Basic hypotheses of statistical thermodynamics; ideal monatomic, diatomic and polyatomic gases; Einstein and Debye models of solids; statistical theory of black-body radiation; Debye-Huckel theory of electrolyte solutions; absolute reaction rate theory of rate processes; theories of solutions. **Professor Eu**

180-597A ANALYTICAL SPECTROSCOPY. (3) (2 lectures; 3 hours laboratory) (Prerequisite 180-367 and 180-377) The design and analytical use of spectroscopic instrumentation will be examined with respect to fundamental and practical limitations. Classical emission, fluorescence, absorption and chemical luminescence will be discussed. Contemporary topics may include photo-acoustic spectroscopy, multielement analysis, X-ray fluorescence and modern multiwavelength detector systems.

Professors Power and Salin

11.7 Cognitive Science

Dr. Tom Shultz, Department of Psychology, Program Director
Telephone: (514) 398-6139/6150

Cognitive Science is the multi-disciplinary study of cognition in humans and machines. The goal is to understand the principles of intelligence with the hope that this will lead to better understanding of the mind and of learning, and to the development of intelligent devices that constructively extend human abilities.

The Minor in Cognitive Science is intended to supplement and support Major or Honours programs in Computer Science, Linguistics, Philosophy, or Psychology. Students wishing to enrol in this Minor must register with the Program Director.

MINOR PROGRAM IN COGNITIVE SCIENCE (27 credits)
[MARS Program Code 6-265600]

Required Course (3 credits)
204-532 (3) Cognitive Science

Complementary Courses (24 credits)
from outside of the student's home department, selected from the courses listed below.

Computer Science
308-424 (3) Topics in Artificial Intelligence I
308-426 (3) Automated reasoning

Educational Psychology
416-555 (3) Applied Cognitive Science

Linguistics
104-321 (3) Linguistics Applied to Language Learning
104-351 (3) Phonology I
104-360 (3) Syntax I
104-370 (3) Semantics I
104-440 (3) Morphology
104-491 (3) Linguistic Theory I
104-530 (3) Phonology II
104-555 (3) Linguistic Theory & Language Acquisition
104-571 (3) Syntax II
104-590 (3) Introduction to Neurolinguistics

Mathematics
189-318 (3) Mathematical Logic
189-328 (3) Computability and Mathematical Linguistics

Philosophy
107-210 (3) Introduction to Deductive Logic
107-306 (3) Philosophy of Mind
107-310 (3) Intermediate Logic
107-410 (3) Topics in Advanced Logic I
107-415 (3) Philosophy of Language
107-419 (3) Epistemology
107-506 (3) Seminar: Philosophy of Mind
107-507 (3) Seminar: Cognitive Science

Psychology
204-311 (3) Human Behaviour and the Brain
204-314 (3) Thinking and Concepts
204-334 (3) Computer Simulation - Psych. Process.
204-335 (3) Formal Models of Psych. Processes
204-340 (3) The Psychology of Language
204-343 (3) Language Acquisition in Children
204-352 (3) Laboratory in Cognitive Psychology
204-353 (3) Laboratory in Human Perception
204-401 (3) Theories of Cognition
204-413 (3) Cognitive Development
204-470 (3) Memory and Brain
204-472 (3) Scientific Thinking and Reasoning
204-501 (3) Auditory Perception
204-540 (3) Computational Modelling of Reasoning

11.8 Computer Science (308)

McConnell Engineering Building, Room 318
3480 University Street
Montreal, QC H3A 2A7
Telephone: (514) 398-7071
Fax: (514) 398-3883
Email: ugrad-sec@cs.mcgill.ca
Website: http://www.cs.mcgill.ca

Director — Denis Thérien

Emeritus Professor
Christopher Paige

Professors
David M. Avis; B.Sc.(Wat.), Ph.D.(Stan.) *(on leave Winter 2000)*
Luc P. Devroye; M.S.(Louvain), Ph.D.(Texas)
Tim H. Merrett; B.Sc.(Queen's), D.Phil.(Oxon.)
Monroe M. Newborn; B.E.E.(R.P.I.), Ph.D.(Ohio St.), F.A.C.M.
Prakash Panangaden; M.Sc.(I.I.T. Kanpur), Ph.D.(Wis.)
Gerald F.G. Ratzer; B.Sc.(Glas.), M.Sc.(McG.)
Denis Thérien; B.Sc.(Montr.), M.Sc., Ph.D.(Wat.)
Godfried T. Toussaint; B.Sc.(Tulsa), Ph.D.(Br.Col.)

Associate Professors
Claude Crepeau; B.Sc., M.Sc.(Montr.) Ph.D.(M.I.T.)
Nathan Friedman; B.A.(W.Ont.), Ph.D.(Tor.)
Laurie Hendren; B.Sc., M.Sc.(Qu.), Ph.D.(C'nell)
Nazim Madhavji; B.Sc.(Essex), Ph.D.(Man.)
Carl Tropper; B.Sc.(McG.), Ph.D.(Brooklyn Poly.)
Sue Whitesides; M.S.E.E.(Stan.), Ph.D.(Wis.)

Assistant Professors
Xiao-Wen Chang; B.Sc., M.Sc.(Nanjing, Ph.D.(McG.)
Gregory Dudek; B.Sc.(Queen's), M.Sc., Ph.D.(Tor.)
Kaleem Siddiqi; B.Sc.(Lafayette), M.Sc., Ph.D.(Brown)

Lecturer
Alan Greenberg; M.Sc.(McG.)

Adjunct Professors
Renato De Mori, Petre Dini, Guang R.Gao, Syed Hyder, Vincent Van Dongen

The study of computer science encompasses everything from pure theory to hands-on applications including the analysis of algorithms, the study of computer architectures, compilers, databases, operating systems, networks and the study of software engineering.

The School currently operates a general purpose computing facility to support teaching, a large undergraduate workstation laboratory and seven dedicated laboratories for research in computational geometry and robotics, parallel processing, compilers, concurrent programming, software engineering, database systems, mobile robotics, and cellular automata.

The teaching facility consists of a network of over 50 Pentium workstations running the Linux operating system, 25 Pentium workstations running Windows NT, 4 SGI graphics workstations and 3 Power PC Macs. The facility also includes several compute engines including 3 SUN sparc20 servers. Dialup access is provided through the Computing Centre along with PPP network connections. For introductory courses most work is completed using the NT workstations and compute engines. All other courses use UNIX as a development environment.

The School of Computer Science offers a Majors program and an Honours program through the Faculty of Science, and a Minor program through the Faculties of Science and Engineering. The School also offers Major and Minor Concentrations through the Faculty of Arts. In conjunction with the Department of Mathematics and Statistics, the School offers a Joint Honours program, a Joint Majors program and two Faculty programs through the Faculty of Science. Special programs involving Computer Science are also available in the Faculties of Management, Engineering, and Music. For further details on programs outside the Faculty of Science, consult the other faculties' sections of this Calendar. *All students planning to enter Computer Science programs should make an appointment with an academic adviser through the School's Undergraduate secretary.*

Some graduate courses in Computer Science are available to suitably qualified senior undergraduates. The School also offers graduate research studies leading to M.Sc. and Ph.D. degrees. For further details, consult the Graduate Studies Calendar.

The School's courses are available as electives to Engineering students. Engineering students interested in a Minor in Computer Science should consult "Computer Science Courses and Minor Program" on page 259 in the Faculty of Engineering section.

An industrial internship year is available to Computer Science students. IYES, the Internship Year Program for Engineering and Science, is a pre-graduate work experience program for Computer Science students normally between their U2 and U3 years. See the Faculty of Engineering section 2.8 for further information on IYES.

MINOR PROGRAM IN COMPUTER SCIENCE (24 credits)
[MARS Program Code 6-265700]

The Computer Science Minor may be taken in conjunction with any program in the Faculties of Science and Engineering (with the exception of the other programs based on Computer Science) with the approval of the Adviser of the student's main program and the School of Computer Science. At the time of registration in the penultimate year, students must declare their intent to receive a Computer Science Minor and approval must be given by the School for the particular sequence of courses the student wishes to call the Computer Science Minor. All courses must be passed with a grade of C or better.

Students may receive credit towards their Computer Science Minor by taking certain approved courses outside the School of Computer Science. These courses must have a high computer science content. A student will not be permitted to receive more than six credits from such courses. These courses must be approved by the School of Computer Science in advance.

If a student's Major program requires Computer Science courses, up to six credits of Computer Science courses may be used to fulfill both Major and Minor requirements.

Required Courses (12 credits)

308-202A,B	(3)	Introduction to Computing I
308-203A,B	(3)	Introduction to Computing II
308-273A,B	(3)	Introduction to Computer Systems
308-302A,B	(3)	Programming Languages and Paradigms

Complementary Courses (12 credits)
selected from:

308-305A	(3)	Computer System Architecture
308-310B	(3)	Computer Systems and Organization
308-335B	(3)	Software Engineering Methods
308-350A	(3)	Numerical Computing
or189-317A	(3)	Numerical Analysis
308-360A	(3)	Algorithm Design Techniques
308-420A	(3)	Files and Databases
308-421B	(3)	Introduction to Database Systems
308-424A	(3)	Topics in Artificial Intelligence I
308-426B	(3)	Automated Reasoning
308-433A	(3)	Personal Software Engineering
308-505A	(3)	High-Performance Computer Architecture
308-506B	(3)	Advanced Analysis of Algorithms
308-507A	(3)	Computational Geometry
308-520B	(4)	Compiler Design
308-524B	(3)	Theoretical Found. of Prog. Languages
308-530A	(3)	Formal Languages
308-534B	(3)	Team Software Engineering
308-535A	(3)	Computer Networks
308-537B	(3)	Internet Programming
308-538B	(3)	Person-Machine Communication
308-540B	(3)	Matrix Computations
308-557B	(3)	Fundamentals of Computer Graphics
308-560A	(3)	Graph Algorithms and Applications
308-566A	(3)	Computer Methods in Operations Research
308-573A,B	(3)	Microcomputers
308-575A	(3)	Fundamentals of Distributed Algorithms

or from courses outside of the School approved by the adviser, to a maximum of 6 credits.

FACULTY PROGRAM IN MATHEMATICS AND COMPUTER SCIENCE See page 382 in the Mathematics and Statistics section for complete program information.

FACULTY PROGRAM IN MATHEMATICS, STATISTICS AND COMPUTER SCIENCE See page 382 in the Mathematics and Statistics section for complete program information.

MAJOR PROGRAM IN COMPUTER SCIENCE (60 credits)
[MARS Program Code 1-265700]

To enter the program, students must have completed 189-140 and 189-141, or their equivalents. 189-133, or its equivalent, may be taken prior to entry or concurrently with 308-250 during the first semester in the program. Freshman Program students interested in Computer Science should take 308-102. A student entering with insufficient programming background may take 308-202 but it will not count for program credit.

