

## 11.18 Neurology and Neurosurgery (531)

### Course Lecturers – Assistant Professors

Timothy Kennedy; B.Sc.(McM.), M.Phil, Ph.D.(Columbia) (*joint appt. with Anatomy & Cell Biology*)

Peter McPherson; B.Sc.(Manit.), Ph.D.(Iowa) (*joint appt. with Anatomy & Cell Biology*)

David Ragsdale; B.S.(Ill.); Ph.D.(Calif.)

Wayne Sossin; S.B.(M.I.T.), Ph.D.(Stan.) (*joint appt. with Anatomy & Cell Biology*)

It is the brain that makes us what we are, and understanding how the brain works and how it is affected by disease is a major goal of Neuroscience. Neuroscience is both pure science, offering challenging basic research pursuits, as well as medical science, with important clinical applications. The approach to problems in Neuroscience has roots in many of the basic sciences including biology, biochemistry, pharmacology, physiology, and psychology. Powerful techniques of molecular biology, biochemistry, and genetics have revealed new molecules, given insight to how gene expression is controlled, and allowed the identification of defective genes responsible for diseases of the nervous system. Neuronal and glial cells are studied in the context of adult or developing nervous systems, and how neural networks are formed and maintained. Signalling and information transfer within and between cells are investigated by studying individual cells and their synaptic connections, or through research on complex neuronal circuitry. Higher neural functions are explored by mapping neural architecture, through the study of specific systems with sophisticated physiological and imaging techniques, and by investigations of the neurobiological mechanisms of behaviour.

The Department of Neurology and Neurosurgery sponsors an undergraduate course in Neuroscience, and additional undergraduate courses are offered in the Departments of Biology, Pharmacology, Biochemistry, Psychology, Physiology, and Anatomy and Cell Biology. Graduate studies are a very large component of the Department of Neurology and Neurosurgery. The curriculum for graduate degrees in Neurology and Neurosurgery is provided in the Faculty of Graduate Studies and Research Calendar. Inquiries should be directed to the Graduate Program Coordinator, Montreal Neurological Institute, 3801 University Street, Montreal, H3A 2B4.

**531-310B CELLULAR NEUROBIOLOGY.** (3) (2 lectures each week) (Prerequisite or corequisite; 177-200A and 177-201B, or 552-209A, or 552-210B) A survey of the functional organization of nerve cells, signalling in the nervous system, and principles of neural development. Topics include cell polarity, neurotransmitters, neurotrophins, receptors and second messengers, cell lineage, guidance of axon outgrowth, and nerve regeneration. Emphasis will be placed on analysis of neurons at the molecular level.

**Professor Sossin (Co-ordinator)**

## 11.19 Neuroscience

### Minor Program in Neuroscience

Program Coordinator: Professor Ellis Cooper, Department of Physiology. Telephone: (514) 398-4337.

Neuroscience is a multidisciplinary science devoted to the understanding of the nervous system. The brain is one of the most complex systems in the universe, and understanding how it functions is among the most challenging questions in science. Scientists are investigating the brain at many levels, from the molecules at synapses to complex forms of behaviour, with diverse approaches ranging from genetic, biochemical, anatomical, physiological, embryological and psychological. In addition, scientists are investigating the nervous system of many different animals, from simple invertebrates to humans. These wide-ranging investigations are providing a clearer understanding of how neurons work; how they communicate with one another; how they are organized into local or distributed networks; how the connections between neurons are established and change with experience; how neuronal functions are influenced by drugs, nutrients, toxins, and disease states. As a result, we are gaining deeper insights into the neural basis of mental activity, as well as developing new therapeutic approaches to alleviate neurological and psychological diseases.

### MINOR PROGRAM IN NEUROSCIENCE (24 credits)

[MARS Program Code 6-668200]

The Minor Program in Neuroscience is a program designed for undergraduate students interested in how the nervous system functions. The program consists of courses from the departments of Anatomy and Cell Biology (504), Biochemistry (507), Biology (177), Neurology and Neurosurgery (531), Pharmacology and Therapeutics (549), Physiology (552), Psychiatry (555), and Psychology (204). The Minor is composed of 24 credits, 18 of which must be selected from two of the five topic areas listed below.

Twelve credits of the 18 must be at the 400/500 level and from at least two different departments. A maximum of 6 credits can be counted both for the student's primary program and for the Minor Program in Neuroscience, where appropriate.

**All course selections for the Minor Program in Neuroscience must be approved by the Program Coordinator.**

#### Complementary Courses (24 credits)

6 credits selected from:

- 204-308A (3) Physiological Psychology I: Fundamentals
- or 177-306A (3) Neurobiology and Behaviour
- or 552-311A (3) Intermediate Physiology I
- 504-321A (3) Circuitry of the Human Brain
- 531-310B (3) Cellular Neurobiology

18 additional credits:

9 credits each from 2 of the 5 areas listed below, 6 credits in each area must be from 400- or 500-level courses

#### Neurobiology and Behaviour

- 177-306A (3) Neurobiology and Behaviour
- 177-389B (3) Laboratory in Neurobiology
- 204-318B (3) Physiological Psychology II: Motivation and Learning
- 552-311A (3) Intermediate Physiology I
- 177-430B (3) Neural Basis of Behaviour
- 177-431A (3) Neurobiology of Learning & Memory
- 204-427B (3) Motor Control and Human Performance
- 204-505A (3) The Psychology of Pain
- 552-556B (3) Topics in Systems Neuroscience
- 555-500B (3) Advances in the Neurobiology of Mental Disorders

#### Molecular and Developmental Neurobiology

- 504-321A (3) Circuitry of the Human Brain
- 531-310B (3) Cellular Neurobiology
- 552-311A (3) Intermediate Physiology I
- 177-532B (3) Developmental Neurobiology Seminars
- 177-588A (3) Molecular/Cellular Neurobiology
- 204-431B (3) The Environment and the Developing Brain
- 507-455B (3) Neurochemistry
- 552-451A (3) Advanced Neurophysiology

#### Neurophysiology

- 177-389B (3) Laboratory in Neurobiology
- 504-322B (3) Neuroendocrinology
- 552-311A (3) Intermediate Physiology I
- 177-431A (3) Neurobiology of Learning & Memory
- 177-588A (3) Molecular/Cellular Neurobiology
- 204-427B (3) Motor Control and Human Performance
- 552-451A (3) Advanced Neurophysiology
- 552-520B (3) Ion Channels
- 552-556B (3) Topics in Systems Neuroscience

#### Neuropsychology

- 177-306A (3) Neurobiology and Behaviour
- 204-311A (3) Human Behaviour and the Brain
- 204-318B (3) Physiological Psychology II: Motivation and Learning
- 504-321A (3) Circuitry of the Human Brain
- 504-322B (3) Neuroendocrinology
- 204-410B (3) Special Topics in Neuropsychology
- 204-431B (3) The Environment and the Developing Brain
- 204-470A (3) Memory and Brain
- 204-505A (3) The Psychology of Pain
- 204-526A (3) Advances in Visual Perception



**Neuropharmacology**

549-300A	(3)	Drug Action
549-301B	(3)	Drug and Disease
555-301B	(3)	Issues in Drug Dependence
504-321A	(3)	Circuitry of the Human Brain
552-311A	(3)	Intermediate Physiology I
507-455B	(3)	Neurochemistry
552-451A	(3)	Advanced Neurophysiology
555-500B	(3)	Advances in the Neurobiology of Mental Disorders
552-520B	(3)	Ion Channels
549-562A	(3)	General Pharmacology I
177-588A	(3)	Molecular/Cellular Neurobiology

**11.20 Nutrition (382)**

Please see the School of Dietetics and Human Nutrition entry beginning on [page 437](#) in the Faculty of Agricultural and Environmental Sciences section for further information about the School's other courses, programs and academic staff. This information includes a Minor Program in Human Nutrition which can be taken by Science students.

**382-307A 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**

**11.21 Nursing (576)**

For a complete listing of Nursing courses and their descriptions, consult the School of Nursing website (<http://www.nursing.mcgill.ca>) or refer to the Health Sciences Calendar.

□ Denotes limited enrolment.

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

□ **576-308 ISSUES IN WOMEN'S HEALTH.** (3) (Prerequisite: Introductory Psychology or Sociology or permission of the instructor.) (Complementary course for the Women's Studies and Social Studies of Medicine Concentrations.) Exploration of a wide range of topics on the health of women. Topics include use of health care system, poverty, roles, immigration, body image, lesbian health, and violence against women. Additional topics vary by year. A Health Science elective open to students in the Faculties of Arts, Science, and Medicine. **A. Gilchrist**

□ **576-309 WOMEN'S REPRODUCTIVE HEALTH.** (3) (Prerequisite: Introductory Psychology or Sociology or permission of the instructor.) (Restriction: not open for credit to students who have taken 576-308 prior to September 1997.) (Complementary course for the Women's Studies and Social Studies of Medicine Concentrations.) Concepts of health and medicalization. Canadian and international perspectives. Topics include contraception, abortion, infertility, menstruation, menopause, new reproductive technologies, prenatal care, childbirth. Additional topics vary by year. A Health Science elective open to students in the Faculties of Arts, Science, and Medicine. **TBA**

**11.22 Pathology (546)**

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

**546-300B HUMAN DISEASE.** (3) (Prerequisites: 177-200A, 177-201B or 507-212B, 552-209A. Pre- or co-requisite: 552-210B.) Provides a fundamental understanding of the diseases prevalent in North America, for upper level students in the biological sciences. Includes: general responses of cells and organ systems to injury; assessment of individual diseases by relating the causes, symptoms, diagnosis, treatment and prevention to the primary biological abnormalities in each disorder. **Professor Zorychta**

**11.23 Pharmacology and Therapeutics (549)**

McIntyre Medical Building  
3655 Promenade Sir-William-Osler  
Montreal, QC H3G 1Y6  
Telephone: (514) 398-3623  
Website: <http://www.pharma.mcgill.ca>

*Chair* — TBA

*Vice-Chair* — Radan Capek

*Professors*

Jack Aranda; M.D.(Manila Central), Ph.D.(McG.)  
Radan Capek; M.D., Ph.D.(Prague)  
Paul B.S. Clarke; M.A.(Cantab.), Ph.D.(Lond.)(*on leave*)  
Brian Collier; B.Sc., Ph.D.(Leeds)  
A. Claudio Cuello; M.D.(Buenos Aires), M.A., D.Sc.(Oxon.)  
Claude De Montigny; M.D., Ph.D.(Montr.), F.R.C.P.(C)  
Barbara Hales; M.Sc.(Phil. Coll. of Pharmacy and Science), Ph.D.(McG.)  
Peter J. McLeod; M.D.(Manit.), F.R.C.P.(C.)  
John B. Richardson; B.Sc., M.D.C.M., L.M.C.C., F.R.C.P., Ph.D.(McG.)  
Bernard Robaire; B.A.(Calif.), Ph.D.(McG.)  
Allan Tenenhouse; B.Sc., M.D., C.M., Ph.D.(McG.)  
Daya R. Varma; M.D.(Lucknow), Ph.D.(McG.)

*Associate Professors*

Guillermina Almazan; Ph.D.(McG.)  
Barbara Esplin; M.D.(Warsaw)  
Howard S. Katz; M.Sc., Ph.D., D.D.S.(McG.)  
Dusica Maysinger; Ph.D.(Los Angeles)  
Stanley Nattel; B.Sc., M.D., C.M.(McG.)  
Ante L. Padjen; M.D., M.Sc., D.Sc.(Zagreb);  
Alfredo Ribeiro-da-Silva; M.D., Ph.D.(Oporto) (*joint appt. with Anatomy & Cell Biology*)  
H. Uri Saragovi; Ph.D.(Miami)  
Betty I. Sasyniuk; B.S.P., Ph.D.(Man.)  
Moshe Szyf; M.Sc., Ph.D.(Hebrew Univ.)  
Jacquetta Trasler; M.D.C.M., Ph.D.(McG.)  
Edith A. Zorychta; B.Sc.(F.X.), M.Sc., Ph.D.(McG.)

