

46 Mathematics and Statistics

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Chair — K. GowriSankaran

Graduate Program Director — E.Z. Goren

46.1 Staff

Emeritus Professors

M. Barr; A.B., Ph.D.(Penn.) (*Peter Redpath Emeritus Professor of Pure Mathematics*)
J.R. Choksi; B.A.(Cantab.), Ph.D.(Manc.)
J. Lambek; M.Sc., Ph.D.(McG.), F.R.S.C. (*Peter Redpath Emeritus Professor of Pure Mathematics*)
A.M. Mathai; M.Sc.(Kerala), M.A., Ph.D.(Tor.)
W.O.J. Moser; B.Sc.(Manit.), M.A.(Minn.), Ph.D.(Tor.)
V. Seshadri; B.Sc., M.Sc.(Madras), Ph.D.(Oklahoma)
J.C. Taylor; B.Sc.(Acad.), M.A.(Queen's), Ph.D.(McM.)

Professors

W.J. Anderson; B.Eng., Ph.D.(McG.)
W. Brown; B.A.(Tor.), M.A.(Col.), Ph.D.(Tor.)
M. Bunge; M.A., Ph.D.(Penn.)
H. Darmon; B.Sc.(McG.), Ph.D.(Harv.)
S. Drury; M.A., Ph.D.(Cantab.)
K. GowriSankaran; B.A., M.A.(Madr.), Ph.D.(Bomb.)
J. Hurtubise; B.Sc.(Montr.), D.Phil.(Oxon.)
N. Kamran; B.Sc., M.Sc.(Bruxelles), Ph.D.(Wat.)
O. Kharlampovich; M.A., (Ural State), Ph.D.(Lenin.), Dr. of Sc., (Steklov Inst.)
M. Makkai; M.A., Ph.D.(Bud.)
S. Maslowe; B.Sc.(Wayne St.), M.Sc., Ph.D.(Calif.)
C. Roth; M.Sc.(McG.), Ph.D.(Hebrew)
K.P. Russell; Vor. Dip.(Hamburg), Ph.D.(Calif.)
G. Schmidt; B.Sc.(Natal), M.Sc.(S.A.), Ph.D.(Stan.)
G. Styan; M.A., Ph.D.(Col.)
L. Vinet; B.Sc., M.Sc., Ph.D.(Montr.), Doctorat 3^e cycle(Paris VI) (*joint appt. with Physics*)
D. Wolfson; M.Sc.(Natal), Ph.D.(Purdue)
K.J. Worsley; B.Sc., M.Sc., Ph.D.(Auck.)
J.J. Xu; B.S.(Beijing), Ph.D.(Ren. Poly.)
S. Zlobec; M.Sc.(Zagreb), Ph.D.(Northwestern)

Associate Professors

P. Bartello; B.Sc.(Tor.), M.Sc., Ph.D.(McG.) (*joint appt. with Atmospheric and Oceanic Sciences*)
E.Z. Goren; B.A., M.S., Ph.D.(Hebrew)
V. Jaksic; B.S.(Belgrade), Ph.D.(Caltech)
W. Jonsson; M.Sc.(Manit.), Dr.Rer.Nat.(Tubingen)
I. Klemes; B.Sc.(Tor.), Ph.D.(Cal.Tech.)
J. Labute; B.Sc.(Windsor), M.A., Ph.D.(Harv.)
B. Lawruk; M.Sc., Ph.D.(Lwow)
J. Loveys; B.A.(St.Mary's), M.Sc., Ph.D.(S. Fraser)
R. Rigelhof; B.Sc.(Sask.), M.Sc.(Wat.), Ph.D.(McM.)
N. Sancho; B.Sc., Ph.D.(Belf.)
J.A. Toth; B.Sc., M.Sc.(McM.) Ph.D.(M.I.T.) (*William Dawson Scholar*)

Assistant Professors

M. Asgharian; B.Sc.(Shahid Beheshti), M.Sc., Ph.D.(McG)
D. Bryant; B.Sc. Honours, Ph.D. (Canterbury) (*joint appt. with School of Computer Science*)
M.J. Gander; M.S.(E.T.H.), M.S., Ph.D.(Stanford)
D. Jakobson; B.Sc.(M.I.T.), Ph.D.(Princeton)

D. Leisen; B.Sc.(Mainz), M.Sc., Ph.D.(Bonn) (*joint appt. with Management*)

Nilima Nigam; B.Sc.(IIT - Indian Institute of Technology, Bombay), M.S., Ph.D. (Delaware)
A. Vandal; B.Sc., M.Sc.(McG), Ph.D.(Auckland)
D.T. Wise; B.A.(Yeshiva), Ph.D.(Princeton)

Assistant Professor (Special Category)

V. Rosta; M.Sc., Ph.D.(Lorand Eotvos, Budapest)

Adjunct Professors

D.A. Dawson; B.Sc., M.Sc.(McG), Ph.D.(M.I.T.)
V.P. Havin; M.Sc., Ph.D.(Leningrad)
R. Murty; B.Sc.(Car.), Ph.D.(M.I.T.), F.R.S.C.
B. Rowley; B.Sc.(Wat.), M.Sc., Ph.D.(McG.)
R.A. Seely; B.Sc.(McG.), Ph.D.(Cantab.)

Associate Members

L.P. Devroye (*Computer Science*); P.R.L. Dutilleul (*Plant Science*); L. Glass (*Physiology*); J.-L. Goffin (*Management*); J. Hanley (*Epidemiology & Biostatistics*); L. Joseph (*Epidemiology & Biostatistics*); M. Mackey (*Physiology*); L.A. Mysak (AOS); P. Panangaden (*Computer Science*); J.O. Ramsay (*Psychology*); G.A. Whitmore (*Management*)

Faculty Lecturers

Axel Hundemer; M.Sc., Ph.D.(Munich)
Fabrice Rouah; B.Sc.(C' dia), M.Sc.(McG.)

46.2 Programs Offered

The brochure "Information for Graduate Students in Mathematics and Statistics", available on the Department website, supplements the information contained in this Calendar.

The Department offers both a Master's degree (M.A. or M.Sc.) and a Ph.D. degree.

By the choice of courses and thesis (or project topic) these degrees can be focussed in applied mathematics, pure mathematics or statistics.

The Institut des Sciences Mathématiques (ISM), among other activities, coordinates intermediate and advanced level graduate courses among the following universities: Concordia University, Université Laval, McGill, Université de Montréal, UQAM, Université de Sherbrooke. A list of courses available under the ISM auspices at the other universities can be obtained by consulting the ISM website (<http://www.math.uqam.ca/ISM/>). The ISM also offers fellowships and promotes a variety of joint academic activities greatly enhancing the mathematical environment in Montreal and indeed in the province of Quebec.

46.3 Admission Requirements

In addition to the general Graduate and Postdoctoral Studies Office requirements, the Department requirements are as follows:

Master's Degree

The normal entrance requirement for the Master's programs is a Canadian Honours degree or its equivalent, with high standing, in mathematics, or a closely related discipline in the case of applicants intending to concentrate in statistics or applied mathematics. For applicants intending to continue in a doctoral program, an Honours degree or its equivalent is the preferred background.

Applicants wishing to concentrate in pure mathematics should have a strong background in linear algebra, abstract algebra, and real and complex analysis.

Applicants wishing to concentrate in an applied area of statistics should have a strong background in matrix algebra, advanced calculus and undergraduate statistics; some knowledge of computer programming and numerical analysis is also desirable.

Applicants wishing to concentrate in applied mathematics should have a strong background in linear algebra, real and complex analysis, ordinary differential equations and numerical analysis. Some knowledge of computer programming is also desirable. Students whose preparation in mathematics is insufficient may have to be admitted to a Qualifying Year.

Ph.D. Degree

Students normally enter the Ph.D. program after completing a Master's degree program with high standing. However, the Department admits interested and excellent students directly into the Ph.D. program.

46.4 Application Procedures

Applications will be considered upon receipt of:

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

All information is to be submitted directly to the Graduate Secretary in the Department of Mathematics and Statistics.

Deadline: Applicants are urged to submit complete applications by March 1 for September admission, or by August 1 for January admission.

Commencing with applications for entry in January 2003, McGill's on-line application form will be available to all graduate program candidates at <http://www.mcgill.ca/applying/graduate>.

46.5 Program Requirements**Master's Degrees**

Students must choose between the thesis option, which requires a thesis (24 credits) and 6 approved courses for a total of at least 22 credits, and the project option, which requires a project (15 credits) and 8 approved courses for at least 30 credits. Normally students must declare which option they choose to follow after one semester. It is expected that the degree be completed in at most four semesters.

The choice of courses must be approved by the advisor or thesis supervisor as well as by the Director of the Graduate Program.

Some suggestions for the choice of courses in the Master's programs are:

- For students in applied mathematics: at least two of the following course sequences: MATH 487 and MATH 560; MATH 578 and MATH 579; MATH 586 and MATH 585.
- For students in pure mathematics: at least two of the following course sequences: MATH 564, MATH 565 and MATH 566; MATH 570 and MATH 571; MATH 576 and MATH 577.
- Students in statistics are required to take MATH 556 and MATH 557 and, if they intend to continue in a doctoral program, they should also take MATH 587 and MATH 589.

Master's students who wish to keep open the possibility of continuing in a doctoral program should adhere closely to these suggestions since they will provide the background necessary for the comprehensive examination which all doctoral students are required to pass.

Further courses can be chosen from the departmental list of course offerings. A comprehensive list of courses, from which annual offerings are selected, is given below.

Ph.D. Degree

To complete a Ph.D. program students must:

- a) pass twelve approved courses beyond the Bachelor's level ;
- b) pass a Comprehensive Examination consisting of a written Part A, which is concerned with their general mathematical background, and an oral Part B concerned with two topics at an advanced graduate level;
- c) demonstrate a reading knowledge of French;
- d) submit a thesis judged to be an original contribution to knowledge.

46.6 Courses

For the term (Fall and/or Winter), days, and times when courses will be offered, please refer to the 2002-2003 Class Schedule on the Web, <http://www.mcgill.ca/minerva-students/>

class/. Class locations and names of instructors are also provided.

Students preparing to register are advised to consult the Class Schedule website for the most up-to-date list of courses available. New courses may have been added or courses rescheduled after this Calendar went to press. Approximately 15 of the 600- and 700-level courses will be given.

The schedule of courses to be offered in Summer 2003, will be available on the website in January 2003.

NOTE: All undergraduate courses administered by the Faculty of Science (courses at the 100- to 500-level) have limited enrolment.

The course credit weight is given in parentheses after the title. Term(s) offered (Fall, Winter, Summer) may appear after the credit weight to indicate when a course would normally be taught. Please check the Class Schedule to confirm this information.

MATH has replaced 189 as the prefix for Mathematics and Statistics courses.

- Denotes courses not offered in 2002-03

NOTE: With the permission of the instructor, prerequisites and corequisites for courses may be waived in individual cases.

MATH 523 GENERALIZED LINEAR MODELS. (4) (Winter) (Prerequisite: MATH 423 or EPIB 697) (Not open to students who have taken MATH 426) Modern discrete data analysis. Exponential families, orthogonality, link functions. Inference and model selection using analysis of deviance. Shrinkage (Bayesian, frequentist viewpoints). Smoothing. Residuals. Quasi-likelihood. Sliced inverse regression. Contingency tables: logistic regression, log-linear models. Censored data. Applications to current problems in medicine, biological and physical sciences. GLIM, S, software.

MATH 524 NONPARAMETRIC STATISTICS. (4) (Fall) (Prerequisite: MATH 324 or equivalent) (Not open to students who have taken MATH 424) Distribution free procedures for 2-sample problem: Wilcoxon rank sum, Siegel-Tukey, Smirnov tests. Shift model: power and estimation. Single sample procedures: Sign, Wilcoxon signed rank tests. Nonparametric ANOVA: Kruskal-Wallis, Friedman tests. Association: Spearman's rank correlation, Kendall's tau. Goodness of fit: Pearson's chi-square, likelihood ratio, Kolmogorov-Smirnov tests. Statistical software packages used.

MATH 525 SAMPLING THEORY AND APPLICATIONS. (4) (Winter) (Prerequisite: MATH 324 or equivalent) (Not open to students who have taken MATH 425) Simple random sampling, domains, ratio and regression estimators, superpopulation models, stratified sampling, optimal stratification, cluster sampling, sampling with unequal probabilities, multistage sampling, complex surveys, non-response.

MATH 555 FLUID DYNAMICS. (4) (Fall) Kinematics. Dynamics of general fluids. Inviscid fluids, Navier-Stokes equations. Exact solutions of Navier-Stokes equations. Low and high Reynolds number flow.

MATH 556 MATHEMATICAL STATISTICS 1. (4) (Fall) (Prerequisite: MATH 357 or equivalent) Probability and distribution theory (univariate and multivariate). Exponential families. Laws of large numbers and central limit theorem.