Required Courses (42 credits)

308-250A	(3)	Introduction to Computer Science
308-251A,B	(3)	Data Structures and Algorithms
308-273A,B	(3)	Introduction to Computer Systems
308-302A,B	(3)	Programming Languages and Paradigms
308-305A	(3)	Computer System Architecture
308-310B	(3)	Computer Systems and Organization
308-330A	(3)	Theoretical Aspects of Computer Science
308-350A	(3)	Numerical Computing
308-360A	(3)	Algorithm Design Techniques
189-222A,B	(3)	Calculus III
189-223A,B	(3)	Linear Algebra
189-240A	(3)	Discrete Structures and Computing
189-323A,B	(3)	Probability Theory
189-340B	(3)	Abstract Algebra and Computing

Complementary Courses (18 credits)
15 credits from:

308-335B	(3)	Software Engineering Methods
308-420A	(3)	Files and Databases
308-421B	(3)	Introduction to Database Systems
308-424A	(3)	Topics in Artificial Intelligence I
308-426B	(3)	Automated Reasoning
308-433A	(3)	Personal Software Engineering
308-505A	(3)	High-Performance Computer Architecture
308-506B	(3)	Advanced Analysis of Algorithms
308-507A	(3)	Computational Geometry
308-520B	(4)	Compiler Design
308-524B	(3)	Theoretical Foundations of Prog. Languages
308-531B	(3)	Theory of Computation
308-534B	(3)	Team Software Engineering
308-535A	(3)	Computer Networks
308-537B	(3)	Internet Programming
308-538B	(3)	Person-Machine Communication
308-540B	(3)	Matrix Computations
308-557B	(3)	Fundamentals of Computer Graphics
308-560A	(3)	Graph Algorithms and Applications
308-566A	(3)	Computer Methods in Operations Research
308-573A,B	(3)	Microcomputers
308-575A	(3)	Fundamentals of Distributed Algorithms
304-323A,B	(3)	Digital System Design

304-426A,B (3) Microprocessor Systems
304-531B (3) Real Time Systems
304-548A (3) Introduction to VLSI Systems

3 credits from Mathematics selected from:
189-314A,B (3) Advanced Calculus
189-315A,B (3) Ordinary Differential Equations
189-322B (3) Dynamical Systems, Fractals and Chaos
189-324A,B (3) Statistics
189-348A (3) Topics in Geometry
189-407B (3) Dynamic Programming
189-417A (3) Mathematical Programming
189-591B (3) Mathematical Logic I

JOINT MAJOR PROGRAM IN MATHEMATICS AND COMPUTER SCIENCE See page 383 in the Mathematics and Statistics section for complete program information.

HONOURS PROGRAM IN COMPUTER SCIENCE (72 credits)
[MARS Program Code 2-265700]

Honours students must maintain a CGPA of 3.0 and must have at least this average upon graduation as well.

Required Courses (45 credits)
all Major Program required courses, plus
308-400A,B (3) Technical Project and Report

Complementary Courses (27 credits)
24 credits from Major Program complementary courses
3 credits from Major Program complementary courses in Mathematics

JOINT HONOURS PROGRAM IN MATHEMATICS AND COMPUTER SCIENCE See page 385 in the Mathematics and Statistics section for complete program information. Students must consult an Honours adviser in both Departments.

MINOR IN COGNITIVE SCIENCE Students following Major or Honours programs in Computer Science may want to consider the Minor in Cognitive Science.

COURSE DESCRIPTIONS

The course credit weight is given in parentheses (#) after the course title.

● Denotes courses not offered in 1999-2000.
▭ Denotes courses with limited enrolment

Notes:

A. A student cannot receive credit for both 308-202 and 308-208. 308-202 is intended as a general introductory course, while 308-208 is intended for students interested in scientific computations. The credits for either of these courses will not count towards the 60-credit Major in Computer Science.

B. 308-203 and 308-250 are considered to be equivalent from a prerequisite point of view, and may not both be taken for credit. Computer Science Major and Honours students are strongly advised to take 308-250 insead of 308-203. They are also advised to take 189-240 with 308-250 (or with 308-202 or 308-203) but before 308-251.

C. A student cannot receive credit for both 308-330 and 308-530.

D. A student cannot receive credit for 308-102 if it is taken concurrently with, or after any of the following: 308-202, -203, -208, or -250.

E. 308-431 is restricted to students in Electrical Engineering. A student cannot receive credit for both 308-431 and 308-251, or for both 308-431 and 308-360 or 308-405.

F. Management students may not receive credit for both 308-202 and 635-300. Likewise, they may not receive credit for both 308-203 and 635-301.

308-102A COMPUTERS AND COMPUTING. (3) (2 hours lectures; 2 hours laboratory) (Prerequisite: high school level mathematics course on functions.) (For restrictions, see Note D.) A course for students with no previous knowledge of computer science who may be interested in further study. The structure of a computer; methodologies for problem solving – algorithm design and data structures, the limitations of computers. An introduction to programming in a high level language. **Professor Friedman**

▭ **308-199A EXCURSIONS IN COMPUTER SCIENCE.** (3) (3 hours) (Prerequisite: high school mathematics) (FYS - for first year students only, maximum 25.) This is a seminar format course intended for freshman and other beginning students. The topics are chosen to encourage critical discussion of fundamental ideas. Possible topics are computability, complexity, geometry, vision, AI, pattern recognition, machine models, cryptography and security and social implications of computing. **Professor Toussaint**

▭ **308-202A,B INTRODUCTION TO COMPUTING I.** (3) (3 hours) (Prerequisite: a CEGEP level mathematics course.) (For restrictions, see Notes A and F.) Overview of components of microcomputers, the internet, design and implementation of programs using a modern high-level language, and introduction to modular software design and debugging. Programming concepts are illustrated using a variety of application areas. **Professor Hendren**

308-203A,B INTRODUCTION TO COMPUTING II. (3) (3 hours) (Prerequisite: 189-133 and 308-202.) (For restrictions, see Notes B and F.) Basic data structures. Representation of arrays, stacks, and queues. Linked lists and their applications to binary trees. Internal sorting. Graph representation. Elementary graph algorithms. **Professors Avis and Friedman**

308-206A PROGRAMMING TECHNIQUES. (1) (3 hours) (Corequisiste: 308-203 or 308-250) Brief but comprehensive overview of programming in C. Language constructs, systems programming. **Staff**

308-208A,B COMPUTERS IN ENGINEERING. (3) (3 hours) (Prerequisite: differential and integral calculus. Co-requisite: linear algebra: determinants, vectors, matrix operations.) (For restrictions, see Note A.) Introduction to computer systems. Concepts and structures for high level programming. Elements of structured programming using FORTRAN 90 and "C". Assignments in both mainframe and microcomputer environment. Numerical algorithms such as root finding, numerical integration and differential equations. Non-numerical algorithms for sorting and searching. **Professor Ratzer**

308-250A INTRODUCTION TO COMPUTER SCIENCE. (3) (3 hours) (Prerequisites: Familiarity with a high level programming language and CEGEP level Math.) (For restrictions, see Note B.) An introduction to the design of computer algorithms, including basic data structures, analysis of algorithms, establishing correctness of programs and program testing. Overview of topics in computer science. **Professor Panangaden**

308-251A,B DATA STRUCTURES AND ALGORITHMS. (3) (3 hours) (Prerequisite: 308-250 or 308-203.) (For restrictions, see Notes B and E.) Design and analysis of algorithms. Complexity of algorithms. Data structures. Introduction to graph algorithms and their analysis. **Professor Devroye**

308-273A,B INTRODUCTION TO COMPUTER SYSTEMS. (3) (3 hours) (Prerequisite: 308-202. Corequisite: 308-250 or 308-203.) Computer structure, machine instruction execution, addressing techniques, digital representation of data. Assemblers, cross-assemblers and simulators. Interrupts. Input and output programming and devices. System support macros and software. Program segmentation and linkage. **Professor Dudek**

▭ **308-302A,B PROGRAMMING LANGUAGES AND PARADIGMS.** (3) (3 hours) (Prerequisite: 308-250 or 308-203) Programming language design issues and programming paradigms. Binding and scoping, parameter passing, lambda abstraction, data abstraction, type checking. Functional and logic programming. **Professors Friedman and Panangaden**

308-305A COMPUTER SYSTEM ARCHITECTURE. (3) (3 hours) (Prerequisite: 308-273) A functional description of computer hardware. Hardware concepts and current technology. Memories, memory hierarchies and dynamic address translation. CPU characteristics, performance factors, overlap, parallel and pipeline

systems. Microprogramming. Interrupt mechanism and clocks. Input/Output devices including telecommunications.
Mr. Greenberg

308-310B COMPUTER SYSTEMS AND ORGANIZATION. (3) (3 hours) (Prerequisite: 308-305) Control and scheduling of large information processing systems. Operating system software – resource allocation, dispatching, processors, access methods, job control languages, main storage management. Batch processing, multiprogramming, multiprocessing, time sharing. **Professor Tropper**

308-330A THEORETICAL ASPECTS OF COMPUTER SCIENCE. (3) (3 hours) (Prerequisite: 308-251. For Major and Honours students.) (For restrictions, see Note C.) Mathematical models of computers, finite automata, Turing machines, counter machines, push-down machines, computational complexity.
Professor Thérien

▭ **308-335B SOFTWARE ENGINEERING METHODS.** (3) (3 hours) (Pre/co-requisite: 308-302A.) This course in software engineering teaches basic concepts and methods for software development. The focus is on engineering and analysing requirements, design and code. Small software development exercises will be given where students would learn how to apply different methods. **Staff**

308-350A NUMERICAL COMPUTING. (3) (3 hours) (Prerequisites: 308-202 OR -208 OR -250, and 189-222 and -223, or equivalents.) Computer representation of numbers, IEEE Standard for Floating Point Representation, computer arithmetic and rounding errors. Numerical stability. Matrix computations and software systems. Polynomial interpolation. Least-squares approximation. Iterative methods for solving a nonlinear equation. Discretization methods for integration and differential equations. **Professor Chang**

308-360A ALGORITHM DESIGN TECHNIQUES. (3) (3 hours) (Prerequisite: 308-251.) (For restrictions, see Note E.) A study of techniques for the design and analysis of algorithms.
Professor Whitesides

308-400A,B TECHNICAL PROJECT AND REPORT. (3) (Prerequisites: 15 Computer Science credits. For Honours students.) A computer related project, typically a programming effort, along with a report will be carried out in cooperation with a staff member in the School of Computer Science. **Staff**

308-420A FILES AND DATABASES. (3) (3 hours) (Prerequisite: 308-302.) Language essentials for file processing; sequential files; sorting, updating, tree files; direct files; files of structured data; basics of relational databases. **Professor Merrett**

308-421B INTRODUCTION TO DATABASE SYSTEMS. (3) (3 hours) (Prerequisite: 308-420.) Database concepts. The relational, hierarchical and network models of data. Uses of implementations of the three data models. Data description languages. Data manipulation languages. Security, integrity and concurrency problems in databases. **Staff**

308-424A TOPICS IN ARTIFICIAL INTELLIGENCE I. (3) (3 hours) (Prerequisite: 308-203 or -250 or equivalent.) Introduction to search methods in AI problems. Mechanical theorem-proving techniques, game playing by computers, the minimax and alpha-beta algorithms, and heuristic approaches to state space search problems.
Professor Newborn

