Master of Science in Applied Science

Program Coordinator: Dr. Pawan Lingras

Participating Departments
& Program Executive Representatives:

Dr. Tanya Peckmann	Department of Anthropology
Dr. Hugh Broders	Department of Biology
Dr. Kathy Singfield	Department of Chemistry
Dr. Jeremy Lundholm	Environmental Studies Program
Dr. Hai Wang	Department of Finance, Information Systems and Management Science
Dr. Cristian Suteanu	Department of Geography
Dr. Andrew MacRae	Department Geology
Dr. Sageev Oore	Department of Mathematics and Computing Science

General Information

The Master of Science in Applied Science Program is a research thesis-oriented, multidisciplinary degree program The objectives of the program are to provide graduate students with the opportunity to conduct research in a single or a multidisciplinary field of study with practical application; to produce graduates with valuable skills in research and communication preparing them for careers in related fields of research and development in industry or government, as well as for further graduate studies at the doctoral level. The normal duration of the Program for full-time students is two years. Students may also be admitted for part-time study with the permission of the Program Executive. Students may pursue their degree through a series of work and study terms; this Co-operative option is available for both full and part-time students in the Program. Students benefit from the able guidance of experts in related fields of study within the institution and from outside, as the composition of the supervisory committee reflects the Program's emphasis on the multidisciplinary approach to research. Collaborative research projects with experts at recognized external research institutions are encouraged and, in the case of Co-operative option of study, essential to the success of the student.

Admission Requirements

In order to be eligible to make an application for admission to the Program, applicants must have:

a. successfully completed an honours Bachelor's degree in Science from a recognized institution or the equivalent.

b. achieved a minimum cumulative quality point average of 3.0 (a 'B' standing) in their overall academic record.

Application Procedures

Applicants should visit the Faculty of Graduate Studies and Research (FGSR) website, http://fgsr.smu.ca/ for relevant application, referee and supplementary forms, current application fee information, mailing addresses and an *Applicant's Checklist* for admission to the Masters of Science in Applied Science Program.

Applicants should arrange to have the following sent to the FGSR office: (i) a completed application form (including appropriate application fee) with the completed Supplementary Form and support documents (e.g., letter and resume); (ii) an official copy of the applicant's transcript(s); (iii) three confidential letters of reference from individuals who can attest to the applicant's academic competence and/or interest in pursuing academic training; (iv) official English language proficiency test results, if appropriate (*see below*).

All applicants whose native language is not English and whose undergraduate education was conducted in a language other than English must fulfill the language requirement as set out in the relevant section of the Saint Mary's Academic Calendar and may be required to attend language training at the Teaching English as a Second Language (TESL) Centre.

Application Deadline

Students should apply by **February 1st** of their first intended year of study. Applications received after this date are reviewed periodically on an individual basis by the Program Committee.

Interested prospective students are encouraged to visit the websites of the participating Departments and informally contact any potential supervisors.

Financial Support

Graduate Fellowships (value up to $6,000 per year) and teaching assistantships (approximately $3,000 per year) are available to eligible, accepted students. Students are also encouraged to seek support under the NSERC Industrial Postgraduate Scholarship (IPS) scheme (contact Dean of Graduate Studies and Research). Faculty supervisors, in the absence of an NSERC Postgraduate Scholarship or NSERC IPS or financial support from other external sources, will contribute to the support of accepted students from NSERC operating grants or research contract funds to ensure that students normally have a minimum support from all sources of $14,000 for co-op option per annum for two years (this includes the co-op wage which is normally paid to students during the co-op work terms) and $15,000 for non co-op option per annum for two years.