MATH 557 MATHEMATICAL STATISTICS 2. (4) (Winter) (Prerequisite: MATH 556) Sampling theory (including large-sample theory). Likelihood functions and information matrices. Hypothesis testing, estimation theory. Regression and correlation theory.

MATH 560 OPTIMIZATION. (4) (Winter) (Prerequisite: Undergraduate background in analysis and linear algebra, with instructor's approval) Classical optimization in n variables. Convex sets and functions, optimality conditions for single-objective and multi-objective nonlinear optimization problems with and without constraints. Duality theories and their economic interpretations. Optimization with functionals. Connections with calculus of variations and optimal control. Stability of mathematical models. Selected numerical methods.

● **MATH 561 ANALYTICAL MECHANICS.** (4) (Prerequisites: MATH 354 and MATH 380 or instructor's approval)

MATH 564 ADVANCED REAL ANALYSIS 1. (4) (Fall) (Prerequisites: MATH 354, MATH 355 or equivalents) Review of theory of measure and integration; product measures, Fubini's theorem; L_p spaces; basic principles of Banach spaces; Riesz representation theorem for $C(X)$; Hilbert spaces; part of the material of MATH 565 may be covered as well.

MATH 565 ADVANCED REAL ANALYSIS 2. (4) (Winter) (Prerequisite: MATH 564) Continuation of topics from MATH 564. Signed measures, Hahn and Jordan decompositions. Radon-Nikodym theorems, complex measures, differentiation in \mathbb{R}^n , Fourier series and integrals, additional topics.

MATH 566 ADVANCED COMPLEX ANALYSIS. (4) (Winter) (Prerequisites: MATH 466, MATH 564) Simple connectivity, use of logarithms; argument, conservation of domain and maximum principles; analytic continuation, monodromy theorem; conformal mapping; normal families, Riemann mapping theorem; harmonic functions, Dirichlet problem; introduction to functions of several complex variables.

MATH 570 HIGHER ALGEBRA 1. (4) (Fall) (Prerequisite: MATH 371 or equivalent) Review of group theory; free groups and free products of groups. Sylow theorems. The category of R -modules; chain conditions, tensor products, flat, projective and injective modules. Basic commutative algebra; prime ideals and localization, Hilbert Nullstellensatz, integral extensions. Dedekind domains. Part of the material of MATH 571 may be covered as well.

MATH 571 HIGHER ALGEBRA 2. (4) (Winter) (Prerequisites: MATH 570 or consent of instructor) Completion of the topics of MATH 570. Rudiments of algebraic number theory. A deeper study of field extensions; Galois theory, separable and regular extensions. Semi-simple rings and modules. Representations of finite groups.

● **MATH 574 ORDINARY DIFFERENTIAL EQUATIONS.** (4) (Prerequisites: MATH 325, MATH 354)

● **MATH 575 PARTIAL DIFFERENTIAL EQUATIONS.** (4) (Prerequisite: MATH 375)

MATH 576 GEOMETRY AND TOPOLOGY 1. (4) (Fall) (Prerequisite: MATH 354) Basic point-set topology, including connectedness, compactness, product spaces, separation axioms, metric spaces. The fundamental group and covering spaces. Simplicial complexes. Singular and simplicial homology. Part of the material of MATH 577 may be covered as well.

MATH 577 GEOMETRY AND TOPOLOGY 2. (4) (Winter) (Prerequisite: MATH 576) Continuation of the topics of MATH 576. Manifolds and differential forms. De Rham's theorem. Riemannian geometry. Connections and curvatures 2-Manifolds and imbedded surfaces.

MATH 578 NUMERICAL ANALYSIS 1. (4) (Fall) (Prerequisites: A first course in numerical analysis with programming and a background in real and complex analysis, with Instructor's approval) Errors in computation, vector and matrix norms. Iteration methods for roots in \mathbb{R}^n and the complex plane. Interpolation including osculating and spline interpolation. Numerical differentiation and integration including Romberg and Gaussian methods and the Peano theorem. Matrix calculations with condition numbers and error bounds. Band matrices, eigenvalue calculations and applications to boundary value problems.

MATH 579 NUMERICAL DIFFERENTIAL EQUATIONS. (4) (Winter) (Prerequisites: a background in ordinary and partial differential equations as well as numerical analysis, with instructor's approval) Basic error analysis. Numerical solution of initial and boundary value problems for ordinary differential equations; simple, multiple shooting methods and finite difference methods. Finite difference methods for partial differential equations: parabolic, hyperbolic and elliptical equations, consistency, convergence and stability of numerical schemes. Explicit and implicit methods, alternating direction explicit and alternating direction implicit methods.

MATH 585 INTEGRAL EQUATIONS AND TRANSFORMS. (4) (Winter) Integral transforms. Introduction to the theory of Hilbert spaces. Fredholm and Volterra integral equations; exact and approximate solutions. Equations with Hermitian kernels. Hilbert Schmidt theo-

rem and consequences. Representation formulas for the solutions of initial and boundary value problems. Green's functions. Applications.

MATH 586 APPLIED PARTIAL DIFFERENTIAL EQUATIONS. (4) (Fall or Winter) (Prerequisites MATH 316, MATH 375 or equivalent) Linear and nonlinear partial differential equations of applied mathematics. Classification and appropriate partial initial and/or boundary conditions for elliptic, hyperbolic and parabolic equations. Method of characteristics for first-order systems and quasi linear equations. Transform methods. Introduction to generalized functions. Special techniques for finding exact solutions of nonlinear equations.

MATH 587 ADVANCED PROBABILITY THEORY 1. (4) (Fall) (Prerequisite: MATH 356 or equivalent and approval of instructor) Probability spaces. Random variables and their expectations. Convergence of random variables in L^p . Independence and conditional expectation. Introduction to Martingales. Limit theorems including Kolmogorov's Strong Law of Large Numbers.

MATH 589 ADVANCED PROBABILITY THEORY 2. (4) (Winter) (Prerequisites: MATH 587 or equivalent) Characteristic functions: elementary properties, inversion formula, uniqueness, convolution and continuity theorems. Weak convergence. Central limit theorem. Additional topic(s) chosen (at discretion of instructor) from: Martingale Theory; Brownian motion, stochastic calculus.

MATH 591 MATHEMATICAL LOGIC 1. (4) (Winter) (Prerequisites: MATH 488 or equivalent or consent of instructor) Propositional logic and first order logic, completeness, compactness and Löwenheim-Skolem theorems. Introduction to axiomatic set theory. Some of the following topics: introduction to model theory, Herbrand's and Gentzen's theories, Lindström's characterization of first order logic.

MATH 592 MATHEMATICAL LOGIC 2. (4) (Winter) (Prerequisites: MATH 488 or equivalent or consent of instructor) Introduction to recursion theory; recursively enumerable sets, relative recursiveness. Incompleteness, undecidability and undefinability theorems of Gödel, Church, Rosser and Tarski. Some of the following topics: Turing degrees, Friedberg-Muchnik theorem, decidability and undecidable theories.

MATH 600 MASTER'S THESIS RESEARCH 1. (6) (Not open to students who have taken or are taking MATH 640) Thesis research under supervision.

MATH 601 MASTER'S THESIS RESEARCH 2. (6) Thesis research under supervision.

MATH 603 LIE GROUPS AND LIE ALGEBRAS 1. (4)

MATH 604 MASTER'S THESIS RESEARCH 3. (6) Thesis research under supervision.

MATH 605 MASTER'S THESIS RESEARCH 4. (6) Thesis research under supervision.

MATH 606 ALGEBRAIC TOPOLOGY. (4) (Prerequisite: MATH 577) Homology and Cohomology theories. Duality theorems. Higher homotopy groups.

● **MATH 609 LIE GROUPS AND LIE ALGEBRAS 2.** (4)

MATH 612 ALGEBRAIC CURVES. (4) A concrete introduction to algebraic geometry. Topics may vary from year to year and will include: plane algebraic curves, function fields in one variable, linear series and the theory of Riemann-Roch, elliptic curves.

● **MATH 614 THEORY OF RINGS.** (4)

● **MATH 615 COMMUTATIVE ALGEBRA.** (4)

● **MATH 616 HOMOLOGICAL ALGEBRA.** (4)

MATH 622 CATEGORIES 1. (4) Categories, functors, natural transformations. Adjoint functors and limits. Embeddings and completions. Algebraic categories and standard constructions. Abelian and homological categories. Categories and the foundations of mathematics.

MATH 623 CATEGORIES 2. (4) A continuation of the topics listed in the description of MATH 622.

MATH 624 APPLIED CATEGORY THEORY 1. (4) Review of adjoint functors, triples and their algebras. Localization with applications to modules, topological spaces and sheaves. Duality theory with applications to Morita theory and the duality theorems of Pontrjagin, Stone, Gelfand and Kaplansky. Categories and deductive systems. Introduction to toposes. Applications to computer science and linguistics.

● **MATH 625 APPLIED CATEGORY THEORY 2.** (4)

MATH 626 ADVANCED GROUP THEORY 1. (4) The structure of groups. Special classes of groups. Representation theory. Additional topics to suit the class.

MATH 627 ADVANCED GROUP THEORY 2. (4) A continuation of the topics listed in the description of MATH 626.

● **MATH 628 MATHEMATICAL LINGUISTICS.** (4) (Given in collaboration with the Department of Linguistics. Prerequisites: MATH 328 or LING 360, or equivalent)

MATH 631 COMPLEX FUNCTION THEORY 1. (4) (Prerequisite: MATH 564, MATH 565, and MATH 566 or equivalent.) Advanced topics in one complex variable, and some topics in several complex variables.

● **MATH 632 COMPLEX FUNCTION THEORY 2.** (4) (Prerequisite: MATH 631)

MATH 633 HARMONIC ANALYSIS 1. (4) (Prerequisite: MATH 564, MATH 565, and MATH 566) Classical harmonic analysis on the circle (Fourier series) and on the line (Fourier integrals). A brief introduction to harmonic analysis on locally compact groups.

● **MATH 634 HARMONIC ANALYSIS 2.** (4) (Prerequisites: MATH 633 and MATH 635)

MATH 635 FUNCTIONAL ANALYSIS 1. (4) (Prerequisite: MATH 564, MATH 565, and MATH 566) Banach spaces. Hilbert spaces and linear operators on these. Spectral theory. Banach algebras. A brief introduction to locally convex spaces.

MATH 636 FUNCTIONAL ANALYSIS 2. (4) (Prerequisites: MATH 564, MATH 565, MATH 635) A continuation of the topics listed in the description of MATH 635.

MATH 637 PARTIAL DIFFERENTIAL EQUATIONS. (4) A modern introduction to the theory of linear differential equations, using the theory of distributions and Fourier transforms.

● **MATH 639 INTRODUCTION TO POTENTIAL THEORY.** (4)

MATH 640 PROJECT 1. (6) (Not open to students who have taken or are taking MATH 600) Project research under supervision.

MATH 641 PROJECT 2. (9) Project research under supervision.

MATH 651 ASYMPTOTIC EXPANSION AND PERTURBATION METHODS. (4) Asymptotic series. Summation. Asymptotic estimation of integrals. Regular and singular perturbation problems and asymptotic solution of differential equations.

● **MATH 658 ADVANCED NUMERICAL ANALYSIS 2.** (4)

MATH 670 RANDOM PROCESS. (4) Basic concepts. Stationary and nonstationary processes. Correlation function. Power spectra. Linear systems. Mean square periodicity and Fourier series. Sampling theorems. Series expansions. Linear mean square estimation.

MATH 671 APPLIED STOCHASTIC PROCESSES. (4) Discrete parameter Markov chains, including branching processes and random walks. Limit theorems and ergodic properties of Markov chains. Continuous parameter Markov chains, including birth and death process. Topics selected from the following areas: renewal processes, Brownian motion, statistical inference for stochastic processes.

MATH 674 EXPERIMENTAL DESIGN. (4) Review of one-way and two-way analyses of variance; randomized block, Latin square and incomplete block designs; factorial designs, confounding, fractional replications; random and mixed models; split-plot designs; nested and hierarchical designs; response surface analysis. Weighted least squares. Analysis of variance with equal and unequal numbers in cells. Latin squares, complete factorial designs. Prediction and confidence bands, multiple comparisons. Random effects models.

MATH 676 MULTIVARIATE ANALYSIS. (4) Properties of the multivariate normal distribution. Central and noncentral Wishart distribution. Statistical inference for multivariate normal populations. Hotelling's T^2 . The product-moment correlation coefficient. Canonical correlations. Multivariate linear models. Principal components. Factor analysis.

MATH 677 DECISION THEORY. (4) Formulation of the statistical decision problem. Bayes and minimax solutions. Hypothesis testing and estimation from the point of view of decision theory. Sequential analysis.