308-426B AUTOMATED REASONING. (3) (3 hours) (Prerequisites: 308-424; or 308-302 with 189-340.) Representing and reasoning with knowledge. The case for logics. Introduction to Logic Programming and, for example, PROLOG. Introduction to some Artificial Intelligence applications of Logic Programming: Meta-interpreters, Expert Systems and their implementation, Planning, Natural Language Processing, Machine Learning. **Staff**

308-431A ALGORITHMS AND DATA STRUCTURES. (3) (3 hours) (Prerequisites: 304-222 and 189-363.) (For restrictions, see Note E.) Advanced data structures: heaps, binary search trees, graphs, algorithmic analysis: space-time analysis, worst-case and expected complexity. Examples of searching sorting and merging. Algorithm design: divide-and-conquer, dynamic programming, greedy methods, backtracking. Algorithms: set manipulation, tree traversals. Memory management: hashing, dynamic storage allocation and garbage collection. **Staff**

▭ **308-433A PERSONAL SOFTWARE ENGINEERING.** (3) (3 hours) (Prerequisite: 308-335B.) This software engineering course teaches students how to develop, manage and improve their personal processes for developing software. Selected software development practices are introduced through 10 small programming exercises. The students then use these programs to analyse data on their personal performance, plan homework projects, and guide their process improvement. **Professor Madhavji**

308-505A HIGH-PERFORMANCE COMPUTER ARCHITECTURE. (3) (3 hours) (Prerequisites: 308-302 and 308-305 or equivalent.) Basic principles and techniques in the design of high-performance computer architecture. Topics include memory architecture: cache structure and design, virtual memory structures; pipelined processor architecture: pipeline control and hazard resolution, pipelined memory structures, interrupt, evaluation techniques; vector processing; RISC vs. CISC architectures; general vs. special purpose architectures; VLSI architecture issues. **Staff**

308-506B ADVANCED ANALYSIS OF ALGORITHMS. (3) (3 hours) (Prerequisite: 308-330 or 308-360 or 308-405 or 308-431.) The study of computational complexity and intractability: Cook's Theorem, NP-completeness, oracles, the polynomial hierarchy, lower bounds, heuristics, approximation problems.
Professor Whitesides

308-507A COMPUTATIONAL GEOMETRY. (3) (3 hours) (Prerequisite: 308-360 or 308-405 or equivalent or co-requisite 506.) Problems in computational geometry; worst-case complexity of geometric algorithms; expected complexity of geometric algorithms and geometric probability; geometric intersection problems; nearest neighbor searching; point inclusion problems; distance between sets; diameter and convex hull of a set; polygon decomposition; the Voronoi diagram and other planar graphs; updating and deleting from geometric structures. **Professor Toussaint**

308-520A COMPILER DESIGN. (4) (3 hours, 1 hour consultation) (Prerequisites: 308-273 and 308-302.) The structure of a compiler. Lexical analysis. Parsing techniques. Syntax directed translation. Run-time implementation of various programming language constructs.Introduction to code generation for an idealized machine. Students will implement parts of a compiler.
Professors Friedman and Hendren

308-524B THEORETICAL FOUND. OF PROG. LANGUAGES. (3) (3 hours) (Prerequisite: 308-302, and 189-340 or 189-235) Operational and denotational semantics of programming languages. Equivalence theorems for first-order languages. Lambda calculus. Type-inference, typed lambda calculus. Polymorphism. Elements of domain theory and fixed-point induction.
Professors Friedman and Panangaden

308-530A FORMAL LANGUAGES. (3) (3 hours) (Prerequisite: 308-203.) (For restrictions, See Note C.) The definition of a language. Grammars. Finite automata and regular languages. Context free languages. Pushdown automata. Turing machines and undecidable problems. Context sensitive and phrase-structure languages.
Professor Thérien

308-531B THEORY OF COMPUTATION. (3) (3 hours) (Prerequisite: 308-330.) Models for sequential and parallel computations: Turing machines, boolean circuits. The equivalence of various models and the Church-Turing thesis. Unsolvable problems. Model dependent measures of computational complexity. Abstract complexity theory. Exponentially and super-exponentially difficult problems. Complete problems. **Professor Thérien**

308-534B TEAM SOFTWARE ENGINEERING. (3) (3 hours) (Prerequisite: 308-433A or equivalent.) Team-work and team-processes for evolving software systems. Guided by defined processes, project teams will elicit new requirements, design code and test an enhanced software system. Team members will play various technical and managerial roles in carrying out their software project.
Professor Madhavji

308-535A COMPUTER NETWORKS. (3) (3 hours) (Prerequisite: 308-310.) Exposition of the first four layers of the ISO model for computer network protocols, i.e., the physical, data, network, and transport layers. Basic hardware and software issues with examples drawn from existing networks, notably SNA, DECnet, and ARPAnet. **Professor Tropper**

308-537B INTERNET PROGRAMMING. (3) (3 hours) (Prerequisite: 308-302 and 308-251) Sockets, User Datagram Protocol (UDP), Transmission utility protocals; Remote Terminal Protocol (Telnet), Simple Mail Transfer Protocol (SMTP), File Transfer Protocol (FTP) Hypertext Transfer Protrocol (HTTP), Internet resource database and search engines. Transactions and transaction processing systems and monitors. Distributed objects, Common Object Request Broker Architecture (CORBA) and OpenDoc. **Professor Merrett**

308-538B PERSON-MACHINE COMMUNICATION. (3) (3 hours) (Prerequisite: 308-424 or -425 or -426) Introduction to programming techniques and hardware design concepts that facilitate interaction between humans and computers. Theories and models for person-machine communication, object oriented Design and Software Engineering of interfaces. Natural language facilities. **Staff**

308-540B MATRIX COMPUTATIONS. (3) (3 hours) (Prerequisite: 189-327 or 308-350) Designing and programming reliable numerical algorithms. Stability of algorithms and condition of problems. Reliable and efficient algorithms for solution of equations, linear least squares problems, the singular value decomposition, the eigenproblem and related problems. Perturbation analysis of problems. Algorithms for structured matrices. **Professor Chang**

308-557B FUNDAMENTALS OF COMPUTER GRAPHICS. (3) (3 hours) (Prerequisite: 189-223, and 308-251 or -302.) The study of fundamental mathematical, algorithmic and representational issues in computer graphics. The topics to be covered are: overview of graphics process, projective geometry, homogeneous coordinates, projective transformations, quadrics and tensors, line-drawing, surface modelling and object modelling reflectance models and rendering, texture mapping, polyhedral representations, procedural modeling, and animation. **Professor Dudek**

308-560A GRAPH ALGORITHMS AND APPLICATIONS. (3) (3 hours) (Prerequisite: 308-360 or 308-405 or 308-431 or 189-343) Algorithms for connectivity, partitioning, clustering, colouring and matching. Isomorphism testing. Algorithms for special classes of graphs. Layout and embeddings algorithms for graphs and networks. **Professor Whitesides**

308-566A COMPUTER METHODS IN OPERATIONS RESEARCH. (3) (3 hours) (Prerequisites: 308-360 or 308-405 and 189-223) Use of the computer in solving deterministic problems in operations research. Linear programming and extensions. Efficient methods for large problems. Transportation problems. Network models. Integer programming. **Professor Avis**

308-573A,B MICROCOMPUTERS. (3) (3 hours) (Prerequisite: 308-305.) Characteristics and internal structure of microcomputers and workstations. Architectures of current CISC and RISC micro processors. Assembler and machine languages for microcomputers. System software. Applications for single and networked microcomputers. Students will be assigned "hands-on" projects. **Professor Ratzer**

308-575A FUNDAMENTALS OF DISTRIBUTED ALGORITHMS. (3) (3 hours) (Prerequisite: 308-310.) Study of a collection of algorithms which are basic to the world of concurrent programming. Discussion of algorithms from the following areas: termination detection, deadlock detection, global snapshots, clock synchronization, fault tolerance (byzantine and self-stabilizing systems). Students will implement algorithms on the BBN butterfly and will present papers on topics in these areas. **Professor Tropper**

11.9 Dietetics and Human Nutrition (382)

Please see the School of Dietetics and Human Nutrition entry beginning on page 428 in the Faculty of Agricultural and Environmental Sciences section for further information about the School's other courses, programs and academic staff.

382-307B HUMAN NUTRITION. (3) (Prerequisites: 180-212 and 177-201 or equivalents.) (Credit cannot be obtained for both 382-307 and 382-207.) Cellular and organismal aspects of nutrition with emphases on biochemical and physiological roles of carbohydrates, lipids, proteins, minerals and vitamins in disease prevention and promotion of optimal health. **Professor Jones**

11.10 Earth and Planetary Sciences (186)

Frank Dawson Adams Building, Room 238
3450 University Street
Montreal, QC H3A 2A7
Telephone: (514) 398-6767
Fax: (514) 398-4680
Email: carol@geosci.lan.mcgill.ca
Website: http://www.eps.mcgill.ca

Chair — A.E. (Willy) Williams-Jones

Emeritus Professors
Wallace H. MacLean; B.Geol.Eng.(Colorado Sch. of Mines), M.Sc.(Appl.), Ph.D.(McG.)
Eric W. Mountjoy; B.A.Sc.(U.B.C.), Ph.D.(Tor.) *(William E. Logan Emeritus Professor of Geology)*
Colin W. Stearn; B.Sc.(McM.), M.S., Ph.D.(Yale), F.R.S.C.

Professors
Jafar Arkani-Hamed; B.Eng.(Tehran), Ph.D.(M.I.T.)
Ron Doig; B.Sc., M.Sc., Ph.D.(McG.) *(Dawson Professor of Geology)*
Don M. Francis; B.Sc.(McG.), M.Sc.(U.B.C.), Ph.D.(M.I.T.)
Andrew J. Hynes; B.Sc.(Tor.), Ph.D.(Cantab.) *(William E. Logan Professor of Geology)*
Olivia G. Jensen; B.Sc., M.Sc., Ph.D.(U.B.C.)
Robert F. Martin; B.Sc.(Ott.), M.S.(Penn. State), Ph.D.(Stan.)
Alfonso Mucci; B.Sc., M.Sc.(Montr.), Ph.D.(Miami)
A.E. (Willy) Williams-Jones; B.Sc., M.Sc.(Natal), Ph.D.(Queen's)

Associate Professors
Don Baker; B.A.(Chic.), Ph.D.(Penn.)
Jeanne Paquette; B.Sc., M.Sc.(McG.), Ph.D.(Stonybrook)
Hojatollah Vali; B.Sc., M.Sc., Ph.D.(Munich) *(Director, Electron Microscopy Centre)*

The domain of Earth and Planetary Sciences includes the solid Earth and its hydrosphere and extends to the neighbouring terrestrial planets. It is a multidisciplinary field in which the principles of chemistry, physics, and mathematics are applied to the rich problems of the real world in order to understand how planets like the Earth work; in the past, the present, and the future.