Program Requirements

a. Students must successfully complete the required core courses, which include the successful completion and defense of the research thesis: APSC 6600.0; APSC 6601.1; APSC 6602.2; APSC 6603.0; and APSC 6604.0.

b. Non co-op students must successfully complete a total of 12 credit hours of graduate-level courses in addition to the required core courses.
c. Co-op students must successfully complete a total of 12 credit hours in work terms in a cognate field.
d. Students must achieve a minimum cumulative GPA of 3.0 (B) in the Program.
e. As stated in the Academic Regulations Section of the Graduate Programs Academic Calendar, all degree requirements must be completed within 5 years and not sooner than 2 years for full-time students; and within 7 years and not sooner than 4years for part-time students, after entry into the Master of Science in Applied Science Program.
f. Students must submit and successfully defend their research thesis before an Examination Committee, comprised of the Supervisory Committee and an External Examiner. Details on this process and the events leading to it are outlined in the *Graduate Student Handbook*, available on the FGSR website.

Other Important Program Notes

a. Supervisory Committee
The composition of the Supervisory Committee is consistent with the Program's multidisciplinary objective and consists of the research thesis Supervisor and two other faculty members, not all of whom are from the same department and with at least one member an expert in a discipline sufficiently removed from the primary research focus. The Supervisory Committee membership should be submitted to and approved by the Program Executive within one month of the commencement of the program.

b. Research Proposal
The student must make an oral presentation of his/her research proposal to the Supervisory Committee and obtain approval of the proposed work and schedule by such Committee within eight months of commencing the Program.

c. Annual Assessment
The student must meet with his/her Supervisory Committee in September beginning in their second year to assess the student's progress in research and course work. The annual assessment should be submitted and approved by the Program Executive by September 30.

Graduate Courses

Applied Science (APSC)

APSC 6600.0 Graduate Seminar
The instructional part of this course focuses on research project definitions, project planning and scientific writing. Students are expected to read articles chosen for discussion, contribute to the critiquing process and make several presentations during the course. Students are expected to attend a designated number of seminars either at Saint Mary's University or at other surrounding research institutions. Students normally enroll in this course in the first year of the Master of Science in Applied Science program.

APSC 6601.1 Research Techniques I
Research Techniques I is an interdisciplinary course designed to introduce students to a range of issues and concepts in research techniques across a range of scientific disciplines. This course is divided into four modules: 1) Research Design, Scientific Method and Model Building; 2) Data Collection and Experimentation; 3) Data Analysis and Statistics and 4) Data Interpretation and Communication. There are approximately 3 hours of lecture/seminar and associated laboratory/demonstration/seminar work per week.

APSC 6602.2 Research Techniques II
This course is intended to help students learn research techniques that are specific to their discipline through a series of project modules. Each module may include instructions, seminars, laboratory work, and independent study. In each module, students will select a research problem and will be required to understand the theoretical basis underlying the analysis of the problem and the practical procedures necessary to solve the problem.

APSC 6603.0 Thesis I
Prerequisite: APSC 6600.0 and APSC 6602.2
Thesis I constitutes the first segment of the student's thesis research project. Students normally register for this course in May of their first year in the program. Research is conducted under the guidance of the research thesis Supervisor in conjunction with the other Supervisory Committee members. Successful completion of APSC 6603 includes a satisfactory evaluation and Annual Assessment of the student's written and oral presentation of his/her Research Progress Report by the Supervisory Committee. The Supervisor normally submits the completed evaluation to the Program Committee on or before September 30th of that year.

APSC 6604.0 Thesis II
Prerequisite: APSC 6603.0
Thesis II constitutes the second segment of the student's thesis research project. Students normally register for this course in the Fall semester of their second year in the Program. Research is conducted under the guidance of the faculty Research Supervisor in conjunction with the Supervisory Committee.

APSC 6605.1(.2) Directed Studies
This course is taken during the first or second year of enrolment in the Master of Science in Applied Science program. The directed studies will be conducted under the supervision of a faculty member following approval by the Program Co-ordinator.

All of the following courses require permission of the instructor to register.

Biology (BIOL)

BIOL 6606.1(.2) Current Topics in Biology
A journal article-based examination of developments in biology that are relevant to all biology graduate students.
NOTE: This course is compulsory for all graduate students in biology and is normally taken in the first year.

