

**305-691A,B,C M.ENG. THESIS LITERATURE REVIEW.** (3) A comprehensive literature review in the general area of the thesis topic, to be completed in the first semester.

**305-692A,B,C M.ENG. THESIS RESEARCH PROPOSAL.** (4) Initiation of research with particular emphasis on the definition of the thesis topic.

**305-693A,B,C M.ENG. THESIS PROGRESS REPORT I.** (3) A first status report on the progress in the thesis research.

**305-694A,B,C M.ENG. THESIS PROGRESS REPORT II.** (6) A second status report on the progress in the thesis research.

**305-695A,B,C M.ENG. THESIS.** (12) Submission of the M.Eng. thesis for examination.

**305-701A,B,C Ph.D. PRELIMINARY ORAL EXAM.** Presentation of the Ph.D. thesis proposal by the student and oral examination of the student's background in related areas.

## 48 Medical Physics

Medical Physics Unit  
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### 48.1 Staff

#### Professors

S.M. Lehnert; B.Sc.(Nott.), M.Sc., Ph.D.(Lond.)  
E.B. Podgorsak; Dipl. Ing.(Ljubljana), M.Sc., Ph.D.(Wis.),  
F.C.C.P.M.  
C.J. Thompson; B.Sc., M.Sc., D.Sc.(Otago), F.C.C.P.M.

#### Associate Professors

G.W. Dean; B.Sc.(Salf.), M.Sc.(Man.), Ph.D.(E. Anglia),  
F.C.C.P.M.  
G.B. Pike; B.Eng.(St.John's), M.Eng., Ph.D.(McG.)  
J.P.F. Seuntjens; M.Sc., Ph.D.(Ghent)

#### Assistant Professors

M.D.C. Evans; B.A.(Queen's), M.Sc.(McG.), F.C.C.P.M.  
C.J. Henri; B.Sc.(New Orleans), M.Sc., Ph.D.(McG.)  
D.H. Hristov; B.Sc.(Sofia), Ph.D.(McG.)  
M. Olivares; B.Sc.(Madrid), M.Sc.(Sask.), F.C.C.P.M.

#### Adjunct Professors

A.C. Evans; B.Sc.(Liv.), M.Sc.(Sur.), Ph.D.(Leeds)  
T.M. Peters; B.Eng., Ph.D.(Cant.), F.C.C.P.M.  
R.B. Richardson; B.Sc.(Lond.), M.Sc.(Aberdeen), Ph.D.(Bristol)

#### Lecturers

R.A. Corns; B.Sc., M.Sc., Ph.D.(Man.), M.Sc.(McG.)  
G. Durante; B.Eng.(McG.)  
P. Léger; B.Eng.(École Poly.) O.I.Q.  
W.A. Parker; B.Sc.(C'dia), M.Sc.(McG.), M.C.C.P.M.  
H.J. Patrocinio; B.Sc.(C'dia), M.Sc.(McG.), M.C.C.P.M.  
N. Sharoubirn; B.Eng.(Ain Shams)

### 48.2 Programs Offered

The Medical Physics Unit offers an M.Sc. in Medical Radiation Physics. Facilities are available for students to undertake a Ph.D. in Medical Physics through the Department of Physics.

The Unit is a teaching and research unit concerned with the application of physics and related sciences in medicine, especially (but not exclusively) in radiation oncology, i.e. radiation oncology, medical imaging and nuclear medicine.

The research interests of members of the Unit include various aspects of medical imaging, including 3D imaging, the development of new imaging modalities and applications of imaging in radiation therapy; radiation dosimetry, especially solid state, electret and NMR systems; nuclear cardiology; and applications of radiation biology to therapy.

The M.Sc. and Ph.D. programs in Medical Physics are accredited by the Commission on Accreditation of Medical Physics Education Programs, Inc., sponsored by The American Association of Physicists in Medicine (AAPM), The American College of Medical Physics (ACMP), and The American College of Radiology (ACR).

### 48.3 Admission Requirements

Candidates applying to the M.Sc. program must normally hold a B.Sc. degree (Honours or Major) in Physics or Engineering, with a minimum overall GPA of 3.0/4.0 (minimum of 70%).

### 48.4 Application Procedures

Students are admitted to the M.Sc. program only at the start of the Fall semester in September of a given academic year. Applications for consideration for the Fall semester of 2000-2001 should be submitted between September 1, 1999 and March 15, 2000.

Only complete applications will be considered. Interested candidates should (a) ask their university(ies) to send two originals of each transcript, and (b) request that original confidential letters of recommendation be sent by professors familiar with their work. The application fee of \$60 Cdn should be remitted in Canadian funds in negotiable form, such as a bank draft, money order, etc. payable to McGill University.

Non-Canadian applicants whose mother tongue is not English and who have not completed a degree using the English language must submit documented proof of competency in English by a TOEFL (Test of English as a Foreign Language) with a minimum score of 550, or an equivalent test. The original test report must be sent by the testing center, i.e. a photocopy sent by the applicant is not acceptable.

All application materials should be sent directly to the Graduate Secretary, Medical Physics Unit.

### 48.5 Program Requirements

#### M.Sc. in Medical Radiation Physics

This two-year program provides a comprehensive introduction to the academic, research and practical aspects of physics applied to radiation medicine. In addition to the thesis requirement (32 credits) there are 12 mandatory courses (28 credits). The practical and laboratory sections of the program are conducted in various McGill teaching hospitals.

The program comprises:

- 1) didactic courses in radiation physics, radiation dosimetry, the physics of nuclear medicine and diagnostic radiology, medical imaging, medical electronics and computing, radiation biology and radiation hazards and protection;
- 2) seminars in radiation oncology, diagnostic radiology and miscellaneous aspects of medical physics, e.g. lasers;
- 3) laboratory courses in radiation dosimetry and medical imaging;
- 4) an individual research thesis.

### 48.6 Graduate Level Courses

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

**563-601A RADIATION PHYSICS.** (3) The production and properties of directly and indirectly ionizing radiations and their interactions with matter; basic theoretical and experimental aspects of radiation dosimetry.

**563-602B APPLIED DOSIMETRY.** (3) (Prerequisite: 563-601A) Theoretical and practical dosimetry of radiation sources, both external and internal with respect to the human body, as applied to

radiotherapy, diagnostic radiology, nuclear medicine, radiobiology and radiation protection.

**563-603B LABORATORY PRACTICUM.** (2) (Prerequisite: 563-601A. Corequisite: 563-602B) This laboratory course gives some experience in practical/clinical aspects as applied to radiation therapy and to the techniques for the measurement of different physical parameters which characterize radiation beams. The student is exposed to the operation of various therapy units, dose measuring devices, 3D treatment planning, virtual simulator units.

**563-607A INTRODUCTION TO MEDICAL IMAGING.** (3) (Corequisite: 563-615A) A review of the principles of medical imaging as applied to conventional diagnostic radiography, digital subtraction radiography, computed tomography and magnetic resonance imaging. The course emphasizes a linear system approach to the formation, processing and display of medical images.

**563-608B LABORATORY IN DIAGNOSTIC RADIOLOGY AND NUCLEAR MEDICINE.** (2) (Prerequisite: 563-615A. Corequisite: 563-614B.) This laboratory course takes place in hospital departments of diagnostic radiology and nuclear medicine and is designed to give the student a working knowledge of calibration techniques and quality assurance in these fields of medicine, together with practical applications of the concepts studied in 563-614B and 563-615A.

**563-609A RADIATION BIOLOGY.** (2) Deals with the effects and mode of action of ionizing radiation on biological material from molecular interactions, through sub-cellular and cellular levels of organization, to the response of tissues, organs and the whole body. Includes application of radiation biology in oncology and the biological aspects of environmental radiation exposure.

**563-611A MEDICAL ELECTRONICS.** (2) An introductory course on electronics, with emphasis on digital electronics, data acquisition and microprocessors applied to instrumentation. A basic knowledge of electronics is assumed, but the detailed course contents may vary from year to year, depending on the background of the students.

**563-612B COMPUTERS IN MEDICAL IMAGING.** (2) (Prerequisites: 563-607A, 563-611A or equivalent, 563-615A. Corequisite: 563-614B.) The role of computers in the acquisition and storage of data in medical imaging systems, with special reference to computed tomography, gamma cameras, positron emission tomography. Special attention is paid to the interfacing requirements of each device and to image display systems. Demonstrations of some of these systems are included.

**563-613B HEALTH PHYSICS.** (2) (Prerequisites: 563-601A, 563-609A) The hazards of ionizing radiations and the safe handling of radiation sources. Topics covered include basic principles; safety codes, laws and regulations; organization of radiation safety; and practical safety measures and procedures.

**563-614B PHYSICS OF DIAGNOSTIC RADIOLOGY.** (3) (Prerequisite: 563-607A) A rigorous treatment of the physical principles and the instrumentation of radiology, computed tomography and ultrasound medical imaging systems. Special attention is paid to the analysis of the relations between imaging system design, image quality, and safety. Measurement techniques for the evaluation of medical imaging systems are reviewed.