Career opportunities are many and varied for graduates in the Earth and Planetary Sciences. There is presently a very strong demand for graduates with expertise in geology. Students graduating in this field are recruited for employment in the mining and petroleum industries, and in the environmental sector. In addition, government geological surveys employ goescientists. During the summer months undergraduate students are generally able to obtain employment from industry and government agencies, providing them with both financial benefits and first-hand geoscientific experience. Career opportunities in planetary science are presently limited to universities and research organizations.

The Department has a full-time staff of 11 professors and one faculty lecturer. There are approximately 50 graduate and 60 undergraduate students. Classes are therefore small at all levels, resulting in an informal and friendly atmosphere throughout the Department in which most of the faculty and students interact on a first name basis. Emphasis is placed equally on quality teaching and research providing undergraduate students with a rich and ex-

citing environment in which to learn and explore. The Department offers two entrance scholarships of $1,000 each to new undergraduate students. To be considered for one of these scholarships, new applicants should forward a copy of their transcript directly to the Department Chair.

The undergraduate curriculum is designed to provide both a rigorous foundation in the physical sciences and the flexibility to create an individualized program in preparation for careers in industry, teaching, or research. In addition to the Major and Honours undergraduate programs, the Department also offers a Joint Major in Physics and Geophysics which provides a rigorous mathematics and physics preparation and a geological background in the geosciences.

The Minor in Earth and Planetary Sciences offers Science students from other departments the opportunity to obtain exposure to the Earth Sciences while the Minor in Geochemistry is oriented towards Chemistry Major students who want to see the application of chemistry to problems in the Earth and Planetary Sciences.

Students interested in any of the programs should inquire at Room 238, Frank Dawson Adams Building, (514) 398-6767, or should consult the Undergraduate Director, Don Francis, Room 311, Frank Dawson Adams Building, (514) 398-4885, if they do not have an advisor.

MINOR PROGRAM IN EARTH AND PLANETARY SCIENCES
(18 credits) [MARS Program Code 6-480100]

Required Courses (7 credits)
186-210A (3) Mineralogy
186-212B (4) Petrology

Complementary Courses (11 credits)
186-201A (3) Understanding Planet Earth
or 186-233A (3) Earth & Life History
8 credits selected from:
186-203B (3) Structural Geology I
186-231E (2) Field School I
186-243A,B (3) Environmental Geology
186-334B (3) Invertebrate Palentology & Evolution
186-350B (3) Tectonics
186-430B (3) Geology of Energy Sources
186-451B (3) Hydrothermal Mineral Deposits
186-452A (3) Mineral Deposits
186-542A (3) Chemical Oceanography
177-352B (3) Vertebrate Evolution
Other Earth and Planetary Sciences courses may be substituted with permission.

MINOR PROGRAM IN GEOCHEMISTRY (25 credits)
[MARS Program Code 6-460000]

Required Courses (10 credits)
186-201A (3) Understanding Planet Earth
186-210A (3) Mineralogy
186-212B (4) Petrology

Complementary Courses (15 credits)
15 credits selected from:
186-220B (3) Principles of Geochemistry
186-243A,B (3) Environmental Geology
186-501A (3) Crystal Chemistry
186-519A (3) Isotope Geology
186-542A (3) Chemical Oceanography
186-545B (3) Low-Temperature Geochemistry & Diagenesis

MAJOR AND HONOURS PROGRAMS IN EARTH AND PLANETARY SCIENCES
[MARS Program Codes: Major 1-480100; Honours 2-480100]
Undergraduate Director: Don Francis, FDA 311, (514) 398-4885

Common U1 Year:

Required Courses (27 credits)
186-210A (3) Mineralogy
186-220A (3) Principles of Geochemistry
186-233A (3) Earth and Life History
189-222A (3) Calculus III
186-203B (3) Structural Geology
186-212B (4) Petrology
186-312B (3) Spectroscopy of Minerals
186-320B (3) Elementary Earth Physics
186-231C (2) Field School I

Note: Students intending to take the Honours Planetary Sciences Program in U2 must also take 189-223B Linear Algebra.

Note: Students who have not had the equivalent in CEGEP or the Freshman Program may be required to take 189-133A,B Vectors, Matrices and Geometry.

U2 and U3: MAJOR PROGRAM IN EARTH AND PLANETARY SCIENCES (66 credits in total)

Students who began their programs prior to 1996-97 should refer to the 1995-96 Calendar for program requirements.

Required Courses (21 credits)
186-350B (3) Tectonics
186-423B (3) Igneous Petrology
186-425A (3) Depositional Environments & Sequence Stratigraphy
186-445B (3) Metamorphic Petrology
186-452A (3) Mineral Deposits
186-519A (3) Isotope Geology
186-331C (3) Field School II
or 186-341C (3) Field School III

Complementary Courses (18 credits)
3 credits of statistics, course to be approved by EPS Academic Advisor
plus15 additional credits approved by EPS Academic Advisor

U2 and U3: HONOURS IN EARTH SCIENCES PROGRAM
(CGPA ≥3.2) (75 credits in total) [MARS Program Code 2-480200]

Required Courses (33 credits)
186-350B (3) Tectonics
186-423B (3) Igneous Petrology
186-425A (3) Depositional Environments & Sequence Stratigraphy
186-445B (3) Metamorphic Petrology
186-452A (3) Mineral Deposits
186-480D (6) Honours Research Project
186-519A (3) Isotope Geology
186-331C (3) Field School II
or 186-341C (3) Field School III
189-314A (3) Advanced Calculus
189-315A (3) Ordinary Differential Equations

Complementary Courses (15 credits)
3 credits of statistics, course to be approved by EPS Academic Advisor
plus12 additional credits approved by EPS Academic Advisor

U2 and U3: HONOURS IN PLANETARY SCIENCES PROGRAM
(CGPA ≥3.2) (77 credits in total) [MARS Program Code 2-480300]

Required Courses (42 credits)
186-330B (3) Earthquakes & Earth Structure
186-350B (3) Tectonics
186-423B (3) Igneous Petrology
186-480D (6) Honours Research Project
186-510A (3) Global Geodynamics & Geomagnetism
186-519A (3) Isotope Geology
186-570B (3) Cosmochemistry
189-314A (3) Advanced Calculus
189-315A (3) Ordinary Differential Equations
189-317A (3) Numerical Analysis
189-319B (3) Partial Differential Equations
198-251A (3) Classical Mechanics
or 198-230A (3) Dynamics of Simple Systems
198-340B (3) Electricity & Magnetism

Complementary Courses (9 credits)
To be approved by EPS Academic Advisor

JOINT MAJOR PROGRAM IN PHYSICS AND GEOPHYSICS
See page 399 in the Physics section for complete program information.

COURSE DESCRIPTIONS

The course credit weight is given in parentheses (#) after the course title.

● Denotes courses not offered in 1999-2000.

The following courses are without prerequisite and could be taken by students in the Faculty of Arts: 186-200A,B; 186-201A,B; 186-202A; 186-233A; and 186-243A,B. Other courses assume as a prerequisite completion of the courses required in the Sciences option of the CEGEP curriculum.

186-200A,B THE TERRESTRIAL PLANETS. (3) (3 hours lectures) A comparative survey of the planets of our solar system with an emphasis on the terrestrial planets and their implications for the Earth as a planet. Topics include: structure and origin of the solar system, meteorites, and comparisons of the terrestrial planets in terms of their rotational properties, magnetic fields, atmospheres, surface histories, internal structure, chemical composition, volcanism, and tectonics. **Staff**

186-201A,B UNDERSTANDING PLANET EARTH. (3) (3 lectures; afternoon field trips) Geological time and methods of dating. Paleomagnetism, seismology and structure of the Earth's interior. Continental drift, sea-floor spreading, and global plate tectonics. Evolution of continental margins. Minerals and rocks. Heat flow, metamorphism and igneous petrology. Economic geology. Geosynclines, mountain building and orogeny. Geology of the moon, Earth's place in the universe. **Staff**

186-202A INTRODUCTION TO GEOLOGY – LABORATORY. (1) (3 hours laboratory) (Corequisite: 186-201A.) Identification of minerals and rocks; interpretation of geological maps and cross-sections. **Staff**

186-203B STRUCTURAL GEOLOGY I. (3) (2 hours lectures, 3 hours laboratory) Primary igneous and sedimentary structures, attitudes of planes and lines, stress and strain, fracturing of rocks, faulting, homogeneous strain, description and classification of folds, foliation and lineation, orthographic and stereographic projections. **Professor Hynes**

186-205A ASTROBIOLOGY. (3) (3 hours lectures) (Not open to students who have taken or are taking 504-205A.) Astrobiology is the search for the origin, evolution and destiny of life in the universe. The course will provide insight into the formation and evolution of habitable worlds, the evolution of life and the biogeochemical cycles in the Earth's oceans and atmosphere, and the potential for biological evolution beyond an organism's planet of origin. **Professor Vali**

186-210A INTRODUCTION TO MINERALOGY. (3) (2 hours lecture, 3 hours laboratory) Crystal chemistry and identification of the principal rock-forming and ore minerals. Elementary crystallography. Optional 2-day field trip. **Professor Paquette**

186-212B INTRODUCTORY PETROLOGY. (4) (3 hours lecture, 3 hours laboratory) (Prerequisite: 186-210A) Survey course of igneous, sedimentary and metamorphic rocks and the processes leading to their formation. Emphasis in the laboratory on hand-specimen description and classification, supplemented by thin sections. **Professor Francis**

● **186-215B ANALYSIS OF GEOLOGICAL DATA.** (3) (3 lectures, and problems) (Note: Credit for other statistics courses may preclude credit for this course and conversely. See "Course Overlap" on page 339.)

186-220A PRINCIPLES OF GEOCHEMISTRY. (3) (2 lectures, 3 hours laboratory) (Prerequisites: 186-201A, -210A) Basic concepts in geochemistry and the application of geochemical principles of chemistry to geological subdisciplines. Particular emphasis on origin of elements, controls on their distribution in Earth and cosmos, isotopes, organic geochemistry and water chemistry. Application of phase diagrams to geology. **Professors Mucci and Baker**

186-231C FIELD SCHOOL I. (2) (Two-week field school in May) (Prerequisite: 186-203B, 186-212B, or equivalent.) Geological mapping of selected areas, preparation of maps, reports from field notes, aerial photographs, etc. **Professor Hynes**

186-233A EARTH AND LIFE HISTORY. (3) (3 lectures) Interpretation of stratified rocks; history of Earth with special emphasis on the regions of North America; outline of the history of life recorded in fossils. **Staff**

186-243A,B ENVIRONMENTAL GEOLOGY. (3) (3 hours lectures) Introduction to the relationship of geological processes and materials to the human environment; geologic hazards; hydrogeology; impacts of waste disposal, energy use, land resource development. **Professor Baker or Staff**

186-312B SPECTROSCOPY OF MINERALS. (3) (6 hours laboratory and relevant in-lab lectures) (Prerequisite: 186-210A) Interaction of minerals with electromagnetic radiation. Optical mineralogy on thin and polished sections. Demonstrations of other spectroscopic techniques applied to the identification of minerals and to the analysis of their composition and structure. **Professor Paquette**

186-320B ELEMENTARY EARTH PHYSICS. (3) (3 hours lectures) (Prerequisite: 189-222A,B) Physical properties of Earth and the processes associated with its existence as inferred from astronomy, geodesy, seismology, geology, terrestrial magnetism and thermal evolution. **Professor Arkani-Hamed**

● **186-330B EARTHQUAKES & EARTH STRUCTURE.** (3) (3 hours lectures, tutorial as required) (Prerequisites: 189-314B, 186-320A. Corequisites: 189-319)

● **186-331C FIELD SCHOOL II.** (3) (Two-week field school in May.)

