*-299* Directed Readings in Special Subjects.

301J* Palestinian Archaeology
An introduction to archaeological discoveries in Palestine. The course will deal with selected evidence for each successive archaeological period, with particular emphasis on those periods and sites which shed light on biblical sources from both the Old and New Testaments. Other areas of concern will include a critical introduction to methods of excavation and a discussion of the applicability of archaeological evidence to the reconstruction of the history and culture of the ancient Near East.
Prerequisite: R.S. 103G*-104G*, or R.S. 201J*-202J*, or the consent of the instructor.
3 lectures, fall term

302J* Covenant Theologies in Ancient Israel
This course will analyse the various theologies of covenant developed in the Old Testament, with particular emphasis on the Mosaic and Davidic covenants; these will be examined both in their earliest formulations, as compared with ancient Near Eastern documents of similar form, and in their later re-interpretations in response to political, military and moral crises in Israel's history.
Prerequisite: R.S. 103G*, or R.S. 201J* or the consent of the instructor.
3 lectures, winter term

309G* The Theologians of Early Christianity
3 lectures, winter term

313* Modern Religious Movements in the Indian Sub-Continent and Ceylon
A study of new movements in the major religions of India and Ceylon in the 19th and 20th centuries and of the thought of some of the outstanding figures in these movements.
3 lectures, winter term

314* Zen Buddhism
A seminar based on interpretations of Zen, East and West. The course will develop through four areas of concern: a) basic Mahayana principles, b) the uniqueness of Zen within Mahayana, c) Eastern interpretations, and d) Western interpretations.
Will not be offered in 1972-73.

319* History of Muslim-Christian Relations
A study of the Muslim-Christian relations from the times of the Arab conquests to the present, with a reference to representative figures and literature produced, as well as to actions taken by both sides in the course of this encounter.
Not offered in 1972-73.

321G* (History 347G*) The Radical Reformation
A study of radical reform spokesman Andreas Carlstadt, Thomas Muntzer, and others, and of the violent revolt of the peasants, 1524-1525.
3 lectures, fall term
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| 322G*      | (History 348G*) The Radical Reformation          | A study of Anabaptism, a socio-religious movement committed to change through nonviolence, and of other dissenters like Sebastian Franck, Caspar Schwenckfeld, and Michael Servetus.  
Prerequisite: 321G* Radical Reformation I.  
3 lectures, winter term |                                                                                               | 3                                                 |
| 323*       | (History 353*) Medieval Church History from 312-1122 | A study of the evolution of the dogmatic approach. Topics will include dogmatic, moral and political questions which have affected the teaching of the Church.  
3 hours, lectures and seminars |                                                                                               | 3       |
| 324*       | (History 354*) Medieval Church History from 112-1449 | A study of the evolution of the dogmatic approach. Topics will include dogmatic, moral and political questions which have affected the teaching of the church.  
3 hours, lectures and seminars |                                                                                               | 3       |
| 325*       | The Orthodox Church                              | A study of the Eastern branch of Christianity, which claims to preserve intact the purest continuation of Christian doctrine and tradition; its history, theology, mysticism, culture, art and its modern situation in Greece, Russia, Eastern Europe, the Middle East, as well as in the West.  
Prerequisite: Consent of the instructor.  
3 lectures, winter term |                                                                                               | 3       |
| 330J       | Catholic Social Teaching                         | An examination of the theology elaborated in modern papal and episcopal teaching as it encounters the great movements of our time and explores the meaning of civil, domestic, professional and international societies.  
Prerequisite: 2nd Year standing.  
3 lectures |                                                                                               | 3       |
| 331J       | The Church in the Modern World                   | An examination of the technological society and an investigation of the capacity and willingness of the Church to respond to the challenges presented by a radically new world situation. Special consideration of controversial questions: War and Non-Violence; Politics and Revolution; Secularism and Secularization; Racism and Poverty; Sexuality and Marriage.  
Prerequisite: 2nd Year standing.  
3 lectures |                                                                                               | 3       |
| 336P       | Contemporary Theology                            | The sources of contemporary theology in 18th and 19th century thought, with particular reference to Kant, Schleiermacher and Kierkegaard. Selected 20th century theologians, including Buber, Barth, Tillich, Bonhoeffer and Teilhard de Chardin. Special attention to current themes such as secularization, the 'death of God', hope and the recovery of religion.  
(Cross-listed as Philosophy 336).  
3 lectures |                                                                                               | 3       |
| 337J       | The Ideas of Teilhard de Chardin                 | An analysis of Teilhard de Chardin's worldview which is founded on the phenomenological observations of the scientist and on the mystical experience of the cosmic Christ. Special consideration will be given to the problems raised by Teilhard's writing such as the influence of science in theology, 'the omega point', love and personalization, the problem of evil, hominisation, etc.  
Prerequisite: 2nd Year standing.  
2 hours |                                                                                               | 2       |
338J* Theologians of Renewal:
John Henry Newman
An investigation of the renewal in Catholic Theology through a study of contemporary theologians with special reference to this nineteenth century English Churchman. His specific contribution will be evaluated by an analysis of his concern and methods.
Prerequisite: 2nd Year standing.
2 hours, fall term

339J* Theologians of Renewal:
Bernard Lonergan
An investigation of the renewal of Catholic Theology through a study of contemporary theologians with special reference to this twentieth century Canadian Jesuit. His specific contribution will be evaluated by an analysis of his concerns and methods.
Prerequisite: 2nd Year standing.
2 hours, winter term

343*/344* (Philosophy 365*-366*)
Oriental Philosophy
Studies of a selected area of non-western Philosophy (e.g. Indian or Chinese). Parallels will be drawn between modes of Eastern thinking and European conceptions with emphasis on essential difference as well as similarities.
Prerequisite: Consent of the instructor.

346* (Philosophy 335*)
Philosophy of Religion
A critical examination of the methods and substantive arguments found in selected major works of religious philosophy. The writings chosen for consideration will be announced in advance each year.
Prerequisite: One full or two half Philosophy courses.
3 hours

353* Ethics in Indian Thought
A study of ethical theory in the classical literature of India—the Vedas and the Upanisads, the unorthodox systems of the Carvakas (materialists), the Jains and the Buddhists, the six orthodox schools and the Bhagavadgita—and in the modern period—the thought of Tagore, Radhakrishnana, Gandhi and Nehru.
3 lectures, winter term

362* Religion and Technology
A survey of the Religious problems of the era of technology and an analysis of some of the theories that have been given to explain the influence of the Judaeo-Christian religious tradition on the rise of the modern technological world-view.
3 lectures, winter term

363* The Religious Thought of
Nicholas Berdyaev
A study of Berdyaev's assessment of the religious crisis of western civilization, a comparison of his basic outlook with those of other modern 'theologians of culture' such as Paul Tillich, Pierre Teilhard de Chardin and Leslie Dewart, and an exploration of selected themes from his writings: God and Being, Person and Community, History and Eschatology, Love and Sexuality, the Meaning of Creativity.
3 lectures, fall term

365* Religious Issues in Marxism
An examination of essentially religious issues in the writings of Karl Marx and in selected 'classical literature' of Marxism: the nature of transcendence, the question of ultimate reality, the nature of man, the meaning of history, the problems of alienation, ideology and ethics.
3 lectures, winter term
366R* Literary and Religious Horizons 1
A discussion of fundamental presuppositions concerning the relationship of religion and literature in general. Subsequently, an investigation of religion as a factor in literary vision, drawing from a wide selection of writings, including novels, essays, poetry and short stories from Eastern and Western cultures.

Prerequisite: any introductory R.S. course or consent of the instructor.
3 lectures, fall term

367R* Literary and Religious Horizons 2
A thematic consideration of religious questions in contemporary literature. Reading selections will include in addition to selected theological writings a variety of representative materials from contemporary authors.

Prerequisite: any introductory R.S. course or consent of the instructor.
3 lectures, winter term

375* (Sociology 355*) Sociology of Religion
The analysis of religion as a social institution; its relationship to culture, personality and social change with consideration given to theories of religious behaviour and contemporary research findings.
3 lectures

398*-399* Directed Reading in Special Subjects†

401 Studies in the Jewish Scriptures†

402 Studies in the Christian Scriptures†

415 Studies in Comparative Religion†

21 (History 405) Senior Tutorial in History of the Reformation
Prerequisite: History 260 or R.S. 223G*-224G*.
2 hours

421 Tutorial in the History and Methodology of the History of Religions†

425 Studies in Church History†

430 Studies in Historical Theology†

431 Studies in Contemporary Religious Thought†

432 Studies in Selected Theological Problems†

15*-449* (Philosophy 435*-439*) Studies in Philosophy of Religion
A study of a particular philosopher or problem. The topic will be announced in advance each year.

Prerequisite: Consent of instructor.
3 hours

† Students wishing to enrol in a course marked with a dagger (†) should consult the department.
Science

The Faculty of Science offers the following courses of a general nature, intended mainly for students registered in the Faculties of Arts and Mathematics, the School of Physical Education or the Division of Environmental Studies as well as for Science students desiring electives, especially in the General Science Programme, as noted.

100* Geological Foundations of the Environment

2 lectures per week. 2 hours laboratory alternate weeks, offered in fall and winter terms.
Not normally available to students in Regular Science programmes.

Note Students desiring a full-year Geology elective should consider Earth Sciences 130 (Introductory Geology) to be found in the listings of the Earth Sciences Department.

200* Contemporary Science 1

An examination of some of the issues and development in contemporary science (e.g., molecular biology, astrophysics, etc.) at a non-technical level. The interaction between science and society will also be discussed. Extensive skills or background knowledge in mathematics or science are not necessary. Open to first year or upper year students. (Students registered in Science or Engineering may not take this course for credit).
No prerequisites.
3 lectures per week, fall term.

201* Contemporary Science 2

Similar discussions to those of Science 200*. (Science 200* need not be taken first.) Open to first year or upper year students. (Students registered in Science or Engineering may not take this course for credit.)
No prerequisites.
3 lectures per week, winter term.

209* Scientific Literature and Writing

Information search and retrieval: libraries, scientific and technical literature, abstracts, sources of data, use of computers. Patents. The art of writing: scientific papers, technical reports, letters.
No specific course prerequisites but only recommended for students in upper years of any Science programme or for similar Mathematics students who are pursuing a Science minor.
2 lectures or discussion sessions per week, offered in fall and winter terms.

220* Chemistry of Pollution

A study of the chemistry involved in pollution problems encountered with consumer products and in selected industries. Progress in overcoming the pollution will be discussed with emphasis on the chemistry. (Open to all interested students.)
Prerequisite: at least one year of high school Chemistry.
2 lectures, winter term.
237* Descriptive Astronomy  A survey course in astronomy intended for non-Science students (primarily Arts, Environmental Studies and Physical Education students). The solar system, stars, the galaxy, galaxies and the universe. Open to first year or upper year students. (Students registered in Engineering, Mathematics or Science may not take this course for credit.)

*No prerequisites.*

3 lectures per week, one term only.

238* Descriptive Astronomy  A survey course in astronomy intended for Mathematics, Engineering and Science students. The solar systems, stars, the galaxy, galaxies and the universe. Open to first year or upper year students. (Students whose major field is Physics may not take this course for credit.)

*No prerequisites.*

3 lectures per week, one term only.

**Note**  Students interested in the above courses in Astronomy should note that because of overlapping material both courses may not be taken for credit – only the one most suitable to their background.

250* Environmental Geology  The influence of geological factors on the natural environment: natural hazards: effects of engineering works on the environment: geological aspects of water resources and waste disposal with particular attention to solid waste (garbage) and deep well injection of liquid wastes.

*Prerequisite: Students will find a course in Physical Geography or Earth Sciences to be an advantage.*

3 lectures, winter term.