**563-615A PHYSICS OF NUCLEAR MEDICINE.** (3) (Corequisite: 563-601A) The physics of radioactivity and the applications of radioisotopes and radiopharmaceuticals in medical diagnosis. Topics covered include radiation spectrometry, the scintillation camera, single photon emission tomography, and image analysis and data processing in nuclear medicine.

**563-616D SELECTED TOPICS IN MEDICAL PHYSICS.** (1) This course deals with anatomy and physiology, etiology and treatment of cancer and introductory medical statistics, three topics not covered by other courses in the program. Also clinical aspects of radiation oncology physics.

**563-625D M.Sc. THESIS RESEARCH.** (32)

## 49 Medicine, Experimental

Division of Experimental Medicine  
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### 49.1 Staff

#### Professors

A.J. Aguayo; M.D.(C' dia)  
H. Bennett; B.A.(York, U.K.), Ph.D.(Brun.)  
R. Blostein; M.Sc., Ph.D.(McG.)  
G.M. Bray; B.Sc.(Bran.), M.D., B.Sc.(Med.) (Man.), F.R.C.P.(C)  
T.M.S. Chang; B.Sc., M.D., C.M., Ph.D.(McG.), F.R.C.P.(C)  
M. Cosio; B.Sc.(Oviedo), M.D.(Madrid)  
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S.O. Freedman; O.C., B.Sc., M.D., C.M.(McG.), F.R.C.P.(C),  
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G. Hendy; B.Sc.(Sheff.), Ph.D.(Lond.)  
A. Herscovics; B.Sc., Ph.D.(McG.)  
J. Hiscott; B.Sc., M.Sc.(W.Ont.), Ph.D.(N.Y.)  
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B. Leyland-Jones; B.Sc., M.B., B.S.(Lond.), F.R.C.P.(C), F.A.C.P.  
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S. Magder; M.D.(Tor.), F.R.C.P.(C)  
O.A. Mamer; B.Sc., Ph.D.(Windsor)  
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J. Milic-Emili; M.D.(Milan), F.R.S.C.  
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C.K. Osterland; M.D.(Man.)  
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E. Silva; M.D.(Chile), F.A.C.P.  
E. Skamene; M.D., (Charles U., Czech.), Ph.D.(Czech. Acad. of  
Sci.), F.R.C.P.(C), F.A.C.P.  
A.D. Sniderman; M.D.(Tor.)  
S. Solomon; B.Sc., M.Sc., Ph.D.(McG.), F.R.S.C.  
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S.L. Tan; M.B.B.S., M.Med.(Sing.)  
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M. Wainberg; B.Sc.(McG.), Ph.D.(Col.)  
E. Wang; B.Sc.(Taiwan), M.A.(N.Mich.), Ph.D.(Case)  
M. Zannis-Hadjopoulos; B.Sc., M.Sc., Ph.D.(McG.)  
H. Zingg; M.D.(Basel), Ph.D.(McG.)

#### Associate Professors

A. Bateman; B.Sc., Ph.D.(Lond.)

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 L.F. Congote; B.Sc.(Z[u.r.], Ph.D.(Marburg)  
 D. Courmoyer; M.D.(Sher.), F.R.C.P.(C)  
 A. Cybulsky; M.D.(Tor.), F.R.C.P.(C)  
 D. Eidelman; M.D., C.M.(McG.), F.R.C.P.(C)  
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 M.S. Featherstone; B.Sc., M.Sc.(Ott.), Ph.D.(McG.)  
 R. Gagnon; B.Sc.(Montr.), M.D.(Laval), D.Phil.(Oxon.)  
 R. Germinario; B.A., M.Sc.(Seton Hall U., N.J.), Ph.D.(Dakota)  
 F. Gervais; B.Sc., M.Sc., Ph.D.(Montr.)  
 V. Giguere; B.Sc., Ph.D.(Laval)  
 S.B. Gottfried; M.D.(Penn.)  
 Q.A. Hamid; M.D.(Mosul, Iraq), Ph.D.(Lond.)  
 L.J. Hoffer; B.Sc., M.D., C.M.(McG.), Ph.D.(M.I.T.)  
 L. Kleiman; B.Sc.(Ill.), Ph.D.(Johns H.)  
 R. Kremer; M.D., Ph.D.(Paris)  
 M. Laughrea; B.Sc.(Laval), M.Sc., M.Phil., Ph.D.(Yale)  
 R. Loertscher; M.D.(Basel)  
 W.H. Miller; A.B.(Prin.), Ph.D.(Rock.), M.D.(C'nell)  
 S. Mulay; M.Sc., Ph.D.(McG.)  
 J. Nalbantoglu; B.Sc., Ph.D.(McG.)  
 A. Nepveu; B.Sc., M.Sc.(Montr.), Ph.D.(Sher.)  
 M. Newkirk; B.Sc., M.Sc.(Queen's), Ph.D.(Tor.)  
 T. Owens; B.Sc., M.Sc.(McG.), Ph.D.(Ott.)  
 R. Palfree; B.Sc., M.Sc.(Lond.), Ph.D.(McG.)  
 K. Pantopoulos; B.Sc., Ph.D.(Aristotelian, Greece)  
 M. Parniak; B.Sc., Ph.D.(Wat.)  
 A.C. Peterson; B.Sc.(Vic., B.C.), Ph.D.(Br.Col.)  
 S. Rabbani; M.B.B.S.(King Edward Med. Coll., Lahore)  
 D. Radzioch; M.Sc., Ph.D.(Jagiellonian, Cracow)  
 J. Rauch; B.Sc., Ph.D.(McG.)  
 C.P. Rose; B.Sc.(Queen's), M.D., C.M., Ph.D.(McG.)  
 E. Schurr; Diplom., Ph.D.(Al. Ludwigs U., Freiburg)  
 G. Spurl; B.Sc.(Med.), M.D.(Man.)  
 C. Srikant; M.Sc., Ph.D.(Madr.)  
 M. Trifiro; B.Sc., M.D.(McG.)  
 C. Tsoukas; B.Sc.(McG.), M.Sc.(Hawaii), M.D.(Athens),  
 F.R.C.P.(C)  
 B. Turcotte; B.Sc., Ph.D.(Laval)  
 A. Veillette; B.Sc., M.D.(Laval), F.R.C.P.(C)  
 B.J. Ward; M.D.(McG.), M.Sc.(Oxon.), F.R.C.P.(C)

#### Assistant Professors

M. Alaoui-Jamali; D.V.M.(Rabat, Morocco), Ph.D.(René-  
 Descartes, Paris)  
 S. Ali; B.Sc.(C'dia), Ph.D.(McG.)  
 D. Baran; M.D.C.M.(McG.), F.R.C.P.(C)  
 R. Benoit; M.D.(Montr.)  
 N. Bernard; B.Sc.(McG.), Ph.D.(Duke)  
 L. Chalifour; B.Sc., Ph.D.(Man.), M.A.(Harv.)  
 K. Cianflone; B.Sc., Ph.D.(C'dia)  
 A.E. Clarke; M.D.(Nfld.), M.S.(Stan.), F.R.C.P.(C)  
 C. Couture; B.Sc., M.Sc.(Laval), Ph.D.(McG.)  
 W. Cupples; B.Sc.(Vic., B.C.), M.Sc.(Calg.), Ph.D.(Tor.)  
 S. Daly; B.Sc.(C'dia), Ph.D.(W. Ont.)  
 S. David; B.P.T., Ph.D.(Man.)  
 J. Falutz; B.Sc., M.D., C.M.(McG.), F.R.C.P.(C)  
 G.I. Fantus; B.Sc., M.D., C.M.(McG.), F.R.C.P.(C)  
 J. Galipeau; M.D.(Montr.)  
 B. Gilfix; B.Sc.(Man.), Ph.D.(W. Ont.), M.D.C.M.(McG.),  
 F.R.C.P.(C)  
 M. Greenwood; B.Sc., M.Sc.(C'dia), Ph.D.(McG.)  
 J. Henderson; B.Sc., Ph.D.(McG.)  
 H. Huynh; B.Sc., M.Sc., Ph.D.(McG.)  
 A.C. Karaplis; B.Sc., M.D., Ph.D.(McG.)  
 A.E. Koromilas; B.Sc., Ph.D.(Aristotelian U., Greece)  
 G.A. Kuchel; M.D.(McG.)  
 P. Laneuville; B.Sc.(McM.), M.D.(Ott.), F.R.C.P.(C)  
 L. Larose; B.Sc., Ph.D.(Montr.)  
 D. Lasko; B.S.(Yale), Ph.D.(M.I.T.)  
 J.-J. Lebrun; B.Sc., M.Sc., Ph.D.(Rennes, France)

R. Lin; B.Sc., M.Sc.(PRC), Ph.D.(C'dia)  
 M. Lipman; M.D.(McG.), F.R.C.P.(C)  
 D.K. Lloyd; B.Sc., Ph.D.(York, UK)  
 M.S. Ludwig; M.D.(Man.), F.R.C.P.(C)  
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 B. Mazer; B.Sc.(Columbia, NY), M.D.(McG.), F.R.C.P.(C)  
 M. Park; B.Sc., Ph.D.(Glas.)  
 B.J. Petrof; M.D.(Laval)  
 R.P. Rehfuss; B.Sc.(State U.), Ph.D.(Syr.)  
 P. Renzi; M.D.(Montr.), F.R.C.P.(C)  
 S. Richard; B.Sc., Ph.D.(McG.)  
 D. Richardson; B.Sc., M.Sc., Ph.D.(W. Austr.)  
 G. Rouleau; B.Sc., M.D.(Ott.), Ph.D.(Har.), F.R.C.P.(C)  
 A. Sculptoreanu; B.Sc., M.Sc.(Carl.), Ph.D.(Sher.)  
 A. Sherker; M.D.(Queen's), F.R.C.P.(C)  
 T. Takano; M.D., Ph.D.(Tokyo)  
 J.P.H. Th'gn; B.Sc., M.Sc.(W.Ont.)  
 P. Tonin; B.Sc., M.Sc., Ph.D.(Tor.)  
 J. Viallet; B.Sc., M.D.(Montr.), F.R.C.P.(C)  
 M. Ward; M.D.(Queen's), Ph.D.(McG.)  
 S. Wing; B.Sc., M.Sc.(McG.)  
 X.-J. Yang; B.Sc.(Zhejiang), Ph.D.(Shanghai)  
 S.-P. Yee; B.Sc., M.Sc., Ph.D.(McM.)