*Assistant Professor*

Yves De Koninck; Ph.D.(McG.)

*Associate Members*

Moulay Alaoui-Jamali; Ph.D.(Sorbonne)  
Gerald Batist; M.D., C.M.(McG.)  
Serge Gauthier; M.D.(Montr.)  
Yogesh C. Patel; M.D.(Otago), Ph.D.(Monash)  
Roger Prichard; B.Sc., Ph.D.(N.S.W.)  
Remi Quirion; M.Sc., Ph.D.(Sher.)

*Adjunct Professors*

Paul Albert; Ph.D.(Harv.)  
Sylvain Chemtob; M.D.(Montr.), Ph.D.(McG.)  
Anthony Ford Hutchinson; M.Sc.(Warwick), Ph.D.(Lond.)  
Lorella Garofalo; Ph.D.(McG.)  
Kathleen Metters; Ph.S.(London)  
George S. Robertson; Ph.S.(Dal.)

Pharmacology is the science which deals with all aspects of drugs and their interactions with living organisms. Thus, it involves the physical and chemical properties of drugs, their biochemical and physiological effects, mechanisms of action, pharmacokinetics, and therapeutic and other uses. Since the word "drug" encompasses all chemical substances that produce an effect on living cells, it is evident that pharmacology is a very extensive subject. Pharmacology is a multi-disciplinary science. It has developed its own set of principles and methods to study the mode of the action of drugs, but it has also utilized many techniques and approaches from various disciplines including biochemistry, physiology, anatomy and molecular biology, as well as others. Pharmacology can be subdivided into a number of different areas such as neuropharmacology, molecular biology, reproductive pharmacology, endocrine pharmacology, receptor pharmacology, cardiovascular pharmacology, toxicology, developmental pharmacology, auto-

conomic pharmacology, biochemical pharmacology, and therapeutics.

Training in pharmacology is conducted at both the undergraduate and graduate levels. Because of its breadth, students may be attracted to the subject from a variety of viewpoints; this includes those completing a Bachelor's degree in any number of basic science disciplines, such as biology, zoology, chemistry, physics, biochemistry, microbiology, anatomy and physiology. At the undergraduate level, four lecture courses are offered. A course involving research projects in pharmacology is also available to provide the student with the opportunity to get first-hand experience in a pharmacology research laboratory. These courses should provide students with knowledge concerning the actions of drugs on living systems and insight into approaches to basic pharmacological research.

**MINOR PROGRAM IN PHARMACOLOGY** (24 credits)  
[MARS Program Code 6-680000]

The Minor Program in Pharmacology is intended for students registered in a complementary B.Sc. program who are interested in a focused introduction to specialized topics in pharmacology to prepare them for professional schools, graduate education, or entry into jobs in industry or research institutes. Students should declare their intent to enter the Minor Program in Pharmacology at the beginning of their U2 year. They must consult with, and obtain the approval of, the Coordinator for the Minor Program in the Department of Pharmacology and Therapeutics.

All courses in the Minor Program must be passed with a minimum grade C or better. Generally, no more than 6 credits of overlap are permitted between the Minor and the primary program.

**Required Courses** (18 credits)

549-300A	(3)	Drug Action
549-301B	(3)	Drugs and Diseases
549-562A	(3)	General Pharmacology I
549-563B	(3)	General Pharmacology II
549-599A,B,D,T	(6)	Research Projects in Pharmacology

**Complementary Courses** (6 credits)

one of the following sets:

177-200A	(3)	Molecular Biology
and 177-201B	(3)	Cell Biology and Metabolism
or 507-212B	(3)	Molecular Mechanisms of Cell Function
OR		
552-209A	(3)	Mammalian Physiology I
and 552-210B	(3)	Mammalian Physiology II

**549-300A DRUG ACTION.** (3) (Prerequisites: 177-200A and 177-201B or 507-212B, 552-209A and 552-210B or permission of instructor.) This course covers the fundamental principles of pharmacology and toxicology. Frequently encountered drugs are used as a focus to illustrate sites and mechanisms of action, distribution, metabolism, elimination and adverse effects.

**Professor Zorychta**

**549-301B DRUGS AND DISEASE.** (3) (Prerequisites: 177-200A, 177-201B or 507-212B, 552-209A and 552-210B and 549-300A or permission of instructor.) This course further explores the basic principles of pharmacology as illustrated by drugs used in the treatment of disease. Emphasis is placed on drugs used for diseases prevalent in North America.

**Professor Hales and Staff**

**549-562A GENERAL PHARMACOLOGY I.** (3) (Prerequisites: 552-209A and 552-210B, 177-200A and 177-201B or 507-311A and 507-312B or equivalent.) (Restrictions: Open to U3 students with permission of instructors, and students registered in the Minor Pharmacology Program.) Principles of pharmacology as illustrated by current issues with an emphasis on the nervous system will be discussed. Drugs classified by their molecular target of action, their mechanism of action, and possibly a rationale for therapeutic use will be presented. Students will be required to examine and interpret scientific data, to write a paper and participate in small group discussions.

**Professor Esplin and Staff**

**549-563B GENERAL PHARMACOLOGY II.** (3) (Prerequisites: 552-209A and 552-210B, 177-200A and 177-201B or 507-311A and

507-312B or equivalent.) (Restrictions: Open to U3 students with permission of instructors, and students registered in the Minor in Pharmacology Program.) Selected topics of basic interactions between chemicals and biological systems. Actions of drugs at the molecular and cellular levels. Principles of drug development. Chemotherapy of infections and of cancer. Toxicology and pharmacokinetics/dynamics. Drug metabolism.

**Professor Saragovi and Staff**

**549-599A,B,C,D,L,T RESEARCH PROJECTS IN PHARMACOLOGY.**

(6) (Pre- or co-requisite 549-562A and 549-563B or 549-300A and 549-301B.) (Restrictions: Open to U3 students with permission of instructors, and students registered in the Minor Pharmacology Program. Students should consult instructors 3 - 4 weeks before registration. Students may not register (via MARS) without prior approval of the course co-ordinator(s).) (Please see regulations concerning Project Courses, [section 2.6.2](#) in the Faculty Degree Requirements section.) This course involves individual research work. Students select a project under the supervision of a staff member. Areas of interest include toxicology, endocrine, developmental, cardiovascular, reproductive and neuropharmacology. This course requires a minimum of 6 hours per week for the full year course (D), and a minimum of 12 hours per week for the half year course (A,B) to be spent in the laboratory and/or library.

**Professors Maysinger, Sasyniuk and Staff**

**11.24 Physics (198)**

Rutherford Physics Building, Room 108  
3600 University Street  
Montreal, QC H3A 2T8  
Telephone: (514) 398-6485  
Fax: (514) 398-8434  
Email: [secretariat@physics.mcgill.ca](mailto:secretariat@physics.mcgill.ca)  
Website: <http://www.physics.mcgill.ca>

*Chair* — J. Barrette

*Emeritus Professors*

M.P. Langleben; B.Sc., M.Sc., Ph.D.(McG.), F.R.S.C.  
E.R. Pounder; B.Sc., Ph.D.(McG.), F.R.S.C. (*William C. Macdonald Emeritus Professor of Physics*)  
R.T. Sharp; B.Sc., M.Sc., Ph.D.(McG.)

*Post-Retirement*

Andreas P. Contogouris; B.A.(Athens), Ph.D.(C'nell)  
Martin J. Zuckermann; M.A., D.Phil.(Oxon.), F.R.S.C. (*William C. Macdonald Professor of Physics*)

*Professors*

Jean Barrette; B.Sc., M.Sc., Ph.D.(Montr.)  
Clifford P. Burgess; B.Sc.(Waterloo), Ph.D.(Texas)  
John E. Crawford; B.A., M.A.(Tor.), Ph.D.(McG.)  
Subal Das Gupta; B.A., M.Sc.(Calc.), Ph.D.(McM.)  
Nicholas DeTakacsy; B.Sc., M.Sc.(Montr.), Ph.D.(McG.)  
Martin Grant; B.Sc.(P.E.I.), M.Sc., Ph.D.(Tor.)  
Richard Harris; B.A.(Oxon.), D.Phil.(Sus.)  
Harry C.S. Lam; B.Sc.(McG.), Ph.D.(M.I.T.) (*E. Rutherford Professor of Physics*)  
Jonathan K.P. Lee; B.Eng., M.Sc., Ph.D.(McG.)  
Shaun Lovejoy; B.A.(Cantab.), Ph.D.(McG.)  
Tommy S.K. Mark; B.Sc., M.Sc., Ph.D.(McG.)  
Robert B. Moore; B.Eng., M.Sc., Ph.D.(McG.)  
Popat M. Patel; B.Sc., M.Sc.(Manc.), Ph.D.(Harv.)  
David G. Ryan; B.Sc., M.Sc.(Queen's), Ph.D.(Birm.)  
Douglas G. Stairs; B.Sc., M.Sc.(Queen's), Ph.D.(Harv.) (*William C. Macdonald Professor of Physics*)  
John O. Strom-Olsen; B.A., M.S., Ph.D.(Cantab.)  
Mark Sutton; B.Sc., M.Sc., Ph.D.(Tor.)  
John M. Trischuk; B.Eng.(McG.), Ph.D.(Cal. Tech.)

*Associate Professors*

Francis Corriveau; B.Sc.(Laval), M.Sc.(U.B.C.),  
Docteur Sc.Nat.(Zür)  
Charles Gale; B.Sc.(Ott.), M.Sc., Ph.D.(McG.)  
Peter Grutter; Dipl., Ph.D.(Basel)  
Hong Guo; B.Sc.(Sichuan), M.Sc., Ph.D.(Pitt.)

David Hanna; B.Sc.(McG.), M.A., Ph.D.(Harv.)  
 Robert Myers; B.Sc.(Wat.), M.A., Ph.D.(Prin.)  
 Kenneth J. Ragan; B.Sc.(Alta.), Ph.D.(Geneva)  
 Dominic H. Ryan; B.A., Ph.D.(Trin.Coll.)

#### Assistant Professor

James M. Cline; B.Sc.(Calif.), M.Sc., Ph.D.(Cal Tech.)

#### Lecturers

Z. Altounian; B.Sc., M.Sc.(Cairo), Ph.D.(McM.)  
 F. Buchinger; M.Sc., Dr.(Mainz)

#### Associate Members

R. Davies (*Atmospheric & Oceanic Sciences*),  
 B.C. Eu (*Chemistry*), G. Fallone (*Radiation Oncology*),  
 M. Mackey (*Physiology*), E. Podgorsak (*Radiation Oncology*),  
 D. Ronis (*Chemistry*)

#### Curator (Rutherford Museum and McPherson Collection)

M. Cohen; B.Sc., Ph.D.(Lond.), F.Inst.P., A.R.C.S.

Physics is in many ways the parent of the other natural sciences and its discoveries and laws continually affect their development. Its range and scope extend in space and time from subnuclear particles to the universe itself. The subfields of physics such as mechanics, thermodynamics, electricity, atomic physics and quantum mechanics, to mention but a few, permeate all other scientific disciplines. People trained in physics are employed in industry, government, and educational systems where they find many challenges as teachers, researchers, administrators and in the rapidly developing area of scientific business.