● **186-334B INVERTEBRATE PALEONTOLOGY AND EVOLUTION.** (3) (2 lectures and one laboratory period)

186-341C FIELD SCHOOL III. (3) (Prerequisites: 186-210A, -203B, -212B and -231E or permission of the instructor.) A field school which will be given in May in alternate years to 186-331E. The course examines sedimentary strata in the St. Lawrence low lands, igneous rocks of the Monteregian intrusions, and metamorphic rocks in the Grenville Province near Ottawa. **Staff**

● **186-350B TECTONICS.** (3) (Prerequisites: 186-320A, Calculus III or equivalent.)

● **186-401B ADVANCED ENVIRONMENTAL GEOLOGY.** (3 credits, 1 lecture, 2 seminar) (Prerequisite: 186-220B or 180-204A or equivalent. Corequisite: 186-580A)

● **186-402C ENVIRONMENTAL FIELD SCHOOL.** (2) (1 laboratory, 2 other) (Prerequisites: 186-220B or 180-204A or equivalent.)

● **186-405A PLANETARY GEOLOGY.** (3) (3 lecture) (Prerequisites: 186-210A, -203B, -212B or permission of the instructor.)

186-423B IGNEOUS PETROLOGY. (3) (2 hours lectures, 3 hours laboratory) (Prerequisites: 186-212B, 312B) Physical properties, nucleation, crystallization, differentiation and emplacement of magmas. Integrated studies on various rock suites. **Professor Martin**

● **186-425A DEPOSITIONAL ENVIRONMENTS & SEQUENCE STRATIGRAPHY.** (3) (2 lecture, 3 laboratory) (Prerequisites: 186-210A, -212B)

● **186-430A GEOLOGY OF ENERGY SOURCES.** (3) (2 lecture and 2 hours laboratory or seminar) (Corequisite: 186-425A or permission of the instructor.)

186-435A EXPLORATION & ENVIRONMENTAL GEOPHYSICS. (3) (3 hours lecture) (Prerequisites: Calculus III, Linear Algebra and 186-320A Elementary Earth Physics or equivalents.) Methods in geophysical surveying including gravity, magnetism, electromagnetism, resistivity and induced polarisation, seismology and radioactivity; applications to oil and mineral exploration and near surface environmental and hydrological targets. **Professor Jensen**

● **186-445B METAMORPHIC PETROLOGY.** (3) (Prerequisites: 186-212B, 303A, 312B)

● **186-451B HYDROTHERMAL MINERAL DEPOSITS.** (3) (Prerequisite: 186-220B)

● **186-452A MINERAL DEPOSITS.** (3) (Prerequisite: 186-312B, 220B)

186-480D HONOURS RESEARCH PROJECT. (9) (For Honours students in 3rd year.) A written proposal outlining the studies to be undertaken must be submitted to the undergraduate Student Adviser by May 1st of the U-2 year. The proposal will be reviewed by a committee and a decision forwarded by mail. If approved the investigation will be supervised by a staff member, and the results must be presented in the form of an undergraduate thesis. **Staff**

186-482A,B,D INDEP. STUDIES IN EARTH & PLANETARY SCIENCES. (3) (May not be taken concurrently with 186-480D.) Research and/or reading project enabling independent study under the guidance of qualified staff in areas of special interest to the student. A statement of the proposed project and the method of evaluation must be approved by the Department curriculum committee before commencement of the course. This statement will be included in the student's file. **Staff**

● **186-483D INDEP. STUDY IN ENVIRONMENTAL GEOLOGY.** (3) (To be taken concurrently with 182-500D.)

186-501B CRYSTAL CHEMISTRY. (3) (2 hours lectures, 1 hour seminar) (Prerequisite: 180-203A or 180-213A,B) Discussion of crystal structures and compositions of important mineral groups, especially oxides, sulphides and silicates. Solid solution. Relation of structure to morphology and to chemical and physical properties of the rock-forming minerals. **Professors Martin and Paquette**

186-510B GLOBAL GEODYNAMICS AND GEOMAGNETISM. (3) (3 lecture) (Prerequisites: 186-320A, 189-319B or permission of the instructor. Corequisite: 186-350B.) The gravity field of the Earth and planets, body and orbital dynamics the Earth, moon and planets, tidal interactions of the Earth-moon-sun system, deformation of the Earth under static and dynamic loads, the magnetic field of the Earth and planets: the magnetosphere, the external radiation belts, magnetohydrodynamic models of the core dynamo, geochemical convection in the core, fluid dynamic motions of the outer core, dynamics of the inner core. **Professor Arkani-Hamed**

● **186-519A ISOTOPE GEOLOGY.** (3) (3 lectures) (Prerequisites: U2 core program.)

● **186-540B PHANEROZOIC GEOLOGY OF NORTH AMERICA.** (3) (2 hours lectures, 3 hours laboratory) (Prerequisite: U2 Major sequence. Corequisite: U3 Major sequence.)

● **186-542A CHEMICAL OCEANOGRAPHY.** (3) (Prerequisites: 180-213A,B, 180-257D or equivalents, or registration in Graduate Program in Oceanography.)

● **186-545B LOW-TEMPERATURE GEOCHEMISTRY & DIAGENESIS.** (3) (Prerequisites 180-203A/213B, 186-212B, -312B)

● **186-546A DIAGENESIS OF SEDIMENTARY ROCKS.** (3) (2 lecture, 3 laboratory/seminars) (Prerequisites: 186-212B, -220B, -312A)

● **186-547A THERMOCHEMISTRY OF HIGH-TEMPERATURE GEOLOGICAL SYSTEMS.** (3) (2 hours lectures, 3 hours laboratory) (Prerequisites 180-203/4 or 180-213, or permission of instructor.)

186-548A MECHANISMS OF IGNEOUS PETROGENESIS. (3) (2 hours lecture, 1 hour seminar) (Prerequisite: 186-423B) Investigation of the primary mechanisms causing the diversity of igneous rock compositions on the Earth, other planets, asteroids, and meteorite parent bodies. **Professor Baker**

● **186-549B HYDROGEOLOGY.** (3) (3 hours lecture, 1-2 hours laboratory) (Prerequisite: permission of the instructor.)

186-550A SELECTED TOPICS IN EARTH AND PLANETARY SCIENCES I. (3) (2 hours seminar, permission of department undergraduate adviser.) Research seminar and readings in topics concerning some aspects of current development in geological sciences. **Staff**

186-551B SELECTED TOPICS IN EARTH AND PLANETARY SCIENCES II. (3) (2 hours seminar, permission of department undergraduate adviser.) Research seminar and readings in topics concerning some aspects of current development in geological sciences. **Staff**

186-570B COSMOCHEMISTRY. (3) (3 hours lecture) (Prerequisites: 186-220B, -210A or permission of instructor.) Examines the implications of phase equilibria and the compositions of meteorites and the solar system for the formation and internal differentiation of the terrestrial planets and the nature of chemical fractionation processes in both planetary interiors and the solar system as a whole. **Professors Francis and Baker**

186-580A AQUEOUS GEOCHEMISTRY. (3) (3 hours lecture) (Prerequisites: 186-210A, 186-212B or permission of instructor.) The use of chemical thermodynamics to study fluid-rock interations with an emphasis on the aqueous phase. The course will introduce basic concepts and will discuss aqueous complexation, mineral surface adsorption, and other controls on crustal fluid compositions. Applications will range from considering contaminated groundwater systems to metamorphic reactions. **Professor Mucci**

● **186-590B APPLIED GEOCHEMISTRY SEMINAR.** (3) (3 hours seminar) (Prerequisite: permission of instructor.)

The following courses are offered by the Department of Earth and Planetary Sciences for Faculty of Engineering students:

186-221A GENERAL GEOLOGY. (3) (3 hours lecture, 3 hours laboratory) A survey course in physical geology with emphasis on engineering and economic aspects. **Staff**

186-225A PROPERTIES OF MINERALS. (1) (1 hour lecture, 1 hour laboratory) (Not open to students who have taken 186-210A) Survey of the physical and chemical properties of the main mineral groups. Discussion of their relationships to the chemical composition and structure of minerals. The practical exercises emphasize the physical and chemical properties that relate to industrial uses and environmental issues, and the identification of hand specimens. **Professor Paquette**

11.11 Environmental Studies

Science students who are interested in studying the environment should refer to the McGill School of Environment section, page 457, where they will find information concerning the Minor, the Major, and the Diploma in Environment.

11.12 Experimental Medicine (516)

Experimental Medicine is a division of the Department of Medicine. Information regarding these courses may be obtained by calling the telephone numbers indicated below:

516-401 – (514) 842-1231, ext. 5738
516-502 and 516-503 – (514) 842-1231, ext. 5243 or 5833
516-504 – (514) 934-8038
516-506 – (514) 937-6011, ext. 2908
516-507 and 516-508 – (514) 398-3864, ext. 3249
516-509 – (514) 937-6011, ext. 8093
516-510 – (514) 937-6011, ext. 3022
516-511 – (514) 398-3466
516-512 – (514) 987-5550

516-401B PHYSIOLOGY AND BIOCHEMISTRY OF ENDOCRINE SYSTEMS. (3) (Prerequisite: 177-200A and 177-201B) Offered in conjunction with the Department of Physiology. The course provides a basic knowledge of endocrine systems encompassing biosynthesis, metabolism and physiological actions of hormones. Specific topics covered are hormones of the hypothalamus, pituitary, adrenals, thyroids, parathyroids, pancreas, gut and the gonads. The role of hormones and growth factors in pregnancy and fetal development are also discussed. **Professors Mulay, Cianflone and Staff**

516-502A ADVANCED ENDOCRINOLOGY – PART I. (3) (Prerequisite: 516-301A or an equivalent course.) This course is designed for U3

students who are in a major or honours program in anatomy, biology, biochemistry or physiology and for graduate students. A multidisciplinary approach will be used to teach biosynthesis and processing of hormones, their regulation, function and mechanism of action. The material will cover hypothalamic, pituitary, thyroid, atrial and adrenal hormones as well as prostaglandins and related substances. **Professors Bennett, Bateman and Staff**

516-503B ADVANCED ENDOCRINOLOGY – PART II. (3) (Prerequisite: 516-502A) Study of the parathyroids, gut and pancreatic hormones and growth factors. In addition, the role of hormones and growth factors in reproduction and fetal maturation will be discussed. **Professors Bennett, Bateman and Staff**

516-504A BIOLOGY OF CANCER. (3) (Prerequisite: A good knowledge of biology at the cellular and molecular level. Open to U3 and graduate students only.) An introduction to the biology of malignancy. A multidisciplinary approach dealing with the etiology of cancer, the biological properties of malignant cells, the host response to tumour cell growth and the principles of cancer therapy. **Professor Thomson and Staff**