251* Genetics and Evolution  The principles, methods and applications of genetics. The basis and implications of modern evolutionary theory. The modern approach and social implications will be discussed. Open to first year or upper year students. (Students whose major field is Biology may not take this course for credit.)

*No prerequisites.*

3 lectures per week, fall term.

252* Biology and Society  A topical approach to problems of human society directly related to biological systems. Areas for discussion in any one year will be chosen from a wide range of topics. These will be dealt with both from the theoretical and practical aspects of modern biology. Open to first year or upper year students. (Students whose major field is Biology may not take this course for credit.)

*No prerequisites.*

3 lectures per week, winter term.

260* Man and Vision  Elementary treatment of physical, physiological and psychological aspects of vision. Emphasis will be placed upon the visual environment and man. Selected phenomena in vision will also be covered. (Open to non-Optometry students only.)

*No prerequisites.*

2 lectures per week, fall term.
**270* Nuclear Science**  A non-mathematical general treatment of the following areas of nuclear Science: historical development and discovery of new fundamental particles; artificial transmutation of elements; nuclear sources of energy; biological effects of radiation and use of radioisotopes in industry, medicine and agriculture. The impact of nuclear science on social, economic and political systems will be discussed.  
*Prerequisites: at least one year of high school Chemistry or Physics.*  
3 lectures per week, winter term.

*Prerequisites: An interest in both Music and Physics; Mathematics 130 or an equivalent course in Calculus, or consent of instructor.*  
3 lectures, winter term.

**351* Human Biology 1**  An approach to man as a "biological machine", and the effect of these changes on homeostasis. (Science 351* or 352* are not recommended to those students who have taken or are taking Biology 301, 303*, 304* or 337. Not available to students who are Honours Biology or 4-year Biology majors.)  
3 lectures.

**352* Human Biology 2**  A physiological and behavioural approach to man's performance under specific environmental pressures. Such topics as the physiological effects of industrial pollution, crowding, high and low temperatures will be discussed. (Science 351* or 352* are not recommended to those students who have taken or are taking Biology 301, 303*, 304* or 337. Not available to students who are Honours Biology or 4-year Biology majors).  
3 lectures.

**400 The History of Science**  The development of scientific concepts from the Renaissance to the early 20th century, Copernicus and Galileo, Sir Isaac Newton. The physical and biological sciences during the 18th century. Lavoiser. 19th century developments in physics, chemistry, geology, biology and technology. Evolution and the rise of modern genetics. The 20th century revolution. Emphasis will be given to the reading of the works of historically important scientists.  
*Prerequisites: The first year Science programme (page 232) or equivalent.*  
2 lectures per week, two terms.

**410* Technical Report (For Students in Co-op Applied Chemistry and Co-op Applied Physics only.)**  Technical reports covering work term assignments are submitted by all Co-op Science students. These will be carefully evaluated for technical content and writing ability. Four satisfactory reports are required prior to graduation but this number will be reduced to three for students transferring to Co-op Science in the 2B or later terms. A word Grading system will be used and will range from Excellent to Unsatisfactory. This course will be added to the student's transcript at the completion of Year 4 and will be given 0.50 course credit; this credit is to be in addition to the regularly required number of course credits shown in the program listings.
1* Our Biological Environment. A lecture, seminar and practical course providing a study of the terrestrial environment with special reference to the impact of man. Topics covered will include a consideration of the main terrestrial ecosystems of the world; energy flow and material cycling, succession and adaptation; soils and soil erosion; applied ecology including aspects of conservation and pollution; biological versus chemical control of pests; and a discussion of the problems of human population and world food supply. (Students registered in Honours Biology programmes may not take this course for credit.)

No prerequisites.

2 lectures and 3 hour laboratory or field trip per week, or 3 lectures per week at the discretion of the instructor, fall term.

2* Our Biological Environment. A lecture, seminar and practical course providing a study of freshwater and marine environments with special reference to the effects of modern man. Topics covered will include a survey of the ecosystems and biota; nutrients and biological growth; eutrophication; biological aspects of water supply and water pollution; pests and their control; fish and fisheries problems; introduction to oceanography. (Students registered in Honours Biology programmes may not take this course for credit.)

No prerequisites.

2 lectures and 2 hour laboratory or field trip per week, winter term.
Social Science (Applied) Programme

Professor, Director of Programme  D. G. S. M'Timkulu, M.A. (S. Africa), M.A. (Yale), Ph.D. (Natal)

Associate Professors  B. Sheppard, B.A. (Queen's), M.S.W. (Ottawa)
J. Cossom, B.A. (Western), B.S.W. (Toronto), M.S.W. (Toronto)

Assistant Professors  J. Denys, B.A. (Western), B.Th. (St. Peter's), M.A. (Windsor), Ph.D. (Waterloo)
J. Winc, B.Sc. (Lewis and Clark), M.Sc. (Wisconsin), Ph.D. (Waterloo)

Lecturer (Part-time)  H. Miller, B.Sc. (McGill), M.A. (Waterloo)

1) The Applied Social Science Programme is a three-year integrated programme leading to the B.A. within the Arts Faculty of the University of Waterloo. It is an interdisciplinary programme in the Social Sciences, with teaching done by social workers, psychologists and sociologists. In-class study is supplemented by community involvement as an integral part of the overall programme. The programme is designed to provide:

a) an academic preparation for advanced work in graduate schools leading to the M.S.W. degree;
b) an academic background for the understanding of social problems in our day for those persons intending to seek employment in welfare services, human service professions such as community development programmes, journalism, law, communications, medicine and theology or service overseas with international relief organizations.

2) For the general programme, students are required to take fifteen courses, including the following:

Year 1  Social Work 120R
         Sociology 120R
         Psychology 120R
         Two electives

Year 2  Social Work 220R
         Sociology 220R*, 221R*
         Psychology 220R
         Two electives

Year 3  Sociology 320R
         Social Work 325R
         Psychology 330R
         Social Work 335R
         Social Work 340R

3) All students in the Social Science (Applied) Programme must meet the Arts Faculty Group A and Group B requirements.

4) For further information, consult the Programme Director.
Social Science (Applied) Programme

Undergraduate Courses

Social Work 120R Social Problems
A study of contemporary social problems with which social work concerns itself. Emphasis is divided between theoretical approaches to understanding the problem and study of societal responses to and intervention in the problem.

Sociology 120R Fundamentals of Sociology
Survey of key topics and study of the basic skills, concepts and interests comprising the sociologist’s tools of analysis. The course will include social organization, culture, socialization, primary groups, social stratification, associations.

Psychology 120R Introductory Psychology
Basic concepts and techniques of modern psychology as a behavioural science, with special emphasis on social aspects of behaviour. The development of behaviour, learning and remembering, motivation, values and attitudes, personality, sensation and perception, and small group processes will be studied with reference to physiological correlates and environmental factors.

Social Work 220R Social Welfare
History and development of social welfare as an institution from its origins to the modern welfare state. Emphasis on current issues in social welfare and patterns of service.

Sociology 220R* Sociological Analysis
Applying sociological analysis to three selected areas: the major institutions of education, religion and law, and developing a pattern and an approach which would be applied to the study of other social areas.

Sociology 221R* Master Trends in Modern Society
Introducing the student to the main ideas of urban, industrial and political sociology studied within a framework emphasizing social change; illustrations will be drawn from emergent as well as advanced societies.

Psychology 220R Social Psychology
An examination of the psychological principles involved in the interaction between the individual and society. Emphasis on social attraction, socialization of the child, language and social communication, interpersonal perception, attitude formation, personality and society, status and roles, social control, group dynamics and leadership.

Sociology 320R Ethnic and Cultural Minorities
Implications of minority group status for social work practice: the place of ethnic and cultural minorities within contemporary social structures, principles in majority-minority relations, minority relations and social stratification. An analysis of prejudice and discrimination and their functions as weapons in group conflict, the responses of minority group members to prejudice and discrimination. Family patterns of minorities.

Social Work 325R Social Work Research
The role and purpose of research in social work; elements in the method and design of research, and the research process. Interviewing, participant observation, scaling and experimental design will be included along with research in social work methods: casework, group work, community organization, administration.
Psychology 330R Social Functioning and Human Behaviour
Selected aspects of social responses to growth, health, disease and disability. The course will also examine abnormal behaviour as a social problem and as a manifestation of culture. There will also be a brief survey of modern diagnostic and treatment procedures.

Social Work 335R Foundations of Practice
An examination of the methods of social work practice: casework, group work, community organization and administration.

Social Work 340R Social Work Tutorial
An independent in-depth study of a selected area of social work theory or practice undertaken by individual or small groups of students with faculty consultation.
Department of Sociology and Anthropology

Sociology

Professor and Chairman of the Department
L. Krader, B.A. (City College, N.Y.), Ph.D. (Harvard)

Professors
G.L. DeGre, B.S.S. (City College, N.Y.), M.A., Ph.D. (Columbia), Cated Hon. (San Marcos, Lima)
H.J. Fallding, B.A., B.Sc., M.A. (Sydney), Ph.D. (Australian Nat.)
N. High, B.S.A. (Toronto), M.S., Ph.D. (Cornell)
H.D. Kirk, B.S. (City College, New York), M.A., Ph.D. (Cornell)

Associate Professor
J. Cossom, B.A. (University of Western Ontario), B.S.W. (Toronto), M.S.W. (Toronto)
F.A. Fasick, B.A. (Pennsylvania State), M.A., Ph.D. (Columbia)
D. Kubat, M.A. (Kansas), Ph.D. (L. Maximilian, Munich)
R.D. Lambert, B.A., M.A. (McMaster), Ph.D. (Michigan)
R D.G.S. MtTimkulu, M.A. (S. Africa), M.A. (Yale), Ph.D. (Natal)
W.G. Scott, B.A. (Western), M.A. (Toronto)

Assistant Professors
J.M. Alleyne, B.A. (Sir George Williams), Ph.D. (Johannes Gutenburg)
M.A. Beuchamp, B.A., M.A. (Buffalo)
J. Curtis, B.A. (Sir George Williams), M.A. (Central Michigan), M.A. (Cornell)
M. Eichler, B.A. (Goettingen), M.A., Ph.D. (Duke)
A.Q. Lodhi, M.A. (Punjab), M.A., Ph.D. (Toronto)
K.E. Rawling, A.B. (Catawba)

Lecturers
L. Fischer, B.A. (Rutgers), M.A. (Northwestern)
B. Leathers, B.A., M.A. (Carleton)

Associated Faculty
H. Abell, M.S., Ph.D. (Cornell), School of Urban and Regional Planning.
G.S. Kenyon, B.Phys.Ed. (British Columbia), M.S. (Indiana), Ph.D. (New York University), School of Physical Education and Recreation.
Anthropology

Professor L. Krader, B.A. (City College, N.Y.), Ph.D. (Harvard)

Associate Professor Wm. B. Roosa, B.A. (Texas Christian), M.A. (New Mexico), Ph.D. (Michigan)

Assistant Professors T.S. Abler, B.A. (Northwestern), M.S. (Wisconsin-Milwaukee), Ph.D. (Toronto)
D.E. Counts B.S. (S.W. Texas State College), M.A. (Kentucky), Ph.D. (Southern Illinois)

(Environmental Studies) C.E. De'Ath, B.A. (Aukland), ASOPA Cert. (Sydney), M.Ed., Ph.D. (Pittsburgh)
S.M. Weaver, B.A., M.A., Ph.D. (Toronto), (on leave 1972-1973)
J. Rogers, B.A. (Radcliffe), M.A. (New Mexico)

Lecturers S. Gabow, B.A. (California, Berkeley)
J.G.E. Ph.B. Ph.D., (Chicago), M.A. (Chicago)

Undergraduate Courses in Anthropology

Note 1 General students who major in anthropology must elect the following courses: Anthropology 101*/102* and at least four additional courses (or half course equivalents) in Anthropology.