#### Associate Members, McGill

C. Autexier, D. Boivin, P. Brodt; M.N. Burnier; D.H. Burns; M.  
 Chevette; S.Chevalier; T. Chow; H. Clarke; E. Colle; R. Farookhi;  
 M.M. Frojmovic; C. Gagnon; A. Gaiad; C. Goodyer; P. Goodyer; B.  
 Gour; B.J. Jean-Claude; W. Lapp; S. Lehnert; B. Massie; M. Miller;  
 E. Mills; C. Polychronakos; R.D. Rajan; G. Rouleau; S.-H. Shen;  
 G. Tannenbaum; H. Tenenhouse; I. Wainer; K. Watkin; S.N. Young

#### Associate Members, Université de Montréal

R. Butterworth; T. Bradley; P. Chartrand; J. Davignon; A. Deng;  
 C.F. Deschepper; J. Drouin; R. Garcia; J. Genest Jr.;  
 J. Gutkowska; P. Hamet; T. Hoang; P. Hugo; P. Jolicoeur; M. Klein;  
 C. Lazure; D. Lohnes; M. Nemer; M. Raymond; T. Reudelhuber;  
 M. Sairam; G. Sauvageau; E. Schiffrin; N. Seidah; R.-P. Sekaly;  
 D. Skup; M. Trudel; J. Vacher

#### Associate Members, Institut Armand Frappier, Université du Québec

S. Lemieux; E. Potworowski; L. Zamir

## 49.2 Programs Offered

Ph.D. in Experimental Medicine.  
 M.Sc. – Specialization in Bioethics.  
 Graduate Diploma in Clinical Research.

## 49.3 Admission Requirements

For all three programs, candidates educated outside of Canada and the United States must submit GRE (General Examination) scores.

### Ph.D.

Admission to graduate studies and research in Experimental Medicine is restricted to students who wish to register for the Ph.D. degree. Candidates must hold a Major or Honours B.Sc. degree, or an M.D. degree.

Admission is based on an evaluation by the Admissions Committee, which looks for evidence of high academic achievement, and on acceptance by a research director. It is the policy of the Division that all students must be financially supported either by their supervisor or through studentships or fellowships.

In addition to the documentation currently required by the Faculty of Graduate Studies, a letter from the candidate's research director outlining the Ph.D. project is necessary.

### M.Sc. (Specialization in Bioethics)

Admission to the Master's program in Bioethics, from the base discipline Medicine, shall be limited to students having degrees in Medicine, Nursing, Physical and Occupational Therapy, as well as any other professional health training degree.

For further information regarding this program, please refer to the Bioethics entry.

### Graduate Diploma in Clinical Research

The diploma program is open to health care and research professionals, medical residents, pharmacists, nurses, and those with an undergraduate degree in the medical and allied sciences.

#### 49.4 Application Procedures

Applications will be considered upon receipt of:

1. application form;
2. transcripts;
3. letters of reference;
4. \$60 application fee;
5. test results (TOEFL and GRE).

All information is to be submitted to the Departmental Office.

#### 49.5 Program Requirements

##### PH.D.

##### Comprehensive Examination

All students must take and pass the Comprehensive Oral Examination, listed as course 516-701D in the second year of the Ph.D. Students shall give a 30-minute presentation of their Ph.D. project and then answer questions from the Oral Committee. This examination will test: (i) If the student's work is progressing satisfactorily and is of sufficiently high calibre to warrant continuation in the program, and (ii) If the student has a broad knowledge, not only of his/her own field of research, but also of related areas in her/his discipline.

##### Course Work

A minimum of 18 course credits is required for students entering the program with a Bachelor's or M.D. degree. Depending on their background, students with a Masters degree may be required to take only 12 course credits. The following courses are highly recommended: 516-604D Recent Advances in Cellular and Molecular Biology; 516-610B Biochemical Methods in Medical Research.

After consultation with their research supervisor and the Director of the Division, students may choose their courses from those offered by Experimental Medicine, Physiology, Biochemistry as well as other graduate and advanced undergraduate courses in the medical and allied sciences. Where necessary, students may enroll for credit in courses offered in the physical and mathematical sciences.

Students in the third year of the Ph.D. must give a 20-minute oral presentation of their work at the Annual Research Seminar.

##### M.Sc. (Specialization in Bioethics)

The curriculum is composed of required courses (for 6 credits) offered in the Biomedical Ethics Unit, bioethics courses (3 credit minimum) offered by the base department and any graduate courses required or accepted by the base department for the granting of a Master's degree, for a total of 18 to 21 credits. A minimum of 45 credits is required including the thesis.

For further information please contact the Chair, Master's Specialization in Bioethics, Biomedical Ethics Unit, 3690 Peel Street, Montreal, QC, H3A 1W9. Telephone: (514) 398-6980; Fax: (514) 398-8349; e-mail: Glass\_K@falaw.lan.mcgill.ca.

##### Graduate Diploma in Clinical Research

The Diploma consists of 30 credits, 24 of which include specific courses. The additional supplemental 6 credits are electives and may be chosen from course work available through the Division of Experimental Medicine, Department of Pharmacology and Therapeutics and Department of Epidemiology and Biostatistics.

The core element of the diploma is the Practicum in Clinical Research (18 credits). It is a six-step program with active 'clerkship' or 'intern-resident-type' participation in each component that is essential to the successful development and evaluation of a clinical trial.

Six 1-credit workshops will be provided by experts in the academic, industrial and government sectors, and cover wide-ranging issues pertinent to the conduct of clinical research.

#### 49.6 Courses for Higher Degrees

● Denotes not offered in 2000-01.

★ Denotes courses offered in alternate years.

□ Denotes limited enrolment.

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

**516-502A ADVANCED ENDOCRINOLOGY – PART I.** (3) A multidisciplinary approach will be used to teach biosynthesis and processing of hormones, their regulation, function and mechanism of action. The material will cover hypothalamic, pituitary, thyroid, atrial and adrenal hormones as well as prostaglandins and related substances. **Professors Bennett, Bateman and Staff**

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

□ **516-504A BIOLOGY OF CANCER.** (3) An introduction to the biology of malignancy. A multidisciplinary approach dealing with the etiology of cancer, the biological properties of malignant cells, the host response to tumor cell growth and the principles of cancer therapy. **Professor Thomson and Staff**

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

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

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

● **516-509B GASTROINTESTINAL PHYSIOLOGY AND PATHOPHYSIOLOGY.** (3) (Prerequisite: Graduate students, U3 undergraduates)

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

**516-511B JOINT VENTURING WITH INDUSTRY.** (3) Presentation skills; preparing a business plan; the planning and control process; and legal, financial and human resource issues as they apply to the researcher. Given in conjunction with the Centre for Continuing Education. **Professors Price and Yalovsky**

● **516-512C RECENT PROGRESS IN AIDS RESEARCH.** (6)

**516-602B ADVANCED TECHNIQUES IN MOLECULAR GENETICS.** (3) (Admission by permission of instructor.) Offered in conjunction with the Department of Human Genetics. Precise description of available methods in molecular genetics, and rationales for choosing particular techniques to answer questions posed in research proposals for targeting genes in the mammalian genome. Emphasis placed on analysis of regulation of gene expression and mapping, strategies for gene cloning. Course divided between lectures and student seminars. **Professors Malo and Radzioch**

**516-603B SEMINARS IN ENDOCRINOLOGY.** (3) For graduate students to develop skills in critical reading of current literature, interpretation of research data, and seminar organization and presentation. Staff suggest topics. Each student presents two seminars on topics of their choice, supervised by professors responsible for those topics, and one mini-symposium style presentation on any topic. **Professor Palfree and Staff**