516-506B ADVANCED CARDIOVASCULAR PHYSIOLOGY. (3) (Prerequisite: 552-313B or by permission of Instructors.) Offered in conjunction with the Department of Physiology. Current topics, methods and techniques for studying the cardiovascular system. Basic and applied cardiac electrophysiology, mechanisms of pacemaker activity, arrhythmias, the effects of drugs on cardiac functions, fetal circulation, coronary circulation, mechanics of blood flow, cardiovascular diseases, renal and neural control of the circulation, and cardiac assist devices. **Professors Goldsmith and Shrier**

516-507A ADVANCED APPLIED RESPIRATORY PHYSIOLOGY. (3) (Prerequisite: 552-313B) Offered in conjunction with the Department of Physiology. In depth coverage of respiratory biology including: functional anatomy of the respiratory system, pulmonary statics and dynamics, chest wall and respiratory muscles, ventilation and perfusion, control of breathing, and defense mechanisms. This course is aimed at providing a solid grounding in pulmonary biology and its research applications. **Professors Fixman and Grassino**

516-508B ADVANCED TOPICS IN RESPIRATION. (3) (Prerequisite: 516-507A) Offered in conjunction with the Department of Physiology. In depth coverage of developmental physiology, pulmonary vascular physiology, biology of airway smooth muscle, respiratory epithelium and molecular biology of respiratory muscles. Dyspnea, mechanical ventilation and respiratory failure will also be covered. This course emphasizes application of respiratory biology to basic and applied research and touches on pulmonary pathophysiology. **Professors Fixman and Grassino**

516-509B GASTROINTESTINAL PHYSIOLOGY AND PATHOPHYSIOLOGY. (3) (Prerequisite: Graduate students, U3 undergraduates.) Course deals with various aspects of gastrointestinal and hepatic function in health and altered physiological states. The principal focus is on the recent literature pertaining to cell and molecular mechanisms underlying the motility secretory process, absorption and secretion. The molecular biology of the hepatic viruses and various aspects of colonic neoplasia will also be considered. **Professors Wild and Barkun**

516-510A BIOANALYTICAL SEPARATION METHODS. (3) The student will be taught the capabilities and limitations of modern separation methods (gas and high-performance liquid chromatography, capillary electrophoresis, hyphenated techniques). Application of these techniques to solve analytical problems relevant to biomedical research will be emphasized, with special attention being paid to the processing of biological samples. **Professor Wainer and Staff**

516-511B JOINT VENTURING WITH INDUSTRY. (3) (Offered in conjunction with the Centre for Continuing Education.) Using problem-based learning, the course examines the various business interactions between researchers and their business partners in support and development of research into commercial endeavours using models such as venture capital, business partnerships, or grants-in-aid. **Professors Price and Yalovsky**

516-512C RECENT PROGRESS IN AIDS RESEARCH. (6) Interdisciplinary seminar course on basic, clinical, epidemiological and psychosocial aspects of HIV infection. Topics include: the pathophysiology of HIV-associated immunodeficiency; review of current antiviral treatment and mechanisms of resistance to anti-HIV drugs; sessions on the natural history, clinical manifestations and general aspects of treatment interventions, as pertaining to different populations. (Awaiting University Approval) **Professor Sekaly and Staff**

11.13 Geography (183)

Burnside Hall, Room 705
805 Sherbrooke Street West
Montreal, QC H3A 2K6
Telephone: (514) 398-4111
Fax: (514) 398-7437
Website: http://www.geog.mcgill.ca

Chair — G.O. Ewing

Emeritus Professor
B.J. Garnier; M.A.(Cantab.)

Professors
W.R. Armstrong; M.A., Ph.D.(Vic., Wellington), M.Sc.(Lond.)
T.R. Moore; B.Sc.(Swansea), Ph.D.(Aberd.)
N.T. Roulet; B.Sc., M.Sc.(Trent), Ph.D.(McM.)

Associate Professors
P.G. Brown; B.A.(Haverford), M.A., Ph.D.(Col.) *(joint appt. with McGill School of Environment)*
G.L. Chmura; B.Sc.(Mass.), M.Sc.(R.I.), Ph.D.(L.S.U.)
O.T. Coomes; B.Sc.(U.Vic.), M.A.(Tor.), Ph.D.(Wis.)
G.O. Ewing; M.A.(Glas.), M.A., Ph.D.(McM.)
M.F. Lapointe; B.Sc., M.Sc.(McG.), Ph.D.(Br.Col.)
J.E. Lewis; M.A.(Ind.), Ph.D.(Ill.)
T.C. Meredith; B.E.S.(Wat.), M.Sc., Dip.Cons.(Lond.), Ph.D.(Camb.)
L. Müller-Wille; Dr.phil.(Münster)
W.H. Pollard,; B.A., M.Sc.(Guelph), Ph.D.(Ott.)
G.W. Wenzel; Ph.D.(McG.); Geography

Assistant Professors
W.M. Brown; B.A.(St.M.), M.A.(McM.)
B.K. Ray; B.E.S.(Wat.), M.A.(Tor.), Ph.D.(Queen's)

The Department of Geography offers programs in both Arts and Science. To avoid duplication, course descriptions that are of special interest to Arts students are provided in the Geography entry in the Faculty of Arts section. Many Science students choose to take some of these courses. All B.A. programs in Geography (including Urban Systems) are listed in the Faculty of Arts entry, beginning on page 86.

Geography is the study of physical environments and human habitats. It deals with people and places. It covers issues such as global warming and climate change, regional economic disparities, urban transportation, native land claims and permafrost problems. Both a physical and a social science, it provides a unique opportunity to obtain a broad exposure to modes of analysing the many environmental and locational problems of contemporary society.

The World Commission on Environment and Development has identified the evidence and possible consequences of currently widespread land use practices which cannot be sustained. Geography is an integrative discipline concerned with the relations between culture systems and resource bases. Students interested in understanding, or working towards the resolution of, the environmental "crisis" should select courses which deal with (1) the dynamics of natural systems (courses in the physical geography of terrestrial, atmospheric and hydrological systems); (2) the dynamics of human systems (courses in cultural, social, economic, political and urban geography); (3) the context of development and land use changes; and (4) practical skills such as Geographical In-

formation Systems, cartography, remote sensing, image analysis and resource management.

Students may pursue programs focusing on urban systems, the geography of economic development, people and their natural environment, the geography of living systems. The interdisciplinary Minor in Environment is also available to students in Arts or Science. Students planning to enter a program in Geography should telephone (514) 398-4111 for an appointment with an adviser and should consult the *Department of Geography Undergraduate Handbook,* which is available from the departmental office.

Graduates find employment in a wide range of industrial and commercial activities, as well as in government and education. Others pursue graduate work in geography or urban planning.

PREREQUISITES

There are no departmental prerequisites for entrance to the B.Sc. Geography programs. Students who have completed college or pre-university geography courses fully equivalent to those in the first year of university may, with an adviser's approval, substitute other courses as part of their program.

MINOR PROGRAM IN GEOGRAPHY (expandable into the B.Sc. Major in Geography) (18 credits) [MARS Program Code 6-450000]

The Minor in Geography is designed to provide students in the Faculty of Science with an overview of basic elements of geography at the introductory and advanced level.

This Minor permits no overlap with any other programs.

Required Courses (12 credits)

183-203	(3)	Environmental Systems
183-216	(3)	Geography of the World Economy
183-217	(3)	The Canadian City
183-302	(3)	Environmental Analysis and Management: Problems and Policy

Complementary Courses (6 credits)
6 credits of Geography courses at the 300 and 400 level.

B.Sc. MAJOR PROGRAM IN GEOGRAPHY (58 credits)
[MARS Program Code 1-450000]

The Major is designed to provide a coverage of the main elements of physical geography.

Required Courses (25 credits)
Geography

183-201	(3)	Geographic Information Systems I
183-203	(3)	Environmental Systems
183-216	(3)	Geography of the World Economy
183-217	(3)	The Canadian City
183-272	(3)	Landforms & Environmental Systems
183-302	(3)	Environmental Analysis and Management
183-351	(3)	Quantiative Methods in Geography (AUA)
183-290	(1)	Local Geographical Excursion (In 1999 reserve Sept. 24-26)

Mathematics

189-203	(3)	Principles of Statistics I

Complementary Courses (33 credits)
3 credits from GIS techniques:

183-306	(3)	Geographic Information Systems II
183-308	(3)	Remote Sensing

12 credits from systematic physical geography:

183-305	(3)	Soils and Environment
183-321	(3)	Climatic Environments
183-322	(3)	Environmental Hydrology
183-350	(3)	Ecological Biogeography
183-372	(3)	Running Water Environments

3 credits from field courses:

183-495C	(3)	Field Studies - Physical Geography
183-496B	(3)	Regional Geographical Excursion
183-497T	(3)	Coastal Marsh Plant Ecology
183-499T	(3)	Subarctic Field Studies: Schefferville

(Field course availability is determined each year in February.)

15 credits from **approved** courses
in Geography, or elsewhere in the Faculty of Science, or in the Faculty of Engineering; at least 9 credits of which are to be taken outside Geography. Students may also include any courses that are not already counted towards the GIS techniques or the systematic physical geography requirements. Admission to 500-level courses in Geography requires the instructor's permission. It is not advisable to take more than one 500-level course in a semester.

B.Sc. HONOURS PROGRAM IN GEOGRAPHY (67 credits)
[MARS Program Code 2-450000]

The Honours program is designed to provide specialized systematic training in physical geography. The student must maintain marks of B or higher and must complete a 6-credit research paper. Honours students are encouraged to participate in 500-level seminars with graduate students, but it is not advisable to take more than one in a semester.

Required Courses (34 credits)
25 credits of introductory courses
(see B.Sc. Major program in Geography)
9 credits of research and thesis courses:

183-381	(3)	Evolution of Geography
183-491D,N	(6)	Honours Research and Reading

Complementary Courses (33 credits)
from the same list as for the B.Sc. Major Program in Geography.

ENVIRONMENTAL STUDIES COURSES

See the McGill School of Environment section for other courses that may be relevant to Geography programs.

COURSE DESCRIPTIONS

To avoid duplication, course descriptions that are of special interest to Arts students are provided in the Geography entry in the Arts section 11.18 beginning on page 86. Many Science students choose to take some of these courses.

The course credit weight is given in parentheses (#) after the course title.

● Denotes courses not offered in 1999-2000.
▭ Denotes Limited Enrolment.

▭ **183-199A PEOPLE, PLACE AND ENVIRONMENT.** (3) (FYS – for first year students only, maximum 25. Closed to Geography Majors.) Geography studies the complex but crucial relationships between people and their physical and socio-cultural environments. The course is constructed around field trips and preparatory seminars which provide an opportunity for students to learn about a variety of physical environments and their utilisation. (Awaiting University Approval)

● ▭ **183-190A ENVIRONMENTAL PERSPECTIVES.** (1) (FYS – for first year, non-Geography students only, maximum 25.)