● **MATH 678 APPLIED STATISTICAL METHODS 1.** (4)

● **MATH 679 ADVANCED STATISTICAL METHODS 2.** (4)

MATH 680 COMPUTATION INTENSIVE STATISTICS. (4) (Prerequisites: MATH 556, MATH 557 or permission of instructor) (Not open to students who have taken or are taking EPIB 680) Introduction to a statistical computing language, such as S-PLUS; random number generation and simulations; EM algorithm; bootstrap, cross-validation and other resampling schemes; Gibbs sampler. Other topics: numerical methods; importance sampling; permutation tests.

MATH 681 TIME SERIES ANALYSIS. (4) Stationary stochastic processes. Autocovariance and autocovariance generating functions. The periodogram. Model estimation. Likelihood function. Estimation for autoregressive moving average and mixed processes. Computer simulation; diagnostic checking, tests with residuals. Estimation of spectral density; Bartlett, Daniell, Blackman-Tukey spectral windows. Asymptotic moments of spectral estimates.

MATH 682 MATRIX THEORY - STATISTICAL AND OTHER APPLICATIONS. (4) Inequalities for trace and rank. Generalized inverses; idempotent matrices. Schur complement. Factorizations into triangular and diagonal form; singular values. Normal matrices. Algebraic and geometric multiplicity. Computational procedures; Householder transformations, condition number. Applications to least squares. Courant-Fisher min-max theorem; related inequalities. Quadratic forms in normal variables: distribution, Characteristic function, cumulants and independence.

MATH 683 LINEAR MODELS. (4) General univariate linear models with full rank and with less than full rank. Best linear unbiased estimators. General linear hypothesis. Computational procedures.

● **MATH 684 APPLIED SAMPLING TECHNIQUES.** (4)

MATH 685D1 STATISTICAL CONSULTING. (2) (Prerequisites: MATH 423, MATH 523, MATH 556, MATH 557. Equivalent may be substituted at instructor's discretion) (Password required) Statistical consultation skills; overview of widely used statistical techniques; understanding the client's problem; suggesting designs and statistical analyses; performing statistical analyses; communicating with clients orally and in writing. Format: Simulated and real consultations with clients.

MATH 685D2 STATISTICAL CONSULTING. (2)

MATH 686 SURVIVAL ANALYSIS. (4) (Prerequisites: MATH 556, MATH 557 or permission of instructor) (Not open to students who have taken or are taking EPIB 686) Parametric survival models. Nonparametric analysis: Kaplan-Meier estimator and its properties. Covariates with emphasis on Cox's proportional hazards model. Marginal and partial likelihood. Logrank tests. Residual analysis. Homework assignments a mixture of theory and applications. In-class discussion of data tests.

Reading Courses are available at the 600-level in: Algebra, Analysis, Applied Mathematics, Geometry and Topology, Mathematical Logic, Optimization, Statistics and Probability. Contact the Department for information.

MATH 700 PH.D. PRELIMINARY EXAMINATION PART A. (0)

MATH 701 PH.D. PRELIMINARY EXAMINATION PART B. (0)

MATH 704 TOPICS IN MATHEMATICAL LOGIC 1. (4)

MATH 705 TOPICS IN MATHEMATICAL LOGIC 2. (4)

MATH 706 TOPICS IN GEOMETRY AND TOPOLOGY 1.

TO MATH 709 TOPICS IN GEOMETRY AND TOPOLOGY 4. (4 credits each)

MATH 720 TOPICS IN ALGEBRA 1.
TO MATH 725 TOPICS IN ALGEBRA 6. (4 credits each)
MATH 726 TOPICS IN NUMBER THEORY 1.
TO MATH 729 TOPICS IN NUMBER THEORY 4. (4 credits each)
MATH 740 TOPICS IN ANALYSIS 1.
TO MATH 745 TOPICS IN ANALYSIS 6. (4 credits each)
MATH 756 TOPICS IN OPTIMIZATION 1.
TO MATH 759 TOPICS IN OPTIMIZATION 4. (4 credits each)
MATH 761 TOPICS IN APPLIED MATHEMATICS 1.
TO MATH 768 TOPICS IN APPLIED MATHEMATICS 8. (4 credits each)
 ● **MATH 771 THEORY OF STOCHASTIC PROCESSES.** (4)
 ● **MATH 772 TOPICS IN STOCHASTIC PROCESSES.** (4)
MATH 782 TOPICS IN STATISTICS AND PROBABILITY 1.
TO MATH 785 TOPICS IN STATISTICS AND PROBABILITY 4. (4 credits each)
MATH 790D1 LANGUAGE REQUIREMENTS. (0)
MATH 790D2 LANGUAGE REQUIREMENTS. (0)
MATH 791D1 SEMINARS IN MATHEMATICAL LOGIC. (3)
MATH 791D2 SEMINARS IN MATHEMATICAL LOGIC. (3)
MATH 792D1 SEMINARS IN ALGEBRA. (3)
MATH 792D2 SEMINARS IN ALGEBRA. (3)
MATH 794D1 SEMINARS IN GEOMETRY AND TOPOLOGY. (3)
MATH 794D2 SEMINARS IN GEOMETRY AND TOPOLOGY. (3)
MATH 796D1 SEMINARS IN ANALYSIS. (3)
MATH 796D2 SEMINARS IN ANALYSIS. (3)
MATH 797D1 SEMINARS IN APPLIED MATHEMATICS. (3)
MATH 797D2 SEMINARS IN APPLIED MATHEMATICS. (3)
MATH 798D1 SEMINARS IN STATISTICS AND PROBABILITY. (3)
MATH 798D2 SEMINARS IN STATISTICS AND PROBABILITY. (3)

47 Mechanical Engineering

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Website: <http://www.mcgill.ca/mecheng>

Chair — A.K. Misra

Chair of Graduate Program — J. A. Nemes

47.1 Staff

Emeritus Professors

W. Bruce; B.A.Sc., M.A.Sc.(Tor.), Eng.
 R. Knystautas; B.Eng., M.Eng., Ph.D.(McG.), Eng.
 M.P. Paidoussis; B.Eng.(McG.), Ph.D.(Canlab.), Eng., F.I.
 Mech.E., F.A.S.M.E., F.A.A.M., F.C.S.M.E., F.R.S.C., F.C.A.E.
 (Thomas Workman Emeritus Professor of Mechanical
 Engineering)

Post-Retirement

G. Bach; B.Sc. (Alta), MSc.(Birm), Ph.D.(McG.)
 L. Kops; B.Eng., M.Eng., D.Sc., Eng.(Krakow Tech U.), Eng.,
 M.C.I.R.P., F.A.S.M.E., F.C.S.M.E.

Professors

A.M. Ahmed; B.Sc.(Dhaka), Ph.D.(McG.), Eng. (Thomas
 Workman Professor of Mechanical Engineering)
 J. Angeles; B.Sc., M.Sc.(Unam Mexico), Ph.D.(Stan.), Eng.
 F.A.S.M.E., F.C.S.M.E.
 B.R. Baliga; B.Tech.(I.I.T. Kanpur), M.Sc.(Case), Ph.D.(Minn.)
 W.G. Habashi; B.Eng., M.Eng.(McG.), Ph.D.(C'nell), P.Eng.,
 F.A.S.M.E.

J.H.S. Lee; B.Eng.(McG.), M.Sc.(M.I.T.), Ph.D.(McG.), Eng.
 A.K. Misra; B.Tech.(I.I.T., Kgp.), Ph.D.(Br.Col.), P.Eng.
 S.J. Price; B.Sc., Ph.D.(Brist.), P.Eng.

Associate Professors

M. Buehler; M.Sc., Ph.D.(Yale)
 L. Cortezzi; M.Sc., Ph.D.(Caltech)
 D.L. Frost; B.A.Sc.(Br.Col.), M.S., Ph.D.(Caltech.), P.Eng.
 T. Lee; M.S.(Portland State), Ph.D.(Idaho)
 L. Lessard; B.Eng.(McG.), M.Sc., Ph.D.(Stan.), P.Eng.
 D.F. Mateescu; M.Eng.(Poli. Univ. Buch.), Ph.D.(Rom. Acad. Sci.),
 Doctor Honoris Causa (Poli. Univ. Buch.), AFAIAA, FCASI
 M. Nahon; B.Sc.(Queen's), M.Sc.(Tor.), Ph.D.(McG.) Eng.
 J.A. Nemes; B.Sc.(Maryland), M.Sc., D.Sc.(GWU) (William
 Dawson Scholar)
 M. Ostoja-Starzewski; M.Eng., Ph.D.(McG.), F.A.S.M.E.
 P. Radziszewski; B.Sc.(U.B.C.), M.Sc., Ph.D.(Laval)
 I. Sharf, B.A.Sc., Ph.D.(Tor.)
 V. Thomson; B.Sc.(Windsor), Ph.D.(McM.), (Werner Graupe
 Professor of Manufacturing Automation)
 P.J. Zsombor-Murray; B.Eng., M.Eng., Ph.D.(McG.), Eng.,
 F.C.S.M.E.

Assistant Professors

A.J. Higgins; B.Sc.(Illinois), M.S., Ph.D.(Washington)
 R. Mongrain; B.Sc., M.Sc.(Montr.), Ph.D.(Ecole Polytechnique),
 Eng.
 L. Mydlarski; B.Sc.(Wat.), Ph.D.(C'nell)

Adjunct Professors

R. Edwards, G. Guévremont, Z. Liu, K. MacKenzie, W.D. May,
 A. Pavillet, M.P. Robichaud, R. Sumner, G.A. Wagner, T. Yee,
 D. Zorbas

Associate Members

R.E. Kearney; B.Eng, Ph.D.(McG.), Biomedical Engineering Unit
 B.H.K. Lee; B.Eng, M.Eng, Ph.D.(McG.)
 M. Tanzer; M.D., Orthopaedic Surgery

47.2 Programs Offered

M.Eng., M.Sc. and Ph.D. degrees in Mechanical Engineering.

Advanced courses and laboratory facilities are available for graduate study leading to the M.Eng. and Ph.D. degrees in Mechanical Engineering. Some of the specific areas of research are as follows:

Aerodynamics: experimental and computational studies in subsonic, transonic and supersonic, steady and unsteady flows.

Bioengineering: mechanics of the human musculoskeletal system and design of joint prostheses.

Combustion, shock wave physics and vapour explosions: dust combustion, solid and liquid propellants, explosion hazard, and nuclear reactor safety.

Computational fluid dynamics and heat transfer: turbulent, reacting and multiphase flows in engineering equipment and in the environment.

Fluid-structure interactions and dynamics: vibrations and instabilities of cylindrical bodies, fluidelasticity, aeroelasticity, dynamics of shells containing axial and annular flows.

Manufacturing and industrial engineering: thermoelastic effects in machine tools, functional behaviour of machined surfaces, optimization in production systems.

Robotics and automation: artificial intelligence based simulation of industrial processes, design optimization of manipulators, finite automata, geometric modeling and control systems.

Solid mechanics: composite materials, structural analysis, composite manufacturing, fracture, fatigue and reliability, microscopic and macroscopic approaches.

Space dynamics: orbital analysis, large space structures, space manipulators and tethered satellites.

47.3 Admission Requirements

The general rules of the Graduate and Postdoctoral Studies Office apply. Candidates who come from other institutions are expected to have an academic background equivalent to the undergraduate curriculum in mechanical engineering at McGill or to make up any deficiencies in a qualifying year. Applicants are requested to state in as much detail as possible their particular field of interest for graduate study.

47.4 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)

All information is to be submitted directly to the Graduate Program Secretary in the Mechanical Engineering Department

Deadlines:

- February 1st for Fall admission;
- May 15th for Winter admission.

Commencing with applications for entry in January 2003, McGill's on-line application form will be available to all graduate program candidates at <http://www.mcgill.ca/applying/graduate>.

47.5 Program Requirements

The minimum residence requirement for the M.Eng. degree is three terms of full-time study, one of which may be a summer term. In the case of M.Eng. (Project) a part-time program is available.

M.Eng. (Thesis) Degree (minimum 45 credits)

Thesis Component – Required (29 credits)

- MECH 609 (1) Seminar
- MECH 691 (3) M.Eng. Thesis Literature Review
- MECH 692 (4) M.Eng. Thesis Research Proposal
- MECH 693 (3) M.Eng. Thesis Progress Report 1
- MECH 694 (6) M.Eng. Thesis Progress Report 2
- MECH 695 (12) M.Eng. Thesis

MECH 691 is to be completed in the first semester of the student's program.

Complementary Courses (16 credits)

A minimum of 16 credits at the graduate level (500 or above), at least eight of which must be from within the Faculty of Engineering. In special cases (e.g., interdisciplinary research), one undergraduate course from outside the Department may be used to fulfill the requirement, provided there is no overlap in the content of the course with that of any offered in the Department.

Students who do not hold an undergraduate engineering (or equivalent) degree and who are accepted into this option will register for the M.Sc. degree in Mechanical Engineering. This applies particularly to students engaged in interdisciplinary research. A thesis describing the candidate's research is to be submitted in accordance with the regulations of the Graduate and Postdoctoral Studies Office and is the major requirement for the degree.