BIOL 6607.1(.2) Advanced Molecular Biology
The application of molecular techniques to broad biological problems is the focus of this course. It is suitable not only for students pursuing a degree in molecular biology but also to those who will use advanced techniques such as DNA sequencing, bioinformatics and genomics to approach larger aspects of biology e.g. population genetics, taxonomic problems, paternity identification, etc.

BIOL 6608.1(.2) Biostatistics for Graduate Students
Analysis of biological data at the advanced level. The course will build on previous biostatistics experience and include multivariate analysis, nonparametric methods, and model selection as well as manipulation and analysis of large, complex databases.

BIOL 6609.1(.2) Field Methods and Experimental Design
Students will be exposed to standard methodologies for data collection under field conditions, including sampling protocols, technical devices available and types of numerical and descriptive data that are typically collected. Design of both experimental and ecological research projects will be discussed.

BIOL 6620.1(.2) Cross-listed as ENVS 6620.1(2) Restoration Ecology
This course offers an advanced treatment of contemporary issues in restoration ecology, including conservation genetics, invasive species, phytoremediation, restoration ethics, and ecological integrity. Experiential learning is emphasized and there may be opportunities for hands-on experience in actual restoration projects or in experimental microcosms. Students will also develop scientific writing skills by writing real grant proposals or review papers.

BIOL 6625.1(.2) Theoretical Plant Ecology
This course offers an advanced treatment of plant ecology, starting with theoretical principles but moving into empirical tests of theory. Topics covered include competition, facilitation, coexistence, ecosystem functioning, plant traits and modeling. Students will collaborate on common experiment or field study during the course.

BIOL 6690.1(.2) to BIOL 6699.1(.2) Directed Study in Biology
These courses are intended to supplement the course offerings in biology and allow students to delve deeper into a subject of particular interest to them. Students must show some initiative and be willing to work independently.

Chemistry (CHEM)

CHEM 6612.1(.2) Quantum Chemistry
The basic principles of quantum physics are used to develop an understanding of atomic and molecular structure. This is a modified version of undergraduate course CHEM 4412.1(.2.). Students attend the undergraduate lectures and are expected to complete at least the course requirements of the undergraduate course as well as any supplementary graduate requirements as specified by the instructor.

CHEM 6613.1(.2) Physical Chemistry
An introduction to statistical thermodynamics and the study of chemical reaction rates and mechanisms. This is a modified version of undergraduate course CHEM 4413.1(.2.). Students attend the undergraduate lectures and are expected to complete at least the course requirements of the undergraduate course as well as any supplementary graduate requirements as specified by the instructor.

CHEM 6614.1(.2) Symmetry and Chemical Applications of Group Theory
An introduction to symmetry and group theory for the experimental chemist. Applications of point groups and space groups in organic chemistry, inorganic chemistry, molecular spectroscopy, atomic and molecular structure and crystallography. This is a modified version of undergraduate course CHEM 4414.1(.2.). Students attend the undergraduate lectures and are expected to complete at least the course requirements of the undergraduate course as well as any supplementary graduate requirements as specified by the instructor.

CHEM 6622.1(.2) Advanced Topics in Inorganic Chemistry
Current topics and applications of inorganic chemistry will be covered, and may include the following: cluster chemistry, chemistry of the lanthanides and actinides, inorganic and organometallic materials, bioinorganic chemistry and inorganic photochemistry. This is a modified version of undergraduate course CHEM 4422.1(.2.). Students attend the undergraduate lectures and are expected to complete at least the course requirements of the undergraduate course as well as any supplementary graduate requirements as specified by the instructor.

CHEM 6632.1(.2) Instrumental Analysis I
Emphasis will be placed on (i) separation techniques including high performance and gas chromatography; (ii) organic mass spectrometry; (iii) analogue circuits and devices and digital electronics. This is a modified version of undergraduate course CHEM 3432.1(.2.). Students attend the undergraduate lectures and are expected to complete at least the course requirements of the undergraduate course as well as any supplementary graduate requirements as specified by the instructor.