**516-604D RECENT ADVANCES IN CELLULAR AND MOLECULAR BIOLOGY.** (6) Offered in conjunction with the Université de Montréal: given Thursdays 16:00-18:00 at Institut de Recherches Cliniques de Montréal, 110 Pine West. The course is bilingual with abstracts in the other language supplied; more than half the lectures are in French. Aimed at bringing students up to date on recent aspects of cell and molecular biology including cellular organelle structure and function, molecular genetics, signal transduction, cell growth and development, and immunology. **Professor Drouin and Staff**

**516-607B MOLECULAR CONTROL OF CELL GROWTH.** (3) A course for graduate students in Experimental Medicine, Biology, Biochemistry, Microbiology and Physiology, dealing with molecular control in normal and malignant cell growth, including cell cycle and physiological controls (nutritional and hormonal), mammalian DNA replication, viral effects on host cell growth for DNA and RNA-tumor viruses and oncogenes, and tissue and organ growth-renewal mechanisms. **Professors Price and Zannis-Hadjopoulos**

★**516-608A MOLECULAR EMBRYOLOGY.** (3) (Offered in conjunction with the Department of Oncology.) The course will deal with the structure and function of genes whose products play key roles in the development of vertebrates and invertebrates. Particular emphasis will be paid to the embryonic axes, the action of cell surface molecules in the embryo, and the urogenital system. **Professors Featherstone, Beauchemin and Pelletier**

**516-610B BIOCHEMICAL METHODS IN MEDICAL RESEARCH.** (3) A course intended to introduce students to a variety of basic techniques used in medical research. Lectures and demonstrations given on the purification of biologically active substances by chromatography, analysis of compounds by spectrophotometry and mass spectrometry, immunological techniques, centrifugation, cell culture, binding of hormones to receptors, molecular biology, tumor biology and electron microscopy. **Professor Powell and Staff**

● □ ★**516-611D SEMINARS IN ONCOLOGY.** (6)

**516-614B ENVIRONMENTAL CARCINOGENESIS.** (3) Methods for identification of carcinogens, including epidemiological studies, animal modelling and molecular biomarkers, and characteristics of known environmental carcinogens (viruses, chemical and physical agents and diet). Environmental factors will be placed in the context of overall cancer risk, which involves interaction of genetics, host and environment. **Professors Lehnert, Franco, Matlashewski and Alaoui-Jamali**

**516-615B MEMBRANE CARBOHYDRATES.** (3) The structure, function and biosynthesis of glycoproteins, glycolipids and glycosaminoglycans, and the biological role of complex carbohydrates at the cell surface. **Professor Herscovics**

□ **516-616A MOLECULAR & CELL BIOLOGY TOPICS.** (3) Structured and instructor-directed student presentations and discussions of recent advances in molecular and cellular biology. The course will reinforce the students' knowledge of currently major areas of investigation, with a focus on human disease and medical

applications. Important recent publications will extend material from textbook and review articles. **Professors Miller and Richard**

**516-617A,B,C,T WORKSHOP IN CLINICAL TRIALS I.** (1) Intensive day-long workshop discussing Industrial/Academic/Governmental interactions in the design, testing and approval of drugs. **Professors Gold, Wainer and Price**

**516-618A,B,C,T WORKSHOP IN CLINICAL TRIALS II.** (1) Intensive day-long workshop discussing the role of the physician in drug testing. **Professors Gold, Wainer and Price**

**516-619A,B,C,T WORKSHOP IN CLINICAL TRIALS III.** (1) Intensive day-long workshop discussing the pharmacoeconomics of drug design and testing. **Professors Gold, Wainer and Price**

**516-620A,B,C,T CLINICAL TRIALS AND RESEARCH I.** (1) Intensive day-long workshop discussing a topical subject or recent advance relevant to clinical research and the conduct of clinical trials. **Professors Gold, Wainer and Price**

**516-625A,B,C,T CLINICAL TRIALS AND RESEARCH II.** (1) Intensive day-long workshop discussing a topical subject or recent advance relevant to clinical research and the conduct of clinical trials. **Professors Gold, Wainer and Price**

**516-626A,B,C,T CLINICAL TRIALS AND RESEARCH III.** (1) Intensive day-long workshop discussing a topical subject or recent advance relevant to clinical research and the conduct of clinical trials. **Professors Gold, Wainer and Price**

**516-627A,B,C,T PRACTICUM IN CLINICAL RESEARCH.** (18) Six-step program: 1. Identification of the problem; 2. Experimental design; 3. Protocol development; 4. Execution of the protocol; 5. Data analysis; 6. Generation of final report with active "clerkship" participation in each component with team leaders and experts designated for each stage. **Professors Gold, Wainer and Price**

**516-631L ADVANCED TOPICS IN ECONOMIC EVALUATION.** (3) This course will cover methodologies in economic evaluation of health care technologies which are currently in development or changing rapidly, including: willingness-to-pay, theoretical arguments for inclusion/exclusion of cost components, statistical issues in cost effective analysis. Discussion will rely on recently published material. **Professor Penrod and Staff**

**516-640A,B,C EXPERIMENTAL TOPICS I.** (3) Study, through guided reading, visits, practicals, assignments, of an elected and approved topic of importance in medical science. **Professor Price and Staff**

**516-641A,B,C, EXPERIMENTAL TOPICS II.** (3) Study, through guided reading, visits, practicals, assignments, of an elected and approved topic of importance in medical science. **Professor Price and Staff**

**516-642A,B,C EXPERIMENTAL TOPICS III.** (3) Study, through guided reading, visits, practicals, assignments, of an elected and approved topic of importance in medical science. **Professor Price and Staff**

**516-701D COMPREHENSIVE EXAMINATION.**

**Department of Physiology**

**552-508A ADVANCED RENAL PHYSIOLOGY.** (3) **Professor Levy and Staff**

**552-513A CELLULAR IMMUNOLOGY.** (3) **Professor Lapp**

**552-515A PHYSIOLOGY OF BLOOD I: HEMOSTASIS AND THROMBOSIS.** (3) **Professors Frojmovic and Solymoss**

**552-516B PHYSIOLOGY OF BLOOD II: ERYTHROCYTES AND BONE MARROW.** (3) **Professors Ponka and Hiscott**

**552-517B ARTIFICIAL INTERNAL ORGANS.** (3) **Professors Sipehia and Chang**

**552-518A ARTIFICIAL CELLS: IMMOBILIZED ENZYMES AND BIOMATERIALS.** (3) **Professors Mishiya and Chang**

**519-604B SELECTED TOPICS IN HUMAN IMMUNOLOGY.** (3) **Professor Brodt and Staff**

**Department of Microbiology & Immunology**

**528-510B SEMINARS ON THE INFLAMMATORY PROCESS. (3)**  
**Professors Gervais and Newkirk**

**Scheduled Graduate Seminars**

The Royal Victoria Hospital (1 hour per week):

Respiratory Research  
 Immunopathology  
 Endocrinology and Metabolism  
 Haematology Research  
 Renal and Electrolyte Seminar  
 Transplantation Conference  
 Gastroenterology Conference  
 Diabetes Conference  
 Chest-Cardiac Disease Conference  
 Clinical Endocrinology Conference  
 Steroid Biochemistry Research  
 Haematology Clinical Conference  
 Endocrinology and Metabolism Research Conference  
 Clinical Immunology Conference  
 Arthritis Conference  
 Internal Medicine  
 Dermatology Research  
 University Clinic Seminar  
 Cardiology Research

The Montreal General Hospital (1 hour per week, or in some cases alternate week):

Gastroenterology Conference  
 Respiratory Diseases  
 Dermatology  
 Internal Medicine  
 Allergy and Immunology  
 Infectious Diseases  
 Combined Staff Conference  
 Haematology  
 Arthritis  
 Metabolic Diseases  
 Cardiac Disease  
 Neurology – Neurosurgery  
 University Medical Clinic Seminar

A. Dascal; D.C.S.(McG.), M.D.,(Montr.)  
 G.J. Matlashewski; B.Sc.(C'dia), Ph.D.(OH.)  
 E. Mills; B.Sc., M.D.(Sask.)  
 T. Owens; B.Sc., M.Sc.(McG.), Ph.D.(Ont.)

**Assistant Professors**

G.J. Marczynski; B.S., Ph.D.(Ill.)  
 D. Portnoy; B.Sc.(Sir G.Wms.), M.D.(Liege)  
 J. Portnoy; B.Sc., M.D.C.M., M.Sc.(McG.)  
 P. René; B.A., M.D.(Sher.)