M.Eng. (Project) Degree (minimum 45 credits)

This is a course-type Master's degree which requires 12 graduate courses for completion. All candidates are required to take the following courses:

Required Courses (29 credits)

- MECH 605 (4) Applied Mathematics 1
- MECH 610 (4) Fundamentals of Fluid Mechanics
- MECH 632 (4) Theory of Elasticity
- MECH 642 (4) Advanced Dynamics
- MECH 603* (6) Design Project 1
- MECH 604* (6) Design Project 2
- MECH 609* (1) Seminar

* these three courses are taken near the end of the program. In these courses, industrial liaison is encouraged.

Complementary Courses (16 credits)

The remaining courses (minimum 16 credits) may be selected individually by the student (based on interest and the choice of the area of specialization) from the following groups of courses, although it is not necessary that students confine their choice to one of these groups

- Thermo-fluids
- Solid Mechanics and Stress Analysis
- System Dynamics and Control
- Industrial and Production Engineering

M.Eng. Aerospace Degree (minimum 45 credits)

The M.Eng. Aerospace Degree is offered to the students who wish to specialize in the general area of aerospace engineering. This degree is given in conjunction with Concordia University, École Polytechnique, Université Laval, Université de Sherbrooke, and École de Technologie Supérieure. Students registered at McGill are required to take two courses from two other institutions.

Students holding an undergraduate degree in engineering other than Mechanical Engineering are also eligible to apply for this degree. Depending on their background, students would specialize in one of the three areas:

1. Aeronautics and Space Engineering;
2. Avionics;
3. Aerospace Materials and Structures.

Required Courses (9 credits)

- MECH 687 (3) Aerospace Case Studies
- MECH 688 (6) Industrial Stage

Complementary Courses (36 credits)

The other courses, depending on the area of concentration, will be chosen in consultation with an Aerospace Engineering Advisor.

Master in Management (Manufacturing) (56 credits)

The Master in Manufacturing Management program (MMM) is offered to students who wish to have a career as manufacturing managers. The curriculum is a balance between manufacturing and management subjects and provides exposure to industry through case studies, seminars, tours and a paid industry internship. The MMM program is a 12-month academic program starting in September followed by a 4-month industrial internship. The program is a collaboration between the Faculties of Engineering and Management, which jointly grant the Master of Management degree.

Students should hold an undergraduate degree in engineering or science. Two or more years of industrial experience is preferred, but not mandatory. Students with other academic backgrounds and appropriate industrial experience will be considered, but may have to take one or two qualifying courses. The program is intended for full time as well as part time students. Enrolment is limited.

The MMM program is a self-funded program. Tuition is \$25,000.

Management Segment – Required Courses (14 credits)

- MGSC 608 (3) Data Decisions and Models
- INDR 603 (3) Industrial Relations
- MGCR 611 (2) Financial Accounting
- MGCR 612 (2) Organizational Behaviour
- MGCR 616 (2) Marketing
- MGCR 641 (2) Elements of Modern Finance I

Management Segment – Complementary Courses (3 credits)

one of the following two courses:

- ORGB 632 (3) Group Dynamics and Interpersonal Behaviour
- ORGB 640 (2) Leadership, Power and Influence

A background in statistics is a prerequisite for the program; otherwise MGSC 671 Statistics for Business Decisions is required.

Manufacturing Segment – Required Courses (15 credits)

- MGSC 603 (3) Logistics Management
- MGSC 605 (3) Total Quality Management

- MGSC 631 (3) Analysis of Manufacturing Systems
 MECH 524 (3) Computer Integrated Manufacturing
 MECH 526 (3) Manufacturing and the Environment

Manufacturing Segment –

Complementary Courses (12 credits)

two of the following courses:

- MGSC 601 (3) Management of Technology in Manufacturing
 MGSC 602 (3) Manufacturing Strategies
 MGSC 615 (3) The Internet and Manufacturing
 MET 6.904 (3) Strategic Planning and Technological Forecasting

and one of the following 6-credit options:

Discrete Manufacturing Option

- MECH 528 (3) Product Design
 MECH 529 (3) Discrete Manufacturing Systems

Process Manufacturing Option

- CHEE 572 (3) Process Dynamics and Control
 CHEE 653 (3) Advanced Process Design

Industrial Segment – Required Courses (12 credits)

- MECH 627 (9) Manufacturing Industrial Stage
 MECH 628 (2) Manufacturing Case Studies
 MECH 629 (1) Manufacturing Industrial Seminar

For more information, contact Program Coordinator, Mechanical Engineering, (514) 398-7201

Email: mmm@mecheng.mcgill.ca, or Masters Program Office, Faculty of Management, (514) 398-4648.

Ph.D. Degree Candidates normally register for the M.Eng. degree in the first instance. However, in exceptional cases where the research work is proceeding very satisfactorily, or where the equivalent of the M.Eng. degree has been completed at another university, candidates may be permitted to proceed directly to the Ph.D. degree without submitting a master's thesis as long as they have satisfied the course requirements for the M.Eng. degree.

Courses of study selected for a Ph.D. program will depend upon the existing academic qualifications of the candidate and those needed for effective research.

Candidates are required to pass a preliminary oral examination within twelve months of their initial registration for the Ph.D. degree.

The residence requirement for Ph.D. candidates is outlined in the General Information section of the *Graduate and Postdoctoral Studies Calendar*.

47.6 Courses

For the term (Fall and/or Winter), days, and times when courses will be offered, please refer to the 2002-2003 Class Schedule on the Web, <http://www.mcgill.ca/minerva-students/class/>. Class locations and names of instructors are also provided.

Students preparing to register are advised to consult the Class Schedule website for the most up-to-date list of courses available. New courses may have been added or courses rescheduled after this Calendar went to press.

The schedule of courses to be offered in Summer 2003, will be available on the website in January 2003.

MECH has replaced 305 as the prefix for Mechanical Engineering courses.

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

- Denotes courses not offered in 2002-03.
- Denotes limited enrolment.

Undergraduate Courses Approved for Higher Degrees

The following courses, available in the undergraduate curriculum of the Mechanical Engineering Department, may be selected for graduate credit provided that both of the following conditions are met: the course is recommended by the candidate's supervisor, and no equivalent course was taken during the candidate's undergraduate program.

- MECH 413 CONTROL SYSTEMS.** (3)
MECH 432 AIRCRAFT STRUCTURES. (3)

Courses open to Graduate and to Qualified Undergraduate Students

MECH 500 SELECTED TOPICS IN MECHANICAL ENGINEERING. (3) (3-0-6) A course to allow the introduction of new topics in Mechanical Engineering as needs arise, by regular and visiting staff.

MECH 501 SPECIAL TOPICS: MECHANICAL ENGINEERING. (3) (3-0-6) A course to allow the introduction of new topics in Mechanical Engineering as needs arise, by regular and visiting staff.

MECH 522 PRODUCTION SYSTEMS. (3) (3-0-6) (Course description change awaiting University approval) Characteristics of production systems. System boundaries, input-output, feedback time-lag effects, dynamics of production systems. Design for manufacturability. Process planning, process/machine tool selection, break-even analysis, CAPP. Production planning, scheduling and control of operations; quality management. Competitive strategies; FMS, CIM. Hands-on experience with production modeling and industrial simulation software.

□ **MECH 524 COMPUTER INTEGRATED MANUFACTURING.** (3) (3-0-6) (Prerequisite: Permission of the instructor) A study of the present impact of computers and automation on manufacturing. Computer aided systems. Information modelling. Information system structures. Study of several types of production systems. Integration issues: inter-and intra-enterprise. Laboratory experience with manufacturing software systems.

● □ **MECH 526 MANUFACTURING AND THE ENVIRONMENT.** (3) (3-0-6)

● **MECH 527 COMPUTER-AIDED MECHANICAL DESIGN.** (3)

□ **MECH 528 PRODUCT DESIGN.** (3) (3-0-6) A study of the design issues present in product life cycle demands. Computer aided systems. Rapid prototyping. Design for manufacturability. Integration of mechanics, electronics and software in products. Effect on design of product cost, maintainability, recycling, marketability.

□ **MECH 529 DISCRETE MANUFACTURING SYSTEMS.** (3) (3-0-6) An overview of present day production machines and systems with special emphasis on automation, computer control and integration techniques. Material handling, automatic inspection, process monitoring, maintenance. Socio-economic and environmental issues. Laboratory experience with factory simulation.

MECH 530 MECHANICS OF COMPOSITE MATERIALS. (3) (3-0-6) (Corerequisite: MECH 321 or equivalent/instructor's permission) Fiber reinforced composites. Stress, strain, and strength of composite laminates and honeycomb structures. Failure modes and failure criteria. Environmental effects. Manufacturing processes. Design of composite structures. Computer modeling of composites. Computer techniques are utilized throughout the course.

● **MECH 531 AEROELASTICITY.** (3) (3-1-5) (Prerequisite: MECH 533)

MECH 532 AIRCRAFT PERFORMANCE, STABILITY AND CONTROL. (3) (3-1-5) (Prerequisite: MECH 533) Aircraft performance criteria such as range, endurance, rate of climb, maximum ceiling for steady and accelerated flight. Landing and take-off distances. Static and dynamic stability in the longitudinal (stick-fixed and stick-free) and coupled lateral and directional modes. Control response for all three modes.

MECH 533 SUBSONIC AERODYNAMICS. (3) (3-1-5) Kinematics: equations of motion; vorticity and circulation, conformal mapping and flow round simple bodies. Two dimensional flow round aerofoils. Three dimensional flows; high and low aspect-ratio wings; airscrews. Wind tunnel interference. Similarity rules for subsonic irrotational flows.

● **MECH 534 AIR POLLUTION ENGINEERING.** (3) (3-0-6)

MECH 537 HIGH-SPEED AERODYNAMICS. (3) (3-0-6) Equations of compressible flows. Planar and conical shock waves. Expansion and shock wave interference; shock tubes. Method of characteristics. Supersonic nozzle design. Aerofoil theory in high subsonic, supersonic and hypersonic flows. Conical flows. Yawed, delta and

polygonal wings; rolling and pitching rotations. Wing-body systems. Elements of transonic flows.

- **MECH 538 UNSTEADY AERODYNAMICS.** (3) (3-0-6)

- **MECH 539 COMPUTATIONAL AERODYNAMICS.** (3) (3-0-6) (Pre-/Co-requisite: MECH 533 or equivalent)

MECH 540 DESIGN: MODELLING AND DECISION. (3) (3-3-3) 3-D geometric modelling for design; principles and practice. Selected topics/case studies requiring use of: 3-D CAD; component selection and integration; use of machine element design analysis software; practice in developing simple applications. Use of modern software for design decision making. Introduction to mechanism animation. Introduction to design for NC production.

MECH 541 KINEMATIC SYNTHESIS. (3) (3-0-6) Outline of kinematic synthesis and its applications. Degree of freedom, kinematic pairs and bonds. Function-generation problems: Synthesis matrix, transmission quality, six-bar linkages. Rigid-body guidance problem: Planar and spherical Burmester problem; centre-point and circle-point curves. Path generation problem and planar, spherical and spatial coupler curves. Cam mechanisms.

MECH 542 SPACECRAFT DYNAMICS. (3) (3-0-6) (Course description change awaiting University approval) Review of central force motion; Hohmann and other coplanar transfers, rotation of the orbital plane, patched conic method. Orbital perturbations due to the earth's oblateness, solar-lunar attraction, solar radiation pressure and atmospheric drag. Attitude dynamics of a rigid spacecraft; attitude stabilization and control; attitude maneuvers; large space structures.

MECH 543 DESIGN WITH COMPOSITE MATERIALS. (3) (3-3-3) (Prerequisite: MECH 530) Material systems/selection process. Cost vs performance. Laminate layup procedures. Theory and application of filament winding of composite cylinders. Regular oven and autoclave oven curing, analysis of resulting material performance. Practical design considerations and tooling. Analysis of environmental considerations. Joining techniques. Analysis of test methods. Theory of repair techniques.

MECH 545 ADVANCED STRESS ANALYSIS. (3) (3-1-5) Tensor Analysis: Review of continuum mechanics. Equilibrium and constitutive equations in tensor form. Finite element methods. Torsion of non-circular cross-sections; spherical problems; advanced airy stress function problems. Introduction to plates and shells. Thermal deformations and stresses. Introduction to plasticity and viscoelasticity.

MECH 552 ADVANCED APPLIED MATHEMATICS. (3) (3-1-5) (Prerequisite: Permission of instructor.) Solutions of ordinary differential equations using integral methods; asymptotic series, Stirling's approximation. Bessel and Laguerre functions. Green's functions. Laplace, Helmholtz, diffusion, wave, telegraph partial differential equations. Variational methods. Numerical solutions to partial differential equations.

- **MECH 554 MICROPROCESSORS FOR MECHANICAL SYSTEMS.** (3) (2-3-4)

- **MECH 555 APPLIED PROCESS CONTROL.** (3) (3-2-4) (Prerequisite: MECH 554 or equivalent)

MECH 557 MECHATRONIC DESIGN. (3) (3-1-5) Team project course on the design, modeling, model validation, and control of complete mechatronic systems, constructed with modern sensors, actuators, real time operating systems, embedded controllers, and intelligent control.