CHEM 6633.1(.2) Instrumental Analysis II
Emphasis will be placed on (i) atomic spectroscopy including atomic absorption and emission; (ii) x-ray fluorescence; (iii) modern electro-chemical techniques including differential pulse voltammetry and stripping analysis;; (iv) inorganic mass spectrometry. This is a modified version of undergraduate course CHEM 4443.1(.2.). Students attend the undergraduate

lectures and are expected to complete at least the course requirements of the undergraduate course as well as any supplementary graduate requirements as specified by the instructor.

CHEM 6643.1(.2) Organic Reaction Mechanisms
A study of the more important mechanisms of reactions of organic molecules and the methods by which they are elucidated: applications of kinetic data, isotope effects, linear free energy relationships, orbital symmetry control and acid and base catalysis. This is a modified version of undergraduate course CHEM 3443.1(.2.). Students attend the undergraduate lectures and are expected to complete at least the course requirements of the undergraduate course as well as any supplementary graduate requirements as specified by the instructor.

CHEM 6644.1(.2) Synthesis in Organic Chemistry
A study of the principles involved in the planning and execution of the synthesis of organic molecules. Laboratory experiments are designed so that students learn to identify their products by the use of spectroscopic and other techniques. This is a modified version of undergraduate course CHEM 4444.1(.2.). Students attend the undergraduate lectures and are expected to complete at least the course requirements of the undergraduate course as well as any supplementary graduate requirements as specified by the instructor.

CHEM 6645.1(.2) Organic Spectroscopy
An introduction to the interpretation of ^{1}H and ^{13}C nuclear magnetic resonance spectra. Infrared spectroscopy, mass spectrometry, and ultra-violet spectrophotometry will also be applied to the problems of organic and organometallic structural determination. This is a modified version of undergraduate course CHEM 3445.1(.2.). Students attend the undergraduate lectures and are expected to complete at least the course requirements of the undergraduate course as well as any supplementary graduate requirements as specified by the instructor.

CHEM 6651.1(.2) Biochemistry
This course reviews and/or presents an introduction to the chemistry and biochemistry of macromolecules such as proteins, enzymes, simple and complex carbohydrates, lipids, nucleic acids, and coenzymes. A relationship between the molecular structure of a given macromolecule, its properties, and its function in the living system is explored. The laboratory work concentrates on the isolation, purification, and analysis of naturally occurring macromolecules and includes study of their properties, using micro chemical measurements. This is a modified version of undergraduate course CHEM 3451.1(.2.). Students attend the undergraduate lectures and are expected to complete at least the course requirements of the undergraduate course as well as any supplementary graduate requirements as specified by the instructor.

CHEM 6652.1(.2) Biochemistry: Metabolism
A course presenting principles of metabolism of biomolecules involved in energy production, formation of biosynthetic substrates and metabolism of nucleic acids. Both catabolic and anabolic processes as well as transport of biomolecules within cells and organs are considered. This is a modified version of undergraduate course CHEM 4452.1(.2.). Students attend the undergraduate lectures and are expected to complete at least the course requirements of the undergraduate course as well as any supplementary graduate requirements as specified by the instructor.

CHEM 6611.0 Selected Topics in Physical Chemistry
This is a graduate-level directed study course in a specific area of physical chemistry. Topics can vary but reflect the expertise of the instructor and the research interests of the student(s).

CHEM 6621.0 Selected Topics in Inorganic Chemistry
This is a graduate-level directed study course in a specific area of inorganic chemistry. Topics can vary but reflect the expertise of the instructor and the research interests of the student(s).

CHEM 6631.0 Selected Topics in Analytical Chemistry
This is a graduate-level directed study course in a specific area of analytical chemistry. Topics can vary but reflect the expertise of the instructor and the research interests of the student(s).