**Associate Members**

J. Antel; Neurology and Neurosurgery  
 N.V. Christou; Surgery  
 C. Couture; Medicine (Div. Exp. Med.)  
 G. Faubert; Institute of Parasitology  
 L. Kleiman; Microbiology and Immunology  
 A.E. Koromilas; Oncology  
 V. Loo; Medicine  
 J.D. MacLean; Medicine  
 M.A. Miller; Medicine  
 M. Newkirk; Medicine  
 C.K. Osterland; Medicine  
 R.G.E. Palfree; Medicine  
 A.R. Poole; Surgery  
 J. Rauch; Medicine  
 P. Ribeiro; Institute of Parasitology  
 S. Richard; Oncology  
 B. Turcotte; Medicine  
 B.J. Ward; Medicine

**Adjunct Professors**

A. Descoteaux; B.Sc., M.Sc.(Montr.), Ph.D.(McG.)  
 P. Hugo; B.Sc., M.Sc., Ph.D.(McG.)  
 G. Kukolj; B.Sc., Ph.D.(McG.)  
 P. Lau; Ph.D.(Ottawa)  
 C. Rioux; B.Sc., M.Sc.(Laval), Ph.D.(Guelph)  
 R.-P. Sekaly; B.A.(Stanislas), B.Sc., M.Sc.(Montr.),  
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**50 Microbiology and Immunology**

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Chair — G.J. Matlashewski

**50.1 Staff****Professors**

N.H. Acheson; A.B.(Harv.), Ph.D.(Rockefeller)  
 Z. Ali-Khan; B.Sc.(Bilar), M.Sc.(Karachi), Ph.D.(Tulane)  
 E.C.S. Chan; M.A.(Texas), Ph.D.(Maryland)  
 J.W. Coulton; B.Sc.(Tor.), M.Sc.(Calg.), Ph.D.(W. Ont.)  
 M.S. Dubow; B.Sc.(S.U.N.Y.), M.A., Ph.D.(Ind.)  
 J. Hiscott; B.Sc., M.Sc., Ph.D.(W. Ont.)  
 J. Mendelson; M.Sc.(Rock), M.D., C.M.(McG.), F.R.C.P.(C.)  
 R.A. Murgita; B.Sc.(Maine), M.S.(Vt.), Ph.D.(McG.)  
 M.J.H. Ratcliffe; B.A.(Glas.), Ph.D.(Coll. Lond.)  
 H.G. Robson; B.Sc., M.D., C.M.(McG.), F.R.C.P.(C.)  
 M.A. Wainberg; B.Sc.(McG.), Ph.D.(Col.)

**Associate Professors**

M.G. Baines; B.Sc., M.Sc., Ph.D.(Queen's)  
 D.J. Briedis; B.A., M.D.(Johns H.)

**50.2 Programs Offered**

The Department offers graduate programs leading to the degrees of M.Sc., M.Sc. Applied and Ph.D. Each program is tailored to fit the needs and backgrounds of individual students.

The Department concentrates on four key areas of research: cellular and molecular immunology, microbial physiology and genetics, molecular biology of viruses, and medical microbiology.

**50.3 Admission Requirements****Master's and Master's Applied**

Candidates are required to hold a B.Sc. degree in microbiology and immunology, biology, biochemistry or another related discipline; those with the M.D., D.D.S. or D.V.M. degrees are also eligible to apply. The minimum grade point average for acceptance into the program is 3.2 (out of 4.0) B+. All international applicants whose language of instruction is not English must have a TOEFL score of 550.

**Ph.D**

Students who have satisfactorily completed a M.Sc. degree in microbiology and immunology, a biological science, or biochemistry, or highly qualified students enrolled in the departmental M.Sc. program, may be accepted into the Ph.D. program provided they meet its standards.

**50.4 Application Procedures**

Applications will be considered upon receipt of:

1. application form;
2. two official transcripts;
3. two letters of reference;
4. \$60 application fee;
5. TOEFL test (GRE not required but recommended).

All information is to be submitted directly to the Student Affairs Officer in the Department of Microbiology and Immunology.

All applicants are encouraged to approach academic staff members during or before the application process since no applicants are accepted without a supervisor.

#### Deadlines(s)

All applications and documents must be submitted by the following dates:

##### Canadian Applicants

November 1	for the Winter term (January)
March 1	for the Summer term (May)
June 1	for the Fall term (September)

##### International Applicants

September 1	for the Winter Term (January)
January 1	for the Summer term (May)
April 1	for the Fall term (September)

## 50.5 Program Requirements

### M.Sc. Degree (45 credits)

The following requirements must be satisfied:

- 1) Students must register for and satisfactorily complete the requirements of courses 528-611, 528-612, 528-613, 528-614, 528-615 and two of the following courses: 528-616, 528-617, 528-618 and 528-619 (see list below).
- 2) Other courses may be required to strengthen the student's background.
- 3) A satisfactory M.Sc. thesis (24 credits) must be presented.

### M.Sc.A. Degree (non-thesis degree) (45 credits)

The principal aim is to provide specialized training in Applied Medical Microbiology and Immunology.

Candidates must satisfy requirements (1) and (2) above. In addition, applied laboratory research projects must be pursued as a major part of the overall program. The results of each project form the basis of a formal report which is reviewed by the Department staff.

### Ph.D

Candidates will be judged principally on their research ability and on the presentation of a satisfactory thesis.

Students must also register for and satisfactorily complete the requirements of courses 528-701D, 528-711, 528-712, 528-713, 528-714, 528-715 and 528-716 and three or the following courses: 528-704A, 528-705B, 528-706A, 528-707B (see list below). Other courses may be required to strengthen the student's background.

Each Ph.D. student has an advisory committee (three professors including research advisor) that meets yearly to consider the student's progress.

## 50.6 Courses

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

**528-603H PRACTICAL DIAGNOSTIC MICROBIOLOGY.** (12) (offered to M.Sc.A. students only)

**528-604D INDEPENDENT RESEARCH PROJECT.** (6) (offered to M.Sc.A. students only)

**528-605D ADVANCED INDEPENDENT RESEARCH PROJECT IN APPLIED MICROBIOLOGY AND IMMUNOLOGY.** (12) (offered to M.Sc.A. students only)

**528-611A,B GRADUATE SEMINAR.** (3)

**528-612A,B GRADUATE SEMINAR.** (3) (M.Sc. students - presentation of two seminar topics throughout the course of their degree program).

**528-613A,B CURRENT TOPICS IN MICROBIOLOGY AND IMMUNOLOGY.** (3)

**528-614A,B CURRENT TOPICS IN MICROBIOLOGY AND IMMUNOLOGY.** (3)

**528-615A,B CURRENT TOPICS IN MICROBIOLOGY AND IMMUNOLOGY.** (3) M.Sc. Students (discussion groups with guest speakers).

**528-616A,B READING AND CONFERENCE.** (3)

**528-617A,B READING AND CONFERENCE.** (3)

**528-618A,B READING AND CONFERENCE.** (3)

**528-619A,B READING AND CONFERENCE.** (3) (M.Sc. students - two of these courses required throughout the course of their degree program.) Student presentations, taken from current literature, are concerned with aspects of a central topic. Presentations are designed to be informal and to generate student discussions. Topic will change from term to term.

**528-697A,B,C MASTER'S RESEARCH I.** (8)

**528-698A,B,C MASTER'S RESEARCH II.** (8)

**528-699A,B,C MASTER'S RESEARCH III.** (8) (M.Sc. students) Independent work under the direction of a supervisor on a research problem in the student's designated area of research.

**528-701D COMPREHENSIVE EXAMINATION.**

**528-704A READING AND CONFERENCE.** (3)

**528-705B READING AND CONFERENCE.** (3)

**528-706A READING AND CONFERENCE.** (3)

**528-707B READING AND CONFERENCE.** (3) (Ph.D. students - three of these courses required throughout the course of their degree program.) Description as for M.Sc. students.

**528-711A,B GRADUATE SEMINAR.** (3)

**528-712B GRADUATE SEMINAR.** (3)

**528-713A,B GRADUATE SEMINAR.** (3) (Ph.D. students) Presentation of a maximum of three seminars topics throughout the course of their degree program.

**528-714A,B CURRENT TOPICS IN MICROBIOLOGY AND IMMUNOLOGY.** (3)

**528-715A,B CURRENT TOPICS IN MICROBIOLOGY AND IMMUNOLOGY.** (3)

**528-716A,B CURRENT TOPICS IN MICROBIOLOGY AND IMMUNOLOGY.** (3) (Ph.D. students) Discussion groups with guest speakers.

**528-721D PH.D. RESEARCH PROGRESS REPORT.** (1)

**528-722D PH.D. RESEARCH PROGRESS REPORT.** (1)

**528-723D PH.D. RESEARCH PROGRESS REPORT.** (1)

**528-724D PH.D. RESEARCH PROGRESS REPORT.** (1) Each Ph.D. student has an advisory committee (3 professors including research advisor) that meets yearly to consider student's progress. Students submit a 6-page progress report to the committee and give a 20-minute oral presentation, discussing data obtained and future research plans. Committee gives advice on progress and fine-tuning the research project.

## 51 Mining and Metallurgical Engineering

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Mining Engineering –  
Telephone: (514) 398-2215  
Fax: (514) 398-7099

Metallurgical Engineering –  
Telephone: (514) 398-1040  
Fax: (514) 398-4492

*Chair* — R.A.L. Drew

*Director, Mining Engineering* — H.S. Mitri

*Chair, Graduate Program* — H.S. Mitri

*Co-Chair, Graduate Program* — M. Hasan  
*Graduate Program Secretary* — P. Mujumdar

## 51.1 Staff

### *Emeritus Professor*

W.M. Williams; B.Sc., M.Sc.(Brist.), Ph.D.(Tor.), Eng.

### *Professors*

G.P. Demopoulos; Dipl.Eng.(NTU Athens), M.Sc., Ph.D.(McG.), Eng.