MECH 561 BIOMECHANICS OF MUSCULOSKELETAL SYSTEMS. (3) (3-0-6) The musculoskeletal system; general characteristics and classification of tissues and joints. Biomechanics and clinical problems in orthopaedics. Modelling and force analysis of musculoskeletal systems. Passive and active kinematics. Load-deformation properties of passive connective tissue, passive and stimulated muscle response. Experimental approaches, case studies.

MECH 562 ADVANCED FLUID MECHANICS. (3) (3-0-6) Conservation laws, control volume analysis, Navier Stokes equations, dimensional analysis and limiting forms of N-S equation, laminar

viscous flows, boundary layer theory, inviscid potential flows, lift and drag, introduction to turbulence.

MECH 565 FLUID FLOW AND HEAT TRANSFER EQUIPMENT. (3) (3-1-5) Pipes and piping systems, pumps, and valves. Fans and building air distribution systems. Basic thermal design methods for fins and heat exchangers. Thermal design of shell-and-tube and compact heat exchangers.

MECH 572 INTRODUCTION TO ROBOTICS. (3) (3-0-6) (Not open to students who have taken MECH 573) Manipulator hardware structure, kinematics, statics, dynamics planning and control. Rigid-body, three-dimensional statics, kinematics and dynamics. Direct and inverse kinematics and dynamics. Trajectory planning subject to constraints. Manipulator control. In depth study of serial manipulators with extension to more complex robotic devices.

MECH 573 MECHANICS OF ROBOTIC SYSTEMS. (3) (3-0-6) (Prerequisite: Permission of the instructor) Numerical methods for the kinematic inversion of serial manipulators. The handling of redundancies and singularities. Kinematics and dynamics of parallel manipulators, manipulator performance evaluation and optimization, multifingered hand grasping and manipulation, robot compliant and constrained motion. Obstacle avoidance.

MECH 576 COMPUTER GRAPHICS AND GEOMETRICAL MODELLING. (3) (2-3-4) Review of pertinent linear algebra and projective geometry. Explicit, implicit and parametric polynomial forms. Splines: curves and surfaces. Properties: curvature, twist, continuity. Ruled surfaces and other quad patches. Constructive solid models; Octree/Voxel, sweep wire frame, Boolean, boundary representation. Mechanical Engineering applications.

MECH 577 OPTIMUM DESIGN. (3) (2-3-4) The role of optimization within the design process: Design methodology and philosophy. Constrained optimization: The Kuhn-Tucker conditions. Techniques of linear and non-linear programming. The simplex and the complex methods. Sensitivity of the design to manufacturing errors. Robustness of the design to manufacturing and operation errors.

- **MECH 578 ADVANCED THERMODYNAMICS.** (3) (3-0-6)

- **MECH 581 NONLINEAR DYNAMICS AND CHAOS.** (3) (3-1-5)

COURSES FOR GRADUATE STUDENTS ONLY

MECH 602 ADVANCED TOPICS IN MECHANICAL ENGINEERING. (3) New developments related to Mechanical Engineering will be presented either by staff or by visiting professors.

MECH 603 DESIGN PROJECT 1. (6) A design project undertaken under the direct supervision of at least one staff member. Examination entails the writing of a report which is examined internally by the supervisor and another staff member appointed by the Mechanical Engineering Department.

MECH 604 DESIGN PROJECT 2. (6) A continuation of MECH 603.

MECH 605 APPLIED MATHEMATICS 1. (4) A brief treatment of tensor analysis. A review of complex variables. Analytical methods of solution for partial differential equations occurring with great frequency in engineering. Perturbation methods, integral methods, asymptotic methods and variational techniques. Numerical methods of solution.

- **MECH 606 APPLIED MATHEMATICS 2.** (4) (Prerequisite: MECH 605)

- **MECH 608 NUMERICAL ANALYSIS COMPUTER USERS 2.** (4)

MECH 609 SEMINAR. (1) All candidates for a Master's degree (except those in the Aerospace Program) are required to participate and to deliver one paper dealing with their particular area of research or interest.

MECH 610 FUNDAMENTALS OF FLUID DYNAMICS. (4) (Prerequisite: MECH 605 or permission of instructor) Conservation laws control volume analysis, Navier Stokes Equations and some exact solutions, dimensional analysis and limiting forms of Navier Stokes Equations. Vorticity, Potential flow and lift, boundary layer theory, drag, turbulence.

- **MECH 615 UNSTEADY GASDYNAMICS 1.** (4)

- **MECH 617 UNSTEADY GASDYNAMICS 2.** (4)
- **MECH 620 ADVANCED COMPUTATIONAL AERODYNAMICS.** (4) (Evening course)
- **MECH 626 ADVANCED CONCEPTS OF ENGINEERING DESIGN.** (4) (Evening course)

MECH 627 MANUFACTURING INDUSTRIAL STAGE. (9) (Restricted to students in the M.M.M. Program) An industrial work term is an integral component of the M.M.M. program which is to be completed under the supervision of an experienced engineer in the facilities of a sponsoring company.

MECH 628 MANUFACTURING CASE STUDIES. (2) (Restricted to students in the M.M.M. Program) Case studies on a variety of manufacturing topics are given by industry experts. To be attended by all students in the M.M.M. program.

May also be available as:

MECH 628D1, MECH 628D2.

MECH 629 MANUFACTURING INDUSTRIAL SEMINAR. (1) (Restricted to students in the M.M.M. Program) A series of presentations by industry experts and manufacturing managers. To be attended by all students in the M.M.M. program.

May also be available as:

MECH 629D1, MECH 629D2.

MECH 632 THEORY OF ELASTICITY. (4) (Evening course) The continuum concepts of stress, stress boundary conditions, principal stresses and the equations of equilibrium. Small strain theory and principal strains. The elastic constitutive relations. The extension, torsion and flexure of mechanical components. Plane stress and plane strain. Variational principals and the finite element method. Computer techniques are utilized.

- **MECH 634 NONLINEAR CONTINUUM MECHANICS.** (4)
- **MECH 635 FRACTURE AND FATIGUE.** (4) (Evening course) (Prerequisite: MECH 632)

MECH 642 ADVANCED DYNAMICS. (4) (Evening course) Variational methods. Hamilton's principle and equations of motion of engineering systems. Lagrangian formulations for discrete systems. Methods of discretizing continuous systems. Rigid body dynamics. Dynamic behaviour of linear and nonlinear systems. Response of engineering systems to deterministic inputs by classical methods. Stability of linear and nonlinear systems.

- **MECH 643 VIBRATIONS IN ENGINEERING SYSTEMS.** (4) (Evening course) (Prerequisite: MECH 642)
- **MECH 645 FINITE ELEMENTS: DYNAMIC SYSTEMS.** (4) (Evening course) (Prerequisite: MECH 642)

MECH 650 HEAT TRANSFER. (4) (Evening course) Heat conduction: analytical solutions; integral solutions; solid-liquid phase-change. Forced and natural convection: nondimensionalization; boundary layer theory; design correlations for external and internal flows; basic ideas of turbulence modelling. Mixed convection. Boiling and condensation. Radiation heat transfer: basic concepts; black-body enclosure theory; gray-body enclosure theory; participating media.

- **MECH 652 DYNAMICS OF COMBUSTION.** (4)
- **MECH 654 COMPT. FLUID FLOW AND HEAT TRANSFER.** (4) (Evening course)

MECH 681 AERONAUTICS PROJECT 1. (3) (Open to students in the Aeronautical Option only)

MECH 682 AERONAUTICS PROJECT 2. (3) (Open to students in the Aeronautical Option only) A continuation of MECH 681.

MECH 683 AERONAUTICS PROJECT 3. (3) (Open to students in the Aeronautical Option only) A continuation of MECH 682.

MECH 687 AEROSPACE CASE STUDIES. (3) (Restricted to students in the Aerospace Engineering Option/Programs at McGill, Concordia, École Polytechnique or École de Technologie Supérieure.) This course covers topical case studies drawn from aerospace industrial experience. It is conducted in a modular form by experienced engineers from industry. It is given in collaboration with the other two institutions participating in this joint option/program, and

may be conducted at any of the three locations in the language of convenience to the instructors.

MECH 688 INDUSTRIAL STAGE. (6) (Restricted to students in the Aerospace Engineering Option/Program) An integral component of the program that is to be completed under the supervision of an experienced engineer in the facilities of a participating company. The topic is to be decided by a mutual agreement between the candidate, the participating company and the Liaison Committee on Aerospace Engineering. An evaluation of the candidate's performance during the work period becomes a part of the student's record.

MECH 691 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.

MECH 692 M.ENG. THESIS RESEARCH PROPOSAL. (4) Initiation of research with particular emphasis on the definition of the thesis topic.

MECH 693 M.ENG. THESIS PROGRESS REPORT 1. (3) A first status report on the progress in the thesis research.

MECH 694 M.ENG. THESIS PROGRESS REPORT 2. (6) A second status report on the progress in the thesis research.

MECH 695 M.ENG. THESIS. (12) Submission of the M.Eng. thesis for examination.

MECH 701 PH.D. COMPREHENSIVE PRELIMINARY ORAL EXAMINATION. (0) Presentation of the Ph.D. thesis proposal by the student and oral examination of the student's background in related areas.

48 Medical Physics

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Director — E.B. Podgorsak

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.
M. Olivares; B.Sc.(Madrid), M.Sc.(Sask.), F.C.C.P.M.

Lecturers

R.A. Corns; B.Sc., M.Sc., Ph.D.(Man.), M.Sc.(McG.)
G. Durante; B.Eng.(McG.)
T. Falco; B.Sc., M.Sc., Ph.D.(McG.), M.C.C.P.M.
G. Hegyi; Ph.D.(Cluj), M.Sc.(McG.)
C. Janicki; B.Sc., M.Sc., Ph.D.(Montr.)
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. Sharoubim; B.Eng.(Ain Shams)
W. Wierzbicki; M.Sc.(Warsaw), Ph.D.(Montr.)

Associate Members

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)

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 medicine, 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 2003 should be submitted by March 15, 2003.

Applications being made to McGill University graduate programs for September 2003 may be made on-line via McGill's website. For information regarding the application procedure and to access the application form, please go to <http://www.mcgill.ca/applying/graduate/application/>.

It is preferable for applicants to apply on-line for consideration for programs beginning in September 2003. However application packages can be made available via mail (special request). Mailed applications for the M.Sc. program in Medical Physics (September 2003) will be accepted at this office from September 1, 2002 until March 15, 2003.

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 may be remitted in either Canadian or US funds. If using the preferred on-line application form, the application fee is remitted via a valid credit card; if using the paper application, the fee must be remitted in negotiable form payable to McGill University, such as a bank draft, money order, etc.

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 or IELTS. The original test report must be sent by the testing center, i.e. a photocopy sent by the applicant is not acceptable.

All supporting 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

For the term (Fall and/or Winter), days, and times when courses will be offered, please refer to the 2002-2003 Class Schedule on the Web, <http://www.mcgill.ca/minerva-students/class/>. Class locations and names of instructors are also provided.

Students preparing to register are advised to consult the Class Schedule website for the most up-to-date list of courses available. New courses may have been added or courses rescheduled after this Calendar went to press.

The schedule of courses to be offered in Summer 2003, will be available on the website in January 2003.

MDPH has replaced 563 as the prefix for Medical Physics courses. The course credit weight is given in parentheses after the title.

- Denotes courses not offered in 2002-03

MDPH 601 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.

MDPH 602 APPLIED DOSIMETRY. (3) (Prerequisite: MDPH 601) Theoretical and practical dosimetry of radiation sources, both external and internal with respect to the human body. Equipment used for external beam radiotherapy and brachytherapy.

MDPH 603 LABORATORY PRACTICUM 1. (2) (Prerequisite: MDPH 601. Corequisite: MDPH 602) 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, brachytherapy, quality assurance, calibration and thermoluminescent dosimetry.

MDPH 607 INTRODUCTION TO MEDICAL IMAGING. (3) (3 hours lectures/week) (Prerequisite: MDPH 615) 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.

MDPH 608 LABORATORY - DIAGNOSTIC RADIOLOGY AND NUCLEAR MEDICINE. (2) (Prerequisite: MDPH 615. Corequisite: MDPH 614) This laboratory course takes place in hospital departments of medical diagnostic imaging and is designed to give the student a working knowledge of the performance parameters of the diagnostic imaging equipment. Laboratory classes will offer the student the practical experience of image quality control, on selected imaging equipment currently used in diagnostic medicine together with practical applications of the concepts studied in MDPH 614 and MDPH 615.

MDPH 609 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 the application of radiation biology to oncology and the biological aspects of environmental radiation exposure.

MDPH 611 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.