Note 2 Students who pursue on Honours Programme in Anthropology must take Anthropology 101*/102*, a theory course at the 400 level, and at least eight other courses (or half course equivalents) in Anthropology.

Note 3 Students may pursue a joint honours programme with the permission of Anthropology and the other discipline involved. Ordinarily this would mean taking seven anthropology courses (including Anthropology 101*/102*, and a theory course at the 400 level, seven courses in the other discipline and eight electives. Requirements of the second department may lead to some alteration of the formula. Students taking a combined honours programme should consult with advisers in both disciplines to obtain a programme tailored to their needs.

101* Origins of Man and Culture
An introductory course in Physical Anthropology and Archaeology. Lectures on living and fossil primates, the fossil primates, the fossil evidence for the origins and development of man, modern races, and archaeological evidence for the origins and development of culture. Prerequisites: 102 or permission of instructor.

102* Cultural and Social Anthropology
An introductory course on the nature of culture. Data are presented on several primitive cultures.

210* Primitive Mythology
An introduction to the study of the beliefs and practices of primitive peoples about the world of nature and of man. The course will deal with the religious and related systems of selected primitive peoples. Readings will reflect these accounts in the ethnographic literature.
218* North American Archaeology Paleo-Indian and Archaic
A survey of the earliest known cultures in North America. 
Prerequisites: 101 or permission of the instructor.

219* North American Archaeology – the later cultures
A survey of North American cultures from the emergence of food production as a major factor in cultural development to the advent of Europeans. 
Prerequisites: 101 or permission of the instructor.

220* Old World Prehistory The Food Procuring Phases
A survey of the development of culture, from the beginnings of tool making to the transition to agriculture. Primary attention to sequences from Africa, Western Asia, and Europe. Comparative attention to the nonagriculture peoples of recent times.
Prerequisites: 101 or permission of the instructor.

221* Old World Prehistory The Food Producing Phases
Examination of the transition to an economy based on food production, the spread of food producing economics, the rise of civilization in the Near East to the early literate periods. Consideration of later prehistoric developments in Africa, Asia and Europe.
Prerequisites: 101 or permission of the instructor.

227* Peoples of Africa
A survey of the cultures and societies of sub-Saharan Africa. An emphasis will be placed upon the ethnographic present.
Prerequisites: 102 or permission of the instructor.

228* Peoples of the Pacific
A comparative ethnological survey of selected indigenous societies in the Pacific region.
Prerequisites: 102 or permission of the instructor

230* (Art 216*) Primitive Art
A study of Palolithic, Mesolithic and Neolithic world art, aspects of Bronze Age Europe, Asia, and the Near East, the art of the African continent, the North and South American Indians in pre-Columbian and colonial times, and Australian-Oceania, together with related fields such as folk art, naive art and child art.

233* Eskimo Cultures
Eskimo cultures of Alaska, Canada and Greenland from the time of European and Asian contact to the present. Administrative systems imposed on the Eskimo will be analysed and compared, as will the contemporary problems these communities face today.
Prerequisites: 102 or permission of the instructor.

234 North American Indians
A survey of the cultures of the native peoples of Canada and the United States at the time of contact with European Civilization. Emphasis will be placed upon such aspects as cultural ecology, tribal socio-political organization and nativistic reactions to Europeans.
Prerequisites: Anthropology 102 or permission of the instructor.

235 Contemporary Canadian Indian Scene
An analysis of present day Canadian Indian politics, economics, social organization, education and religion. The Indian Act and its implementation by the Indian Affairs Department will be studied in view of assessing its role in maintaining Indian cultures. Comparative data will be drawn from the literature of Indians in the United States.
Prerequisites: Anthropology 102 or permission of the instructor.
236J* Social and Cultural Change in South East Asia
This course analyses the traditional social structure as well as changes in social, economic and cultural spheres in selected Asian countries. Historical perspective will be emphasized. Current topics such as land reform, the consequent changes, or changing values in the traditional societies will also be discussed.
Prerequisite: Sociology 101* or Anthropology 101*, 102*.

238* Caribbean Society
A survey of Caribbean society in which particular attention will be devoted to an analysis of the historical, cultural and socioeconomic background of selected representative Caribbean societies, within the general framework of the continuing process of acculturation in this area.
Prerequisites: Anthropology 102 or permission of the instructor.

247* Urban Anthropology
Approaches to the study of urban centres as undertaken by anthropologists. Selected topics such as urban social networks, the urbanization of non-western societies, and the culture of poverty will be pursued.
Prerequisites: 102 or permission of the instructor.

248* Peasant Society
A survey course with data taken from Latin America, Europe, India, Southeast Asia. Included will be a consideration of different types of peasant societies, the relationship of peasants to urban areas, and the effects of modernization on peasant society.

260* Human Evolution
Data, methods and theory in the study of the origin and evolution of man. Emphasis will be on the fossil evidence.
Prerequisites: 101 or permission of the instructor.

261* Primate Behaviour
An introduction to the behaviour of non-human primates with emphasis on the relevance to the origin of man.

270* (Music 270G) The Folk Music of Europe and North America
Countries to be discussed: British Isles, France, Germany, the Balkans and Eastern Europe, including the Ukraine and Russia; Canada and the USA through Library of Congress record albums, Czechoslovakia, Greece, Hungary, Rumania.

280* Language and Culture
The importance of language in culture. Language is examined as a vehicle of culture (a linguistic code as a device for communication), as a mirror for culture (lexical and semantic aspects), and as a tool of society (uses and functions of language). Illustrations will be from a variety of languages.
Prerequisites: 102*, 234 or permission of instructor.

283* Phonology for Non-Linguists
Devising adequate writing systems for unwritten languages. The class will simulate field sessions, with an informant who speaks an unfamiliar language.

285 Introduction to Structural Linguistics
A general introduction to structural linguistics. A survey of linguistic approaches to the analysis and description of language.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Prerequisites</th>
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<tbody>
<tr>
<td>310*</td>
<td>Ethnology of North American Sub-Arctic</td>
<td>An analysis of Northern Athabaskan and Algonkian Social organisation and culture from earliest European contact, the fur trade periods to the period of modern, concentrated village life. Emphasis will be upon culture change and adaptation in a theoretical framework of cultural ecology and historical development.</td>
<td>Prerequisites: 101*, 234 or permission of the instructor.</td>
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<tr>
<td>330*</td>
<td>Cultural Ecology</td>
<td>This course will study the interrelations between societies and their environments. It will cover both the cultural relations to the natural surroundings and community organization.</td>
<td>Prerequisites: 101* and 102* or permission of instructor.</td>
</tr>
<tr>
<td>342J</td>
<td>Introduction to the Study of Acculturation</td>
<td>A study of culture contact and the cultural changes that result, pursued through a study of representative non-European peoples in different parts of the world including their indigenous cultures and the problems of adapting themselves to the modern world.</td>
<td>Prerequisites: Anthropology 101*, 102* or permission of instructor.</td>
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<tr>
<td>353*</td>
<td>Primitive Social Organization</td>
<td>A study of primitive social structure. Systems of Kinship and marriage, residence patterns, and family structure are discussed.</td>
<td>Prerequisites: 102* or permission of instructor.</td>
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<tr>
<td>355J</td>
<td>Ethnic and Cultural Pluralism in World Perspective</td>
<td>A survey of representative plural societies of the world, including an analysis of the historical background and genesis of ethnic and cultural pluralism in these societies. An attempt will be made to establish the relevance of the concept of plural society for some national societies not usually recognized as such on the basis of the nature of some of their major continuing internal social problems. Considerable attention will also be given to race and ethnicity and the major role these two factors play in plural societies.</td>
<td>Prerequisites: Anthropology 101*, 102* or permission of the instructor.</td>
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<tr>
<td>356*</td>
<td>Comparative Economic Organization</td>
<td>A discussion of the alternative means of organizing economic activity, focused primarily on non-market societies.</td>
<td>Prerequisites: 102 or permission of the instructor.</td>
</tr>
<tr>
<td>357*</td>
<td>Hunting and Gathering Cultures of North America</td>
<td>Archaeological and ethnological data on various prehistoric and historic groups are presented. Emphasis is on hunting and gathering cultures as a distinct type.</td>
<td>Prerequisites: 101* and 102*, or permission of instructor.</td>
</tr>
<tr>
<td>359*</td>
<td>Political Anthropology</td>
<td>The study of political behaviour in both state and non-state society. A comparative approach will be used with a thorough examination of the political systems of selected societies.</td>
<td>Prerequisites: 102 or permission of the instructor.</td>
</tr>
<tr>
<td>360*</td>
<td>Variability in Human Populations</td>
<td>Study of physical variation and its causes in contemporary human populations.</td>
<td>Prerequisites: 260* or permission of instructor.</td>
</tr>
<tr>
<td>361*</td>
<td>Behaviour and Evolution</td>
<td>Analysis of the relationship between behaviour and natural selection in human evolution. Attention will be paid to theory as well as data from fossil evidence and other sources.</td>
<td>Prerequisites: 260* or permission of instructor.</td>
</tr>
</tbody>
</table>
362* New World Civilization
Problems in cultural dynamics will be considered as exemplified in the rise and effects of the civilizations of Meso and South America. Data are provided primarily by the archaeological record.
Prerequisites: 101* or permission of the instructor.

370* Ethnographic Field Methods
Traditional and recently developed approaches to ethnographic field work are explored. The problems the worker faces in the field, and possible solutions to them, are discussed. Some effort will be made to develop field technique in simulated and/or real field situations.
Prerequisites: 102* or permission of the instructor.

371 Archaeological Field Methods
Data gathering techniques will be studied and applied in fieldwork on both constructed and natural archaeological sites.
Prerequisites: 101* or permission of instructor.

372* Archaeological Techniques
Methods of gathering, processing and interpreting archaeological data will be studied. Limited excavations will be followed by laboratory analysis of collected materials.
Prerequisite: 101* or permission of instructor. This course will ordinarily be offered in the fall term. Students cannot receive credit for both 371 and 372*.

375* Ethnohistory
Ethnohistory as a method of research in which historical data are used in the solution of anthropological problems. General consideration will be given to Indians of the Americas, with special attention to Indians of Canada.
Prerequisites: 102*, 234 or permission of instructor.

381* Semology
A linguistic approach to the study of meanings expressed in the grammatical systems and lexical sets of particular languages.
Prerequisites: Anthropology 280* or 285.

388* Applied Anthropology
The technical and ethical aspects of directed culture change will be examined.
Prerequisites: 370* or permission of the instructor.

390, 391*, 392, 393*, 395*, 397*
Guided reading in a selected portion of the anthropological literature.
Prerequisites: Anthropology major and permission of the instructor.

401 Seminar in the Literature of Social and Cultural Anthropology
Seminar in the literature of Social and Cultural Anthropology. Intensive reading and discussion of classic studies in ethnography.
Prerequisites: 102* or permission of the instructor.

420* Social and Cultural Change
An analysis of contemporary thought on culture contact and cultural evolution. The concepts to be explored might include integration, assimilation, conflict, nativistic reactions, general and specific evolution.
Prerequisites: Anthropology 102* or permission of the instructor.

449*/450* Honours Seminar
Seminar on selected contemporary issues in anthropology. Open only to Honours Anthropology students.

451* The Formative Years of Cultural Theory
A survey of the history of cultural theory from 1850 to 1940.
Prerequisites: Anthropology 101*, 102*.
452* Contemporary Cultural Theory  
A survey of cultural theory from post World War II to the present.  
*Prerequisites: Anthropology 101*, 102*.

458* Archaeological Theory  
A seminar on selected topics in archaeological theory.  
*Prerequisites: Anthropology 102* and an additional half course in 
archaeology or permission of the instructor.