183-200A GEOGRAPHICAL PERSPECTIVES ON WORLD ENVIRONMENTAL PROBLEMS. (1) (3 hours)

183-201B GEOGRAPHIC INFORMATION SYSTEMS I. (3) (3 hours and lab) (Priority for first-year Geography Majors and Honours.) An introduction to Geographic Information Systems. The systematic management of spatial data. The use and construction of maps. The use of microcomputers and software for mapping and statistical work. Air photo and topographic map analyses.

Professors Lewis and Ewing

183-203A ENVIRONMENTAL SYSTEMS. (3) (3 hours) (Not open to B.A. students in Freshman year.) An introduction to system-level interactions among climate, hydrology, soils and vegetation at the scale of drainage basins, including the study of the global geographical variability in these land-surface systems. The knowledge acquired is used to study the impact on the environment of various human activities such as deforestation and urbanisation.

Professors Chmura, Lapointe and Roulet

183-205B GLOBAL CHANGE: PAST, PRESENT AND FUTURE. (3) (3 hours) An examination of global change, from the Quaternary Period to the present day involving changes in the physical geography of specific areas. Issues such as climatic change and land degradation will be discussed, with speculations on future environments. **Professors Chmura and Moore**

183-216A GEOGRAPHY OF THE WORLD ECONOMY. (3) (3 hours)

183-217B THE CANADIAN CITY. (3) (3 hours)

183-272B LANDFORMS & ENVIRONMENTAL SYSTEMS. (3) (3 hours) Introduction to the study of landforms as products of geomorphic and geologic systems acting at and near the Earth's surface. The process geomorphology approach will be used to demonstrate how landforms of different geomorphic settings represent a dynamic balance between forces acting in the environment and the physical properties of materials present. **Professor Pollard**

▭ **183-290A LOCAL GEOGRAPHICAL EXCURSION.** (1 credit) (Open to first-year Geography Major and Honours students only. Not open to students who have taken 183-199.) Introduction to landscape interpretation and geographical site analysis in physical and human geography. A three-day fall excursion with preparatory and concluding seminars. September 24-26, 1999. **Staff**

183-300B HUMAN ECOLOGY IN GEOGRAPHY. (3) (3 hours) (Prerequisite: 183-203 or 151-202 or 177-111)

183-301A GEOGRAPHY OF THE CIRCUMPOLAR NORTH. (3) (3 hours)

183-302B ENVIRONMENTAL ANALYSIS AND MANAGEMENT: PROBLEMS AND POLICY. (3) (3 hours) (Prerequisite: 183-203 or permission of instructor.) An ecological analysis of the physical and biotic components of natural resource systems. Emphasis on scientific, technological and institutional aspects of related environmental management. Study of the use of Canadian biological resources and of the impact of industrial processes. Students develop dossiers and assess applied research methods. **Professor Meredith**

● **183-305A SOILS AND ENVIRONMENT.** (3) (2 hours and laboratory) (Prerequisite: 183-203 or introductory course in biology or geology.)

183-306A GEOGRAPHIC INFORMATION SYSTEMS II. (3) (2 hours and laboratory) (Prerequisite: 183-201) Formal introduction to a computer-based Geographical Information System (GIS). Topics will focus on map analysis and on transforming and displaying spatial data. GIS will be used by students to solve problems in both physical and human geography. **Professor Lewis**

183-307B SOCIOECONOMIC APPLICATIONS OF GIS. (3) (2 hours and laboratory) (Prerequisites: 183-201, 189-203 or equivalent)

183-308B REMOTE SENSING. (3) (3 hours and laboratory periods) (Prerequisite: 183-201 or permission of instructor.) The principles of air photo interpretation and remote sensing of the environment, applications to urban problems, geomorphology, land use and inventory of natural resources. Elementary photogrammetry and field work. **Staff**

183-309A GEOGRAPHY OF CANADA. (3) (3 hours)

183-311A CANADA – A GEO-ECONOMIC PERSPECTIVE. (3) (3 hours) (Prerequisite 183-216 or permission of the instructor.)

183-315A URBAN TRANSPORTATION GEOGRAPHY. (3) (3 hours) (Prerequisite 183-217 or permission of instructor.)

183-316B POLITICAL GEOGRAPHY. (3) (3 hours)

● **183-321B CLIMATIC ENVIRONMENTS.** (3) (3 hours) (Prerequisite: 183-203 or 195-210 or permission of the instructor.)

183-322B ENVIRONMENTAL HYDROLOGY. (3) (3 hours) (Prerequisite: 183-203 or equivalent) Quantitative, experimental study of the principles governing the movement of water at or near the Earth's surface and how the research relates to the chemistry and biology of ecosystems. **Professor Roulet**

183-323B GEOGRAPHY OF EUROPE'S NORTH. (3) (3 hours)

● **183-326B GEOGRAPHY OF QUEBEC.** (3) (3 hours)

183-331A URBAN SOCIAL GEOGRAPHY. (3) (3 hours) (Prerequisite: 183-216 or 217 or permission of instructor.)

● **183-333C THE HABITABLE CITY.** (3) (Seminar) (Open to students with at least one pertinent 300 level course or permission of instructor.)

183-350A ECOLOGICAL BIOGEOGRAPHY. (3) (3 hours) (Prerequisite: 183-302 or 177-205) The study of the patterns of distribution of organisms in space and time with emphasis on plant communities. Ecological, geographical, historical and anthropological factors affecting these distribution patterns will be discussed. Particular consideration is given to methods for description and classification of plant communities. **Professor Chmura**

183-351B QUANTITATIVE METHODS IN GEOGRAPHY. (3) (3 hours) (Prerequisite: Mathematics 189-203 or permission of instructor.) (Note: Credit for other statistics courses may preclude credit for this course and conversely. See "Course Overlap" on page 339.) Multiple regression and correlation, logit models, discrete choice models, gravity models, facility location algorithms, survey design, population projection. **Professor Ewing**

183-372A RUNNING WATER ENVIRONMENTS. (3) (3 hours) (Prerequisites: 183-203 and 183-272, or 170-200 and 170-202) The course focuses on the physical habitat conditions found in streams, rivers, estuaries and deltas. Based on the laws governing flow of water and sediment transport, it emphasizes differences among these environments, in terms of channel form, flow patterns, substrate composition and mode of evolution. Flooding, damming, channelisation, forestry impacts. **Professor Lapointe**

183-381A EVOLUTION OF GEOGRAPHY. (3) (3 hours)

● ▭ **183-398T FIELD STUDIES IN HUMAN GEOGRAPHY.** (3) (3 hours) (Prerequisite: Any introductory human geography course; or by permission of the instructor.)

183-404A ENVIRONMENTAL MANAGEMENT FOR DEVELOPING AREAS. (3) (3 hours) (Prerequisite: 183-302, course in development studies, or permission of instructor.)

183-407B CONTEMPORARY ISSUES IN GEOGRAPHY. (3) (3 hours)

● **183-408B GEOGRAPHY OF UNEQUAL DEVELOPMENT.** (3) (3 hours) (Prerequisite: 183-216 or permission of instructor.)

183-410B GEOGRAPHY OF UNDERDEVELOPMENT: CURRENT PROBLEMS. (3) (3 hours) (Prerequisite: 183-216 or permission of instructor.)

● **183-415B GEOGRAPHY OF TOURISM.** (3) (3 hours)

183-424A PLACE, PEOPLE & CULTURE: EUROPE. (6) (6 hours) (Prerequisite: 6 credits from any of History, Art History, Anthropology, Philosophy, Political Science, Sociology or permission of instructor)

183-470C WETLANDS. (3) (3 hours and field trips) (Prerequisites: one from 183-305, 183-322, 372-210, 336-217; and one from 183-350, 177-208/308, 367-460, 367-358) An examination of the structure, function and utility of wetlands. Topics include the fluxes of energy and water, wetland biogeochemistry, plant ecology in freshwater and coastal wetlands and wetland use, conservation and restoration. Field trip(s) will illustrate issues covered in class. **Professors Chmura, Moore, Roulet and Waterway**

183-490A,B,G,T INDEPENDENT STUDIES IN GEOGRAPHY. (3) (Open to U3 Geography Major students only.) (Please see regulations concerning Project Courses, section 2.6.2 on page 339 in the Faculty Degree Requirements section.) Research or reading projects permitting independent study under the guidance of a staff member specializing in the field of interest. A project must be arranged with an instructor *before* registration. **Staff**

183-491D,N HONOURS RESEARCH AND READING. (6) (Prerequisite: 183-381) (For U3 B.A. and B.Sc. Honours and Joint Honours Geography students.) Supervised reading, research and preparation of an undergraduate thesis under the direction of a member of staff. **Professor Müller-Wille and Staff**

183-492D,N JOINT HONOURS RESEARCH AND READING. (3) (Only for those U3 Joint Honours students in Geography who opt to enrol in a parallel course in another department.)

▭ **183-494T FIELD STUDIES IN GEOGRAPHY: URBAN.** (3) (Prerequisites: 200-level courses in cartography, statistics, and urban geography, and 183-331B)

183-495C FIELD STUDIES - PHYSICAL GEOGRAPHY. L(3) (2-week field school) (Prerequisites: 6 credits from the following list of Systematic Physical Geography courses: 183-305, 183-321, 183-322, 183-350, 183-372) Field research projects in physical geography. Held locally in Monteregian or Eastern Township regions. The course is organised around field projects designed to formulate and test scientific hypotheses in a physical geography discipline. May summer session. Preregistration in Department required by March 15. **Professor Lapointe and Staff**

▭ **183-496B REGIONAL GEOGRAPHICAL EXCURSION.** (3) (Prerequisites: 183-290 and permission of instructor.)

● ▭ **183-497T FIELD STUDIES IN GEOGRAPHY: COASTAL MARSH PLANT ECOLOGY.** (3) (Prerequisite: 183-350 or 183-305 or 177-208/308)

183-498B HUMANS IN TROPICAL ENVIRONMENTS. (3) (6 hours lecture for 4 weeks, 3 hours seminar, 2 hours laboratory, 8 hours conference) (Restriction: Location in Panama. Student must register for a full semester of studies in Panama.) (Prerequisites: 144-218, 189-203 or equivalents.) Focus on understanding of inter-relations between humans and neotropical environments represented in Panama. Study of contemporary rural landscapes, their origins, development and change. Impacts of economic growth and inequality, social organization, and politics on natural resource use and environmental degradation. Site visits and field exercises in peasant/colonist, Amerindian, and plantation communities. **Staff**

▭ **183-499T SUBARCTIC FIELD STUDIES IN GEOGRAPHY: SCHEFFERVILLE.** (3) (Prerequisite: 183-203 or 301) An introduction to the geography of the subarctic with emphasis on the application of field methods in physical and/or human geography. The course will be given in 1999 at the McGill Subarctic Research Station, Schefferville, during ten days in late August. Preregistration required by March 15. **Professor Pollard**

183-500B GEOGRAPHY OF REGIONAL IDENTITY. (3) (3 hours) (Restriction: Graduate students and final year undergraduates and/or those who have taken 183-408A.)