MDPH 612 COMPUTERS IN MEDICAL IMAGING. (2) (Prerequisites: MDPH 607, MDPH 611 or equivalent, MDPH 615) (Corequisite: MDPH 614) 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.

MDPH 613 HEALTH PHYSICS. (2) (Prerequisites: MDPH 601, MDPH 609) 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.

MDPH 614 PHYSICS OF DIAGNOSTIC RADIOLOGY. (3) 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.

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

MDPH 616D1 SELECTED TOPICS IN MEDICAL PHYSICS. (0.5) (Students must also register for MDPH 616D2) (No credit will be given for this course unless both MDPH 616D1 and MDPH 616D2 are successfully completed in consecutive terms) 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.

MDPH 616D2 SELECTED TOPICS IN MEDICAL PHYSICS. (0.5) (Prerequisite: MDPH 616D1) (No credit will be given for this course unless both MDPH 616D1 and MDPH 616D2 are successfully completed in consecutive terms)

MDPH 625D1 M.Sc. THESIS RESEARCH. (16) (Students must also register for MDPH 625D2) (No credit will be given for this course unless both MDPH 625D1 and MDPH 625D2 are successfully completed in consecutive terms)

MDPH 625D2 M.Sc. THESIS RESEARCH. (16) (Prerequisite: MDPH 625D1) (No credit will be given for this course unless both MDPH 625D1 and MDPH 625D2 are successfully completed in consecutive terms)

**May also be available as:
MDPH 625N1, MDPH 625N2.**

49 Medicine, Experimental

Division of Experimental Medicine
Department of Medicine
Lady Meredith House, Room 304
1110 Pine Avenue West
Montreal, QC H3A 1A3
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Telephone: (514) 398-3466
Fax: (514) 398-3425
Email: divexmed@med.mcgill.ca
Website: <http://www.medcor.mcgill.ca/EXPMED/expmed.htm>

Chair, Department of Medicine — D. Goltzman
Director, Division of Experimental Medicine — G. Price

49.1 Staff

Professors

G. Batist; B.Sc.(Col.), M.D., C.M.(McG.), F.R.C.P.(C)
H. Bennett; B.A.(York, U.K.), Ph.D.(Brun.)
R. Blostein; M.Sc., Ph.D.(McG.)
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)
F. Doualla-Bell; B.Sc., M.S., Ph.D.(Paris XI)
A. Fuks; B.Sc., M.D., C.M.(McG.)
J. Genest, Jr.; M.D., C.M.(McG.), F.R.C.P.(C)
H.L. Goldsmith; B.A., B.Sc., M.A.(Oxon.), Ph.D.(McG.)
D. Goltzman; B.Sc., M.D., C.M.(McG.), F.R.C.P.(C)
A. Grassino; M.D.(Rosario, Argen.)
S.A. Grover; B.A.(Roch.), M.D., C.M.(McG.), M.P.A.(Harv.), F.R.C.P.(C)
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.)
M. Levy; B.Sc., M.D., C.M.(McG.), F.R.C.P.(C)
B. Leyland-Jones; B.Sc., M.B., B.S.(Lond.), F.R.C.P.(C), F.A.C.P.
P.T. Macklem; B.A.(Queen's), M.D., C.M.(McG.), F.R.C.P.(C)
S. Magder; M.D.(Tor.), F.R.C.P.(C)
O.A. Mamer; B.Sc., Ph.D.(Windsor)
E. Marliss; M.D.(Alta.), F.R.C.P.(C)
J. Martin; B.Sc., M.B., B.Ch., M.D.(Cork), F.R.C.P.(C)
J. Milic-Emili; M.D.(Milan), F.R.S.C.
B.E.P. Murphy; B.A., M.D.(Tor.), M.Sc., Ph.D.(McG.), F.A.C.P.(C)
C.K. Osterland; M.D.(Man.)
L. Panasci; B.Sc., M.D.(Georgetown)
Y.C. Patel; M.D.(Otago), Ph.D.(Monash), F.R.A.C.P., F.R.C.P.(C)
M.N. Pollak; M.D., C.M.(McG.), F.R.C.P.(C)
P. Ponka; M.D., Ph.D.(Prague)
B. Posner; M.D.(Man.), F.R.C.P.(C)
W.S. Powell; B.A.(Sask.), Ph.D.(Dal.)
G.B. Price; B.A.(Kansas St.), Ph.D.(Tenn.)
M. Rasminsky; B.A.(Tor.), M.D.(Harv.), Ph.D.(Lond.)
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.)
C.P. Stanners; B.Sc.(McM.), M.A., Ph.D.(Tor.)
M. Stevenson; B.A.(Hood), M.Sc., Ph.D.(Catholic U. of Amer.)
S.L. Tan; M.B.B.S., M.Med.(Sing.)
D.M.P. Thomson; M.D., (W. Ont.), Ph.D.(Lond.), F.R.C.P.(C)
C. Tsoukas; B.Sc.(McG.), M.Sc.(Hawaii), M.D.(Athens), F.R.C.P.(C)
M. Wainberg; B.Sc.(McG.), Ph.D.(Col.)
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.)
N. Beauchemin; B.A., B.Sc., M.Sc., Ph.D.(Montr.)
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)
E.A. Faust; B.Sc., Ph.D.(McG.)
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)
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)
G.A. Kuchel; M.D., C.M.(McG.)
P. Laneville; B.Sc.(McM.), M.D.(Ott.), F.R.C.P.(C)

M. Laughrea; B.Sc.(Laval), M.Sc., M.Phil., Ph.D.(Yale)
 R. Loertscher; M.D.(Basel)
 M.S. Ludwig; M.D.(Man.), F.R.C.P.(C)
 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. Radziach; 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., C.M.(McG.)
 B. Turcotte; B.Sc., Ph.D.(Laval)
 B.J. Ward; M.D., C.M.(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)
 M. Behr; B.Sc.(Tor.), M.D.(Queen's), M.Sc.(McG.)
 N. Bernard; B.Sc.(McG.), Ph.D.(Duke)
 M. Blostein; M.D., C.M.(McG.)
 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.)
 J. Falutz; B.Sc., M.D., C.M.(McG.), F.R.C.P.(C)
 E. Fixman; B.Sc.(Col.), Ph.D.(Johns H.)
 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. Götte; B.Sc., Ph.D.(Max-Planck)
 M. Greenwood; B.Sc., M.Sc.(C'dia), Ph.D.(McG.)
 J. Henderson; B.Sc., Ph.D.(McG.)
 A.C. Karaplis; B.Sc., M.D., Ph.D.(McG.) (*William Dawson Scholar*)
 A.E. Koromilas; B.Sc., Ph.D.(Aristotelian U., Greece)
 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)
 C. Liang; B.Sc., Ph.D.(Nankai)
 R. Lin; B.Sc., M.Sc.(PRC), Ph.D.(C'dia)
 M. Lipman; M.D., C.M.(McG.), F.R.C.P.(C)
 J.-L. Liu; B.Sc., M.Sc.(Beijing), Ph.D.(McG.)
 D. Malo; D.V.M., M.Sc.(Montr.), Ph.D.(McG.)
 B. Mazer; B.Sc.(Columbia, NY); M.D., C.M.(McG.), F.R.C.P.(C)
 M. Park; B.Sc., Ph.D.(Glas.)
 B.J. Petrof; M.D.(Laval)
 P. Renzi; M.D.(Montr.), F.R.C.P.(C)
 S. Richard; B.Sc., Ph.D.(McG.)
 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.)
 S. Wing; B.Sc., M.Sc.(McG.)
 X.-J. Yang; B.Sc.(Zhejiang), Ph.D.(Shanghai)

Associate Members, McGill

C. Autexier, D. Boivin, P. Brodt; K. Brown; M.N. Burnier;
 D.H. Burns; S.Chevalier; M. Chevette; T. Chow; H. Clarke;
 E. Colle; D. Dufort; R. Farookhi; M.M. Frojmovic; C. Gagnon;
 A. Giadi; C. Goodyer; P. Goodyer; R. Gosden; B. Gour; I. Gupta;
 B.J. Jean-Claude; W. Lapp; S. Lehnert; B. Massie; M. Miller;

E. Mills; C. Polychronakos; R. Poole; R.D. Rajan; G. Rouleau;
 S.-H. Shen; G. Tannenbaum; H. Tenenhouse; I. Wainer;
 K. Watkin; J. White; S.N. Young

Associate Members, Université de Montréal

T. Bradley; R. Butterworth; P. Chartrand; J. Davignon; C. Deal;
 A. Deng; C.F. Deschepper; J. Drouin; J. Gutkowska; P. Hamet;
 T. Hoang; P. Hugo; P. Jolicoeur; C. Lazure; D. Lohnes; S. Mader;
 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 Graduate and Postdoctoral Studies Office, 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.

Commencing with applications for entry in January 2003, McGill's on-line application form will be available to all graduate program candidates at <http://www.mcgill.ca/applying/graduate>.

49.5 Program Requirements

Ph.D.

Comprehensive Examination

All students must take and pass the Comprehensive Oral Examination, listed as course EXMD 701 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: EXMD 604D1/EXMD 604D2 Recent Advances in Cellular and Molecular Biology; EXMD 610 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; email: 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

For the term (Fall and/or Winter), days, and times when courses will be offered, please refer to the 2002-2003 Class Schedule on the Web, <http://www.mcgill.ca/minerva-students/class/>. Class locations and names of instructors are also provided.

Students preparing to register are advised to consult the Class Schedule website for the most up-to-date list of courses available. New courses may have been added or courses rescheduled after this Calendar went to press.

The schedule of courses to be offered in Summer 2003, will be available on the website in January 2003.

EXMD has replaced 516 as the prefix for Experimental Medicine courses.

The course credit weight is given in parentheses after the title. Term(s) offered (Fall, Winter, Summer) may appear after the credit weight to indicate when a course would normally be taught. Please check the Class Schedule to confirm this information.

NOTE: All undergraduate courses administered by the Faculty of Science (courses at the 100- to 500-level) have limited enrolment.

● Denotes courses not offered in 2002-03

★ Denotes courses taught only in alternate years.

EXMD 502 ADVANCED ENDOCRINOLOGY. (3) (Fall) This course is designed for U3 students who are in a major or honours program in anatomy, biology, biochemistry or physiology and for graduate students. A multidisciplinary approach will be used to teach biosynthesis and processing of hormones, their regulation, function and mechanism of action. The material will cover hypothalamic, pituitary, thyroid, atrial and adrenal hormones as well as prostaglandins and related substances.

EXMD 503 ADVANCED ENDOCRINOLOGY. (3) (Winter) Study of the parathyroids, gut and pancreatic hormones and growth factors. In addition, the role of hormones and growth factors in reproduction and fetal maturation will be discussed.

EXMD 504 BIOLOGY OF CANCER. (3) (Fall) An introduction to the biology of malignancy. A multidisciplinary approach dealing with the etiology of cancer, the biological properties of malignant cells, the host response to tumour cell growth and the principles of cancer therapy.

EXMD 506 ADVANCED APPLIED CARDIOVASCULAR PHYSIOLOGY. (3) (Winter) 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.

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

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

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

EXMD 510 BIOANALYTICAL SEPARATION METHODS. (3) (Fall) 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.

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

● **EXMD 512D1 RECENT PROGRESS IN AIDS RESEARCH.** (3) (Students must also register for EXMD 512D2) (No credit will be given

for this course unless both EXMD 512D1 and EXMD 512D2 are successfully completed in consecutive terms) Interdisciplinary seminar course on basic, clinical, epidemiological and psychosocial aspects of HIV infection. Topics include: the pathophysiology of HIV-associated immunodeficiency; review of current antiviral treatment and mechanisms of resistance to anti-HIV drugs; sessions on the natural history, clinical manifestations and general aspects of treatment interventions, as pertaining to different populations.

● **EXMD 512D2 RECENT PROGRESS IN AIDS RESEARCH.** (3) (Prerequisite: EXMD 512D1) (No credit will be given for this course unless both EXMD 512D1 and EXMD 512D2 are successfully completed in consecutive terms) See EXMD 512D1 for course description.

EXMD 602 TECHNIQUES IN MOLECULAR GENETICS. (3) (Offered in conjunction with the Department of Experimental Medicine.) (Admission by permission of instructor.) 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.

EXMD 603 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.

EXMD 604D1 RECENT ADVANCES IN CELLULAR AND MOLECULAR BIOLOGY. (3) (Students must also register for EXMD 604D2) (No credit will be given for this course unless both EXMD 604D1 and EXMD 604D2 are successfully completed in consecutive terms) 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.

EXMD 604D2 RECENT ADVANCES IN CELLULAR AND MOLECULAR BIOLOGY. (3) (Prerequisite: EXMD 604D1) (No credit will be given for this course unless both EXMD 604D1 and EXMD 604D2 are successfully completed in consecutive terms) See EXMD 604D1 for course description.

EXMD 607 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.

★ **EXMD 608 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.

EXMD 610 BIOMEDICAL 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.