R.A.L. Drew; B.Tech.(Brad.), Ph.D.(N'cle)

J.A. Finch; B.Sc.(Birm.), M.Eng., Ph.D.(McG.), Eng., F.C.I.M.

J.E. Gruzleski; B.Sc., M.Sc.(Queen's), Ph.D.(Tor.), Eng., F.C.I.M., F.A.S.M.

R.I.L. Guthrie; B.Sc., Ph.D.(Lond.), D.I.C., A.R.S.M., Eng., F.C.I.M.

F.P. Hassani; B.Sc., Ph.D.(Nott.), C.Eng.(U.K. Reg.)

J.J. Jonas; B.Eng.(McG.), Ph.D.(Cantab.), F.A.S.M., F.R.S.C., Eng.

J. Szpunar; B.Sc., M.Sc., Ph.D., D.Sc.(Krakow)

### *Associate Professors*

M.L. Bilodeau; B.Eng.(Montr.), M.Sc.A., Ph.D.(McG.), Eng.

P.A. Distin; B.Sc., Ph.D.(Lond.), D.I.C.

R. Harris; B.Sc.(Q'ld), M.Eng., Ph.D.(McG.)

M. Hasan; B.Eng.(Dhaka), M.Eng.(Dhahran), Ph.D.(McG.)

A. Laplante; B.A.Sc., M.A.Sc.(Montr.), Ph.D.(Tor.), Eng.

H.S. Mitri; B.Sc.(Cairo), M.Eng., Ph.D.(McM.), Eng.

F. Mucciardi; B.Eng., M.Eng., Ph.D.(McG.), Eng.

J. Ouellet; B.Sc.A.(Laval), M.Sc.A., Ph.D.(Ecole Poly.), Eng.

S. Yue; B.Sc., Ph.D.(Leeds)

### *Assistant Professor*

J.A. Kozinski; B.A., M.Eng., D.Sc.(Krakow)

### *Lecturer*

J. Mossop; B.Eng.(McG.)

### *Adjunct Professors*

W. Comeau, R. Dimitrakopoulos, B. Harris, A. Hemami, H. Keira,

Y. Lizotte, B. Mohanty, M. Pugh, M.J. Scoble, G.W. Smith,

J. Stachulak, W.T. Thompson, V. Vaidya, G. Van Weert,

A.E. Wraith

*Liaison Officer, Mining Co-op Program* — M. Vachon

## 51.2 Programs Offered

Graduate programs leading to M.Eng., M.Sc. and Ph.D. research degrees are available in rock mechanics, mining environments, mining automation and robotics, operations research, ground fragmentation, mineral economics, materials handling, chemical and process metallurgy, hydrometallurgy, effluent treatment, mineral processing and related surface chemistry, metal casting, materials engineering, composites, ceramics and mechanical metallurgy.

Course programs leading to the M.Eng. (Project) degree in Mining or Metallurgy/Materials and the Graduate Diploma in Mining Engineering are also available.

Special programs are available for those holding degrees in subjects other than Metallurgy, Materials or Mining (e.g. Chemistry, Physics, Engineering Geology).

## 51.3 Admission Requirements

The Graduate Diploma in Mining Engineering is open to graduates with suitable academic standing in any branch of engineering or science. It is designed to provide a sound technical mining engineering background to candidates intending to work in the minerals industry.

The M.Eng. (thesis) degree is open to graduates holding the B.Eng. degree or its equivalent in Metallurgical or Materials Engineering, Mining Engineering, or other related engineering fields.

The M.Sc. (thesis) degree is open to graduates holding the B.Sc. degree or its equivalent in Metallurgy, Geology or related fields. A high academic standing at the undergraduate level is required for admission to these programs.

The Master of Engineering (Project) program (Metallurgy/ Materials Option) is primarily designed to train people with appropriate engineering or scientific backgrounds to allow them to work effectively in the metals or materials industries. Industrial experience is favourably viewed for entrance into the program, but is not considered a necessity.

The Master of Engineering (Project) program (Mining Option) is primarily designed for graduates from mining engineering programs who have received adequate academic training in modern mining technology, mineral economics, computer programming and probabilities and statistics. Students without this academic training must follow a qualifying semester of courses established by the Mining Program Director. Industrial experience is favourably viewed for entrance into the program, but is not considered a necessity.

Ph.D. Degree applicants may either be "directly transferred" from the M.Eng. or M.Sc. program (see below) or hold an acceptable Master's degree in Metallurgy or Materials Science, Metallurgical or Materials Engineering, Mining Engineering, or other related fields. The Ph.D. degree is awarded in the appropriate field.

## 51.4 Application Procedures

Applications will be considered upon receipt of:

1. Application form
2. Two official copies of transcripts
3. Letters of reference
4. \$60 CDN application fee
5. TOEFL test results

All information is to be submitted directly to the Graduate Secretary in the Department of Mining and Metallurgical Engineering.

Deadlines:

March 1 – Fall admission

July 1 – Winter admission

November 1 – Summer admission

## 51.5 Program Requirements

### Graduate Diploma in Mining Engineering

This program consists of 30 credits of course work, and normally requires one academic year of full-time study to complete. Candidates are required to take an integrated group of courses (including 306-673 Mining Engineering Seminar), selected in consultation with the Program Adviser and based on their academic background.

### M.Eng. and M.Sc. (Thesis) Degrees

The programs consist of 45 credits of course work, seminars and research. The candidate must pass a minimum number of courses, normally equivalent to 12 credits, chosen in consultation with a supervisor and based on his/her academic background and research interests.

In addition, the candidate must participate in an appropriate Research Seminar course and submit an acceptable thesis based on a series of successfully completed research courses.

M.Eng. and M.Sc. candidates may submit to a qualifying examination and on recommendation, may be admitted to the Ph.D. program.

**Direct Transfer from Master's to Ph.D.** – Students enrolled in a Master's program (thesis) may transfer into the Ph.D. program without obtaining a Master's degree if they have satisfied the following:

- 1) they have been in the Master's program for less than 16 months;
- 2) they have satisfactorily passed all the required Master's courses, and given one seminar;
- 3) they have obtained a letter of recommendation from their supervisor;
- 4) they have passed a preliminary examination (as per the Ph.D. program).



**M.Eng. (Project) Degree Metallurgy/Materials Option**

The M.Eng. (Project) program (Metallurgy/Materials Option) consists of 45 credits of course work and projects. The package of courses undertaken will provide any necessary basic training and will be selected in consultation with the Program Advisor to satisfy the desired specialization of the candidate. The project courses may be undertaken in an industrial environment as a 4- to 8-month work term.

The program consists of a minimum of 12 credits of Departmental graduate level courses, 6 to 15 credits of M.Eng Metallurgy Project courses, the Metallurgical Engineering Seminar (306-670) and enough additional courses chosen from within or outside the Department to complete the 45 credit requirement. The external courses and project courses undertaken in an industrial environment are subject to Departmental approval. The program is established in consultation with the Program Advisor.

**M.Eng. (Project) Degree Mining Option**

The M.Eng. (Project) program (Mining Option) consists of 45 credits of course work and projects. It is primarily designed for graduates from mining engineering programs who have received adequate academic training in modern mining technology, Mineral Economics, Computer Programming and Probabilities and Statistics. Students without this academic training must follow a qualifying semester of courses (including 306-420 Feasibility Study) established by the Mining Program Director.

The program consists of a minimum 12 credits of Departmental graduate level courses, 6 to 15 credits of M.Eng Mining Project courses, the Mining Engineering Seminar (306-673) and enough additional courses chosen from within or outside the Department to complete the 45 credit requirement. The program is established in consultation with the Program Director. The external courses are subject to Departmental approval.

**Ph.D. Degree**

A candidate for this degree must pass courses assigned by the Department. These are selected on the basis of the student's previous academic training and research interests. The candidate is required to participate in an appropriate Research Seminar course and is expected to take a preliminary examination within the first year of his/her Ph.D. registration.

The candidate must submit an acceptable thesis based upon successfully completed research and must satisfy the examiners in an oral examination of the thesis and related topics.

**51.6 Graduate Courses Offered by the Department**

The courses in this Department have been numbered to conform with the following classification system. The first three digits (i.e. 306) represent the departmental code. The next digit represents the level of instruction. The last two digits are classified as follows:

- 01 to 19 technical courses
- 20 to 39 mining courses
- 40 to 49 mineral processing courses
- 50 to 59 extractive and process metallurgy courses
- 60 to 69 metallurgy and materials courses
- 70 to 79 seminars

**Certain courses may be cancelled without notice; students should therefore consult the Department before registration.**

- Denotes not offered in 2000-01.

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

**306-515A ADVANCED METALLURGICAL AND MATERIALS THERMODYNAMICS.** (3) (Prerequisite: 306-212 or equivalent.) Computational thermodynamics including phase diagram estimation, Gibbs energy minimization and solution modelling are considered in view of the Facility of Chemical Thermodynamics (F\*A\*C\*T) computer database. Students undertake projects developed in consultation with the instructor and prepare verbal and written reports.