460* Advanced Physical Anthropology  
An examination of selected topics of current research interest in physical 
anthropology. Students will be encouraged to undertake guided research 
projects.  
*Prerequisites: Anthropology 260*, 360* and permission of the instructor.

480* Theoretical Approaches to Linguistic Description  
Different theoretical approaches — stratificational, transformational and 
signals grammar, one approach to be emphasized during each offering.  
*Prerequisites: Anthropology 283 or English 375.

499 Honours Essay  
Directed reading and research in a selected area of anthropological 
inquiry.  
*Open only to Honours Anthropology students.

Undergraduate Courses in Sociology

Note 1  
*General students who major in Sociology must elect the following courses: Sociology 101*, a half course in sociological methods, a half course in 
sociological theory, and three and one half full courses (or equivalent half 
courses) in Sociology. Students are strongly encouraged to elect Sociology 
202*, although this is not required.

Note 2  
*An Honours programme in Sociology is a pre-professional degree, so the 
specific requirements have been formulated in the light of professional and 
graduate school requirements. Students are reminded that Sociology is 
now accepted as a high school teaching subject in Ontario. Potential high 
school teachers should keep informed of the requirements for teaching 
Sociology in high schools. Students may elect Honours Sociology 
(Canadian Studies) by fulfilling the requirements listed under Canadian 
Studies in this calendar.

Note 3  
*The student is reminded that an Honours or a major programme in 
Sociology is intended to provide a liberal arts education. Students are 
couraged to avoid excessive concentration in Sociology, and to elect 
courses in a variety of social sciences, humanities, modern languages, as 
well as in other Faculties.

101* Introduction to Sociology  
An introduction to the basic concepts and frames of reference of 
sociological investigation and interpretation. Topics for analysis will 
include communities, associations and institutions, classes and status 
groups, crowds and publics, social processes, and social change. Special 
attention is given to Canadian society.  
*Not open to students who have taken Soc. 141*.  
2 lectures, Fall and Winter terms.

141* The Sociological Enterprise  
A survey of what sociologists do, with an introduction to rudimentary 
sociological methods. Readings from a variety of sources giving an 
account of the thinking behind sociological projects of small and large 
scale.  
*Not open to students who have taken Soc. 101*.  
2 lectures. Fall term.
Department of Sociology and Anthropology

200* Canadian Society in Comparative Perspective
Analysis of Canadian society: its institutions such as family and religion, and social processes, such as integration, stratification and demography, with comparisons to other industrialized societies.
Prerequisite: Soc. 101*
2 lectures. Fall term.

202* Sociological Statistics
A first course in sociological statistics, sampling, central tendency, probability, co-variance, as illustrated in specifically sociological data.
Prerequisite: Soc. 101*
2 lectures. Fall term.

205* Social Problems
An examination of cultural forces that create social problems and failures in personal and institutional adjustments. Specific attention is paid to the problems of emotional disturbance, addictions, delinquency and crime in Canadian society.
No prerequisite.
2 lectures. Winter term.

208* Elementary Problems in (non-participant) Field Observation
Sociological concepts and ideas are put into use in systematic observation, recording, and analysis of structures and processes related to particular social institutions. For example, courts that are open to the public enable us to combine theoretical learning about the systems of jurisprudence and jurisdiction on the one hand and their application in particular courts on the other. Relevant readings, observational records, and resulting methodological or theoretical questions will be discussed in seminars and tutorials.
Prerequisite: Soc. 101* and permission of the instructor.
2 hour seminar, 4 hour lab., Fall term.

209* Advanced Problems in (non-participant) Field Observation
A continuation of Sociology 208*. Here instruction concentrates on the use of observational data in the formulation of questions about the structures and dynamics that have been and are currently being observed and recorded. A satisfactory grade in Soc. 208* is required for admission to Sociology 209*.
Prerequisite: Soc. 208*
2 hour seminar, 4 hour lab. Winter term.

210* Introductory Social Psychology
Basic concepts in the interdisciplinary field of social psychology; approached from the perspectives of social influence. Individualistic, interpersonal, and group-based strategies for influencing the behaviour of others are examined.
Prerequisite: Soc. 101* or Psych. 101*
3 lectures. Fall term.

212* Interpersonal Relations
The contribution of social organization to interpersonal processes. Consideration of some "theories" of social interaction. The social system approach to the problem of personal and interpersonal control.
Prerequisite: Soc. 101* or Psych. 101*
3 lectures. Winter term.
215* Sociology of Women  
A comparative analysis of women's roles in past and present with selected cross-cultural data. Assessment of the present situation. Subjective factors: socialization of women into "women's" roles, internalization of role expectations by women, perpetuation of stereotypes and symbolic expression of differential worth of men and women. Objective factors: the legal situation, women on the labor market, the "sex revolution", and the women's liberation movement.  
*Prerequisite: Soc. 101*  
2 lectures, 1 discussion, Fall term.

218* Sociology of Adolescence  
The social definitions of adolescence in cross-cultural and historical perspective. Social roles of adolescence in the institutional structures of urban industrial societies with special emphasis on the family, education, and the economy. The relationship of adolescents' social roles to processes of social change and stability.  
*Prerequisite: Soc. 101*  
2 lectures, Winter term.

240* Collective Behaviour  
The sociological analysis of the behaviour of crowds, mobs, publics, and related phenomena and their relationships to social organization and social change.  
*Prerequisite: Soc. 101*  
2 lectures, Fall term.

241* Social Movements  
The sociological analysis of varieties of social movements and their relationships to social organization and social change.  
*Prerequisite: Soc. 101*  
2 lectures, Winter term.

250* Crime and Society  
An analysis and criticism of the major theories of criminal behaviour. Emphasis is given to the relationship between social structure and criminal behaviour; types of criminal behaviour such as drug addiction; statistics and contemporary research. Special attention is given to Canadian data. A sound knowledge of sociological concepts is advisable.  
*Prerequisite: Soc. 101*  
2 lectures, Fall term.

51* Ethnic and Racial Relations  
Relations between different racial and cultural groups; analysis of majority-minority group status with special reference to Canada.  
*Prerequisite: Soc. 101*  
2 lectures, Winter term.

252* Juvenile Delinquency  
A systematic analysis and criticism is presented of biological, psychological, psychoanalytical and sociological theories of juvenile delinquency. Attention is given to statistics and contemporary research with special emphasis on the distribution and types of delinquent subcultures.  
*Prerequisite: Soc. 101*  
3 lectures, Fall term.

261* Population Issues  
The study of population as an area of sociological investigation; population size, composition, and distribution; population trends and problems.  
No prerequisites.  
3 lectures, Fall term.
262* Canadian Population

Study of the basic demographic processes in the population of Canada. Demographic implications for selected social institutions. Use of Canadian enumeration and registration data.

No prerequisites.
2 lectures, Winter term.

265* Social Structure of East Asia: China and Japan

An analysis of the social structure and stratification of East Asia in terms of class, status, prestige, rank and function with especial consideration given to the question of class formation in Japan and attempted class elimination in China.

No prerequisites.
2 lectures, Fall term.

270* Communication

An analysis of the role of language and other symbol systems in social interaction; the interplay between communication and the social system, the formation of attitudes through language; social and individual disorders as caused by, and reflected in, the breakdown in the communication process.

Prerequisite: Soc. 101*
2 lectures, Fall term.

280* Social Organization of Animal Societies

The social behaviour of various species of animals will be examined and compared. The main emphasis will be on exploring the nature of social behaviour and gaining further understanding of human societies by comparing them with others.

Prerequisite: Soc. 101*
2 lectures, Winter term.

290* Introduction to Qualitative Social Thought

Lectures, readings and discussion of selected original sources both Eastern and Western which attempt to define and evaluate the relation of the individual to society, and society to nature and cosmos, as expressed in classical as well as in later documents. Topics will include the mythological world-view; the emergence of an ordered social cosmos in Greece, the Middle East and China; and the response to these issues in the social thought of Europe.

No prerequisite.
2 hours, Fall term.

301* Urban Sociology

The comparative study of urbanization as a process; the culture and social organization of cities, urban problems; special attention is given to industrial cities of Canada, with comparative reference to the principal industrial cities of Western societies.

Prerequisite: Soc. 101*
2 lectures, Winter term.

308* Elementary Problems in (participant) Field Observation

Here, as in Sociology 208* and 209* concepts and ideas are to be put to use. Now, however, the observational setting is complicated by making the observer part of it. Participant observation may take place in formal organization settings such as hospitals, factories, or schools, or in informal association settings involving voluntary associations and groups. Reading, recording and seminar discussion supplement the field experience.

Prerequisite: Soc. 101* and permission of the instructor.
2 hour seminar, 4 hour lab., Fall term.
309* Advanced Problems in (participant) Field Observation
A continuation of Sociology 308*. Here instruction concentrates on the use of observational data in the formulation of questions about the structures and dynamics that have been and are currently being observed and recorded. A satisfactory grade in Sociology 308* is required for admission to Soc. 309*.
Prerequisite: Sociology 308*
2 hour seminar, 4 hour lab, Winter term.

10* Seminar in Group Dynamics
An analysis of natural and experimental groups from a social structural view. The study of processes of differentiation, integration, power, etc., internally; and of nesting of small groups in larger collectives.
Prerequisite: 3rd or 4th year standing in a social science or by permission.
3 hour seminar, Fall term.

315* Social Stratification
Analysis of social classes in society including their basis for development, composition, and consequences for society. Special attention is given to social stratification in Canada.
Prerequisite: Sociology 101*
3 lectures, Fall term.

321* Research Methods 1
A systematic treatment of the logic and practice of methods basic to social research. Emphasis is on problems of research design based on the analysis of case studies. Special attention is given to problems of participant observation, use of available data, measurement of variables, and simple multivariate analysis. Students will be given laboratory and field experience in several techniques of research. Special attention is given to Canadian cases and data.
Prerequisite: Sociology 101*
2 lectures, 1 hour lab., Fall term.

322* Research Methods 2
Continuation of Research Methods 1. Includes an introduction to sampling, scaling, the analysis of change, and experimental design. Students will be asked to construct a research design for the study of a theoretically relevant problem in sociology.
Prerequisite: Sociology 321*
2 lectures, 1 hour lab., Winter term.

323* Project in Sociological Research
Introduction to sociological research through the formation of a theoretically based research objective and its implementation in a small scale team research project. Students must be willing to participate in team research with 6 - 8 other students. Readings are assigned that relate to the steps in the team project. The course grade is based on each team's final project report and on a final examination covering the readings.
Prerequisite: Sociology 101*
2 hour seminar, Winter term.