★ **EXMD 611D1 SEMINARS IN ONCOLOGY.** (3) (Students must also register for EXMD 611D2) (No credit will be given for this course unless both EXMD 611D1 and EXMD 611D2 are successfully completed in consecutive terms) A course in cancer and allied fields aimed at familiarizing students with the current literature relevant to the biology of cancer, developing their critical abilities and providing an opportunity for presenting seminars to their peers.

EXMD 611D2 SEMINARS IN ONCOLOGY. (3) (Prerequisite: EXMD 611D1) (No credit will be given for this course unless both EXMD 611D1 and EXMD 611D2 are successfully completed in consecutive terms) See EXMD 611D1 for course description.

EXMD 614 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.

EXMD 615 MEMBRANE CARBOHYDRATES. (3) The structure, function and biosynthesis of glycoproteins, glycolipids and glycoaminoglycans, and the biological role of complex carbohydrates at the cell surface.

EXMD 616 MOLECULAR AND 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.

EXMD 617 WORKSHOP IN CLINICAL TRIALS 1. (1) Intensive day-long workshop discussing Industrial/Academic/Governmental interactions in the design, testing and approval of drugs.

EXMD 618 WORKSHOP IN CLINICAL TRIALS 2. (1) Intensive day-long workshop discussing the role of the physician in drug testing.

EXMD 619 WORKSHOP: CLINICAL TRIALS 3. (1) Intensive day-long workshop discussing the pharmacoconomics of drug design and testing.

EXMD 620 CLINICAL TRIALS AND RESEARCH 1. (1) Intensive day-long workshop discussing a topical subject or recent advance relevant to clinical research and the conduct of clinical trials.

EXMD 621 SEMINARS IN BIOMEDICAL RESEARCH 1. (3)

EXMD 622 SEMINARS IN BIOMEDICAL RESEARCH 2. (3)

EXMD 623 SEMINARS: BIOMEDICAL RESEARCH 3. (3)

EXMD 624 SEMINARS IN BIOMEDICAL RESEARCH 4. (3)

EXMD 625 CLINICAL TRIALS AND RESEARCH 2. (1) Intensive day-long workshop discussing a topical subject or recent advance relevant to clinical research and the conduct of clinical trials.

EXMD 626 CLINICAL TRIALS AND RESEARCH 3. (1) Intensive day-long workshop discussing a topical subject or recent advance relevant to clinical research and the conduct of clinical trials.

EXMD 627 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.

● **EXMD 627D1 PRACTICUM IN CLINICAL RESEARCH.** (9) (Students must also register for EXMD 627D2) (No credit will be given for this course unless both EXMD 627D1 and EXMD 627D2 are successfully completed in consecutive terms) (EXMD 627D1 and EXMD 627D2 together are equivalent to EXMD 627) See EXMD 627 for course description.

● **EXMD 627D2 PRACTICUM IN CLINICAL RESEARCH.** (9) (Prerequisite: EXMD 627D1) (No credit will be given for this course unless both EXMD 627D1 and EXMD 627D2 are successfully completed in consecutive terms) (EXMD 627D1 and EXMD 627D2 together

are equivalent to EXMD 627) See EXMD 627 for course description.

EXMD 628 QUALITATIVE RESEARCH METHODOLOGY. (3) (Restriction: permission of instructor) This course explores both broad and specific theoretical and methodological issues in qualitative research inquiry. It will discuss both traditional and contemporary paradigmatic thought underlying the qualitative enterprise and it will introduce the student to some qualitative techniques and strategies for collecting, analyzing and reporting data.

EXMD 630 ECONOMIC EVALUATION OF MEDICAL TECHNOLOGIES. (3) (Offered in conjunction with the Department of Epidemiology and Biostatistics.) This course will cover basic costing principles including: discounting, overhead costs, downcosting, increment analysis, data sources, will teach students to critically evaluate the economic evaluation literature, and provide practical experience through case studies.

● **EXMD 631 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.

EXMD 635D1 EXPERIMENTAL/CLINICAL ONCOLOGY. (3) (Students must also register for EXMD 635D2) (No credit will be given for this course unless both EXMD 635D1 and EXMD 635D2 are successfully completed in consecutive terms) The course will deal, on a site by site basis, with the incidence of cancer, present treatment, treatment outcome, underlying causes, current research and directions for development of new treatments. Chemotherapy, surgery, radiation therapy and nutrition as therapy and treatment of cancer will be included.

EXMD 635D2 EXPERIMENTAL/CLINICAL ONCOLOGY. (3) (Prerequisite: EXMD 635D1) (No credit will be given for this course unless both EXMD 635D1 and EXMD 635D2 are successfully completed in consecutive terms) See EXMD 635D1 for course description.

EXMD 640 EXPERIMENTAL MEDICINE TOPIC 1. (3) Study, through guided reading, visits, practicals, assignments, of an elected and approved topic of importance in medical science.

● **EXMD 641 EXPERIMENTAL MEDICINE TOPIC 2.** (3) Study, through guided reading, visits, practicals, assignments, of an elected and approved topic of importance in medical science.

● **EXMD 642 EXPERIMENTAL MEDICINE TOPIC 3.** (3) Study, through guided reading, visits, practicals, assignments, of an elected and approved topic of importance in medical science.

EXMD 690 MASTER'S THESIS RESEARCH 1. (3)

EXMD 691 MASTER'S THESIS RESEARCH 2. (6)

EXMD 692 MASTER'S THESIS RESEARCH 3. (9)

EXMD 693 MASTER'S THESIS RESEARCH 4. (12)

EXMD 694 MASTER'S THESIS RESEARCH 5. (12)

● **EXMD 695 M.D. PH.D. RESEARCH PROJECT 1.** (3)

● **EXMD 696 M.D. PH.D. RESEARCH PROJECT 2.** (6)

EXMD 697 M.D. PH.D. RESEARCH PROJECT 3. (3)

EXMD 698 M.D. PH.D. RESEARCH PROJECT 4. (3)

EXMD 701 COMPREHENSIVE ORAL EXAMINATION. (0)

EXMD 701D1 COMPREHENSIVE ORAL EXAMINATION. (0) (Students must also register for EXMD 701D2) (No credit will be given for this course unless both EXMD 701D1 and EXMD 701D2 are successfully completed in consecutive terms) (EXMD 701D1 and EXMD 701D2 together are equivalent to EXMD 701)

EXMD 701D2 COMPREHENSIVE ORAL EXAMINATION. (0) (Prerequisite: EXMD 701D1) (No credit will be given for this course unless both EXMD 701D1 and EXMD 701D2 are successfully completed in consecutive terms) (EXMD 701D1 and EXMD 701D2 together are equivalent to EXMD 701) See EXMD 701D1 for course description.

Department of Surgery

EXSU 604 SELECT TOPICS IN HUMAN IMMUNOLOGY. (3)

Department of Physiology

PHGY 508 ADVANCED RENAL PHYSIOLOGY. (3)

PHGY 513 CELLULAR IMMUNOLOGY. (3)

PHGY 515 PHYSIOLOGY OF BLOOD 1. (3)

PHGY 516 PHYSIOLOGY OF BLOOD 2. (3)

PHGY 517 ARTIFICIAL INTERNAL ORGANS. (3)

PHGY 518 ARTIFICIAL CELLS. (3)

Department of Microbiology & Immunology

MIMM 509 SEMINAR ON INFLAMMATORY PROCESSES. (3)

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

50 Microbiology and Immunology

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Chair — G.J. Matlashewski

50.1 Staff

Emeritus Professor
E.C.S. Chan; M.A.(Texas), Ph.D.(Maryland)

Professors

N.H. Acheson; A.B.(Harv.), Ph.D.(Rockefeller)
 Z. Ali-Khan; B.Sc.(Bilar), M.Sc.(Karachi), Ph.D.(Tulane)
 M.G. Baines; B.Sc., M.Sc., Ph.D.(Queen's)
 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.)
 R.A. Murgita; B.Sc.(Maine), M.S.(Vt.), Ph.D.(McG.)
 T. Owens; B.Sc., M.Sc.(McG.), Ph.D.(Ont.)
 M.A. Wainberg; B.Sc.(McG.), Ph.D.(Col.)

Associate Professors

A. Berghuis; M.Sc.(The Netherl.), Ph.D.(UBC)
 D.J. Briedis; B.A., M.D.(Johns H.)
 G.J. Matlashewski; B.Sc.(C'dia), Ph.D.(OH.)

Assistant Professors

B. Cousineau; B.Sc., M.Sc., Ph.D.(Montr.)
 S. Fournier; Ph.D.(Montr.)
 A. Gatignol; M.Sc., Ph.D.(Toulouse)
 H. Le Moual; Ph.D.(Montr.)
 G.J. Marczyński; B.S., Ph.D.(Ill.)
 A. Mouland; Ph.D.(McG.)

Associate Members

Institute of Parasitology: Gaétan Faubert, Armando Jardim,
 Paula Ribeiro

Division of Exp. Medicine: Clément Couture

Microbiology and Immunology: Lawrence Kleiman
Medicine: Marcel Behr, André Dascal, Sabah Hussain, Vivian Loo,
 J. Dick Maclean, Jack Mendelson, Mark A. Miller,
 Marianna Newkirk, Roger G.E. Palfree, Kostas Pantopoulos,
 Joyce E. Rauch, Bernard Turcotte, Brian J. Ward.

Neuroimmunology: Amit Bar-Or

Neurology and Neurosurgery: Jack Antel

Oncology: Matthias Gotte, Antonis E. Koromilas,
 Stéphane Richard

Pathology: Gérald Prud'homme

Surgery: Nicholas V. Christou, A. Robin Poole

Adjunct Professors

V. Dave; M.Sc.; Ph.D.(Bombay)
 A. Descoteaux; B.Sc., M.Sc.(Montr.), Ph.D.(McG.)
 P. Hugo; B.Sc., M.Sc., Ph.D.(McG.)
 G. Kukulj; 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.),
 Ph.D.(Lausanne)

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). All international applicants whose language of instruction is not English must have a TOEFL score of 575 on the paper-based test (230 on the computer-based test).

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.

Commencing with applications for entry in January 2003, McGill's on-line application form will be available to all graduate program candidates at <http://www.mcgill.ca/applying/graduate>.

Deadline(s)

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

Canadian Applicants

October 1	for the Winter term (January)
February 1	for the Summer term (May)
March 1	for the Fall term (September), Web application
May 15	for the Fall term (September), paper application

International Applicants

August 1	for the Winter Term (January)
November 15	for the Summer term (May)
February 15	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 MIMM 611, MIMM 612, MIMM 613, MIMM 614, MIMM 615 and two of the following courses: MIMM 616, MIMM 617, MIMM 618 and MIMM 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 that 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 MIMM 701, MIMM 711, MIMM 712, MIMM 713, MIMM 714, MIMM 715 and MIMM 716 and three or the following courses: MIMM 704, MIMM 705, MIMM 706, MIMM 707 (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

For the term (Fall and/or Winter), days, and times when courses will be offered, please refer to the 2002-2003 Class Schedule on the Web, <http://www.mcgill.ca/minerva-students/>

class/ Class locations and names of instructors are also provided.

Students preparing to register are advised to consult the **Class Schedule website for the most up-to-date list of courses available. New courses may have been added or courses rescheduled after this Calendar went to press.**

The schedule of courses to be offered in Summer 2003, will be available on the website in January 2003.

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

MIMM has replaced 528 as the prefix for Microbiology and Immunology courses.

MIMM 601D1 COMPREHENSIVE EXAMINATION - M.Sc.CANDIDATE. (3) (Students must also register for MIMM 601D2) (No credit will be given for this course unless both MIMM 601D1 and MIMM 601D2 are successfully completed in consecutive terms)

MIMM 601D2 COMPREHENSIVE EXAMINATION - M.Sc.CANDIDATE. (3) (Prerequisite: MIMM 601D1) (No credit will be given for this course unless both MIMM 601D1 and MIMM 601D2 are successfully completed in consecutive terms) See MIMM 601D1 for course description.

MIMM 604 INDEPENDENT RESEARCH PROJECT. (6) (Offered to M.Sc.A. students only)

May also be available as:

MIMM 604D1, MIMM 604D2.

MIMM 611 GRADUATE SEMINARS 1. (3)

MIMM 612 GRADUATE SEMINARS 2. (3) (M.Sc. students - presentation of two seminar topics throughout the course of their degree program)

MIMM 613 CURRENT TOPICS 1. (3)

MIMM 614 CURRENT TOPICS 2. (3)

MIMM 615 CURRENT TOPICS 3. (3) M.Sc. Students (discussion groups with guest speakers).

MIMM 616 READING AND CONFERENCE 1. (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.

MIMM 617 READING AND CONFERENCE 2. (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.

MIMM 618 READING AND CONFERENCE 3. (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.

MIMM 619 READING AND CONFERENCE 4. (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.

MIMM 697 MASTER'S RESEARCH 1. (8) (M.Sc. students) Independent work under the direction of a supervisor on a research problem in the student's designated area of research.