**Metallurgy Staff**

**306-520B STABILITY OF ROCK SLOPES.** (3) (Prerequisite: permission of instructor.) The properties of rock masses and of structural discontinuities. Influence of geological structure on stability. Linear, non-linear, and wedge failures. Site investigations. Methods of slope stabilization. **Professor Hassani**

**306-521B,C,T STABILITY OF UNDERGROUND OPENINGS.** (3) (Prerequisite: permission of instructor.) The properties of rock masses and stability classification systems. The influence and properties of geological structural features. Stability related to the design of underground openings and mining systems. Site investigations. Methods of stabilization. **Professor Mitri**

● **306-524B MINERAL RESOURCE ECONOMICS.** (3) (Prerequisite: 306-310 or equivalent, or permission of instructor.)

**306-526A,B MINERAL ECONOMICS.** (3) (Prerequisite: 306-310) Mineral project evaluation techniques and applications. Topics covered include grade-tonnage relationships, capital and operating cost estimation techniques, assessment of mineral market conditions, taxation, discounted cash flow analysis, risk analysis, and optimization of project specifications with respect to capacity and cutoff grade. (Course given once per academic year.)

**Professor Bilodeau**

**306-528B MINING AUTOMATION.** (3) (Prerequisite: 306-426) System analysis and design in the frequency domain. Review of optimization methods. Mining system modelling applied to rock cutting, materials transport and bunkering, and pitch, yaw and roll steering of mining machines. Control and robotics: digitization, discrete systems, sensors, actuators and real time algorithms, Data communications in mines. Simulation exercises. **Professor Mitri**

**306-544A MINERAL PROCESSING SYSTEMS I.** (3) The course covers three main topics: principles of separation, including data presentation, properties of recovery/yield plots, technical and economic efficiency and identification of limits to separation; column flotation, hydrodynamics of collection and froth zones, mixing, scale-up and design, measurements and control; surface and electrochemistry, including adsorption, surface charge, coagulation, electron transfer reactions, electrochemistry in plant practice. Guest lectures on various specialized topics are also included.

**Professor Finch and Dr. Rao**

● **306-545B MINERAL PROCESSING SYSTEMS II.** (3)

**306-551B ELECTROCHEMICAL PROCESSING.** (3) (Prerequisite: 306-352) Characterization of aqueous, fused salt and solid electrolytes; laws of electrolysis; ion transport mechanisms; interfacial phenomena (electrolyte-electrolyte, electrode-electrolyte); reversible cells and potentials; electrode kinetics, overpotential and potential-current laws; industrial applications; electrolytic winning and refining, electroplating, surface cleaning and coating, electro-dialysis and electrochemical sensors. **Professor Demopoulos**

**306-555A THERMAL REMEDIATION OF WASTES.** (3) (Prerequisite: 306-212) Process technology and environmental concerns in thermal remediation of wastes substances. Focus on the nature and pathways of pollutant streams during thermal treatment of wastes. Concepts for reduction and control of harmful remediation products. Topics include classification of waste properties; design of thermal remediation systems; waste combustion; toxic metal encapsulation, etc. **Professor Kozinski**

**306-560B JOINING PROCESSES.** (3) (Prerequisite: 306-361 or equivalent.) Physics of joining; interfacial requirements; energy sources, chemical, mechanical and electrical; Homogeneous hot-joining, arc-, Mig-, Tig-, gas-, thermite- and Plasma-welding; Autogeneous hot-joining, forge-, pressure-, friction-, explosive-, electron beam- and laser-welding; Heterogeneous hot-joining, brazing, soldering, diffusion bonding; Heterogeneous cold joining, adhesives, mechanical fastening; Filler materials; Joint metallurgy; Heat affected zone, non-metallic systems; joint design and economics; defects and testing methods. **Mr. Vaidya**

**306-561A MATERIALS DESIGN AND SELECTION.** (3) (Prerequisite: 306-362 or equivalent) Advanced topics in materials design problems. Discussion and laboratory work, supplemented by detailed

technical reports. Special attention is given to selection, design and failure problems in various materials systems.

**Professors Drew, Gruzleski and Yue**

**306-563A HOT DEFORMATION OF METALS.** (3) (Prerequisite: 306-463 or equivalent.) A lecture and seminar course dealing with the high temperature mechanical properties of metals and alloys, with special emphasis on high strength low alloy steels. Topics covered include recovery and recrystallization; precipitation of microalloy carbonitrides; effect of alloy additions on high temperature mechanical properties, both as solutes and as precipitates; effect of multiple alloying; thermo-mechanical treatment and grain size control; examples of industrial controlled rolling schedules.

**Professor Yue**

**306-564B X-RAY DIFFRACTION ANALYSIS OF MATERIALS.** (3) (Prerequisite: 306-317 or equivalent.) The techniques of X-ray and neutron diffraction are discussed as applied to the minerals and materials production industries. Special emphasis is placed upon automated X-ray powder diffractometry as employed for determining the structure and composition of materials. The application of X-ray techniques to studies of crystal structure, crystal orientation, residual stress, short-range order in liquid metals, phase diagram determination, order-disorder transformation and chemical analysis are presented.

**Professor Szpunar**

● **306-565B INTRODUCTION TO CERAMIC ENGINEERING** (3)

**306-566A TEXTURE, STRUCTURE AND PROPERTIES OF POLY-CRYSTALLINE MATERIALS.** (3) (Prerequisite: 306-317 or equivalent) Concepts and quantitative methods for the description of the structure of minerals and materials are discussed. Special emphasis is placed on experimental techniques of texture measurement. Procedures are demonstrated for the control of deformation and recrystallization textures in order to obtain the properties required of industrial products. Finally, the correlation between texture and the anisotropy of elastic, plastic and magnetic properties of engineering materials is described and analysed.

**Professor Szpunar**

● **306-567B ALUMINUM CASTING ALLOYS.** (3) (Prerequisite: 306-361 or equivalent)

**306-568B TOPICS IN ADVANCED MATERIALS.** (3) (Prerequisite: 306-362 or equivalent) New and emerging materials. Composites. Coatings. Electronic materials. Current and future technologies. Specialised property requirements. Novel processing and fabrication techniques. Future developments.

**Professor Drew**

**306-569B ELECTRON BEAM ANALYSIS OF MATERIALS.** (3) (Prerequisite: 306-317 or equivalent.) Applications of electron beam techniques in minerals and materials engineering are presented. Special emphasis is placed upon scanning and transmission electron microscopy, wavelength and energy dispersive electron probe microanalysis and quantitative image analysis techniques. Applications of electron diffraction, auger electron spectroscopy, E-beam lithography and associated techniques are also discussed. Students are encouraged to take a "hands-on" approach to instrumentation and to design a project suited to their own discipline involving the use of one or more of these techniques.

**Professor Yue**

**Courses at the 600 and 700 level require about 3 contact hours per week per semester or equivalent.**

**306-606A SELECTED TOPICS IN MINERAL/METAL PRODUCTION AND MARKETING I.** (3) (Prerequisite: permission of instructor.) Introduction of new topics in Mining and Metallurgical Engineering.

**Mining & Metallurgy Staff**

**306-608B SELECTED TOPICS IN MINERAL/METAL PRODUCTION AND MARKETING II.** (3) (Prerequisite: permission of instructor.) Introduction of new topics in Mining and Metallurgical Engineering.

**Mining & Metallurgy Staff**

**306-620A ROCK MECHANICS I.** (3) A study of the effects of rock properties and ground stresses on problems in mine design.

**Professors Hassani and Mitri**

**306-621B ROCK MECHANICS II.** (3) The application of the principles of strength of materials to the analysis of problems in ground control.

**Professors Hassani and Mitri**

**306-622A,B HEALTH AND SAFETY IN THE MINERAL INDUSTRY.** (3) (Prerequisite: permission of instructor.) A comprehensive review of health, safety and engineering aspects of the mining environment. Radiation hazards and control; airborne contaminants and ventilation; dust control design; noise and vibration control; illumination theory and design. (Course given once per academic year.)

**Mining Staff**

**306-623A,B GROUND FRAGMENTATION.** (3) (Prerequisite: permission of instructor.) A comprehensive review of principles and theory of explosives; rock information systems, cratering concepts and applications to mining. (Course given once per academic year.)

**Mr. Comeau**

**306-624D MATERIALS HANDLING IN MINES.** (6) (Prerequisite: permission of instructor.) A comprehensive review of materials handling systems used in open pit and underground mines. Review of system selection criteria, and analysis of the impact of particular systems on mine design.

**Professor Mitri**

**306-625A APPLIED MINERAL ECONOMICS I.** (3) (Prerequisite: permission of instructor.) A study of analytical techniques employed for project evaluation and decision-making in the mineral industry.

**Professor Bilodeau**

**306-627B APPLIED MINERAL ECONOMICS II.** (3) (Prerequisite: permission of instructor.) A study of the techniques employed in the analysis of government policy and the financing of projects in the mineral industry.

**Professor Bilodeau**

**306-628D,N,E,G MINING ENGINEERING PROJECT I.** (6) A project of the student's choice, undertaken under the direct supervision of at least one staff member. The final mark is assessed on the basis of a final report which is examined internally, by the supervisor and at least one other staff member.