The two main undergraduate programs in Physics at McGill are the Honours and the Major. The Honours program is highly specialized and the courses are very demanding. This program is appropriate for students who wish to make an in-depth study of the subject in preparation for graduate work and an academic or professional career in physics. The Joint Honours in Mathematics and Physics is an even more specialized and demanding program, intended for students who wish to develop a strong basis in both mathematics and physics in preparation for graduate work and a professional or academic career. Although the program is optimized for theoretical physics, it is broad enough and strong enough to prepare students for further study in either experimental physics or mathematics. High standing in CEGEP or Freshman-year mathematics and physics is a requirement for admission to these Honours programs.

The Major program, on the other hand, offers a broad training in classical and modern physics and yet leaves room for the student to take a meaningful sequence of courses in other areas. It is intended primarily for students who wish to pursue careers in fields for which physics provides a basis. However this program also provides a preparation for graduate studies, especially if a student chooses, in consultation with the departmental adviser, a number of Honours Physics courses in the U2 and U3 years.

There are also a number of other Major programs: Atmospheric Sciences and Physics, Physics and Computer Science, Physics and Geophysics, and Physiology and Physics, offered jointly with other departments, and a Minor program in Electrical Engineering, available only to students in the Physics Major program. In addition, there is a Minor in Physics, a Faculty program in Physics and a Joint Faculty program in Mathematics, Chemistry and Physics, which provide a broad base for students less interested in a specialized education. Almost all the Physics programs can be combined with an Internship Year, as part of the University's IYES program, which provides experience in an industrial or government laboratory as part of the degree program.

For those interested in a career as a high school science teacher, the concurrent program leading to both a B.Sc. and a B.Ed. degree provides two Physics options. Both of these combine physics courses from the Major program with Education courses. They are, respectively, the Major program in Chemistry and Physics for Teachers, and the Major program in Mathematics and Physics for Teachers. (For details, see [section 11.28.](#))

Students from outside of the Province of Quebec will ordinarily register in the Science Freshman program. Physics offers two sequences of courses for this program: they are described below.

The list of pre- and co-requisites is not absolute. In many cases permission of the Department may be sought to have a specific prerequisite waived. The procedure is to ask the professor in charge of the course to review the request for such a waiver. The prerequisites of the 100-level courses are described in the following section entitled Science Freshman Program.

Courses 198-200A, 198-201B, 198-204A,B and 198-224A are designed for students from faculties other than Science (such as Arts and Music) and have no prerequisites as such, although a reasonable knowledge of high-school level algebra, geometry and trigonometry is desirable.

The block of numbers 198-205A, 198-206A, 198-207A, 198-208A, and 198-209A has been reserved for a series of courses "Introduction to Selected Topics in Physics". These courses, of one credit each, will introduce topics in physics which are of current interest. Topics given under numbers 198-205 or 198-206 will have CEGEP Physics\* as prerequisite; those given under numbers 198-208 or 198-209 will have no Physics prerequisite. The topics will vary from year to year. For further information, enquire at the Department of Physics.

All other 200-level courses are designed primarily for Science students and assume successful completion of CEGEP level physics\* and mathematics programs. The phrase "Prerequisite CEGEP Physics\*" has been inserted to make this point clear. Students who have not included Calculus III in their CEGEP program, should register in the first term of the U1 year for Mathematics 189-222.

Students interested in any of the Physics programs should contact the Department for an Adviser

\**Physics 203-101, 203-201, 203-301-78 or equivalent – CEGEP course numbers, standard throughout the Province of Québec.*

### SCIENCE FRESHMAN PROGRAM

Students entering McGill with a Québec CEGEP profile in Science will normally begin their programs in Physics with courses at the 200 level.

Students without this profile will normally take courses 198-131A and 198-142B if they have previously taken physics at the high school level and will be taking differential calculus concurrently with 198-131A and integral calculus concurrently with 198-142B. Those students who have not previously taken physics at the high school level and who intend to do programs in the Biological Sciences may instead take courses 198-101A and 198-102B. All students are expected to have reasonable fluency in algebra, geometry and trigonometry at the high school level. If this is not the case, then Mathematics 189-112A should be taken concurrently with 198-101A. Those for whom this is not necessary are advised to take 189-139A concurrently with 198-101A.

### MINOR PROGRAM IN PHYSICS (18 credits)

[MARS Program Code 6-]

The 18-credit Minor permits no overlap with any other programs. It contains no Mathematics courses, although many of the courses in it have Math pre- or co-requisites. It will, therefore, be particularly appropriate to students in Mathematics, but it is also available to any Science student with the appropriate mathematical background.

Students in certain programs (e.g. the Major in Chemistry) will find that there are courses in the Minor which are already part of their program, or which they may not take for credit because of a substantial overlap of material with a course or courses in their program. After consultation with an advisor, such students may complete the Minor by substituting any other physics course(s) from the Major or Honours Physics programs.

#### Required Course (3 credits)

198-259D (3) Lab in Mechanics, Heat & Optics

#### Complementary Courses (15 credits)

15 credits to be selected as follows:

198-230A (3) Dynamics of Simple Systems  
 or 198-251A (3) Classical Mechanics I  
 198-271A,B (3)  
 or 198-260A (3) Relativity and Modern Physics

- or 198-214 (3) Astrophysics
- or 198-225B (3) Musical Acoustics
- 198-232B (3) Heat and Waves
- or 198-253B (3) Thermal Physics
- 198-240B (3) Computers for Physics
- or 198-241B (3) Signal Processing
- 198-340A (3) Electricity and Magnetism
- or 198-350A (3) Electromagnetism

**FACULTY PROGRAM IN PHYSICS** (54 credits)

[MARS Program Code 4-720000]

**Required Courses** (36 credits)

- 198-230A (3) Dynamics of Simple Systems
- 198-232B (3) Heat and Waves
- 198-241B (3) Signal Processing
- 198-259D (3) Lab in Mechanics, Heat & Optics
- 198-333B (3) Thermal and Statistical Physics
- 198-340A (3) Electricity and Magnetism
- 198-436B (3) Modern Physics
- 198-446A (3) Quantum Physics
- 189-222A,B (3) Calculus III
- 189-223A,B (3) Linear Algebra
- 189-314A,B (3) Advanced Calculus
- 189-315A,B (3) Ordinary Differential Equations

**Complementary Courses** (18 credits)

at least 3 credits selected from:

- 198-434B (3) Optics
- 198-439A (3) Lab in Modern Physics

the remainder selected from:

- 198-328A (3) Electronics
- 198-331B (3) Mechanics
- 198-339B (3) Measurements Laboratory
- 198-342B (3) Electromagnetic Waves
- 186-320A (3) Elementary Earth Physics
- 189-316B (3) Functions of a Complex Variable
- 189-317A (3) Numerical Analysis
- 189-319B (3) Partial Differential Equations
- 308-202A,B (3) Introduction to Computing I

**JOINT FACULTY PROGRAM IN MATHEMATICS, CHEMISTRY AND PHYSICS** See [page 390](#) in the Mathematics and Statistics entry for complete program information.

**MAJOR PROGRAM IN PHYSICS** (60 credits)

[MARS Program Code 1-720000]

**U1 Required Courses** (21 or 23 credits)

- 198-230A (3) Dynamics of Simple Systems
- 198-232B (3) Heat and Waves
- 198-240B (3) Computers for Physics
- 198-259D (3) Lab in Mechanics, Heat & Optics
- 189-222A (3) Calculus III
- 189-223A (3) Linear Algebra
- 198-241B (3) Signal Processing
- or 304-200 (3) Fundamentals of Electrical Engineering
- and 304-210 (5) Circuit Analysis

**U2 Required courses** (24 credits)

- 198-328A (3) Electronics
- 198-331B (3) Mechanics
- 198-333B (3) Thermal & Statistical Physics
- 198-339B (3) Measurements Laboratory
- 198-340A (3) Electricity and Magnetism
- 198-342B (3) Electromagnetic Waves
- 189-314A (3) Advanced Calculus
- 189-315B (3) Ordinary Differential Equations

**U3 Required Courses** (15 credits)

- 198-434B (3) Optics
- 198-436B (3) Modern Physics
- 198-439A (3) Lab in Modern Physics
- 198-446A (3) Quantum Physics
- 198-449B (3) Project Laboratory

**JOINT MAJOR PROGRAM IN PHYSICS AND GEOPHYSICS**

(65 credits) [MARS Program Code 1-720400]

The Joint Major program in Physics and Geophysics provides a firm basis for graduate work in Geophysics and related fields as well as a sound preparation for those who wish to embark on a career directly after the B.Sc.

**U1 Required Courses** (29 credits)

- 198-230A (3) Dynamics of Simple Systems
- 198-232B (3) Heat and Waves
- 198-241B (3) Signal Processing
- 198-259D (3) Lab in Mechanics, Heat & Optics
- 186-203B (3) Structural Geology I
- 186-210A (3) Introduction to Mineralogy
- 186-231E (2) Field School I
- 189-222A (3) Calculus III
- 189-223A (3) Linear Algebra
- 189-314B (3) Advanced Calculus

**U2 Required Courses** (27 credits)

- 198-331B (3) Mechanics
- 198-333B (3) Thermal & Statistical Physics
- 198-339B (3) Measurements Laboratory
- 198-340A (3) Electricity and Magnetism
- 198-342B (3) Electromagnetic Waves
- 186-350B (3) Tectonics
- 186-510B (3) Global Geodynamics and Geomagnetism
- or 186-330B (3) Earthquakes & Earth Structure
- 189-315A (3) Ordinary Differential Equations
- 189-319B (3) Partial Differential Equations

**U3 Required Courses** (9 credits)

- 198-446A (3) Quantum Physics
- 198-332B (3) Physics of Fluids
- 186-510B (3) Global Geodynamics and Geomagnetism
- or 186-330B (3) Earthquakes & Earth Structure

**JOINT MAJOR PROGRAM IN ATMOSPHERIC SCIENCE AND PHYSICS**

Students should consult undergraduate advisers in both departments. See [page 355](#) in the Atmospheric and Oceanic Sciences section for complete program information.

The Major program in Physics and Atmospheric Science provides a firm basis for graduate work in Atmospheric Science and related fields as well as a sound preparation for those who wish to embark on a career directly after the B.Sc.

**JOINT MAJOR IN PHYSICS AND COMPUTER SCIENCE**

(66 credits) [MARS Program Code TBA] (Awaiting Final Approval)

The Joint Major in Physics and Computer Science is designed to give motivated students the opportunity to combine the two fields in a way that will distinguish them from the B.Sc.'s in either field by itself. The two disciplines complement each other, with physics providing an analytic problem-solving outlook and basic understanding of nature, while computer science enhances the ability to make practical and marketable applications, in addition to having its own theoretical interest. Graduates of this program may be able to present themselves as being more immediately useful than a pure physics major, but with more breadth than just a programmer. They will be able to demonstrate their combined expertise in the Special Project courses which is the centerpiece of the final year of the program.

**U1 Required Courses** (21 credits)

- 189-222A,B (3) Calculus III
- 189-223A,B (3) Linear Algebra
- 189-240A (3) Discrete Structures and Computing
- 198-230A (3) Dynamics of Simple Systems
- 198-240B (3) Computers for Physics
- 198-259D (3) Laboratory in Mechanics, Heat and Optics
- 308-250A (3) Introduction to Computer Science

**U2 Required Courses** (24 credits)

- 189-314A,B (3) Advanced Calculus
- 189-315A,B (3) Differential Equations
- 198-232B (3) Heat and Waves
- 198-241B (3) Signal Processing

308-251A,B	(3)	Data Structures and Algorithms
308-302A,B	(3)	Programming Languages and Paradigms
308-350A	(3)	Numerical Computing
308-360A	(3)	Algorithms

**U3 Required Courses** (21 credits)

189-323A,B	(3)	Probability Theory
198-331B	(3)	Mechanics
198-339B	(3)	Measurements Laboratory
198-340A	(3)	Electricity and Magnetism
198-446A	(3)	Quantum Physics
198-489A,B	(3)	Special Project
308-557B	(3)	Fundamentals of Computer Graphics

**JOINT MAJOR PROGRAM IN PHYSIOLOGY AND PHYSICS**

See [page 413](#) in the Physiology section for complete program information.