183-501A MODELLING ENVIRONMENTAL SYSTEMS. (3) (1.15 hours lecture, 0.58 hours seminar, 0.69 hours project, 0.58 hours laboratory) (Restriction: open only to U2 or U3 students who have completed six or more credits from courses at the 300 level of Atmospheric and Oceanic Sciences, Biology, Chemistry, Earth and Planetary Sciences, Geography, Natural Resource Sciences, or a McGill School of Environment domain, or permission of the instructor.) (Prerequisites: 189-139 or 189-140, 189-141, and 189-203, or equivalent.) (Enrolment limited to 20 students by availability of workstations.) Most problems in environmental science deal with weak relationships and poorly defined systems. Model development and simulation will be used in this course to help improve understanding of environmental systems. Simulation of environmental systems is examined, focusing on problem definition, model development and model validation. (Awaiting University Approval) **Professor Roulet**

183-502A GEOGRAPHY OF NORTHERN DEVELOPMENT. (3) (3 hours) (Prerequisite: 183-301 or 436, or permission of instructor.)

● **183-504A INDUSTRIAL RESTRUCTURING – THE GEOGRAPHIC IMPLICATIONS.** (3) (Prerequisites: 183-311 or permission of instructor.)

183-505B GLOBAL BIOGEOCHEMISTRY. (3) (2 hours and research) (Prerequisite: 183-305 and permission of instructor.) An examination of the storage, transfers and cycling of major elements and substances, with an emphasis on the global scale and the linkages between the atmosphere, hydrosphere, lithosphere and biosphere. **Professors Moore and Roulet**

183-506B PERSPECTIVES ON GEOGRAPHIC INFORMATION ANALYSIS. (3) (2 hours and laboratory) (Prerequisite: 183-201 and 306 and permission of instructor.) Examination of a range of applications in automated processing of spatial data. Discussion will focus on both theoretical and practical aspects of Geographic Information Systems. Topics such as resource data base structure, methods of spatial interpolation and data quality and errors are covered. The application of Geographic Information Systems such as GRASS and digital image processing routines are used to answer questions in geographical research. Individual student projects will be emphasized. **Professor Lewis**

183-510B HUMID TROPICAL ENVIRONMENTS. (3) (3 hours) (Prerequisite: 183-203 or equivalent and written permission of the instructor.)

183-513A BEHAVIOURAL GEOGRAPHY. (3) (3 hours) (Prerequisite: a course in introductory statistics.)

● **183-522B ADVANCED ENVIRONMENTAL HYDROLOGY.** (3) (2 hours and 1 tutorial) (Prerequisite: 183-322, or permission of instructor.)

● **183-523B ADVANCED CLIMATOLOGY.** (3) (3 hours) (Prerequisite: a previous course in climatology or meteorology, and written permission of the instructor.)

● **183-535B REMOTE SENSING METHODS & INTERPRETATION.** (3) (3 hours) (Prerequisite: 183-308 and written permission of instructor.)

183-536B PERIGLACIAL AND PERMAFROST ENVIRONMENTS. (3) (3 hours) (Prerequisite: 183-272 and any 300-level geomorphology course approved by instructor.) Study of the unique geomorphic aspects of periglacial and permafrost environments. The focus will be on processes in cold climates, the impact of human activity on permafrost landscapes and potential impacts of climatic change. **Professor Pollard**

183-537A ADVANCED FLUVIAL GEOMORPHOLOGY. (3) (Prerequisites: permission of instructor.) An examination of current advances in fluvial geomorphology: sediment entrainment and transport, alluviation and river channel evolution. **Professor Lapointe**

183-550A QUATERNARY PALEOECOLOGY. (3) (2 hours, laboratory and seminar) (Prerequisite: course in ecology or biogeography, or permission of instructor.) Examination of landscape and ecosystem response to climatic change; addressing persistent problems in Pleistocene and Holocene paleoecology: episodes of temporary warming and cooling, locations of glacial refugia and sea level change. Principles and methods of Quaternary paleoecology and paleoclimatological reconstruction. **Professor Chmura**

183-551A ENVIRONMENTAL DECISIONS. (3) (2 hours seminar, 1 hour tutorial) (Prerequisites: 183-302, 182-451, 183-306 or equivalents)

11.14 Immunology Interdepartmental Honours Program

The Honours Program in Immunology is offered by three Departments: Biochemistry, Microbiology and Immunology, and Physiology. The program is a demanding one which will prepare the student for graduate work in immunology.

All admissions to the Honours program will be after completion of the U1 year, and a student must have obtained a U1 GPA of 3.2. Admission to U3 requires a GPA of 3.2 in U2. Students who do not maintain Honours standing must transfer their registration to a program in one of three participating Departments.

For graduation in the Honours program, the student must complete a minimum of 90 credits, and achieve a CGPA of not less than 3.2. In addition, the five Immunology courses (528-314B, 507-503A, 528-414A, 552-419D, 552-513A) must be passed with a grade not less than B+.

U1 students who are interested in the program are advised to register in either the Faculty or Major program in Biochemistry or Physiology, or the Major program in Microbiology and Immunology. U1 students should inform their advisers of their intent to enter the Honours Immunology Program in U2.

Students wishing to enter the program must apply in writing by April 1 to:

Dr. M. Baines, Department of Microbiology and Immunology, Room 404, Lyman Duff Medical Sciences Building, 3775 University Street, Montreal, QC, H3A 2B4. Telephone (514) 398-4443 or (514) 398-3928; mgbaines@microimm.mcgill.ca

or Dr. W.S. Lapp, Department of Physiology, Room 1137, McIntyre Medical Sciences Building, 3655 Drummond Street, Montreal, QC, H3G 1Y6. Telephone (514) 398-4328 or (514) 398-4327); wlapp@physio.mcgill.ca

All candidates will be interviewed for admission if demand exceeds the number of available places. Enrolment is limited.

INTERDEPARTMENTAL HONOURS PROGRAM IN IMMUNOLOGY (77 credits) [MARS Program Code 2-590500]

U1 Required Courses (20 credits)

	177-200A	(3)	Molecular Biology
	177-201B	(3)	Cell Biology and Metabolism
or	507-212B	(3)	Molecular Mechanisms of Cell Function
	180-212A,B	(4)	Organic Chemistry I
	180-222A,B	(4)	Organic Chemistry II
	180-203A	(3)	Survey of Physical Chemistry
or	180-204A,B	(3)	Physical Chem./Biol. Sci. I
	552-209A	(3)	Mammalian Physiology I

U1, U2 or U3 Required Course (3 credits)

	177-373A	(3)	Biostatistical Analysis
or	189-203A	(3)	Principles of Statistics I
or	204-204A,B	(3)	Introduction to Psychological Statistics

U1 Complementary Courses (6 credits)
Selected from:

528-211A	(3)	Biology of Microorganisms
528-212A	(2)	Laboratory in Microbiology
177-202A,B	(3)	Basic Genetics
177-205B	(3)	Biology of Organisms
177-304A	(3)	Evolution
504-214A	(3)	Systematic Human Anatomy
504-261A*	(4)	Introduction to Dynamic Histology

*students must take this course in U1 or U2

U2 Required Courses (15 credits)

507-311A	(3)	Metabolic Biochemistry
507-312B	(3)	Biochemistry of Macromolecules
528-314B	(3)	Immunology
507-300D	(6)	Laboratory in Biochemistry
or 528-386D	(6)	Laboratory in Microbiology

U2 Complementary Courses (9 credits)
one of:

504-261A	(4)	Introduction to Dynamic Histology
528-211A	(3)	Biology of Microorganisms
552-210B	(3)	Mammalian Physiology II

plus 6 credits selected from:

177-314A	(3)	Molecular Biology of Oncogenes
177-300A	(3)	Molecular Biology of the Gene
552-210B	(3)	Mammalian Physiology II
180-302A,B	(3)	Organic Chemistry III
180-313A	(3)	Intermediate Physical Chemistry I
189-133A,B	(3)	Vectors, Matrices and Geometry
189-222A,B	(3)	Calculus III
189-315A,B	(3)	Ordinary Differential Equations
or 177-309A	(3)	Mathematical Models in Biology
528-323A	(3)	Microbial Physiology
528-324A	(3)	Fundamental Virology
546-300B	(3)	Human Disease
549-300A	(3)	Drug Action
549-301B	(3)	Drugs and Disease
552-311A	(3)	Intermediate Physiology I
552-312B	(3)	Intermediate Physiology II
552-313B	(3)	Intermediate Physiology III

U3 Required Courses (15 credits)

528-414A	(3)	Advanced Immunology
507-503B	(3)	Immunochemistry
552-419D	(6)	Project & Seminar in Immunology
552-513B	(3)	Cellular Immunology

U3 Complementary Courses (9 credits)
9 credits selected from:

177-314A	(3)	Molecular Biology of Oncogenes
507-454A	(3)	Nucleic Acids
507-456B	(3)	Biochemistry of Membranes
507-404B	(3)	Biophysical Chemistry
507-450A	(3)	Protein Structure and Function
552-311A	(3)	Intermediate Physiology I
552-312B	(3)	Intermediate Physiology II
552-313B	(3)	Intermediate Physiology III
552-531B	(3)	Topics in Applied Immunology
552-552B	(3)	Cellular & Molecular Physiology
189-315A,B	(3)	Ordinary Differential Equations
528-324A	(3)	Fundamental Virology
528-413B	(3)	Parasitology
528-465A	(3)	Bacterial Pathogenesis and Host Defences
528-466B	(3)	Viral Pathogenesis and Host Defences
528-509B	(3)	Seminars on Inflammatory Processes

11.15 Management Minor Program

The Minor in Management allows Science students to include courses in their undergraduate program that will help prepare them for a career in management.

Enrolment in this program is restricted. Application forms and advising appointments will be available from February 14, 2000 and applications are considered on a first-come, first-served basis. The first 25 applicants who qualify will be accepted. At the time of application, a CGPA greater than 2.5 is required and at least one course toward the Minor program must have been completed with a grade of C or better.

Students who are not formally registered for the Minor but who nevertheless complete all its requirements may apply to have the Minor approved during their last term.

Students who were registered in 1996-97 or earlier should consult the Minor advisor in the Student Affairs Office regarding their program requirements.

To obtain the Minor in Management, all courses must be completed with a grade of C or better.

MINOR PROGRAM IN MANAGEMENT (24 credits)

Required Courses (9 credits)

280-211	(3)	Introduction to Financial Accounting
280-293	(3)	Managerial Economics
189-203	(3)	Principles of Statistics I

or its equivalent as authorized by the Faculty of Science. Students majoring in certain programs, for example in Mathematics, cannot take 189-203 but must take 189-324 instead.

Complementary Courses (15 credits)
3 credits from:

280-213	(3)	Introduction to Management Accounting
280-341	(3)	Finance I
280-382	(3)	International Business

3 credits from:

280-222	(3)	Organizational Behaviour
280-320	(3)	Managing Human Resources
280-352	(3)	Marketing Management I

3 credits from:

280-360	(3)	Social Context of Business
280-373	(3)	Operations Research
280-423	(3)	Organizational Policy

6 credits from any approved 300- or 400-level Management courses for which the prerequisites, if any, have been met.