**Mining Staff**

**306-629D,N,E,G MINING ENGINEERING PROJECT II.** (6) Continuation of Mining Engineering Project I.

**Mining Staff**

**306-633A INDUSTRIAL EXPLOSIVES.** (4) (Prerequisite: 306-322 and/or Permission of instructor.) Development of industrial explosives and propellants, with particular application to mining, metallurgical and petroleum industries. Chemistry and physics of reactive materials; initiation and detonation process; commercial explosives; rock blasting and explosive energy transfer; specialized blasting techniques; explosive welding and forming; principles of shaped charges; miscellaneous industrial applications.

**Dr. Mohanty**

**306-634A,B,L MINING ENGINEERING PROJECT III.** (3) Continuation of Mining Engineering Project I.

**Mining Staff**

**306-635A THE FINITE ELEMENT METHOD IN ROCK MECHANICS.** (4) (Prerequisites: 306-521 and/or permission of instructor.) Equilibrium equation solvers; elasticity theory; finite element formulative procedures; convergence and accuracy; 2-D and 3-D isoparametric elements; rock failure criteria; applications to rock/mining engineering; computer programming using available software library (FELIBS) and packages.

**Professor Mitri**

**306-636B BOUNDARY ELEMENTS IN GEOMECHANICS.** (4) (Prerequisite: 308-208 or equivalent, and 306-521 or permission of instructor.) Applications of boundary element methods in geomechanics. Elasticity relations. Coordinate transformations. Kelvin's problem, constant tractions, fictitious stress method, symmetry conditions. Displacement discontinuity method. Yield and deformation joint models. Stress and displacement analysis of underground openings in faulted rock. Initial joint deformation technique. Introduction to nonlinear analysis.

**Professor Mitri**

**306-638A MINE WASTE MANAGEMENT.** (4) Nature and generation of mine waste. Characteristics of mine waste material. Surface and underground disposal methods. Surface impoundment. Tailing embankment design and stability analysis. Seepage and containment transport. Seepage control methods. Site reclamation. Computer applications in design and monitoring. Case histories.

**Dr. Keira and Professor Hassani**

**306-639B MANAGEMENT TECHNIQUES FOR ENGINEERING SERVICES OF MINING PROJECTS.** (3) Project phases: preparation of proposals, feasibility studies, tender documents, instrumentation and monitoring during mine development. Project controls: organization charts, scheduling, quality assurance and control, site inspection. Engineering services: budget and manpower, performance analysis, maintenance and filing, policies and administrative procedures. **Dr. Keira**

**306-640D ADVANCED MINERAL PROCESSING.** (6) Modern advances in mineral processing techniques. The student will prepare a series of reports covering developments in mineral processing. **Professors Finch and Laplante**

**306-650D TRANSPORT PHENOMENA IN PROCESS ENGINEERING METALLURGY.** (6) Metallurgical applications of heat, mass and momentum transfer theories. Particular emphasis is placed on the applications of computational fluid dynamics and development of appropriate software programs. These are based on the integral control volume, finite difference approach, employing body-fitted co-ordinate schemes to handle arbitrarily shaped flow domains. Turbulence models such as K-E and large eddy simulation are presented. **Professor Hasan**

**306-652B AQUEOUS PROCESSING.** (3) Advanced treatment of the chemical and engineering principles governing aqueous dissolution, purification and deposition operations. Topics include: ionic activities of dilute and concentrated solutions; solution and solid-liquid equilibria; analysis of complexation and redox reactions; high temperature solution thermodynamic kinetics; solvent extraction, equilibria and mass transfer kinetics; nucleation, growth and agglomeration phenomena in aqueous precipitation systems. **Professor Demopoulos**

**306-653A,B TRANSPORT PHENOMENA IN PROCESS METALLURGY.** (3) Process metallurgical applications of heat, mass and momentum transport theories. Methods of numerical solution in the analysis of: continuous casting, ingot solidification, soaking pits, hot mill operations, alloy addition methods in steel-making, etc. Students are assigned individual computer projects and present a report plus a seminar on their findings. **Professor Hasan**

**306-657A ADVANCED EXTRACTIVE METALLURGY.** (3) Field trips focusing on non ferrous metallurgy: energy considerations and minor elements in production and refining of aluminum, copper, gold, titania slag, zinc and other metals. Advanced technology and process design. Visits will reflect instructor's and students' interests. **Professor Harris**

**306-670D RESEARCH SEMINAR.** (6) For students registered for a Master's degree in Metallurgy. **Metallurgy Staff**

**306-672D ROCK MECHANICS AND GEOPHYSICS SEMINAR.** (6) Theoretical and practical aspects of ground control practice using the case study method. **Professor Hassani**

**306-673D,N,E,G MINING ENGINEERING SEMINAR.** (6) For students registered in the Graduate Diploma or Master's programs in Mining. **Professor Mitri**

**306-680D,E,G METALLURGICAL/MATERIALS ENGINEERING PROJECT I.** (6)

**306-681D,E,G METALLURGICAL/MATERIALS ENGINEERING PROJECT II.** (6)

**306-682A,B,C METALLURGICAL/MATERIALS ENGINEERING PROJECT III.** (3)

**306-690D,N,E,G,B THESIS RESEARCH I.** (6)

**306-691A,B,L THESIS RESEARCH II.** (3)

**306-692D,N,E,G,B THESIS RESEARCH III.** (6)

**306-693A,B,L THESIS RESEARCH IV.** (3)

**306-694D,N,E,G,B THESIS RESEARCH V.** (6)

**306-695A,B,L THESIS RESEARCH VI.** (3)

**306-701A,B,C,T PH.D. THESIS RESEARCH PROPOSAL** (0) For students registered in a Ph.D. program in Metallurgy. Student submits a document and takes an oral examination to demonstrate familiarity with relevant literature, define a methodology and describe a work plan. **Metallurgy Staff**

**306-771D RESEARCH SEMINAR.** (6) For students registered in a Ph.D. program in Metallurgy. **Metallurgy Staff**

**306-776D MINING RESEARCH SEMINAR.** (6) For students registered in a Ph.D. program in Mining. **Professor Mitri**

### Undergraduate Courses

The following undergraduate courses are available to graduate students who have not taken an equivalent course. Please consult the Undergraduate Programs Calendar for descriptions.

**306-200A MINING TECHNOLOGY.** **Mr. Mossop**

**306-320B EXTRACTION OF ENERGY RESOURCES.** **Professor Hassani**

**306-322B ROCK FRAGMENTATION.** **Mr. Comeau**

**306-323B ROCK AND SOIL MASS CHARACTERIZATION.** **Professor Hassani**

**306-419C OR T SURFACE MINING.** **Mining Staff**

**306-420B FEASIBILITY STUDY.** **Mr. Mossop and Professor Bilodeau**

**306-426C OR T DEVELOPMENT AND SERVICES.** **Mr. Mossop**

**306-341B INTRODUCTION TO MINERAL PROCESSING.** **Professor Finch**

## 52 Music

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*Dean, Faculty of Music* — Richard Lawton

*Associate Dean (Academic) and  
Chair, Committee on Graduate Studies* — Don McLean

*Chair, Department of Theory* — Wieslaw Woszczyk

*Chair, Department of Performance* — Gordon Foote

*Associate Dean (Information, Systems and Technology* —  
Bruce Minorgan

### 52.1 Staff

#### *Emeritus Professors*

Bengt Hambræus; Fil Kand(M.A.), Fil Lic(Ph.D.), Fil Dr.(Hon.C.)  
(Uppsala); F.R.A.M.(Sweden)

Kelsey Jones; L.Mus., B.Mus.(Mt.All.), B.Mus., Mus.Dc.(Tor.)

Dorothy Morton; Graduate, Conservatoire de Musique de Québec

#### *Professors*

Brian Cherney; Mus.Bac., Mus.M., Ph.D.(Tor.)

Robert Gibson; B.S., M.F.A., Ph.D.(Minn.)

John Grew; L.T.C.L.(Lond.), B.Mus.(Mt. All.), M.Mus.(Mich.)

D.D.(U.T.C.); LL.D.(Mt.All.); University Organist

Alcides Lanza; Graduate, Instituto Torcuato Di Tella(Buenos  
Aires)

Bruce Mather; B.Mus.(Tor.), M.A.(Stan.), Mus.Doc.(Tor.)

Bruce Pennycook; B.Mus. M.Mus.(Tor.), D.M.A.(Stan.)

John Rea; B.Mus.(Wayne St.), M.Mus.(Tor.), M.F.A., Ph.D.(Prin.)

Charles Reiner; Graduate, Conservatoire de Genève

Wieslaw Woszczyk; M.A., Ph.D.(F. Chopin Academy of Music,  
Warsaw)

#### *Associate Professors*

Dale Bartlett; A.R.A.M.(Lond.), LL.D.(Leth.)

Theodor Baskin; B.Mus.(Curtis), M.Mus.(Auck.), Principal Oboe,  
Montreal Symphony

Pierre Béluse; Graduate, Conservatoire de Musique de Québec

William Caplin; B.M.(S.Calif.), M.A., Ph.D.(Chic.)