CHEM 6641.0 Selected Topics in Organic Chemistry
This is a graduate-level directed study course in a specific area of organic chemistry. Topics may include organic synthesis, stereochemistry, heterocyclic compounds and natural products, *and reflect the expertise of the instructor and the research interests of the student(s).*

CHEM 6653.0 Selected Topics in Biochemistry
This is a graduate-level directed study course in a specific area of biochemistry. Topics can vary but reflect the expertise of the instructor and the research interests of the student(s).

Environmental Studies (ENVS)

ENVS 6620.1(.2) Cross-listed as BIOL 6620.1(2) Restoration Ecology

ENVS 6650.1(.2) Natural Resource Management
This interdisciplinary course examines the management of natural resource industries such as fisheries, forestry, mining and energy, focusing on interactions between biophysical, ecological, socioeconomic, and technological components. The course will cover such topics as sustainable development and environment-economy interactions in the resource sector; approaches to integrated natural resource development; theoretical and practical aspects of managing resources and resource industries; economics of sustainable resource use; methods for analysing the impacts of resource use.

ENVS 6660.1(.2) Methods of Environmental and Natural Resource Analysis
This interdisciplinary course provides a “tool-kit” of methods for planning and evaluation in natural resource and environmental management. Emphasis is placed on methods to assess dynamics of change in biophysical, ecological, socioeconomic, and technological aspects of resource and environmental systems, and for analysing the impacts of management interventions. Topics to be covered include computer-based techniques to acquire and manage information; bio-economic and simulation models; statistical and forecasting

methods; economic valuation and ecological economics; sustainability indicators in resource and environmental systems; analysis of real-world case studies.

ENVS 6690.1(.2) to 6699.1(.2) Directed Studies in Environmental Science Students will pursue a short term research project in such areas as: oceanographic sampling and analysis, policy development or environmental impact assessment. Students must identify an appropriate supervisor; provide a project proposal; and at the end of the project, submit a written report.

Finance, Information Systems & Management Science (MGSC/CISY)

MGSC 6603.1(.2) Statistical Applications in Management Science I
This course brings together many of the theories and skills which the student has learned and uses them in designing, conducting, analyzing, and reporting the results of research designs. Statistical techniques used are: chi-square, analysis of variance, and multiple regression. Extensive use is made of computer-oriented statistical packages.

MGSC 6615.1(.2) Strategic Design and Improvement of Operations
This course is aimed at the student who wants to deepen their understanding of the strategic role of operations and the design of operations to facilitate competitive advantage in both service and production environments. The strategic design and improvement of operations will be examined in the context of key performance priorities such as: cost, quality, flexibility, delivery, and time. Topics include: process design and improvement, implementation of operations improvement strategies, and integration of information technology and operations systems. The course will make significant use of cases and group work.

MGSC 6618.1(.2) Total Quality Management
This course introduces the student to the concepts of total quality management, quality improvement, and statistical quality control as key ingredients of a quality strategy. The role of a quality strategy in improving the competitiveness of the firm in both local and international markets is emphasized. Using a case-oriented approach, students will be introduced to the philosophies of Deming, Juran and Crosby, the dimensions of product and service quality, modern statistical improvement tools, and the relationship between quality strategy and the functional areas of the firm.

CISY 6624.1(.2) Database Systems
Students will examine the design, implementation and management issues associated with database systems. The problems which arise through incorrectly designed databases are identified and their resolutions discussed. Topics on transaction processing and databases on the WWW are also covered. Labs based on an RDBMS package are given to provide a vehicle for practical implementation.

CISY 6636.1(.2) Decision Support Systems
This course will introduce students to the specialized use of computer systems for supporting and enhancing managerial decision-making. Students will be introduced to the basic architecture of DSS, as well as issues involving design and implementation of various types of DSS (i.e., data mining, group DSS, expert systems). The course includes instruction in advanced features of Microsoft Excel. An application project will be completed either in teams or individually during the semester.

CISY 6690.1(.2) Seminar in Computing and Information Systems
This course deals with selected topics in computing and information systems. It is offered when in sufficient demand, and specific topics covered may vary depending on the interests of students and instructor.