24* Field Research in Canadian Institutions
A study of selected institution in the local community, such as the Courts, Mass Media, and Labour Unions, will be conducted employing observational and interview procedures.
Prerequisite: consent of the instructor.
2 lectures, Fall term.
<table>
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<tr>
<th>Course Code</th>
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<th>Description</th>
<th>Prerequisites</th>
<th>Credits</th>
<th>Term</th>
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</table>
| 330*        | Comparative Social Structure                     | General theoretical and methodological issues facing comparative sociology; comparative methods at work in the treatment of Western and non-Western societies (including Canada).  
*Prerequisite: Soc. 101*.  
2 lectures, Winter term. |                                   | 2                                  | Winter |
| 331*        | Theories of Social Change                        | A systematic review and analysis of major theories of social change including some of the classical and modern theories. Analysis will focus upon the sources, patterns, processes and consequences of change. Special topics to be included are: Marxism, social change in developing countries, the role of ideas, and the breakdown and reorganization of social structure.  
*Prerequisite: Soc. 101*.  
2 lectures, Winter term. |                                   | 2                                  | Winter |
| 332*        | Social Conflict and Modernization                | This course constitutes a sociological study of violent and nonviolent conflict and modernization in comparative perspective. A critical review of the selected theoretical explanations of collective protest and social change will be done to discover linkage between social conflict and modernization. An attempt will be made to examine causes and consequences of racial and political violence in modernizing society.  
*Prerequisite: Soc. 101*.  
2 lectures, Winter term. |                                   | 2                                  | Winter |
| 334*        | Northern Lands and Peoples                       | A comparative study of social and cultural change in Arctic and Sub-arctic areas brought about by political and economic development of those lands.  
*No prerequisites. $45.00 fee to cover field trip*.  
2 lectures, Fall term. |                                   | 2                                  | Fall   |
| 338*        | Sociology of Literature                          | This course attempts to provide the student with an opportunity for exploring literature as a social phenomenon. Specific areas to be dealt with might include: 1) the relationship of the artist to his social structure; 2) the nature of the relationship of the work and its audience; 3) the attitudes toward the social structure implicit in the work of art. In general the course is viewed as an attempt to combine both the scientific approach and the humanistic approach to literature. Here literature is viewed as including both belles lettres and popular culture. The course will be taught by someone in Sociology and someone in Literature in dialogue method.  
*Prerequisite: Sociology 101* and English 101 (or equivalent).  
2 lectures, Fall term. |                                   | 2                                  | Fall   |
| 339*        | Industrial Sociology                              | Sociological analysis of industry, including relationships between labour and management and industry and society.  
*Prerequisites: Soc. 101*.  
2 lectures, Fall term. |                                   | 2                                  | Fall   |
340* Formal Organizations  A survey of theory and research on formal organizations making use of selected contributions from the scientific management and human relations approaches, but with emphasis on the structure and functions of large scale organizations. The nature and types of formal organizations; control techniques and leadership; relations of the organization to its clients and publics; informal aspects of the organization; organizational tensions and pathologies of bureaucratic systems; how the organization adjusts to change. 
Prerequisite: Soc. 101*
2 hour seminar, Fall term.

341* Sociology of Occupations  The sociological study of occupations as an aid to understanding the social structure; social and demographic aspects of the labour force; the meaning of work; the relation of work and leisure; career and occupational mobility patterns; occupation and status; professionalization; trends in occupations. 
Prerequisite: Soc. 101*.
2 lectures, Winter term.

350* Seminar in Socialization Processes  The social creation of Actors; the establishment of legitimacy and the development of loyalty; socialization through the life cycle; cohorts and age-grading; generational differences and youth movements. 
Prerequisite: 3rd or 4th year standing in a social science or by permission.
3 hour seminar, Winter term.

355* Sociology of Religion  The analysis of religion as a social institution; its relationship to culture, personality and social change with consideration given to theories of religious behaviour and contemporary research findings. 
Prerequisite: Soc. 101*.
2 lectures, Winter term.

360* Political Sociology  The sociological analysis of the institutionalization of power, political movements, parties, conflict and its accommodation. 
Prerequisite: Soc. 101*.
2 lectures, Winter term.

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. 
No prerequisites.
2 lectures, Fall term.

372* Medical Sociology  Examination of the medical care structures from the point of view of patients, health care professionals in the system, and systems analysis. Structures of interest are primary health care settings, hospitals, and professional associations. Emphasis on cross-cultural comparisons and changes over time as well as critical analysis of current structure from the point of view of the Canadian health care consumer. 
Prerequisite: Soc. 101*.
2 lectures, Winter term.
382* Techniques of Demographic Analysis

Introduction to the standard techniques of analysis of enumeration and registration data.

Prerequisite: Soc. 261*.
1 lecture, 2 hour lab, winter term.

400 Processes of Planned Change

The goal of the course is to develop models of social change, through active participation in action groups in the community, reading, seminars, and written analyses. All students will be expected to join a group oriented to altering or maintaining existing social structures, to participate as full members, and at the same time to make social scientific sense of social process as manifested in the group and its relation to the environsing system.

Prerequisite: Consent of instructor.
2 hour seminar.

402* Marxist Social Theory

This course will focus on the contribution of Marxism to the development of sociological theory in its relation to other types of social thought. Readings will include selections from Marx, Engels, Lenin, Gramsci, Plekhanov, Lukacs, and contemporary sources.

Prerequisite: 4th year Honours or graduate standing.
2 hour seminar, Winter term.

410* Seminar in Self and Social Interaction

Social Psychological theory and research on the self, self-awareness, and self-worth; the self in systems of social interaction.

Prerequisite: 3rd or 4th year standing in a social science or by permission.
3 hour seminar, Winter term.

415* Seminar in Sociology of Women

An examination of selected areas of contemporary sociological theory with respect to their treatment of women.

Prerequisite: Soc. 215 and 3rd or 4th year standing in Sociology.
2 hour seminar, Winter term.

421* Secondary Analysis of Survey Data

Methodological problems in developing and testing social and behavioural theory through the analysis of survey data will be examined, and actual analysis of data from local data banks will be performed, using available computer programs. A term paper consisting of an original analysis and interpretation will be required. No previous experience with the computer is assumed.

Prerequisite: Soc. 202* or permission of instructor.
2 hour seminar, Fall term.

425* The Development of Sociological Theory

Development of sociological theory in the 19th and early 20th centuries. Emphasis is on the European tradition although selective attention is given to North American theorists.

Prerequisite: Open only to students in Sociology.
2 lectures, Fall term.

426* Contemporary Sociological Theory

The development of sociological theory in the 20th century. Included is discussion of current theoretical work.

Prerequisite: Open only to students in Sociology.
2 lectures, Winter term.
432* The Sociology of Political Knowledge

This seminar will undertake to develop a general theory of the sociological roots and implications of political thought in relation to contemporary social movements and ideologies in historical perspective. Comparative illustrative materials will be drawn from Latin America, Europe, Africa and/or Asia, which will also serve as a basis for research papers.

Prerequisite: any 1 of the following Soc. 241*, 331*, 360*, 425*, and Honours Soc. and/or Political Science or graduate standing.

2 hour seminar, Winter term.

451* Seminar: Problems in Contemporary Theory and Research

Examinations of current frames of reference and theories in sociology and related disciplines. Their utility in sociological problem formulation and their test by current methods and techniques.

Prerequisite: 3rd or 4th year Honours.

3 hour seminar, Winter term.

466* Reading 1

Selected readings and essay assignments under the direction of a faculty member.

Prerequisite: 3rd or 4th year standing in Sociology and permission of the instructor.

Fall term.

467* Reading 2

Selected readings and essay assignments under the direction of a faculty member.

Prerequisite: 3rd or 4th year standing in Sociology and permission of the instructor.

Winter term.

0 Seminar: Practicum in Theory and Methodology

A preparation for advanced undergraduate students for an independent, sophisticated orientation to graduate study. The practicum provides opportunities for:

1) developing research designs on the basis of extant theory, and
2) theorizing on the basis of the reanalysis and reinterpretation of extant data.

Prerequisites: 4th year Honours or equivalent.

2 hour seminar.

480* Advanced Social Statistics

Multiple and partial correlation; regression; analysis of variance and covariance; selected non-parametric techniques.

Prerequisite: Sociology 202* or equivalent.

2 lectures, 1 hour lab, Winter term.

481* Mathematical Sociology

Selected mathematical techniques with applications to sociology; sets and graphs, Markov chains and game theory.

Prerequisite: Permission of instructor.

2 lectures, Fall term.

499 Senior Honours Essay

Required of all honours students in Sociology or by election by joint honours students in their fourth year. For students electing Honours Sociology (Canadian Studies) the essay should bear on some topic of particular sociological significance for Canadian Society.

Prerequisite: 4th year Honours.
The following courses are administered by Conrad Grebel College

207* G Educational Sociology
This course is designed for co-op and regular students who plan to enter the teaching field. Attention will be focused on the concepts and theories of sociology as they apply especially to the educational system. 
*Winter Term.*

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

290G Utopian Communities past and Present
An examination of intentional communities; extinct and contemporary. Attention will be paid to origin, purpose, structure and process in each community studied. An assessment of factors contributing to success and failure will be attempted.

307*G Problems in Contemporary Education
A study of problems arising from the interplay between institutionalized education and the forces of rapid social change in the contemporary society; the clash of value systems of youth and the “establishment”. It emphasizes the changing concepts of the roles of the learners and instructors, social dimensions of newer learning theories and educational programmes arising therefrom, goals of formal education, decision making processes within educational organizations, obsolescence of some of the traditional patterns of formal education, and like topics. Themes will be selected and studied in depth on a seminar basis.

370*G Sociology of Law
An overview of the major trends in the sociology of law since World War II. Consideration will be given to contributions of legal scholars as well as of social scientists. Special attention will be paid to the growing public awareness of the failure of law in Canadian society to provide adequate justice or social control in a growing number of situations. Investigations of concrete issues, such as the jury system, courts, police and mass media, will be an integral part of the course. 
*Fall term.*

The following courses are administered by Renison College

120R Fundamentals of Sociology
Survey of key topics and study of the basic skills, concepts and interests comprising the sociologist's tools of analysis. The course will include social organization, culture, socialization, primary groups, social stratification and associations.

220R* Sociological Analysis
Applying sociological analysis to three selected areas: the major institutions of education, religion and law, and developing a pattern and an approach which would be applied to the study of other social areas.

221R* Master Trends in Modern Society
Introducing the student to the main ideas of urban, industrial and political sociology studied within a context emphasizing social change; illustrations will be drawn from emergent as well as advanced societies.
225R* Race and Culture in the Third World 1
A general introduction to the contemporary problems of race, culture and ethnic relations in the developing countries of Asia and Africa. An analysis of historic, geographic, cultural and socio-economic background of selected societies.

226R* Race and Culture in the Third World 2
An introduction to the problems of acculteration as well as intergroup relations in plural societies in selected areas in the Caribbean, South and Southeast Asia, East and Southern Africa.

The following course is administered by St. Jerome's College

232J The Family and Society
The course is designed essentially to assess the role of the family in society. This will be done primarily on the basis of an analysis of the institutions of the family and marriage on a cross-cultural basis. The universality of the family has always been proclaimed by Anthropologists. This view will be challenged in the light of relatively recent ethnographic materials which tend to establish the fact that this proclaimed universality is not absolute.

The biological basis of the family will be examined in some detail, and an attempt will be made to establish the family as a biosocial unit. Courtship, mate selection and divorce, as well as a brief overview of human sexuality and the role of sex in marriage and family stability will be examined.