The Major program in Physiology and Physics provides a firm basis for graduate work in Bio-physics and other interdisciplinary fields involving the physical and biological sciences.

**HONOURS PROGRAM IN PHYSICS** (78 credits)

[MARS Program Code 2-720000]

Students entering this program for the first time should have high standing in mathematics and physics. In addition, a student who has not completed the equivalent of 189-222 must take it in the first term without receiving credits toward the 78 credits required in the Honours program.

A student whose average in the required and complementary courses in any year falls below a GPA of 3.00, or whose grade in any individual required or complementary course falls below a C, may not register in the Honours program the following year, or graduate with the Honours degree, except with the permission of the Department.

**U1 Required Courses** (27 credits)

198-241B	(3)	Signal Processing
198-251A	(3)	Classical Mechanics I
198-253B	(3)	Thermal Physics
198-259D	(3)	Lab in Mechanics, Heat & Optics
198-260A	(3)	Relativity and Modern Physics
189-247B	(3)	Linear Algebra
189-248A	(3)	Advanced Calculus I
189-249B	(3)	Advanced Calculus II
189-325A	(3)	Ordinary Differential Equations

**U2 Required Courses** (24 credits)

198-328A	(3)	Electronics
198-350A	(3)	Electromagnetism
198-357A	(3)	Quantum Physics I
198-359B	(3)	Lab in Modern Physics
198-362B	(3)	Statistical Mechanics
198-451B	(3)	Classical Mechanics
198-457B	(3)	Quantum Physics II
189-375A	(3)	Differential Equations

**U3 Required Courses** (12 credits)

198-551A	(3)	Quantum Theory
198-352A	(3)	Electromagnetic Waves
198-459D	(6)	Honours Research Project
or 198-469A	(3)	Lab in Modern Physics II
and 198-479B	(3)	Honours Project Lab

**U3 Complementary Courses** (15 credits)

15 credits selected from:

198-332B	(3)	Physics of Fluids
198-434B	(3)	Optics
198-514B	(3)	General Relativity
198-557A	(3)	Nuclear Physics
198-558A	(3)	Solid State Physics
198-559A	(3)	Advanced Statistical Mechanics
198-562B	(3)	Electromagnetic Theory
198-567B	(3)	Particle Physics

or other 3-credit course approved by the Department of Physics

**JOINT HONOURS PROGRAM IN MATHEMATICS AND PHYSICS** (81 credits) [MARS Program Code 3-634500]

This is a specialized and demanding program intended for students who wish to develop a strong basis in both Mathematics and Physics in preparation for graduate work and a professional or academic career. Although the program is optimized for theoretical physics, it is broad enough and strong enough to prepare students for further study in either experimental physics or in mathematics.

The minimum requirement for entry into the program is completion with high standing of the usual CEGEP courses in physics and in mathematics. In addition, a student who has not completed the equivalent of 189-222 must take it in the first term without receiving credits toward the 81 credits required in the Joint Honours program.

To remain in the Honours program and to be awarded the Honours degree, the student must maintain a 3.00 GPA in the required and complementary courses, and a grade of C or better in each required or complementary course.

The student will have two advisors, one from Mathematics and the other from Physics.

**U1 Required Courses** (30 credits)

198-241B	(3)	Signal Processing
198-251A	(3)	Classical Mechanics I
198-253B	(3)	Thermal Physics
198-259D	(3)	Lab in Mechanics, Heat & Optics
198-260A	(3)	Relativity and Modern Physics
189-248A	(3)	Advanced Calculus I
189-249B	(3)	Advanced Calculus II
189-325A	(3)	Ordinary Differential Equations
189-235A	(3)	Algebra I
189-251B	(3)	Algebra II
or 189-247B	(3)	Linear Algebra

**U2 Required Courses** (24 credits)

198-350A	(3)	Electromagnetism
198-357A	(3)	Quantum Physics I
198-362B	(3)	Statistical Mechanics
198-451B	(3)	Classical Mechanics
198-457B	(3)	Quantum Physics II
189-242A	(3)	Analysis I
189-255B	(3)	Analysis II
189-375A	(3)	Differential Equations

**U3 Required Courses** (15 credits)

198-359B	(3)	Lab in Modern Physics
198-352A	(3)	Electromagnetic Waves
189-354A	(3)	Analysis III
189-380B	(3)	Differential Geometry
189-370A	(3)	Algebra III
or 189-355B	(3)	Analysis IV

**U3 Complementary Courses** (12 credits)

9 credits selected from:

198-514B	(3)	General Relativity
198-551A	(3)	Quantum Theory
198-557A	(3)	Nuclear Physics
198-558A	(3)	Solid State Physics
198-559A	(3)	Advanced Statistical Mechanics
198-562B	(3)	Electromagnetic Theory
198-567B	(3)	Particle Physics

3 credits in Honours Mathematics

**MINOR PROGRAM IN ELECTRICAL ENGINEERING**

(23 or 25 credits) [Program registration done by Student Affairs Office]

The Minor program does not carry professional recognition. Only students who satisfy the requirements of the Major in Physics are eligible for this Minor. Students registered for this option cannot count 198-241 towards the requirements of the Major in Physics, and should replace this course by another Physics or Mathematics course. Students who select 304-334 in the Minor cannot count 198-328 towards the requirements of the Major in Physics, and should replace this course by another Physics or Mathematics course.

**Required Courses** (17 or 19 credits)

304-200	(3)	Fundamentals of Electrical Engineering
304-210	(5)	Circuit Analysis
304-303	(3)	Signals and Systems
304-330	(3)	Electronic Circuits
304-305	(3)	Probability and Random Signals
or 304-334	(5)	Electronic Circuits II

**Complementary Courses** (6 credits)**INTERNSHIP PROGRAMS – INTERNSHIP YEAR FOR ENGINEERING AND SCIENCE (IYES)**

The following programs are also available with an Internship component. For more information, please see [section 2.8](#) in the Faculty of Engineering section.

Faculty Program in Physics  
Major in Physics  
Honours in Physics  
Joint Honours Program in Physics & Mathematics  
Joint Faculty Program in Mathematics, Chemistry & Physics  
Joint Major Program in Atmospheric Science & Physics  
Joint Major Program in Physics & Geophysics

**COURSE DESCRIPTIONS**

Instructors' names are subject to change, since course assignments are made after this Calendar goes to press. See the Department's Web page <http://www.physics.mcgill.ca> for up-to-date information.

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

**NOTE:** In general, Honours courses are indicated when the fifth character of the six digit course number is 5 or higher.

● Denotes courses not offered in 2000-01.

□ Denotes limited enrolment

★ Denotes courses offered only in alternate years

**198-101A INTRODUCTORY PHYSICS – MECHANICS.** (4) (3 hours lectures; 2 hours laboratory; tutorial sessions) (Not open to students taking or having taken 198-131A, CEGEP physics 203-101 or equivalent.) The object of this course is to give the students a basic understanding of the principles of physics, illustrating these, where possible, with current examples of their use in biology and medicine. (Laboratory sections have limited enrolment.)

**Professor Moore**

**198-102B INTRODUCTORY PHYSICS – ELECTROMAGNETISM.** (4) (3 hours lectures; 2 hours laboratory; tutorial sessions) (Prerequisite: 198-101. Corequisite: 189-139) (Not open to students taking or having taken 198-142B, CEGEP physics 203-101 or equivalent.) Electric field and potential. D.C. circuits and measurements. Capacitance. Magnetic field and induction. A.C. circuits Semiconductor devices and their application. Electromagnetic waves. (Laboratory sections have limited enrolment.)

**Dr. Altounian**

**These courses, 101A and 102B together satisfy the minimum requirement in physics for Medical School.**

**198-109D GENERAL PHYSICS LABORATORY.** (2) (2 hours laboratory) (Not open to students who have taken or are taking 198-101 or 198-102.) The laboratory component of 198-101A and 198-102B. May be taken only by students who have completed the lecture component but not the laboratory of 198-101 and 198-102.

**198-119D GENERAL PHYSICS LABORATORY.** (2) (3 hours laboratory) The laboratory component of 198-131A and 198-142B. This course may be taken only by students who have completed the lecture components of these courses but not the laboratory.

**198-131A MECHANICS AND WAVES.** (4) (3 hours lectures; 1 hour tutorial, 3 hours laboratory in alternate weeks; tutorial sessions) (Corequisite: 189-139A) (Not open to students taking or having taken 198-101A, CEGEP physics 203-101 or equivalent.) The basic laws and principles of Newtonian mechanics; oscillations and waves. (Laboratory sections have limited enrolment.)

**Professor Harris**

**198-142B ELECTROMAGNETISM & OPTICS.** (4) (3 hours lectures, 3 hours laboratory in alternate weeks; tutorial sessions) (Prerequisite: 198-131A. Corequisite: 189-141B) (Not open to students taking or having taken 198-102B, CEGEP physics 203-101 or equivalent.) The basic laws of electricity and magnetism; geometrical and physical optics. (Laboratory sections have limited enrolment.)

**Professor Grutter**

**198-200A SPACE, TIME & MATTER.** (3) (3 hours lectures) (Not open to students in Science or Engineering.) See "Science for Arts Students" in the Arts section.

**Professor Ragan**

**198-204A,B PLANETS, STARS & GALAXIES.** (3) (3 hours lectures; 3 evening periods for star identification and use of telescopes.) (Not open to students who have taken or are taking 198-214A.) An elementary astronomy course for non-science students (see "Science for Arts Students" in the Arts section) and for science students not taking a Physics program.

**Professors Crawford and Burgess**

**198-208A TOPICS IN PHYSICS.** (1 credit; 2 hours lectures, first six weeks) (Not open to students in Physics programs.) Topic for 2000-01: The Safe Use of Nuclear Radiation.

**Professor Cohen**

● **198-209A TOPICS IN PHYSICS.** (1 credit; 2 hours lectures, first six weeks) (Not open to students in Physics programs.)

**198-214A ASTROPHYSICS.** (3) (Prerequisite: CEGEP Physics.) (Not open to students who have taken or are taking 198-204A,B.) An introduction to astrophysics with emphasis placed on methods of observation and current models. Stellar radiation and detectors, stellar classification systems, structures and evolution. Pulsars, quasars, black holes. Galaxies, large scale structure of the universe, cosmology.

**Professor Ragan**

● **198-217B PHYSICS AND THE LIFE SCIENCES.** (3) (3 hours lectures) (Prerequisites: CEGEP Physics or permission of instructor.) (Not open to students who are taking or have taken 198-199B.)

**198-224A PHYSICS & PSYCHOPHYSICS OF MUSIC.** (3) (3 hours lectures) (Designed for students in the Faculty of Music but suitable for students with an interest in music, and how it is received.) An introduction to physics and psychophysics of music with demonstrations of the relevant phenomena and the theories explaining them. Pitch, loudness and timbre in the context of the physics properties of the human ear. The basic physics of music production including modes of oscillation of mechanical systems, resonance, feedback, transmission and reflection of sound. The human voice. Modern methods of sound production using electrical analogue devices and digital computers. Room reverberation and acoustics.