MGSC 6690.1(.2) Seminar in Management Science
This course deals with selected topics in management science. It is offered when in sufficient demand, and specific topics covered may vary depending on the interests of students and instructor.

MGSC/CISY 6692.1(.2) to MGSC/CISY 6699.1(.2) Directed Study in Finance, Information Systems and Management Science
Intended to supplement or provide an alternative to the regular management science courses in order to meet the special needs and interests of students, these courses provides an opportunity to study a particular subject in detail and requires from the student some measure of independence and initiative.

Geography (GEOG)

GEOG 5614.1(.2) Integrated Coastal Zone Management
Spatial approaches to the integrated planning and management of the coastal zone within a sustainable development framework will be discussed and analyzed using case studies from intensively developed coastal zones in Europe, the Mediterranean, Southeast Asia, and North America. Emphasis will be placed on the use of geographical information systems as management and planning tools.

GEOG 5623.1(.2) Glacial Geomorphology
The study of geomorphological processes and landforms in glaciated environments. Emphasis will be placed on descriptions and explanations of glacial processes and glacial landform development. Glacial history will form a minor component of the course.

GEOG 5632.1(.2) Social Geography of the City
Examines the location of residential areas in cities, and the differentiation and segregation of those areas by income, occupation, race, ethnic status, and religion. Emphasis is placed on the historical evolution of social patterns, on the link between social areas and the physical fabric of the city, on competition between groups for amenity locations and facilities, and on the conflicts over noxious facilities.

GEOG 5633.1(.2) Fluvial Geomorphology
This course examines processes and landforms associated with rivers. Topics include channel processes and morphology, sedimentology and depositional environments. Case studies of human impacts on river systems are also presented.

GEOG 5636.1(.2) Advanced Remote Sensing
A course in advanced topics in remote sensing building upon the basic concepts and image processing skills learned in GEOG 3356.1(.2). At the advanced level, remote sensing involves more numerical processing and statistical analysis, and greater understanding of physical principles of remote earth observation. Recent studies in remote sensing will be examined and discussed critically. Students will develop projects based on their background and interests using remote sensing for applied studies.

GEOG 5639.1(.2) Urban Historical Geography
The geography of the city (its morphology and function) is employed as an indication of the landscape impression produced by various historical periods (conceived as cultures) during the evolution of urban forms in Europe and North America. Examples are taken in historical sequence from Greek to Industrial times.

GEOG 5642.1(.2) Urban Planning
Examines the physical and environmental planning of urban areas, with special reference to current practice in Nova Scotia. Topics include the emergence of modern town planning, the Planning Act, planning process, structure plans, general and partial urban allocation models, municipal plans, zoning, subdivision control, site planning, urban renewal, and new towns. The costs and benefits of planning are appraised.

GEOG 5643.1(.2) Natural Hazards
This course considers natural hazards as a part of human-environment relations characterized by changing geographical patterns. Earthquakes, volcanic eruptions, landslides, severe weather, floods, coastal hazards, extraterrestrial body impacts are analyzed in a multi-scale perspective, along with their functional relationships. The human impact of natural hazards is discussed, with an emphasis on environmental perception, public awareness and action. Possibilities of forecasting are examined, as well as risk assessment and mitigation strategies.

GEOG 5652.1(.2) The Geography of Urban Transportation
This course focuses on patterns and processes of movement within cities. Topics for consideration include: the role of transportation in shaping urban form, transportation problems in cities today, the urban transportation planning process, patterns of public transit and automobile use, environmental impacts of urban transportation, the communications-transportation trade-off.

GEOG 5653.1(.2) Costal Geomorphology
This course discusses both the physical processes that operate in the coastal zone and the resulting landforms. The actions of waves, tides, currents, sea level changes, wind, and humans in the formation of coastal features are considered. Additional topics include the long-term development and classification of coasts.