*Prerequisite: Sociology 101* or permission of the instructor.
3 hours, lectures and tutorial. (not offered in 1972-73)
Department of Systems Design

Professor. Chairman  T.M. Fraser, M.D., Ch.B. (Edinburgh), M.Sc (Ohio State), L.M.C., F.A.C.P.M.
Professor, Associate Chairman  P.H. O’N. Roe, B.A.Sc. (Toronto), M.Sc., Ph.D. (Waterloo)

Professors  H.K. Kesavan, B.Sc. B.E. (Mysore), M.S. (Illinois), Ph.D. (Michigan State)
            G.N. Soulis, B.A.Sc. (Toronto)

Associate Professors  M.L. Constant, B.A.Sc. (Toronto)
                    R.N. Howard, B.Sc. (London), Ph.D. (London)
                    G.F. Rabideau, B.A. (Wisconsin), M.A. (Wisconsin), Ph.D. (Purdue)
                    P.L. Seeley, B.A.Sc. (Toronto)
                    B.L. Wills, B.A.Sc., M.A.Sc., Ph.D. (Waterloo)

Assistant Professors  C.K.G. Hahn, M.A.Sc. (Waterloo)
                    P.H. Meincke, B.Sc. (Manitoba)
                    D.D. Schleiermacher, Diploma (Technische Hochschule, Munich), Diploma (Hochschule fur Gestaltung, Ulm)
                    F. Sengupta, B.A.Sc., (Cairo), Diploma (Einshams University, Egypt), Diploma (Cairo), M.A.Sc., (Case Institute)
                    S. Toida, B.S. (U. of Tokyo), M.S., Ph.D. (Illinois)

Lecturers  K. Boekelheide, B.A., M.A. (Oregon)
           P.B. Hildebrand, B.A.Sc. (Queen’s), M.A.Sc. (Toronto)

Associate Faculty
            Professor  D.J. Clough, B.A.Sc. (Toronto), M.B.A. (Toronto)

Associate Professors  I. Bernhardt, B.A. (New York), Ph.D. (Berkeley)
                    W.C. Lennox, B.A.Sc., M.Sc. (Waterloo), Ph.D. (LeHigh)

Assistant Professor  R.W. Cockfield, B.Sc., M.Sc. (Queen’s), Ph.D. (Waterloo)

Undergraduate Courses


112 Calculus 2 (formerly SD111)  Analytic geometry in three-dimensional space. Infinite series. Multiple integrals. Differentiation of an integral, with applications (i.e. optimization of an expected value of a function in statistical models) Partial differentiation. Introduction to Differential Equations.
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<tr>
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<tbody>
<tr>
<td>13</td>
<td>Finite Mathematics (formerly SD112)</td>
<td>Symbolic logic, set theory, permutations, combinations, discrete probability theory.</td>
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<tr>
<td>121</td>
<td>Digital Computation 1 (formerly SD120)</td>
<td>Introduction to electronic digital computers; hardware and software organization, basic features of Fortran, examples of efficient algorithms for engineering computations.</td>
</tr>
<tr>
<td>122</td>
<td>Digital Computation 2 (formerly SD121)</td>
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<tr>
<td>132</td>
<td>Engineering Economics (formerly SD130)</td>
<td>Cost-benefit analysis, critical path methods, interest, project economics, decision making, utility theory, project organizational theory.</td>
</tr>
<tr>
<td>151</td>
<td>Physics 1 (formerly SD150)</td>
<td>Statics of particles, vectors, equilibrium of rigid bodies, centroids, the analysis of structures, forces in beams and cables, friction and moments of inertia.</td>
</tr>
<tr>
<td>152</td>
<td>Physics 2 (formerly SD151)</td>
<td>Rectilinear motion, plane motion, dynamics of particles, work and energy, linear momentum, rotational motion, angular momentum, harmonic motion, gravitational, wave motion, sound waves.</td>
</tr>
<tr>
<td>162</td>
<td>Introduction to Engineering Design (formerly SD160)</td>
<td>An introductory course on the principles of engineering design culminating in a project involving the solution of a relevant need. Specific topics introduced are: The systems approach, principles of planning, the statement of a design problem and the flow of information. Innovation and the creation of design solutions, physical, economic and financial feasibility, solution evaluation and selection. Value and utility, simulation, modelling and optimization.</td>
</tr>
<tr>
<td>181</td>
<td>Graphics (formerly SD180)</td>
<td>A course in fundamentals of graphics with emphasis on basic techniques required for visual communication and computation.</td>
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<tr>
<td>001, 002</td>
<td>Focal Issues In Contemporary Society (these courses also listed as Arts 120<em>G, Arts 121</em>G)</td>
<td>An attempt to bring together and condense what are believed to be essential elements of the several social science disciplines. The core of the study that will be used is a group of selected contemporary issues with implications that cut across all the various disciplines. Some effort will be made to discuss values deemed appropriate for our age. Integrating universal concepts or problems to be dealt with are: personality, work, community, and society.</td>
</tr>
</tbody>
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212 Applicable Mathematics for Systems Design
Topics from differential calculus, partial differential equations; line, surface and volume integrals; functions of the complex variable, Taylor & Laurent series, Cauchy’s integral formula; operational calculus, Laplace Transforms theory; Introduction to Vector calculus and certain special functions.

213 Differential Equations (formerly SD217)

222 Numerical Analysis and Computation (formerly SD221)
Application of digital computers to the solution of equations; determinants and matrices; eigenvalue problems, numerical solution of ordinary differential equations; difference equations, numerical integration methods; error analysis.

231 Micro-Economic Analysis and Policy
Analysis of public and private choices among users of scarce resources. The interaction of choices to form micro systems. Examples of policy questions; costs and benefits of alternative methods of pollution control, pricing of private and public goods.

241 Human Systems Engineering
The structure and function of man in relation to systems design; the relationship of biology and human physiology to engineering; biological concepts, biological variation. Introductory concepts in molecular biology and genetics; the cell as a micro-system; the role of water transport; man as a complex of systems and subsystems; the nature of selected subsystems (including introduction to electrophysiology).

242 Human Systems Engineering
The attributes of man as a functioning system; the nature of human sensory and perceptual processes; memory, learning and the application of information theory to human information processing; arousal and motivation; intelligence, learning and cognitive processes; motor function; the nature of human work, skill and fatigue.

252 Physical Systems 1 (formerly SD251)
Component models, interconnection models, system equations and their rank properties and solutions. These concepts are developed with respect to electrical systems.

261 Systems Design Workshop 1
A problem and project oriented course wherein emphasis is placed on designing and presenting creative solutions to real-life problems. The problems are selected to cover all disciplines to which the student becomes exposed each year. Both the problems and the students work are expected to increase in sophistication and complexity in accordance with the student’s progress through the course.

262 Systems Design Workshop 2

281 Electricity and Magnetism
Electric charge, Coulomb’s Law of Electrostatic Forces; Electric Fields, Gauss’ Law, conductors and electric fields; Electric Potential; Capacitance, dielectrics. Magnetic fields, flux of magnetic induction; current, resistance and electric circuits; Induced EMF, inductance, Lenz’s law, Faraday’s law; magnetism in matter, transformers, motors, generators, introduction to basic electronic devices.

282 Mechanics of Deformable Solids
291 Systems Design Laboratory 1
An integrated laboratory sequence stressing instrumentation and measurement techniques.

292 Systems Design Laboratory 2

311 Operations Research 1
(Formerly SD334)
Introduction and background to the application of scientific models to the study of operational problem. This course is intended to present an integrated view of the "deterministic operations research models". Topics will include: mathematical techniques of unconstrained and constrained optimization, followed by the construction, evaluation and applicability of various models in allocation, inventory, replacement, sequencing and related problems.

312 Operations Research 2
(Formerly SD414)
A continuation of SD311, with emphasis on Stochastic Operations Research Models. Topics will include: Decision making under uncertainty, Queuing models and related probabilistic techniques, feedback control, probabilistic inventory, competitive strategies and related topics.

322 Computer Simulation of Systems
System modelling, discrete and continuous system models; system simulation techniques, digital computer methods, fundamentals of analog computation, time and magnitude scaling; analog computer simulation methods; digital simulation of analog computers; block oriented languages; advantages and disadvantages of digital and analog simulation techniques, introduction to system simulation using hybrid computers.

331 Conflict Analysis (Formerly SD336)
The application for non-quantitative game-theory to the analysis of conflict, particularly conflicts arising in the implementation of design projects, the general characteristics (through Metagame theory) and specific applied techniques for analyzing conflicts between parties each with separate objectives.

333 Experimental Design
Optimum seeking methods: analysis of experimental optimum-seeking techniques. Studies include deterministic and stochastic problems. Topics include; single variable search, simultaneous and sequential search, geometry of multidimensional response surfaces and methods of steepest ascent; regression analysis with a systematic treatment of the analysis of multiple classifications involving fixed and random effects and crossed and nested variables of classification. Applications of statistical methods to the efficient design of industrial experiments with considerations to suitability.

334 Metagame Analysis
Model building techniques for analysing conflict situations, using inputs from the social sciences and operations research.

341 Human Engineering and Rational Design
The man-machine interface; communication and the design of displays (visual, auditory, kinesthetic, tactile, etc.); human motor activities, speed, accuracy, strength and force; functional operation and the design of controls; illumination, colour, and design of workplaces.

342 Problems of Man in the Operational Environment
(Formerly SD343)
The man-machine-environment complex; the nature of the operational environment; neuroendocrine system and the non-specific response to stress (adaptation); specific effects, hazards, and management of specific forms of stress, e.g. acoustic noise, heat and cold, toxic materials, etc.
351 Physical Systems 2 (formerly SD353)
The subject matter is similar to SD252 except that the development is based on other physical systems such as structural and hydraulic systems.

353 Time Domain Models for Physical Systems
State equations for two-terminal component systems; time varying and non-linear components; analytical solutions for state models, numerical and analogue methods for solution.

354 Algorithms for Computer-Aided System Analysis
Techniques for tree selection, manipulation of topological information, evaluation of the exponential function of a matrix, etc. The emphasis is on the algorithms but students will be expected to implement them on the computer. The course includes a survey of the capabilities of existing programmes for system analysis.

361 Systems Design Workshop 3
A continuation of the Systems Design Workshop for third year students.

362 Systems Design Workshop 4

371 Introduction to Human Communication Systems
The course focuses upon a variety of communication systems including man-man, man-machine and machine-machine systems. Various models of communication systems will be examined paying particular attention to the assumptions and situational factors upon which the models are based. Using a systems approach such concepts as redundancy, entropy, feedback, openness-closedness, equi-finality, nonsummativity, homeostasis and stability, etc., will be examined.

381 Materials Engineering
A general introduction to the science of materials: so providing a basic understanding of the scientific principles involved and an introduction to the wide variety of materials available to the designer today. To demonstrate some of the important relationships existing between the structure of a material and its properties, and to consider some of the ways in which materials are shaped, formed and fabricated into articles for our everyday use.

382 Applied Electronics (formerly SD381)
Component models of various electronic devices, oscillation, amplification, modulation, detection, application to instrumentation.

384 Thermodynamics (GE31)

391 Systems Design Laboratory 3
A continuation of SD291/292 for third year students.

392 Systems Design Laboratory 4
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>411</td>
<td>Operations Research 3</td>
<td>Readings suited to individual interests of the students and aimed at solving special project problems which the student may select.</td>
</tr>
<tr>
<td>421</td>
<td>Computer Aided Design (formerly SD323)</td>
<td>The design process; computer-oriented system models; simulation languages for continuous and discrete systems; man-machine interaction; design of problem-oriented computer language.</td>
</tr>
<tr>
<td>432</td>
<td>Macro-Economics and Public Policy (formerly SD433)</td>
<td>The functioning of National and Regional economics. The relations between the behaviour of classes of decision-making units and the performance of the economic system. Examples of policy questions; costs and benefits of alternative methods of attaining price stability. Full employment and economic growth.</td>
</tr>
<tr>
<td>434</td>
<td>Policy Studies</td>
<td>The combined use of model-building techniques and social science methods in approaching real-world problems.</td>
</tr>
<tr>
<td>451</td>
<td>Multi-terminal Representations and Piecewise Analysis of Physical Systems</td>
<td>Multi-terminal representations, coupled 2-terminal components, tree transformations, solution of large systems through sub-systems, two-ports and their interconnection, equivalent 2-terminal component systems.</td>
</tr>
<tr>
<td>452</td>
<td>Introduction to Linear Control Systems</td>
<td>Application of Systems theory to the problems of control. The course integrates this study with an exposition of classical control theory.</td>
</tr>
<tr>
<td>453</td>
<td>Power Systems 1</td>
<td>Application of systems theory to large power distribution networks and electromechanical energy conversion systems.</td>
</tr>
<tr>
<td>454</td>
<td>Hydraulic Systems</td>
<td>Application of systems theory to the analysis of hydraulic systems; particular emphasis is given to the analysis and design of fluid distribution systems.</td>
</tr>
<tr>
<td>455</td>
<td>Transportation Systems</td>
<td>Application of Systems theory to the analysis of urban and inter-urban traffic systems and to combined air, land and sea transportation systems.</td>
</tr>
<tr>
<td>461</td>
<td>Systems Design Workshop 5</td>
<td>A continuation of the Systems Design Workshop for fourth year students. The emphasis will be on an individual problem chosen from the student's technical option area.</td>
</tr>
<tr>
<td>462</td>
<td>Systems Design Workshop 6</td>
<td></td>
</tr>
<tr>
<td>471</td>
<td>Communication Media</td>
<td>The course encompasses the tools of communication and the nature and use of communication media. There will be a particular emphasis on those media containing a large technological component; machine-mediated human communication systems, e.g. computer graphics, film, T.V., etc.</td>
</tr>
<tr>
<td>473</td>
<td>Intercultural Communication</td>
<td>The problems of designing a human communication system where more than one culture is involved. Anthropological, sociological, psychological, political, economic and technological aspects of such design. Environmental perception, value systems, social forms, etc.</td>
</tr>
<tr>
<td>475</td>
<td>Man-Machine Communication Systems</td>
<td>The nature and design of machine-mediated human communication systems. Consideration will be given to displays, computer graphics, computer-aided instruction and mass communication media (Film, T.V., radio, print). The design of new media innovation. A system approach will be adopted with special attention to the socio-economic effects of such systems.</td>
</tr>
</tbody>
</table>
511 Linear Graph Theory

512 Applications of Linear Graph Theory
Topological formulas for general linear systems, synthesis of communication nets, system diagnosis. Applications to switching theory, sociology, economics, etc.