**Professor Cline**

**198-225B MUSICAL ACOUSTICS.** (3) (3 hours lectures) (Prerequisites: CEGEP physics or both 189-112 and 198-224A) (Designed for students in music who have interests in sound recording and reproduction and also suitable for students in science with an interest in music.) Physical acoustics with applications to music. Resonators and radiators, acoustic impedance. Acoustic properties of strings, bars, membranes, pipes and horns. Application to selected musical instruments. Direction characteristics of sound sources. Room acoustics.

**Professor Grant**

**198-230A DYNAMICS OF SIMPLE SYSTEMS.** (3) (3 hours lectures) (Prerequisite: CEGEP physics. Corequisite: Mathematics 189-222A) (Not open to students taking or having passed 198-251A.) Translational motion under Newton's laws; forces, momentum, work/energy theorem. Special relativity; Lorentz transforms, relativistic mechanics, mass/energy equivalence. Topics in rotational dynamics. Noninertial frames.

**Professor Gale**

**198-232B HEAT AND WAVES.** (3) (3 hours lectures) (Prerequisite: 198-230A) (Not open to students taking or having passed 198-253B.) First and second laws of thermodynamics, kinetic theory of gases, optical interference, polarization, electro-optics, physics of microscopic systems.

**Professor Mark**

**198-240B COMPUTERS FOR PHYSICS.** (3) (2 hours lectures, 3 hours laboratory) (Prerequisite 198-230A or 198-251A) (Restricted to students in first year Honours and Majors physics or by

permission of instructor.) The course will extend and consolidate previous knowledge of mechanics and general physics by introducing and applying techniques for data analysis, numerical computation and simulation. Included will be an introduction to local facilities, a programming language and computer graphics.

**Professor Harris**

**198-241B SIGNAL PROCESSING.** (3) (2 hours lectures; 3 hours laboratory alternate weeks) (Prerequisite: CEGEP physics) Linear circuit elements, resonance, network theorems, diodes, transistors, amplifiers, feedback, integrated circuits.

**Professor Lee**

**198-242B ELECTRICITY & MAGNETISM.** (2) (2 hours lectures) (Prerequisites CEGEP Physics, 189-222A,B) Properties of electromagnetic fields, dipole and quadrupole fields and their interactions, chemical binding of molecules, electromagnetic properties of materials, Maxwell's equations and properties of electromagnetic waves, propagation of waves in media.

**Dr. Altounian**

**198-251A CLASSICAL MECHANICS I.** (3) (3 hours lectures) (Prerequisite: CEGEP physics. Corequisite: 189-222A) (Not open to student taking or having taken 198-230A.) Newton's laws, work and energy, angular momentum. Harmonic oscillator, forced oscillations. Inertial forces, rotating frames. Central forces, centre of mass, planetary orbits, Kepler's laws.

**TBA**

**198-253B THERMAL PHYSICS.** (3) (3 hours lectures) (Prerequisite: CEGEP physics. Corequisite: 189-222A,B) (Not open to students taking or having taken 198-232B.) Energy, work, heat; first law. Temperature, entropy; second law. Absolute zero; third law. Equilibrium, equations of state, gases, liquids, solids, magnets; phase transitions.

**Professor Guo**

**198-259D LAB IN MECHANICS, HEAT & OPTICS.** (3) (3 hours) (Prerequisite: CEGEP physics. Corequisite: 198-230A or 198-251A and 198-232B or 198-253B.) Illustrative experiments on topics in mechanics, heat and optics; a project.

**Professors Lee, Muir and Dr. Buchinger**

**198-260A RELATIVITY AND MODERN PHYSICS.** (3) (3 hours lectures. Corequisite: 189-222A.) History of special relativity; Lorentz transformations: kinematics and dynamics; transformation of electric and magnetic forces; introduction to topics in modern physics.

**Professor Lam**

**198-328A ELECTRONICS.** (3) (2 hours lectures; 3 hours laboratory) Semiconductor devices, basic transistor circuits, operational amplifiers, combinatorial and sequential logic, integrated circuits, analogue to digital converters. The laboratory component covers design, construction and testing of basic electronic circuits.

**Professor Crawford**

**198-331B MECHANICS.** (3) (3 hours lectures) (Prerequisite: 198-230A. Corequisite: 189-315A,B) (Not open to students having passed 198-451A.) Forced and damped oscillators, Newtonian mechanics in three dimensions, rotational motion, Lagrangian mechanics, small vibrations, normal modes. Introduction to Hamiltonian mechanics.

**Professor David Ryan**

**198-332B PHYSICS OF FLUIDS.** (3) (3 hours lectures) (Prerequisites: 198-230A, 189-223A, 189-314B, 189-315B) The physical properties of fluids. The kinematics and dynamics of flow. The effects of viscosity and turbulence. Applications of fluid mechanics in biophysics, geophysics and engineering.

**Professor Lovejoy**

**198-333B THERMAL & STATISTICAL PHYSICS.** (3) (3 hours lectures) (Prerequisite: 198-232B) (Not open to students taking or having passed 198-362B.) Introductory equilibrium statistical mechanics. Quantum states, probabilities, ensemble averages. Entropy, temperature, Boltzmann factor, chemical potential. Photons and phonons. Fermi-Dirac and Bose-Einstein distributions; applications.

**Professor Strom-Olsen**

**198-339B MEASUREMENTS LABORATORY.** (3) (6 hours) (Prerequisite: 198-241B) Introduction to modern techniques of measurement. The use of computers in performing and analysing experiments. Data reduction, statistical methods, report writing.

Extensive use of computers is made in this laboratory; therefore some familiarity with computers and computing is an advantage.

**Professor Grutter and Dr. Buchinger**

**198-340A ELECTRICITY AND MAGNETISM.** (3) (3 hours lectures) (Prerequisites: CEGEP physics, Mathematics 189-222A,B, 189-223A,B. Corequisites: 189-314A, 189-315A or equivalent. Not open to students who have passed 198-242A,B or 198-350B.) The electrostatic field and scalar potential. Dielectric properties of matter. Energy in the electrostatic field. Methods for solving problems in electrostatics. The magnetic field. Induction and inductance. Energy in the magnetic field. Magnetic properties of matter. Maxwell's equations. A vector treatment.

**Professor Stairs**

**198-342B ELECTROMAGNETIC WAVES.** (3) (3 hours lectures) (Prerequisites: 198-340A or 198-242A,B, Mathematics 189-314A,B, 189-315A,B) (Not open to students having passed 304-357A.) Maxwell's equations. The wave equation. The electromagnetic wave, reflection, refraction, polarization. Guided waves. Transmission lines and wave guides. Vector potential. Radiation. The elemental dipole; the half-wave dipole; vertical dipole; folded dipoles; Yagi antennas. Accelerating charged particles.

**Professor Myers**

**198-350A ELECTROMAGNETISM.** (3) (3 hours lectures) (Prerequisites: 189-248A,B, 189-325B. Honours students, or permission of the instructor.) (Not open to students having taken 198-340A.) Fundamental laws of electric and magnetic fields in both integral and differential form.

**Professor Lovejoy**

**198-352A ELECTROMAGNETIC WAVES.** (3) (3 hours lectures) (Prerequisite: 198-350A. Honours students, or permission of the instructor.) Vector and scalar potentials; plane waves in homogeneous media; refraction and reflection; guided waves; radiation from simple systems; dipole and quadrupole radiation; introduction to fields of moving charges; synchrotron radiation; Bremsstrahlung.

**Professor Trischuk**

**198-357A QUANTUM PHYSICS I.** (3) (3 hours lectures) (Honours students or permission of instructor.) (Not open to students taking or having passed 198-446A.) Experimental basis for quantum mechanics; wave-packets; uncertainty principle. Hilbert space formalism. Schrodinger equation: eigenvalues and eigenvectors: applications to 1-d problems including the infinite and finite potential wells and the harmonic oscillator. Tunneling. Time independent perturbation theory.

**Professor Das Gupta**

**198-359B LABORATORY IN MODERN PHYSICS.** (3) (6 hours) (Prerequisite: 198-328A. Corequisite: 198-457B. Honours students or permission of instructor.) Advanced level experiments in modern physics stressing quantum effects and some properties of condensed matter.

**Professor D.H. Ryan and Dr. Buchinger**

**198-362B STATISTICAL MECHANICS.** (3) (3 hours lectures) (Prerequisites: 189-248B or equivalents, 198-253B. Honours students, or permission of the instructor.) (Not open to students taking or having taken 198-333B.) Quantum states and ensemble averages. Fermi-Dirac, Bose-Einstein and Boltzmann distribution functions and their applications.

**Professor Das Gupta**

★**198-413A THE PHYSICAL BASIS OF PHYSIOLOGY.** (3) (3 hours lectures) (Prerequisite: 189-315A,B, or 189-325B, and permission of the instructor.) (Intended for Major or Honours students in Physics, Physiology, and Physics, or Mathematics and others with permission.) Analytic and computer simulation techniques are used to examine the role of nonlinearities and time delays in determining the dynamic behaviour of physiological control systems and their relation to normal and pathophysiological states. Examples drawn from the control of respiration, cellular proliferation and differentiation, biochemical feedback networks, thermoregulatory mechanisms, and neural feedback.

**Professor Mackey**

**198-434B OPTICS.** (3) (3 hours lectures) Geometrical optics, wave optics, lasers, Fourier transform spectroscopy, holography, optical data processing, stellar interferometry.

**Professor Trischuk**

**198-436B MODERN PHYSICS.** (3) (3 hours lectures) (Prerequisite: 198-446A) (Not open to students in Honours Physics or in Joint



Honours in Mathematics and Physics.) One electron atoms, radiation, multielectron atoms, molecular bonds. Selected topics from condensed matter, nuclear and elementary particle physics.

**Professor Patel**

**198-439A LABORATORY IN MODERN PHYSICS.** (3) (6 hours) (Prerequisite: 198-339B. Corequisite: 198-446A.) (Not open to students with credit in 198-359B except with permission of instructor.) Advanced level experiments in modern physics stressing quantum effects and some properties of condensed matter.

**Professor Barrette and Dr. Buchinger**

**198-446A QUANTUM PHYSICS.** (3) (3 hours lectures) (Prerequisite: 198-230A and 198-232B, or 198-251A) (Not open to students taking or having taken 198-357A or 198-457B.) de Broglie waves, Bohr atom. Schrodinger equation, wave functions, observables. One dimensional potentials. Schrodinger equation in three dimensions. Angular momentum, hydrogen atom. Spin, experimental consequences.

**Professor de Takacsy**

**198-449B PROJECT LABORATORY.** (3) (6 hours) (Prerequisite: 198-328A, 198-439A) Supervised project work in an area related to material covered in upper year courses.

**Professor Moore and Dr. Buchinger**

**198-451B CLASSICAL MECHANICS.** (3) (3 hours lectures) (Prerequisite: 198-251A. Honours students, or permission of instructor.) (Not open to students having taken 198-331B.) Rigid bodies, angular momentum, gyroscope, moment of inertia, principal axes, Euler's equations. Coupled oscillations and normal modes. Lagrangian mechanics and applications. Hamiltonian mechanics. Topics in advanced analytical mechanics.

**Professor Strom-Olsen**

**198-457B QUANTUM PHYSICS II.** (3) (3 hours lectures) (Honours students or permission of instructor.) (Not open to students having taken 198-446A.) Angular momentum and spin operators. Operator methods in quantum mechanics. Coupling of spin and angular momenta. Variational principles and elements of time dependent perturbation theory (the Golden Rule). Solution of the Schrodinger equation in three dimensions. Applications to the hydrogen and helium atoms and to simple problems in atomic and molecular physics.

**Professor Stairs**

**198-459D HONOURS RESEARCH PROJECT.** (6) (6 hours) (Honours students or permission of instructor.) (Not open to students taking the sequence 198-469A/198-479B.) An experimental project, supervised by members of staff, on some topic related to the ongoing research in the department.