GEOG 5686.1(.2) Concepts in Geographical Information Systems (GIS)
This course provides an introduction to geographic information systems (GIS). Consideration is given to GIS data structure, data input, quality, storage and editing, GIS analysis functions and an introduction to the implementation of a GIS. Although the course has a strong technical component, the central underlying theme is using GIS to improve decision making in natural, human and management sciences.

GEOG 5696.1(.2) Applications in Geographical Information Systems
This course allows students to develop further their understanding of GIS and its applications. The course allows students to further develop their understanding of GIS and its applications. This course is project-oriented, focusing on the use of geographic information systems (GIS) to address practical problems in areas such as resource management, marketing, regional planning, natural hazards and geomorphology. Students will undertake a major research project using various GIS analytical functions, and develop skills relating to data creation, manipulation, quality assessment and presentation.

GEOG 6602.0 Directed Studies in Urban/Regional Geography.
A directed studies course on topics involving urban and regional geography.

GEOG 6603.0 Directed Studies in Environmental Geography
A directed studies course on topics involving environmental geography.

GEOG 6604.0 Directed Studies in Marine Geography
A directed studies course on topics involving marine geography.

GEOG 6605.0 Directed Studies (General)
A directed studies course on general topics in geography.

GEOG 6612.1(.2) Directed Studies in Urban/Regional Geography
A directed studies course on topics involving urban and regional geography.

GEOG 6613.1(.2) Directed Studies in Environmental Geography
A directed studies course on topics involving environmental geography.

GEOG 6615.1(.2) Directed Studies (General)
A directed studies course on general topics in geography.

GEOG 6624.1(.2) Directed Studies in Marine Geography
A directed studies course on topics involving marine geography.

GEOG 6690.1(.2) to GEOG 6699.1(.2) Directed Study in Geography
These courses are intended to supplement the course offerings in geography and allow students to delve deeper into a subject of particular interest to them. Students must show some initiative and be willing to work independently.

Geology (GEOL)

GEOL 6641.1(.2) Mineral Resources
A study of Earth's mineral resources, particularly metallic and some non-metallic mineral deposits, their classification, genesis and distribution in time and space. Important examples from Canada and abroad will be discussed. Topics will also include mineral exploration, mining, and the environmental impact of resource exploitation.

GEOL 6642.1(.2) Economic Mineral Deposits
The course examines the geology, mineralogy, economic geology and origin of major types of metallic and some non-metallic deposits in Canada and elsewhere. Laboratory includes investigation of suites of samples from the deposits.

GEOL 6654.1(.2) Applied Geochemistry
The application of geochemistry to prospecting for minerals and oil fields; methods of sampling and analysis; statistical evaluation of geochemical data; cycling of geochemical species in the environment; environmental geochemistry.

GEOL 6666.1(.2) Petroleum Geology
The origin, migration and accumulation of oil and natural gas. Types of oil bearing structures and basic principles in oil exploration.

GEOL 6690.1(.2) to 6699.1(.2) Directed Study in Geology
Intended to supplement or provide an alternative to the regular geology courses in order to meet the special needs and interests of students. The course provides an opportunity to study a particular subject in detail and requires from the student some measure of independence and initiative.

Mathematics & Computing Science (MATH/CSCI)

CSCI 6623.1(.2) Cryptography
This course provides an introduction to various aspects of data security. Possible topics: classical encryption methods such as Vignere and Vernan ciphers; the Data Encryption Standard; key distribution methods and public key encryption; and authentication using digital signatures. Applications of these methods in the design of protocols for data privacy and security will also be studied.

CSCI 6651.1(.2) Theory of Computation
This course provides an introduction to some of the fundamental theoretical concepts in computing science. Students will be introduced to the concepts of decidable, P, NP, NP-complete, and NP-hard problems. Two classes of languages of interest to computing scientists, namely, regular and context free languages, and corresponding automata for recognizing these languages, will also be studied. A brief discussion on the semantics of programming languages will be included. The concept of automata will be further extended using Turing machines. Turing machines will be used to explore the concept of decidability along with examples of decidable and undecidable problems.