513 Mathematical Programming
Theory and application of linear programming techniques: simplex, the transportation and assignment problems, duality and degeneracy. Industrial applications to production and inventory control. Selected problems from nonlinear and dynamic programming.

514 Multivariate Statistics
Applications of econometric models, regression analysis, factor analysis, statistical decision theory, and other methods and models for the policy analysis of socio-economic systems. Selected references will be assigned.

515 Networks and Combinatorics
The emphasis in this course will be the use of combinatorial and graph-theoretic methods for operations research. Topics will include “Advanced PERT and CPM”, scheduling and routing, graph theoretic methods for socio-economic systems.

521 Analog and Hybrid Computing Systems
Theory and operation of analog computers; parallel logic; digitally simulated analog computers; introduction to hybrid computing.

522 Computer-Aided Design 2
A detailed study of two major simulation languages, one continuous (CSMP or equivalent) and one discrete-event (GPSS or equivalent). Simulation projects.

533 Production and Inventory Control
The objective of the course is to study the nature, problems and techniques of planning and control. Topics: influence of forecasting, inventory management, planning, scheduling, despatching and performance evaluation. Analytic techniques pertaining to these areas are introduced.

534 Planning of Facilities
Industrial and Non-Industrial facilities. Networks, locational analysis, physical layout and spatial analysis, allocation of facilities, criteria for optimality, utilization and occupation, various operations research techniques for the analysis and synthesis of networks of facilities, on-the-job machine problem.

535 Queuing Models
Definition of a queuing process; explicit solution of queuing problems when arrival and service distribution are exponential. Examination of special problems for general arrival and service distributions. Multiserver-problems; queues in series, bulk service and other types of service discipline.

536 Economic Planning Models
Simple dynamic models, static and dynamic Leontief systems, welfare economics, capital investment and project evaluation models, applications to problems of cost-benefit analysis and public enterprises, portfolio selection models and game theoretic models in economics.

538 Special Topics in Operations Research
Given by a guest lecturer. The contents of this course will vary according to the available guest.
541 The Ergonomics of Special Environments
Effects, hazards and management of sustained acceleration, weightlessness, vibration and impact acceleration (with specific reference to aviation, spaceflight, and automotive safety); effects, hazards, and management of exposure to low and high barometric pressure (with specific reference to human problems at altitude, and to underwater engineering).

542 Human Engineering and Systems Development
Human function in systems; man’s capacities and limitations as a component of a complex system; assignment of operations to man and machine; equipment design in relation to human capacity; training programmes, procedures, and devices; task description and analysis; analytic methods for test and evaluation in human engineering.

543 Human Engineering (formerly SD501)
Man-machine systems; man-machine interface; presentation of information; design of displays and controls; workplace layout, human factors in design.

544 Ergonomics (formerly SD502)
Significance of ergonomics; man-machine-environment complex; physiology of work, fatigue, and boredom; environmental factors in industry (noise, vibration, vision, illumination, heat, cold, toxic chemicals, radiation); industrial, and automotive safety.

552 Power Systems 2
A continuation of SD453 with emphasis on load flow, system stability, operation under imbalanced conditions, fault detection.

563 Aesthetic and Perceptual Aspects of Design
Presentation and discussion of appropriate and possible methods for design of systems or artifacts in which aesthetic characteristics and visual form are primary requirements of the design.

564 Methodological Processes in Design
Presentation and discussion of appropriate and possible methods for the design of systems or artifacts in which manufacturing processes, material properties and distribution processes constrain the design.
School of Urban and Regional Planning

Professor and Director (1972-73)
R.S. Dorney, B.Sc., M.Sc., Ph.D. (Wisconsin)

†Professor and Associate Dean
(Graduate Studies)
R.R. Krueger, B.A., M.A. (Western), Ph.D. (Indiana)

†Professor and Dean of
Environmental Studies
P. H. Nash, B.A., M.A. (California), C.E. (Grenoble), M.C.P., M.P.A.,
Ph.D. (Harvard), A.I.P.

Associate Professor and Deputy
Director

Professors
Helen Abell, B.H.Sc. (Toronto), M.Sc., Ph.D. (Cornell)
L.O. Gertler, B.A. (Queen's), M.A. (Toronto), M.T.P.I.C. (on leave
1972-1974)
K. Izumi, B.Arch. (Manitoba), M.C.P. (M.I.T.)
J. W. Wilson, B.Sc. (Glasgow), M.Sc. (M.I.T.), M.R.P. (N. Carolina)

Visiting Professor
E.A. Beecroft, B.A., M.A. (Toronto), Ph.D. (Yale)

Adjunct Professor
J.A. Kennedy, B.A. (Loyola), Q.C.

Associate Professors
T. L. Burton, B.Sc. (London), Ph.D. (London)
† E. M. Cartsonis, B.Arch. (Michigan), M.C.P. (Pennsylvania)
M.G. George, B.Sc. (Mysore), M.Sc. (Bombay), Ph.D. (Delhi)
† J. T. Horton, B.A. (Wheaton), M.A. (Northwestern)
L.R.G. Martin, B.A. (Queen's), M.A., M.R.P., Ph.D. (Syracuse)
K. S. Sayegh, B.Sc. (Cairo), M.C.P., Ph.D. (Harvard)
† W. Shalinsky, B.A., B.S.W. (McGill), M.Sc. (Western Reserve), D.S.W.
(Western Reserve)

†Assistant Professors
S. Herzog, B.Arch. (Toronto)
C.M. Kitchen, B.A. (Queen's), M.A. (Waterloo)
N.E.P. Pressman, B.Arch. (McGill), M.Arch. (Cornell), Cert. Urban and
Social Planning (Manchester)
† G. Priddle, B.A. (Western), M.A., Ph.D. (Clark)
† J. B. Theberge, B.Sc.A. (Guelph), M.Sc. (Toronto), Ph.D. (U.B.C.)

Professional Liaison Officer
H. T. Lemon, M.T.P.I.C.

†Faculty member appointed also in other Schools or Departments of the
Division of Environmental Studies.

Course Descriptions

100 Introduction to Urban and
Regional Planning Concepts and Techniques.
An introduction to the regional city; the development of contemporary
planning concepts and principles; the nature, purpose and scope of urban
planning; the planning process and decision-making in a democratic
society. Particular attention is directed to methodological aspects of
designing a planning programme: identification of objectives and
constraints, conduct of basic surveys and analysis, plans and policies
preparation, evaluation and implementation.
Prerequisite: Planning students only.
One three hour lecture and discussion session, (year).
Instructors: Martin and Wilson.
156* Introduction to Urban and Regional Planning Concepts
An introduction to contemporary planning ideas for students whose subsequent work might bring them in contact with professional planners. Planning concepts and principles; the development of contemporary planning ideas; the nature, purpose and scope of urban and regional planning; the planning process and decision-making in a democratic society.
Prerequisite: none.
One two hour lecture and one hour discussion session. (Fall and winter terms).
Instructor: Rich.

158* Reading and Research in Planning
Special readings and research on planning topics chosen in consultation with instructor.
Prerequisite: Planning students only.
(Fall and winter terms).
Instructors: Faculty.

159* Graphics for Planning
Basic instruction in graphic techniques used in planning. Emphasis will be placed on the use of graphics for the communication of ideas.
Prerequisite: Planning students only.
Two hour studio. (Winter term).

222* Canadian Regional Issues
Selective study of Canadian development issues pertaining to the use of land, urbanization, regional and resource development; issues will be related to the structural and functional forces that are characteristics of the major regions of Canada. e.g., Atlantic Provinces, British Columbia.
Prerequisite: none.
Three hours lectures. (Winter term).
Instructor: Horton.

Note Students may not take both Planning 222* and Geography 322*

255* Planning Surveys and Analysis
Sources of data for planning and their analysis. The course will emphasize the sources and methods of collection of urban and regional land-use data. Particular attention is paid to the types of land-use information essential to transportation, housing, public facilities and recreation planning. The setting up of land-use data systems is examined. Both lecture and workshop are related to a significant problem of land-use planning in Ontario.
Prerequisite: Planning 100 or consent of instructor.
Two hours lectures, two hours workshop. (Fall term).
Instructor: Martin.

256 Principles of Environmental Design
Design concepts in urban and regional planning, illustrated by recent work; integration of aesthetic and functional elements in regional environments; individual and group projects in planning design, using graphic, model, film and verbal presentation.
Prerequisite: Planning 100, or consent of instructor.
Two hours lectures, two hours studio. (Year).
Instructor: Herzog.
258* Readings and Research in Planning
Special readings and research on planning topics chosen in consultation with the instructor. This course gives the opportunity for supervised individual reading and study of planning or related topics in which the student is particularly interested.
Prerequisite: Planning 100, or consent of instructor.
(Fall or Winter terms).
Instructors: Faculty.

271* Introduction to Quantitative Research Methods
An introduction to scientific methods; descriptive and inferential statistics; computer programs. Cross-listed as Geography 271* and Man-Environment 271*.
Prerequisite: Students in Planning, and General or Honours Geography, Man-Environment or Architecture.
Two hours lectures, two hours lab, (fall term)
Instructors: Bryant, Mitchell, Semple, Steiner

272* Computer Programming and Selected Terminal Systems
The course emphasizes programming skills as applied to environmental problems. Cross-listed as Geography 272* and Man-Environment 272*.
Prerequisite: Planning 271*, or consent of instructor.
Three hours (Winter term).
Instructor: Semple.

300 Seminar/Workshop in Urban and Regional Planning
An integrated approach concerned with advanced study, analysis and design synthesis in the structuring of complex environmental problems. Studies range in scope from neighbourhood design to area redevelopment, and new towns. These will take place in a variety of urban, metropolitan and regional contexts and be of such nature as to equip the student with an adequate conceptual framework for practice.
Prerequisite: Plan 256, or consent of instructor.
One three hour workshop, (year)
Instructors: Faculty.

301* Planning Design Projects
A planning project with a design bias. Work is usually done in groups.
Prerequisite: consent of instructor.
One three hour meeting, studio/workshop, (Fall and Winter terms)
Instructor: Herzog.