**Professor David Ryan and Dr. Buchinger**

**198-469A LAB IN MODERN PHYSICS II.** (3) (6 hours) (Honours students, or permission of instructor) (Prerequisite: 198-359B) (Not open to students taking 198-459D.) Advanced level experiments in modern physics stressing quantum effects and some properties of condensed matter. Continuation of 198-359B.

**Professor Barrette and Dr. Buchinger**

**198-479B HONOURS PROJECT LAB.** (3) (6 hours) (Honours students, or permission of instructor) (Prerequisite 198-469A) (Not open to students taking 198-459D.) Supervised project work in an area related to material covered in upper year courses.

**Professor David Ryan and Dr. Buchinger**

**198-489A,B SPECIAL PROJECT.** (3) (6 hours) (Only open to students in their final year of the Joint Major in Physics and Computer Science after consultation with the advisor(s) for the program.) A project incorporating aspects of both physics and computer science, under the joint supervision of the two departments. The Physics aspect may be either laboratory-based or theoretical in nature. The Computational aspect will involve the development and implementation of algorithms arising from the investigation.

**TBA**

**198-514B GENERAL RELATIVITY.** (3) (3 hours lectures) (Honours students, or permission of the instructor.) Transition from special to general relativity. Non-Euclidian geometry. The basic laws of Physics in co-variant form, Einstein's equations. Gravitational waves; neutron stars; black holes; cosmology.

**Professor Myers**

**198-551A QUANTUM THEORY.** (3) (3 hours lectures) (Honours students, or permission of the instructor.) General formulation, scattering theory, WKB approximation, time-dependent perturbation, theory and applications, angular momentum, relativistic wave equations.

**Professor Gale**

**198-557A NUCLEAR PHYSICS.** (3) (3 hours lectures) (Honours students, or permission of the instructor.) General nuclear properties, nucleon-nucleon interaction and scattering theory, radioactivity, nuclear models, nuclear reactions.

**Professor Mark**

**198-558A SOLID STATE PHYSICS.** (3) (3 hours lectures) (Honours students, or permission of the instructor.) Properties of crystals, lattice vibrations and thermal properties of insulators, free electron model and band structure, semi-conductors, metals, optical properties.

**Professor D.H. Ryan**

**198-559A ADVANCED STATISTICAL MECHANICS.** (3) (3 hours lectures) (Honours students, or permission of the instructor.) Self averaging and central-limit theorem; thermodynamic fluctuations; ensemble theory; surface roughening; broken symmetry and Goldstone's theorem; phase transitions; mean-field, Landau and Ornstein-Zernicke theory; Monte Carlo method; molecular dynamics; scaling; renormalization group; epsilon expansion; non-equilibrium theory.

**Professor Grant**

**198-562B ELECTROMAGNETIC THEORY.** (3) (3 hours lectures) (Honours students, or permission of the instructor.) Electrostatics, dielectrics, magnetostatics, timevarying fields, relativity, radiating systems, fields of moving charges.

**Professor De Takacsy**

**198-567B PARTICLE PHYSICS.** (3) (3 hours lectures) (Honours students, or permission of the instructor.) Survey of elementary particles; hadrons, leptons and hadrons' constituents (quarks). Invariance principles and conservation laws. Detectors and accelerators. Phenomenology of strong, electromagnetic and weak interactions.

**Professor Patel**

## 11.25 Physiology (552)

McIntyre Medical Sciences Building, Room 1021  
3655 Promenade Sir-William-Osler  
Montreal, QC H3G 1Y6  
Telephone: (514) 398-4316  
Fax: (514) 398-7452  
Website: <http://www.physio.mcgill.ca>

*Chair* — Alvin Shrier

*Emeritus Professor*

G. Melvill Jones; B.A., M.A., M.B., B.Ch., M.D.(Cantab.)

*Professors*

Catherine Bushnell; B.A.(Maryland), Ph.D.(American U.) (*Harold Griffith Professor of Anaesthesia*) (*joint appt. with Dentistry*)  
Thomas M.S. Chang; B.Sc., M.D., C.M., Ph.D.(McG.), F.R.C.P.(C)  
Monroe W. Cohen; B.Sc., Ph.D.(McG.)  
Ellis J. Cooper; B.Eng.(Sir G.Wms.), M.Sc.(Surrey), Ph.D.(McM.)  
Mony M. Frojmovic; B.Sc., Ph.D.(McG.)  
Leon Glass; B.S.(Brooklyn), Ph.D.(Chic.)  
Phil Gold; C.C., B.Sc., M.Sc., Ph.D., M.D., C.M.(McG.), F.R.C.P.(C.), F.R.S.C. (*joint appt. with Medicine*)  
David Goltzman; B.Sc., M.D., C.M.(McG.) (*Antoine G. Massabki Professor of Medicine*) (*joint appt. with Medicine*)  
John Hanrahan; Ph.D.(U.B.C.)  
James L. Henry; B.Sc.(Tor.), M.Sc., Ph.D.(W.Ont.)  
Robert E. Kearney; B.Eng., M.Eng., Ph.D.(McG.) (*joint appt. with Biomedical Engineering*)  
Kresmir Krnjacic; O.C., B.Sc., Ph.D., M.B., Ch.B.(Edin.), F.R.S.C. (*joint appt. with Anaesthesia Research*)  
Wayne S. Lapp; M.S.A.(Tor.), Ph.D.(McG.)  
Mortimer Levy; B.Sc., M.D., C.M.(McG.), F.R.C.P.(C) (*joint appt. with Medicine*)  
Michael Mackey; B.A., Ph.D.(Wash.)  
Jacopo P. Mortola; M.D.(Milan)  
John Orłowski; B.Sc.(McG.), M.Sc., Ph.D.(Queen's)  
Premysl Ponka; M.D., Ph.D.(Prague)  
Alvin Shrier; B.Sc.(C'dia), Ph.D.(Dal.) (*Hosmer Professor of Physiology*)

Douglas G.D. Watt; M.D., Ph.D.(McG.)

*Associate Professors*

Kathleen Cullen; B.Sc.(Brown), Ph.D.(Chicago)  
 Riaz Farookhi; B.Sc., M.Sc.(M.I.T.), Ph.D.(Tufts)  
 Mladen Glavinovic; B.Sc.(Zagreb), M.Sc.(Tor.), Ph.D.(McG.) (*joint appt. with Anaesthesia Research*)  
 Michael Guevara; B.Sc., M.Eng., Ph.D.(McG.)  
 Sheldon Magder; M.D.(Tor.) (*joint appt. with Medicine*)  
 Ursula Stochaj; Ph.D.(Cologne)  
 Teresa Trippenbach; M.D., Ph.D.(Warsaw)  
 Ann Wechsler; B.A.(Tor.), M.Sc., Ph.D.(McG.)  
 Peter Weldon; B.Sc., Ph.D.(McG.)  
 John White; B.Sc., M.Sc.(Car.), Ph.D.(Harv.)

*Associate Members*

Anaesthesia: Steven Blackman;  
 Dentistry: James Lund;  
 Medicine: Albert Aguayo, Andrey Cybulsky,  
 Samuel O. Freedman, Abraham Fuks, Claude Gagnon,  
 Raymonde Gagnon, Harry Goldsmith, Geoffrey HENDY,  
 Max Katz, Peter Macklem, James Martin, Shree Mulay,  
 Mariana Newkirk, Barry Posner, Shafaat Rabbani, Ian Shrier,  
 J. Enrique Silva, Alan Sniderman, Mary Stevenson,  
 Simon Wing, Hans Zingg;  
 Neurology & Neurosurgery: Massimo Avoli, Charles Bourque,  
 Sal T. Carbonetto, Pierre Drapeau, Daniel Guitton,  
 Michael Rasminsky;  
 Otolaryngology: Bernard Segal;  
 Pediatrics: Immanuela Moss;  
 Psychiatry: Bernardo Dubrovsky, Christina Gianoulakis;  
 Univ. of Montreal, Medicine: Alex Grassino

*Adjunct Professors*

John Milton, Chicago  
 Serge Rossignol, Montreal  
 Malmur R.I. Sairam, Montreal

Physiology has its roots in many of the basic sciences including biology, chemistry, mathematics, and physics. Physiology overlaps with other biomedical sciences such as anatomy, biochemistry, pathology and pharmacology, and with psychology and biomedical engineering, and is one of the prime contributors of basic scientific knowledge to the clinical medical sciences.

Members of the Department of Physiology at McGill are engaged in studies dealing with molecules, single cells, or entire systems in a variety of vertebrates, including man. A wide range of interest and expertise is represented, including cardiovascular, respiratory, gastrointestinal and renal physiology, the physiology of exercise, neurophysiology, endocrinology, immunology, biophysics and biomathematics. Some faculty members have formal or informal links with the departments of mathematics, physics, electrical engineering, chemistry and clinical departments (medicine, surgery, pediatrics, neurology, obstetrics, psychiatry, anesthesia), reflecting and reinforcing the close ties between physiology and other disciplines.

Graduates at the B.Sc. level have found rewarding careers in teaching, in secondary schools and CEGEPs, government service, and laboratory technical assistance, such as in pharmaceutical houses, hospitals, and institutions of higher learning. Moreover, physiology provides an excellent background for medicine, dentistry or other postgraduate work, in such fields as physiology, experimental medicine, pharmacology, biochemistry or physiological psychology.

The programs offered in Physiology differ in their orientation but they all have a common core of material covering cardiovascular, respiratory, gastrointestinal and renal physiology, neurophysiology, endocrinology and immunology. The specified U1 courses are identical for all programs except the Joint Major Programs in Physiology and Physics, Physiology and Mathematics, and the Joint Honours Program in Immunology and thus afford the student maximal flexibility before deciding on a particular program to follow in U2 and U3.

Academic advising is compulsory. All new students to the Department, Freshman and CEGEP, **must** see an advisor upon

entering the program. Contact the Student Affairs Officer at (514) 398-3689 for more information.

Returning students are required to consult with their advisors during the advising period for returning students, and regularly throughout the year. It is important that graduating students have their record checked by their advisor at the beginning of their final year.

**FACULTY PROGRAM IN PHYSIOLOGY** (54 credits)  
 [MARS Program Code 4-750000]

If not previously taken 180-212A,B Organic Chemistry I must be completed in addition to the 54 program credits.

**Required Courses** (33 credits)

552-209A (3) Mammalian Physiology I  
 552-210B (3) Mammalian Physiology II  
 552-212D (2) Introductory Physiology Lab  
 552-311A (3) Intermediate Physiology I  
 552-312B (3) Intermediate Physiology II  
 552-313B (3) Intermediate Physiology III  
 552-314A (3) Integrative Neuroscience  
 177-200A (3) Molecular Biology  
 177-202B (3) Basic Genetics  
 177-301A,B (3) Cell and Molecular Laboratory  
 180-222A,B (4) Organic Chemistry II

**Complementary Courses** (21 credits)

6 credits selected from:

177-201B (3) Cell Biology and Metabolism  
 or 507-212B (3) Molecular Mechanisms of Cell Function  
 177-373A (3) Biostatistical Analysis  
 or 177-309A (3) Mathematical Models in Biology

6 credits selected from physiology courses – see approved list in Department

9 credits selected from science courses – see approved list in Department

**MAJOR PROGRAM IN PHYSIOLOGY** (63-64 credits)

[MARS Program Code 1-750000]

The Major Program includes, in addition to some intensive studies in Physiology, a strong core content of related biomedical and physical sciences. Admission to the Major Program will be in U2, upon completion of the U1 required courses, and in consultation with the student's adviser.

If not previously taken 180-212A,B Organic Chemistry I must be completed in addition to the 63-64 program credits.