CSCI 6652.1(.2) Algorithm Analysis
This course will build on the concepts of algorithm analysis introduced in CSCI 2341. Some of the key techniques of efficient algorithm design that will be discussed: divide and conquer; greedy methods; dynamic programming; graph traversal; and change of representation. Measuring algorithm performance and lower bounds for various problems will be studied. An introduction to complexity theory-P, NP, polynomial time reducibility, and NP-completeness- will also be provided

CSCI 6661.1(.2) Database Systems
This course provides an introduction to the design, implementation, use and maintenance of databases. Topics will include: data models such as the entity-relationship model, the relational model, and the object-oriented model; relational languages such as relational algebra, relational calculus, and SQL; the theory of normal forms of database design; use of indexes for efficient date retrieval; and database implementation using a commercial database management system. Other topics may be included, such as query optimization, database control, and distributed database systems.

CSCI 6663.1(.2) Numerical Software
This course will study the software development process in the area of numerical software. Emphasis will be placed on software development and implementation aspects of a variety of numerical algorithms. The course will also examine a substantial number of software packages including some which are currently available in some of the large commercial software libraries, as well as a number of published software packages which have yet to appear in libraries and even a few experimental codes which have not yet appeared in the literature. The main project in the course will be the development of a large software package by the class working in programming teams in a selected area of numerical algorithms. Other projects to be undertaken during the course include the modification of one or more existing mathematical software packages and the critical analysis of several existing software packages. A number of assignments related to the software packages considered will also be given.

CSCI 6671.1(.2) Computer Graphics
This course provides an overview of the principles and methodologies of computer graphics, including the representation, manipulation, and display of two- and three-dimensional objects. Subtopics may include characteristics of display devices (i.e., raster, vector); representing primitive objects (lines, curves, and surfaces) and composite objects; two- and three-dimensional transformations (translation, rotation, scaling); hidden lines and surfaces; shading and colouring; interactive graphics and the user interface; animation techniques.

CSCI 6674.1(.2) Information Retrieval
This course considers manipulations on a bibliographic database. Topics to be covered include an introduction and basic definitions, inverted file structures, automatic indexing, prototype systems, retrieval and refinements and natural language processing.

CSCI 6676.1(.2) Computer Vision and Digital Image Processing
This course provides an introduction to the concepts used in computer vision and digital image processing. Computer vision techniques extract information from an image, while image processing techniques modifies the image for viewing by the human eye. Topics covered include the following: sampling and resolution, image processing, edge detection, segmentation, discrete image transforms, restoration and enhancement, and image compression.

CSCI 6677.1(.2) Data Mining
Data mining refers to a family of techniques used to detect interesting knowledge in data. With the availability of large databases to store, manage and assimilate data, the new thrust of data mining lies at the intersection of database systems, artificial intelligence and algorithms that efficiently analyze data. The course will use concepts from pattern recognitions, statistics, data analysis and machine learning. The size of databases and high complexity of techniques present many interesting computational challenges.

CSCI 6682.1(.2) Artificial Intelligence
This course provides a general introduction to artificial intelligence (AI). The course will consider philosophical, mathematical, experimental, and implementation aspects of such topics as problem solving, searching, game playing, genetic algorithms, learning, neutral networks, natural language processing, vision, knowledge representation, logic, expert systems, reasoning under uncertainty, fuzzy sets, planning, and robotics. In addition to a theoretical introduction, students will also gain experience using one or more of the popular AI tools.

CSCI 6691.1(.2) to CSCI 6699.1(.2) Special Topics in Computing Science
This course covers advanced topics in computing science chosen according to the interests of the students and instructor, and requires some measure of independence and initiative from the student.

MATH 6690.1(.2) to MATH 6699.1(.2) Directed Study in Mathematics
This course is intended to supplement or provide an alternative to the regular mathematics courses in order to meet the special needs and interests of students. The course provides an opportunity to study a particular subject in detail and requires from the student some measure of independence and initiative.