307* Social Survey Techniques
Social research and the planning process; interview and self-administered surveys; questionnaire design; profile data; data processing; sampling; non-survey data collection techniques; practical applications. Cross-listed as Geography 307*.
Prerequisite: Planning 271*, may be taken in 2nd or 3rd year.
Two hours lectures, one hour practical or discussion. Fall term (Planning Students only); Winter term (other students)
Instructor: Burton

314* Urban Society
An exploration of the economic, technological and social factors which underly the planning for urban areas and the location and distribution of urban settlements. The course stresses comparative analysis of urban behaviour and its reflection in urban physical forms among various cultures in both economically developed and underdeveloped regions.
Prerequisite: Sociology 101*, or consent of instructor.
Three hours lectures, (Winter term).
Instructor: Shalinsky
316* Multivariate Statistics  The theory and application of multivariate statistics, with particular emphasis upon the use of the computer. Cross-listed as Geography 316*.
Prerequisite: Planning 271*, or consent of instructor.
Three hours seminar and/or tutorial, (Fall term).
Instructor: Steiner.

317* Nonparametric Statistics  The theory and application of non-parametric statistics with emphasis upon social science problems. Cross-listed as Geography 317*.
Prerequisite: Planning 271*, or consent of instructor.
Two hours lectures, one hour practical, (Winter term).
Instructor: Mitchell.

318* Spatial Analysis  Advanced quantitative analysis of spatial patterns and interactions. Focus on a selection of techniques from gravity models, linear programming, nearest neighbour analysis, Markov chain analysis, graph theory, simulation and trend surface analysis. Cross-listed as Geography 318*.
Prerequisite: Planning 271*, or consent of instructor.
Three hours lectures, (Winter term).
Instructors: Bryant and Walker.

319* Regional Planning Techniques  Application of economic and social measurement techniques in regional planning. Discussion of input-output analysis; cost-benefit analysis, planning, programming and budgeting systems; and social area analysis. Cross-listed as Geography 319*.
Prerequisite: Econ. 101*, 102*, or consent of instructor.
Three hours seminar and/or tutorial, (Fall term).
Instructor: Burton.

332* The Sociology of Regions  Basic concepts of sociology; occupational and concomitant social adjustments of rural society in response to forces of urbanization and industrialization; social movements generated within the farm population.
Prerequisite: Sociology 101*, or consent of instructor.
Three hours lectures, (Fall term).
Instructor: Abell.

333* The Sociology of Regional Planning  Power structures, basic social institutions, attitudes and values related to the implementation of regional plans; regional development of human and natural resources in Canada and abroad.
Prerequisite: Planning 332*, or consent of instructor.
Three hours lectures, (Winter term).
Instructor: Abell.

342* Urban and Regional Planning: An Overview (Part 1)  The physical structure of the city and its cultural, social, economic and behavioural bases; supporting systems and environmental relationships.
Prerequisite: None
3 hours (fall term)
Instructor: Wilson

343* Urban and Regional Planning: An Overview (Part 2)  Private and governmental roles in city building; government and the role of planning; the planning process and its prime components; current urban issues and plans.
Prerequisite: Planning 156* or 342* or consent of instructor.
Three hours (Winter term).
Instructor: Wilson
344* Principles of Recreation Planning  
An exploration of the nature and functions of recreation in modern urban-industrial societies and an analysis of alternative approaches to the planning of recreation opportunities in urban-centred regions. The demand for and supply of recreation opportunities; standards, models and systems; recreation planning policies and agencies; and selected recreation planning issues.  
Prerequisite: Planning 100 or a full credit in Geography, or consent of instructor.  
Three lectures (Fall term); Winter term (Planning Students Only).  
Instructor: Burton.

357* Conservation and Resource Management  
History of the conservation movement; ecological principles of conservation and resource management. Analysis, use and planning of recreational resources. This course is the same as Geography 357* and Man-Environment 357*.  
Prerequisite: Env. S. 2005 or consent of instructor.  
Three lectures, (Winter term).  
Instructors: Dorney, George, Kitchen, Theberge.

358* Regional Planning and Development  
The relationship of economic planning to regional planning. Theory and practice of regional planning and development to urban-centred, broad socio-economic, and frontier regions. A series of workshops focus upon the social and economic problems of a particular Canadian region and the role of federal, provincial and local governments in formulating and applying remedial policy. Reference is made to comparative planning strategies and policies in other nations.  
Prerequisite: one of Planning 100, 156*, 342*, or consent of instructor.  
Instructor: Martin.

391* Field Research Methods and Projects  
Selected field trip experiences directly related to the theme content of the Seminar/Workshop 300, including assignments, follow-up discussion, and presentation of research papers. The School covers the cost of travel and accommodations for field trips. Students are responsible for the cost of their meals. Approximately $45.00 will cover the cost of meals on a one week field trip.  
Prerequisite: enrolment in Plan 300.  
Instructor: Faculty.

414* Housing Policies  
Focus on Canadian housing policies and programmes, particularly with regard to the housing of low and moderate income families. Economic, political, physical and social considerations underlying these policies will be examined in detail. Some consideration is given to housing problems and programmes in the United States and developing countries.  
Prerequisite: Planning 256, or consent of instructor.  
Three lectures, (Fall term).  
Instructor: Sayegh.

415* The Small Group in the Planning Process  
The small group and its relevance to the planning process. Focus on work groups such as committees, councils and boards. Various important elements of small groups such as leadership, goal setting, influence, decision-making and interpersonal relations will be examined and related to planning.  
Prerequisite: Sociology 101*, or consent of instructor.  
Three lectures, (Winter term).  
Instructor: Shalinsky.
456 Political and Administrative Processes in Urban and Regional Planning

Historical development of planning legislation in various parts of the world; the provincial and federal legislation affecting urban, regional and resource planning in Canada; the jurisdiction of provincial bodies and agencies.

Prerequisite: One course in Political Science, or consent of instructor.
One two hour lecture/seminar, (year).
Instructor: Rich.

470* History of Urban Planning

An overview of the history of urban development and civic design. Aesthetic evaluation; technological, social and cultural influences in the evolution of urban form; comparative analysis of selected urban case studies with particular emphasis upon their relevance to contemporary concerns.

Prerequisite: Year 3 or 4 Planning students, or consent of instructor.
Two one hour lectures/seminars, (Winter term).
Instructor: Pressman.

475* Projects, Problems and Readings in Planning

Special planning projects and problems chosen in consultation with instructor.

Prerequisite: Consent of instructor.
Three hours seminar and/or tutorial, (Fall and Winter term).
Instructors: Faculty.

476 Projects, Problems and Readings in Planning

Special planning projects and problems, chosen in consultation with instructor.

Prerequisite: consent of instructor.
Three hours seminar and/or tutorial, (year).
Instructors: Faculty.

480 The Philosophy and Methodology of Urban and Regional Planning

Focus on basic values implicit in policies and decisions in environmental planning. Major currents in Planning thought are related to the problems and issues typically faced in both urban-centered and resource-based Planning in Canada. The course takes the form of a seminar-workshop, which through a number of student projects, is concerned with relating technological change, environment and the planning process.

Prerequisite: Honours Planning students only.
Three hours seminar-workshop, (year).
Instructor: Izumi.

490 Senior Honours Essay

Practical experience in the identification of a problem in the planning field. Conduction of individual research into this problem and presentation of the results of this research in a form that meets both professional and academic standards. Two credits.

Prerequisite: Honours Planning students only.
Instructors: Faculty.
Women's Studies

A selection of courses concerning women will be offered through the departments of Sociology and Anthropology, Psychology, English, and History. These courses in Women's Studies are designed to approach the study of women from various perspectives and will explore such areas of interest as the past and present roles of women, the treatment of women in contemporary sociological theory, women anthropologists, the nature and role of women in literature, the behavioural development of women and of sex differences, sexual relations and the family in European culture, and the role of sex-related ideologies to larger processes of economic and political change. Students who are interested in the Women's Studies courses listed below will find complete course descriptions in the appropriate departmental sections of this Calendar.

**Anthropology 449**  
Studies and Investigation of Anthropologist Women in the Field.  
*Instructor – D. Counts*

**English 108**  
Women in Literature  
*Instructors – R. Lister and K. Ledbetter*

**History 233**  
Men, Women, and Families in Modern History  
*Instructor – S. Johannesen*

**Psychology 365**  
The Behavioural Development of Women  
*Instructor – P. Rowe*

**Sociology 215**  
Sociology of Women  
*Instructors – M. Eichler and L. Fischer*

**Sociology 415**  
Seminar in Sociology of Women  
*Instructor – M. Eichler*
Governing Bodies and Staff
South Campus Hall Sculpture—“Joy”
The Board of Governors

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A.I. Rosenberg, Kitchener  
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The Vice-Chancellor—B.C. Matthews, B.S.A., A.M., Ph.D.  

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C.L. Siegfried, C.R., B.A., M.Sc., LL.D. (President, St. Jerome's College)  
J.W. Fretz, B.A., M.A., B.D., Ph.D. (President, Conrad Grebel College)  
A.M. McLachlin, M.A., B.D., Th.D. (Principal, St. Paul's United College)  
D.G.S. M'Timkulu, Ph.D. (Acting Principal, Renison College)

The Dean of Each Faculty or School of the University  
J.F. New, M.A., Ph.D. (Acting Dean of Arts)  
A.N. Sherbourne, B.Sc., M.S., M.A., Ph.D. (Dean of Engineering)  
P.H. Nash, B.A., M.A., Ph.D. (Dean of Environmental Studies)  
W.E. Forbes, P.G.C., Ph.D., D.Sc. (Dean of Mathematics)
G.S. Kenyon, B.P.E., M.S., Ph.D. (Dean of Physical Education & Recreation)
L.A.K. Watt, B.Sc., M.S., Ph.D. (Dean of Graduate Studies)

The Academic Dean of each Federated College

J.A. Wahl, C.R., B.A., M.A., Ph.D. (St. Jerome's College)

The Librarian W.J. Watson, B.J., M.A., B.L.S.

The Chairman of the Board of Governors

C.A. Pollock, B.A.Sc., B.S.

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D.S. Scott, B.Sc., M.Sc., Ph.D. (Engineering)
C.F. Fischer, M.A., Ph.D. (Mathematics)
C.A. Griffith, B.A., M.S., Ph.D. (Physical Education and Recreation)
H.D. Sharma, M.Sc., Ph.D. (Science)
P.S. Smith, B.A., M.A., Ph.D. (St. Jerome's)

To 1973
A. Ages, B.A., M.A., Ph.D. (Arts)
W.C. Lennox, B.A.Sc., M.Sc., Ph.D. (Engineering)
H.C. Ratz, B.A.Sc., S.M., Ph.D. (Engineering)
H.C. Abell, B.H.Sc., M.Sc., Ph.D. (Environmental Studies)
J.W. Leech, B.Sc., Ph.D., F.Inst.P. (Science)
F.F Centore, B.Sc., M.A., Ph.D. (St. Jerome's)

To 1974
M. Brown, B.Sc., M.Sc., Ph.D. (Arts)
R.R. Dubinski, B.A., M.A., Ph.D. (Arts)
J.H.G. Howard, B.Sc., M.Sc., Ph.D. (Science)
R.N. Farvolden, B.Sc., M.Sc., Ph.D. (Science)
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D.A. Sprott, M.A., Ph.D. (Mathematics)
M. Houston, B.Sc., Ph.D. (Physical Education and Recreation)
R.R. Krueger, B.A., M.A., Ph.D. (Environmental Studies)
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Alumni Representatives
To 1972
B.C. Hayes, C.R., B.A. (St. Jerome's)

To 1973
Miss C. Lavigne (Miss), B.A. (St. Jerome's)

To 1974
J.F. Stevenson, B.A. (St. Jerome's)

* The terms of office of the Senate and the Board of Governors will expire on October 31, 1972. Elections and appointments to the new...
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Central Stores
Manager
A. Lawrence

Office Services
Manager
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Purchasing
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Director, Physical Planning
A.E. Lappin, P.Eng.

Director, Plant Operations

Director, Safety
N. Ozaruk

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Warden of Residences
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