**U1 Required Courses** (18 credits)

552-209A (3) Mammalian Physiology I  
 552-210B (3) Mammalian Physiology II  
 552-212D (2) Introductory Physiology Lab  
 177-200A (3) Molecular Biology  
 177-202B (3) Basic Genetics  
 180-222A,B (4) Organic Chemistry II

**U2 and U3 Required Courses** (18 credits)

552-311A (3) Intermediate Physiology I  
 552-312B (3) Intermediate Physiology II  
 552-313B (3) Intermediate Physiology III  
 552-314A (3) Integrative Neuroscience  
 177-301A,B (3) Cell and Molecular Laboratory  
 507-311A (3) Metabolic Biochemistry

**Complementary Courses** (27-28 credits)

12-13 credits selected from:

177-201B (3) Cell Biology and Metabolism  
 or 507-212B (3) Molecular Mechanisms of Cell Function  
 177-373A (3) Biostatistical Analysis  
 or 177-309A (3) Mathematical Models in Biology  
 180-203A (3) A Survey of Physical Chemistry  
 or 180-204A,B (3) Physical Chem./Biol. Sci. I  
 504-214A (3) Systemic Human Anatomy  
 or 504-261A (4) Introduction to Dynamic Histology

9 credits selected from physiology courses – see approved list in Department

6 credits selected from science courses – see approved list in Department

**JOINT MAJOR PROGRAM IN PHYSIOLOGY AND MATHEMATICS** (71 credits) [MARS Program Code 1-725400]**U1 Required Courses** (14 credits)

- 552-212D (2) Introductory Physiology Lab  
 189-222A,B (3) Calculus III  
 189-247A,B (3) Linear Algebra  
 177-200A (3) Molecular Biology  
 177-309A (3) Mathematical Models in Biology

**U1 Complementary Courses** (15 credits)

9 credits selected from:

- 552-209A (3) Mammalian Physiology I  
 and 552-210B (3) Mammalian Physiology II  
 or 552-201A (3) Human Physiology: Control Systems  
 and 552-202B (3) Human Physiology: Body Functions  
 177-201B (3) Cell Biology and Metabolism  
 or 507-212B (3) Molecular Mechanisms of Cell Function

6 credits selected from:

- 189-248A (3) Advanced Calculus I  
 or 189-314A,B (3) Advanced Calculus  
 189-325A,B (3) Ordinary Differential Equations  
 or 189-315A,B (3) Ordinary Differential Equations

**U2 Required Courses** (21 credits)

- 552-311A (3) Intermediate Physiology I  
 552-312B (3) Intermediate Physiology II  
 552-313B (3) Intermediate Physiology III  
 189-242A (3) Analysis I  
 189-243B (3) Real Analysis  
 189-323A (3) Probability Theory  
 189-324B (3) Statistics

**U2 Complementary Courses** (3 credits)

- 198-413A (3) The Physical Basis of Physiology  
 or 189-437A (3) Mathematical Methods in Biology

**U3 Required Courses** (3 credits)

- 189-319B (3) Partial Differential Equations

**U3 Complementary Courses** (15 credits)

6 credits selected from Physiology courses (e.g. 552-461D)

3 credits selected from upper level science courses

6 credits selected from:

- 189-316B (3) Functions of a Complex Variable  
 or 189-249B (3) Advanced Calculus II  
 189-317A,B (3) Numerical Analysis  
 189-322B (3) Dynamical Systems, Fractals and Chaos  
 189-447B (3) Stochastic Processes

**JOINT MAJOR PROGRAM IN PHYSIOLOGY AND PHYSICS** (77 credits) [MARS Program Code 1-725500]

This program provides a firm foundation in physics, mathematics and physiology. It is appropriate for students interested in applying methods of the physical sciences to problems in physiology and allied biological sciences.

**U1 Required Courses** (17 credits)

- 552-212D\* (2) Introductory Physiology Lab  
 198-230A (3) Dynamics of Simple Systems  
 198-232B (3) Heat and Waves  
 198-241B (3) Signal Processing  
 198-259D (3) Lab in Mechanics, Heat & Optics  
 189-222A,B (3) Calculus III

**U1 Complementary Courses** (12 credits)

- 552-209A (3) Mammalian Physiology I  
 and 552-210B\* (3) Mammalian Physiology II  
 or 552-201A (3) Human Physiology: Control Systems  
 and 552-202B (3) Human Physiology: Body Functions  
 189-223A (3) Linear Algebra  
 or 189-247A (3) Linear Algebra  
 189-314B (3) Advanced Calculus  
 or 189-248A (3) Advanced Calculus I

\* The corequisite 177-200A, 177-201B is waived for this program.

**U2 Required Courses** (21 credits)

- 552-311A (3) Intermediate Physiology I  
 552-312B (3) Intermediate Physiology II

- 552-313B (3) Intermediate Physiology III  
 198-328A (3) Electronics  
 198-333B (3) Thermal & Statistical Physics  
 198-339B (3) Measurements Laboratory  
 198-340A (3) Electricity and Magnetism

**U2 Complementary Courses** (6 credits)

- 198-413A (3) The Physical Basis of Physiology  
 or 189-437A (3) Mathematical Methods in Biology  
 189-315A (3) Ordinary Differential Equations  
 or 189-325B (3) Ordinary Differential Equations

**U3 Required Courses** (12 credits)

- 552-461D (6) Experimental Physiology  
 198-446A (3) Quantum Physics  
 399-519A (3) Analysis of Biomedical Systems and Signals

**U3 Complementary Courses** (9 credits)

3 credits selected from upper level Physiology courses

6 credits to be approved by Physiology and Physics

**HONOURS PROGRAM IN PHYSIOLOGY** (71 credits) [MARS Program Code 2-750000]

All admissions to the Honours program will be in U2, and the student must have a U1 GPA of 3.30, with no less than a B in 552-209A and 210B. Admission to U3 requires a U2 CGPA of 3.20 with no less than a B in U2 Physiology courses. Decisions for admission to U3 will be heavily influenced by student standing in U2 courses.

The Department reserves the right to restrict the number of entering students in the Honours programs. Students who do not maintain Honours standing may transfer their registration to the Major Program in Physiology.

The deadline to apply to the Honours Program is June 1. Application forms are available in McIntyre 1021. Students should include in their letters telephone numbers where they can be reached during the last week of August. Students are responsible for picking up their letters of decision in McIntyre 1021 no later than one week before classes start.

Graduation: To graduate from the Honours Physiology Program the student will have a CGPA of 3.20 with a mark no less than a B in all Physiology courses.

If not previously taken 180-212A,B Organic Chemistry I must be completed in addition to the 71 program credits.

**Required Courses** (56 credits)

- 552-209A (3) Mammalian Physiology I  
 552-210B (3) Mammalian Physiology II  
 552-212D (2) Introductory Physiology Lab  
 552-311A (3) Intermediate Physiology I  
 552-312B (3) Intermediate Physiology II  
 552-313B (3) Intermediate Physiology III  
 552-314A (3) Integrative Neuroscience  
 552-351B (3) Research Techniques in Physiology  
 552-359D (1) Tutorial in Physiology  
 552-459D (6) Physiology Seminar  
 552-461D (6) Experimental Physiology  
 177-200A (3) Molecular Biology  
 177-202B (3) Basic Genetics  
 177-301A,B (3) Cell and Molecular Laboratory  
 180-222A,B (4) Organic Chemistry II  
 504-261A (4) Introduction to Dynamic Histology  
 507-311A (3) Metabolic Biochemistry

**Complementary Courses** (15 credits)

9 credits selected from:

- 177-201B (3) Cell Biology and Metabolism  
 or 507-212B (3) Molecular Mechanisms of Cell Function  
 177-373A (3) Biostatistical Analysis  
 or 177-309A (3) Mathematical Models in Biology  
 180-203A (3) A Survey of Physical Chemistry  
 or 180-204A,B (3) Physical Chem./Biol. Sci. I

6 credits selected from physiology courses – see approved list in Department.

**INTERDEPARTMENTAL HONOURS PROGRAM IN**

**IMMUNOLOGY** The Departments of Biochemistry, Microbiology and Immunology, and Physiology offer an Interdepartmental Honours Program in Immunology. Physiology students interested in the program should contact Dr. W.S. Lapp. Details of this program may be found in [section 11.13](#).

**COURSE DESCRIPTIONS**

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

- Denotes courses not offered in 2000-01.
- ★ Denotes courses offered in alternate years only
- Denotes limited enrolment

For more detailed information about courses and programs consult the Department's website.

**552-100A THE BODY MATTERS.** (3) (3-hour seminar per week) (Not open to students who have taken or are taking 552-201, 552-202, 552-209, 552-210, or 552-211.) Designed for anyone with an interest in exercise, the course covers the principles of medicine and physiology as they apply to current lifestyles. Topics will include how and why injuries occur, the effects of exercise on the body, and general health considerations such as "Does exercise prevent or promote osteoarthritis?". **Professor Shrier**

● □ **552-198A FEEDBACK & RHYTHMS IN PHYSIOLOGY.** (3) (3 hours seminar) (FYS – for first year students only, maximum 25.) (Corequisite: 189-140)

● □ **552-199A HISTORY OF GENETIC ENGINEERING.** (3) (3 hours seminar per week) (FYS - for first year students only, maximum 20.)

**552-201A HUMAN PHYSIOLOGY: CONTROL SYSTEMS.** (3) (3 hours lecture weekly) (Prerequisites: collegial courses in biology or anatomy, and in chemistry and physics; with 180-212 or equivalent, as a pre- or co-requisite.) (For students in Physical and Occupational Therapy, Nursing, and others with permission of the course coordinator.) (Not open to students who have taken 552-209A.) Physiology of body fluids, blood, nerve and muscle, peripheral nerves, central nervous system, special senses, autonomic nervous system, defense mechanisms. **Professor White and Staff**

**552-202B HUMAN PHYSIOLOGY: BODY FUNCTIONS.** (3) (3 hours lecture weekly) (Prerequisites: collegial courses in biology or anatomy and in chemistry and physics; with 180-212 or equivalent, as a pre- or co-requisite.) For students in Physical and Occupational Therapy, Nursing, Education, and others with permission of the course coordinator.) (Not open to students who took 552-201A in 1976-77 or earlier, or 552-210B.) Physiology of the cardiovascular, respiratory, excretory, endocrine, and digestive systems; organic and energy metabolism; nutrition; exercise and environmental stress. **Professor Orlowski and Staff**

**552-201A and 552-202B are companion courses and it is recommended that they be taken in that sequence; under special circumstances they may be taken in separate years or in the reverse sequence.**

**552-209A MAMMALIAN PHYSIOLOGY I.** (3) (3 hours lectures weekly) (Prerequisites: as for 552-201A and 552-202B. Pre- or co-requisites: 177-200A, 177-201B or 507-212B) (Not open to students who have taken 552-211D or 552-201A.) (For students in the Faculty of Science, and other students by permission of the instructor.) The course covers the physiology of body fluids, blood, body defense mechanisms, peripheral and central nervous system, muscle. Students must be prepared to attend evening (19:00 - 20:00) class tests. **Professor Stochaj and Staff**

**552-210B MAMMALIAN PHYSIOLOGY II.** (3) (3 hours lectures weekly) (Prerequisites: as for 552-201A and 552-202B. Pre or co-requisite: 177-200A) (Not open to students who have taken 552-211D or 552-202B.) (For students in the Faculty of Science, and other students by permission of the instructor.) (Although 552-210B may be taken without the prior passing of 552-209A, students should note that they may have some initial difficulties because of lack of familiarity with some basic concepts introduced in 552-209A.) The

course covers the physiology of the autonomic nervous system; cardiovascular, respiratory and digestive systems; of the kidney; and of physical exercise. Students must be prepared to attend evening (19:00 -20:00) class tests. Tutorials are given from 18:00 to 19:00 hours. **Professor Trippenbach and Staff**

□ **552-212D INTRODUCTORY PHYSIOLOGY LAB.** (2) (One 3-hour lab and one 1-hour lecture every second week) (Corequisites: 552-209A and 552-210B.) (Required for Physiology students enrolled in 552-209A and 552-210B. Open to Honours and Major students from some other departments.) (For students in a Physiology program, 552-212D should be taken concurrently with 552-209A and 552-210B.) Exercises illustrating fundamental principles in human physiology: blood, neurophysiology, smooth muscle; cardiovascular, respiratory, endocrine, and renal physiology. **Professors Guevara, Wechsler and Staff**

**552-311A INTERMEDIATE PHYSIOLOGY I.** (3) (3 hours of lectures per week; 1-3 hours optional lab/demonstration/tutorial arranged for a maximum of 3 afternoons per term.) (Prerequisite: 552-209A and 552-210B or equivalent, or permission of the instructor.) In-depth presentation of experimental results and hypotheses on cellular communication in the nervous system and the endocrine system. **Professors Cooper, Farookhi and Staff**

**552-312B INTERMEDIATE PHYSIOLOGY II.** (3) (3 hours of lectures per week; 1-3 hours optional lab/demonstration/tutorial arranged for a maximum of 3 afternoons per term) (Prerequisites: 552-209A and 552-210B or equivalent, 552-311A or permission of the instructor.) In-depth presentation of experimental results and hypotheses underlying our current understanding of topics in immunology, kidney function and respiration explored beyond the introductory level. **Professor Hanrahan and Staff**

**552-313B INTERMEDIATE PHYSIOLOGY III.** (3) (3 hours of lectures per week; 1-3 hours optional lab/demonstration/tutorial arranged for a maximum of 3 afternoons per term) (Prerequisites: 552-209A and 552-210B or equivalent, 552-311A or permission of the instructor.) In-depth presentation of experimental results and hypotheses underlying our current understanding of the physiology of the cardiovascular system; blood physiology including hemostasis and thrombosis; transport of fluids and cells; general cell kinetics and regulation, and gastrointestinal physiology. **Professor Frojmovic and Staff**

**552-314A INTEGRATIVE NEUROSCIENCE.** (3) (3 hours of lectures per week) (Prerequisites: 552-209A and 552-210B) In depth presentation of experimental results and hypotheses underlying our current understanding of how single neurons and ensembles of neurons encode sensory information, generate movement, and control cognitive functions such as emotion, learning, and memory, during voluntary behaviours. **Professor Cullen and Staff**

**552-351B RESEARCH TECH. IN PHYSIOLOGY.** (3) (2 hour lecture and 3 hour lab weekly) (Prerequisites: 552-209, 552-210 and 552-311. Corequisites: 552-312 and 552-313.) (Restricted to Honours Physiology students.) The course provides an overview of common research methods in Physiology, including critical analysis and practical experience with some of the methods. Topics include ethics of animal experimentation, data analysis, membrane biophysics, radioimmunoassay, ion sensitive dyes, immunocytochemistry, autoradiography, electron microscopy, and molecular biology. **Professor Trippenbach and Staff**

**552-359D TUTORIAL IN PHYSIOLOGY.** (1) (Prerequisites: 552-209A and 552-210B or equivalent. Corequisites: 552-311, 552-312 and 552-313. Enrolment restricted to Honours Physiology students.) The course consists of regularly scheduled meetings between each individual student and a chosen staff member, to consider current problems in biomedical research and to develop background for a research project to be carried out in U3. Brief written summaries of each meeting are required. **Staff**

**552-419D PROJECT & SEMINAR IN IMMUNOLOGY.** (6) (7 hours lab, 2 hours seminar weekly.) (Enrolment restricted to U3 Honours Immunology students.) (Please see regulations concerning Project Courses, [section 2.6.2](#) in the Faculty Degree Requirements section.) Individual research projects in Immunology under

the guidance of staff members in the three participating departments: Physiology, Biochemistry, and Microbiology and Immunology. The students will meet to discuss their research projects in a seminar format during the winter term. They will be evaluated on their laboratory and seminar performance. **Professor Lapp**

**552-423A PHYSIOLOGICAL DYNAMICS.** (3) (Prerequisite: 552-209A and 552-210B or equivalent, and 177-309 or 189-315, or permission of the instructor.) The control of physiological system function from a theoretical standpoint. The basic roles of mass and momentum transport, pacemaker activity and wave propagation, and neural information processing are emphasized. These are related to the concepts of feedback, stability, and oscillation in normal and patho-physiological states. **Professors Mackey and Glass**

● **★552-444A THEORETICAL ELECTROPHYSIOLOGY.** (3) (3 hours lecture/seminar per week) (Prerequisites: 552-209A and 552-210B or equivalent; 177-309A or 189-315A,B.) (Offered in even numbered years.)

□ **552-451A ADVANCED NEUROPHYSIOLOGY.** (3) (3 hours lecture) (Prerequisite: 552-311A or equivalent and 177-301B.) (Limited enrolment. Password required.) Topics of current interest in neurophysiology including the development of neurons and synapses, physiology of ionic channels, presynaptic and postsynaptic events in synaptic transmission and neuronal interactions in CNS function. **Professors Cohen and Cooper**

□ **552-459D PHYSIOLOGY SEMINAR.** (6) (2 hours seminar) (Prerequisite: permission of instructors.) (Required course for U3 Honours students. Limited enrolment – 12 students maximum. Password required.) Discussion of topics in mammalian, cellular and molecular physiology. Students will be required to write one essay and make at least one oral presentation per term. A final course essay is required. **Professor Farookhi**

**552-461D EXPERIMENTAL PHYSIOLOGY.** (6) (Permission of the instructor required. Password required.) (This course is a requirement for U3 students in the Honours Physiology program and the Major program in Physiology and Physics, and is open to a limited number of other U3 Physiology students.) (Please see regulations concerning Project Courses, [section 2.6.2](#) in the Faculty Degree Requirements section.) Individual project work under the supervision of Departmental Staff members. **Professor Wechsler and Staff**

**552-502B EXERCISE PHYSIOLOGY.** (3) (Prerequisite: 552-311A, 552-312B, and 552-313B) Behaviour of physiological processes in response to physical effort, in areas such as structural basis of muscle contraction, neural control of muscle, mechanics and energetics of muscle contraction, fuel utilization, fatigue, physiological adjustments during exercise and influence of training. **Professor Slawnych and Staff**

□ **552-508A ADVANCED RENAL PHYSIOLOGY.** (3) (Prerequisite: 552-312B or the equivalent.) (Limited enrolment. Open to advanced undergraduate and graduate students.) Offered in conjunction with the Department of Medicine. Lectures and seminars will cover advanced concepts in selected areas of kidney physiology (glomerular and tubular function) as well as membrane and epithelial transport. Students will be expected to critically discuss selected experimental papers. **Professor Levy and Staff**

**552-513B CELLULAR IMMUNOLOGY.** (3) (4 hours lectures plus term paper) (Prerequisites: 528-314B, or permission of the instructor.) This course deals with cellular interactions, regulation and effector mechanisms of the normal immune response in relation to diseases and pathogenic processes. It is taught at an advanced level. **Professor Lapp**

**552-515A PHYSIOLOGY OF BLOOD I.** (3) (2 hours lecture plus 1 hour seminar weekly) (Prerequisites: 552-313B, or permission of the instructor.) Study of the cell and molecular physiology of hemostasis and its pathophysiology (bleeding and thrombosis). Emphases on molecular mechanisms regulating clot formation, fibrinolysis, and cell adhesion/aggregation. Experimental approaches and specific clinical disorders will be analyzed. Weekly discussions, and a major term paper. **Professors Frojmovic, Solymoss and staff**

**552-516B PHYSIOLOGY OF BLOOD II.** (3) (2 hours lecture plus 1 hour seminar weekly) Bone marrow hematopoiesis, with emphasis on regulation of stem cell proliferation and differentiation along hematopoietic pathways. Formation and differentiation of red and white blood cells and some of the diseases associated with hemopoiesis will be covered. Emphasis will be given to the molecular mechanisms involved in the normal and pathological conditions. **Professors Ponka and Hiscott**

**552-517B ARTIFICIAL INTERNAL ORGANS.** (3) (Prerequisite: permission of instructors. Password required.) Physiological, bioengineering, chemical and clinical aspects of artificial organs including basic principles and physiopathology of organ failure. Examples: oxygenator, cardiac support, vascular substitutes, cardiac pacemaker, biomaterials and tissue engineering, biocompatibility. **Professors Prakash and Chang**

**552-518A ARTIFICIAL CELLS & BIOTECHNOLOGY.** (3) (Prerequisite: permission of instructors. Password required.) Physiology, biotechnology, chemistry and biomedical application of artificial cells, blood substitutes, immobilized enzymes, microorganisms and cells, hemoperfusion, artificial kidneys, and drug delivery systems. 552-517B and 552-518A when taken together, will give a complete picture of this field. However, the student can select one of these. **Professors Chang and Yu**

★ **552-520B ION CHANNELS.** (3) (1½ hour lecture, 1½ hour seminar) (Prerequisite: 552-311A) (Priority to Graduate and Honours students; others by permission of instructors. Password required.) (Offered in odd numbered years.) A discussion of the principal theories and interesting new developments in the study of ion channels. Based on a textbook, computer exercises & critical reading and presentation of research papers. Topics include: Properties of voltage- and ligand-gated channels, single channel analysis, structure and function of ion channels. **Professors Drapeau, Bourque and Hanrahan**

**552-531B TOPICS IN APPLIED IMMUNOLOGY.** (3) (Permission of the instructor. U3 InterDept. Honours Immunology students and graduate students with strong immunology background i.e. 552-513A and 507-503B.) Seminar format course in which experts in immunologic mechanisms of resistance against a variety of infectious diseases, including AIDS, malaria, and tuberculosis oversee student moderators in their presentation of recent scientific literature in the field. **Professors Stevenson and Bernard**

□ **552-550A PHYSIOLOGY OF BONE.** (3) (1 hour of lecture, 2 hours of seminar per week) (Prerequisites: 552-311A, and 177-202B or equivalent) (Restricted to U3 Physiology students, and graduate students in biomedical departments; others by permission of the instructor.) Students will develop a working knowledge of cartilage and bone. Discussion topics will include: molecular and cellular environment of bone; heritable and acquired skeletal defects; research models used to study metabolic bone disease. (Awaiting University Approval) **Professor Henderson**

□ **552-552B CELLULAR & MOLECULAR PHYSIOLOGY.** (3) (1 hour lecture, 2 hours seminar weekly) (Pre-requisite: 552-311A) (Preference will be given to Physiology Honours and Graduate students. Limited enrolment.) Discussions of recent significant advances in our understanding of the gene products involved in diverse cellular signalling pathways. Topics will include cell-surface hormone receptors, nuclear steroid hormone receptors, and ion channels and transporters. Students will present and critically evaluate experimental approaches, results and interpretations of selected research publications. **Professors Orlowski and White**

□ **552-556B TOPICS IN SYSTEMS NEUROSCIENCE.** (3) (Permission of the instructor required. Limited enrolment. Password required.) (Not open to students who have taken 552-456B.) Topics of current interest in systems neurophysiology and behavioural neuroscience including: the neural representation of sensory information and motor behaviours, models of sensory motor integration, and the computational analysis of problems in motor control and perception. Students will be expected to present and critically discuss journal articles in class. **Professors Cullen and Guitton**