MIMM 698 MASTER'S RESEARCH 2. (8) (M.Sc. students) Independent work under the direction of a supervisor on a research problem in the student's designated area of research.

MIMM 699 MASTER'S RESEARCH 3. (8) (M.Sc. students) Independent work under the direction of a supervisor on a research problem in the student's designated area of research. may also be

MIMM 701 COMPREHENSIVE EXAMINATION-PH.D. CANDIDATE. (0)

May also be available as:

MIMM 701D1, MIMM 701D2.

MIMM 704 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.

MIMM 705 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.

MIMM 706 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.

MIMM 707 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.

MIMM 711 GRADUATE SEMINARS 3. (3) (Ph.D. students) Presentation of a maximum of three seminars topics throughout the course of their degree program.

MIMM 712 GRADUATE SEMINARS 4. (3) (Ph.D. students) Presentation of a maximum of three seminars topics throughout the course of their degree program.

MIMM 713 GRADUATE SEMINARS 5. (3) (Ph.D. students) Presentation of a maximum of three seminars topics throughout the course of their degree program.

MIMM 714 CURRENT TOPICS 4. (3) (Ph.D. students) Discussion groups with guest speakers.

MIMM 715 CURRENT TOPICS 5. (3) (Ph.D. students) Discussion groups with guest speakers.

MIMM 716 CURRENT TOPICS 6. (3) (Ph.D. students) Discussion groups with guest speakers.

MIMM 721 PH.D. RESEARCH PROGRESS REPORT 1. (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.

May also be available as:

MIMM 721D1, MIMM 721D2.

MIMM 722 PH.D. RESEARCH PROGRESS REPORT 2. (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.

May also be available as:

MIMM 722D1, MIMM 722D2.

MIMM 723 PH.D. RESEARCH PROGRESS REPORT 3. (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.

May also be available as:

MIMM 723D1, MIMM 723D2.

MIMM 724 PH.D. RESEARCH PROGRESS REPORT 4. (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.

May also be available as:

MIMM 724D1, MIMM 724D2.

51 Mining, Metals and Materials Engineering

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Department Chair — R.A.L. Drew
Director, Mining Engineering Program — F.P. Hassani
Chair, Graduate Program — G.P. Demopoulos
Graduate Program Secretary — N. Procyszyn

51.1 Staff

Emeritus Professors

G.W. Smith; B.Eng., M.Eng., Ph.D.(McG.), Eng.
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)
R. Gauvin; B.Eng., Ph.D.(Montr.), Eng.
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.
H.S. Mitri; B.Sc.(Cairo), M.Eng., Ph.D.(McM.), Eng.
J. Szpunar; B.Sc., M.Sc., Ph.D., D.Sc.(Krakow)

Associate Professors

M.L. Bilodeau; B.A.Sc.(Montr.), M.Sc.A., Ph.D.(McG.), Eng.
R. Harris; B.Sc.(Q'ld), M.Eng., Ph.D.(McG.)
M. Hasan; B.Eng.(Dhaka), M.Eng.(Dhahran), Ph.D.(McG.)
J.A. Kozinski; B.A., M.Eng., D.Sc.(Krakow) (*William Dawson Scholar*)
A. Laplante; B.A.Sc., M.A.Sc.(Montr.), Ph.D.(Tor.), 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)

Lecturer

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

Adjunct Professors

M.Betournay, W. Caley, R. Dimitrakopoulos, B. Harris, A. Hemami, R. Jassim, E. Lifshin, M. Pugh, J.H. Root, W.T. Thompson, R. Thom, V. Vaidya, 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 Metals and Materials and the Graduate Diploma in Mining Engineering are also available.

Special programs are available for those holding degrees in subjects other than Metals and 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 Metals and 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 (Metals and Materials Option) is primarily designed to train people with appropriate engineering or scientific backgrounds to allow them to work effectively in the metals and 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 Metals and Materials Science 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, Metals and Materials Engineering.

Deadlines:

March 1 – Fall admission
July 1 – Winter admission
November 1 – Summer admission

Commencing with applications for entry in January 2003, McGill's on-line application form will be available to all graduate program candidates at <http://www.mcgill.ca/applying/graduate>.

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 MIME 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.

Direct Transfer from a Master's to a 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 Metals and 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 Mining and Metallurgical Engineering Project courses, the Mining and Metallurgical Engineering Seminar (MIME 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 MIME 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 Engineering Project courses, the Mining Engineering Seminar (MIME 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

For the term (Fall and/or Winter), days, and times when courses will be offered, please refer to the 2002-2003 Class Schedule on the Web, <http://www.mcgill.ca/minerva-students/>

class/. Class locations and names of instructors are also provided.

Students preparing to register are advised to consult the Class Schedule website for the most up-to-date list of courses available. New courses may have been added or courses rescheduled after this Calendar went to press.

The schedule of courses to be offered in Summer 2003, will be available on the website in January 2003.

MIME has replaced 306 as the prefix for Mining, Metals and Materials Engineering courses.

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

D1 and D2 are taught in two consecutive terms (most commonly Fall and Winter). Students must register for both the D1 and D2 components. No credit will be given unless both components (D1 and D2) are successfully completed in consecutive terms, e.g., 200209 (Fall) and 200301 (Winter).

N1 and N2 are taught in two non-consecutive terms (Winter and Fall). Students must register for both the N1 and N2 components. No credit will be given unless both components (N1 and N2) are successfully completed in the same calendar year, e.g., 2003.

- Denotes courses not offered in 2002-03

The courses in this Department have been numbered to conform with the following classification system. The first 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

Undergraduate Courses

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

MIME 200 INTRODUCTION TO THE MINERALS INDUSTRY.

MIME 320 EXTRACTION OF ENERGY RESOURCES.

MIME 322 ROCK FRAGMENTATION.

MIME 323 ROCK AND SOIL MASS CHARACTERIZATION.

MIME 341 INTRODUCTION TO MINERAL PROCESSING.

MIME 419 SURFACE MINING.

MIME 420 FEASIBILITY STUDY.

MIME 426 DEVELOPMENT AND SERVICES.

Graduate Courses

MIME 515 ADVANCED METALLURGICAL AND MATERIALS THERMODYNAMICS. (3) (2-2-5) (Prerequisite: MIME 212) Computational thermodynamics including phase diagram estimation, Gibbs energy minimization, 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.

MIME 520 STABILITY OF ROCK SLOPES. (3) (3-0-6) (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.

● **MIME 521 STABILITY OF UNDERGROUND OPENINGS.** (3) (3-3-3)

● **MIME 522 MINERAL RESERVE ASSESS TECHS.** (3)

● **MIME 524 MINERAL RESOURCES ECONOMICS.** (3) (3-0-6) (Prerequisite: MIME 310 or equivalent, or permission of instructor)

MIME 526 MINERAL ECONOMICS. (3) (3-1-5) (Prerequisite: MIME 310 or equivalent) 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 analy-

sis, risk analysis, and optimization of project specifications with respect to capacity and cutoff grade.

● **MIME 528 MINING AUTOMATION.** (3) (3-3-3) (Prerequisite: MIME 426)

MIME 544 ANALYSIS: MINERAL PROCESSING SYSTEMS 1. (3) (2-3-4) 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 absorption, surface charge, coagulation, electron transfer reactions, electrochemistry in plant practice.

MIME 545 ANALYSIS: MINERAL PROCESSING SYSTEMS 2. (3) (4-2-3) Gold recovery (as a Professional Development Seminar): methods of recovery (gravity, flotation, cyanidation), refractory gold (roasting, pressure oxidation, bacterial leaching), dissolved gold recovery (Merrill-Crowe) and activated carbon methods. Sampling: definition of errors, sample extraction, size, and processing. Mass balancing: basic considerations, definition of networks, software. Blending: auto-correlation functions, transfer functions, blending systems. Effect of feed variability.

● **MIME 546 SURFACE CHEM IN MATERIALS PROC.** (3)

MIME 551 ELECTROCHEMICAL PROCESSING. (3) (3-2-4) (Prerequisite: MIME 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.

MIME 553 IMPACT OF MATERIALS PRODUCTION. (3) (3-0-6) (Prerequisite: Permission of instructor.) Impact on the environment of the production of major materials. Pollution control practices, emerging technologies, cost, resources and conservation. Review of flowsheets for various production methods. Analysis of the use of materials, prices, consumption, fabrication, and recycling of waste materials.

● **MIME 555 THERMAL REMEDIATION OF WASTES.** (3) (3-0-6) (Prerequisites: CHEM 111 and MIME 212 or equivalent)

MIME 560 JOINING PROCESSES. (3) (3-3-3) (Prerequisite: MIME 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.

MIME 561 ADVANCED MATERIALS DESIGN. (3) (0-4-5) (Prerequisite: MIME 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.

● **MIME 562 SOLIDIFICATION PROCESSING.** (3)

MIME 563 HOT DEFORMATION OF METALS. (3) (2-2-5) (Prerequisite: MIME 463 or equivalent.) High temperature deformation processing of metallic materials. Topics include static and dynamic recrystallization, recovery, precipitation; effect of deformation on phase transformations and microstructural evolution during industrial processing. Mathematical modelling of microstructural evolution.

MIME 564 X-RAY DIFFRACTION ANALYSIS OF MATERIALS. (3) (2-3-4) (Prerequisite: MIME 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 appli-

cation 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.

MIME 566 TEXTURE, STRUCTURE & PROPERTIES OF POLYCRYSTALLINE MATERIALS. (3) (2-3-4) (Prerequisite: MIME 317) 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 analyzed.

● **MIME 567 ALUMINUM CASTING ALLOYS.** (3) (3-0-6) (Prerequisite: MIME 361 or equivalent)

MIME 568 TOPICS IN ADVANCED MATERIALS. (3) (Prerequisite: MIME 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.

MIME 569 ELECTRON BEAM ANALYSIS OF MATERIALS. (3) (2-3-4) (Prerequisite: MIME 317) Emphasis on operation of scanning and transmission electron microscopes. Topics covered are electron/specimen interactions, hardware description; image contrast description; qualitative and quantitative (ZAF) x-ray analysis; electron diffraction pattern analysis.

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

● **MIME 602 ORG AND MGMT CHANGE IN MINERAL IND.** (3)

MIME 606 MINERAL/METAL PRODUCTION AND MARKETING 1. (3) (Prerequisite: permission of instructor) Introduction of new topics in Mining, Metals and Materials Engineering.

MIME 608 MINERAL/METAL PRODUCTION AND MARKETING 2. (3) (Prerequisite: permission of instructor) Introduction of new topics in Mining, Metals and Materials Engineering.

MIME 620 ROCK MECHANICS 1. (3) A study of the effects of rock properties and ground stresses on problems in mine design.

MIME 621 ROCK MECHANICS 2. (3) The application of the principles of strength of materials to the analysis of problems in ground control.

MIME 622 HEALTH AND SAFETY - MINERAL INDUSTRY. (3) (Prerequisite: permission of instructor) (Course given once per academic year) 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.

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

MIME 624D1 MATERIALS HANDLING IN MINES. (3) (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.

MIME 624D2 MATERIALS HANDLING IN MINES. (3)

MIME 625 APPLIED MINERAL ECONOMICS 1. (3) (Prerequisite: permission of instructor) A study of analytical techniques employed for project evaluation and decision-making in the mineral industry.

● **MIME 626 APPLIED GEOSTATISTICS.** (3)

MIME 627 APPLIED MINERAL ECONOMICS 2. (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.

MIME 628 MINERAL ENGINEERING PROJECT 1. (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.

May also be available as:
MIME 628D1, MIME 628D2;
MIME 628N1, MIME 628N2.

MIME 629 MINERAL ENGINEERING PROJECT 2. (6) Continuation of Mining Engineering Project.

May also be available as:
MIME 629D1, MIME 629D2;
MIME 629N1, MIME 629N2.

MIME 633 INDUSTRIAL EXPLOSIVES. (4) (Prerequisite: MIME 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.

MIME 634 MINERAL ENGINEERING PROJECT 3. (3) Continuation of Mining Engineering Project 1.

May also be available as:
MIME 634D1, MIME 634D2;
MIME 634N1, MIME 634N2.

MIME 635 FINITE ELEMENT METHOD - ROCK MECHANICS. (4) (Prerequisites: MIME 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.

MIME 636 BOUNDARY ELEMENTS: GEOMECHANICS. (4) (Prerequisite: COMP 208 or equivalent, and MIME 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.

● **MIME 638 MINE WASTE MANAGEMENT.** (4)

MIME 639 MANAGEMENT OF ENGINEERING SERVICES - 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.

MIME 640 ADVANCED MINERAL PROCESSING. (6) Modern advances in mineral processing techniques. The student will prepare a series of reports covering developments in mineral processing.

May also be available as:
MIME 640D1, MIME 640D2.

MIME 641D1 MINERAL DRESSING AND MILL DESIGN. (3)

MIME 641D2 MINERAL DRESSING AND MILL DESIGN. (3)

MIME 642D1 MINERAL DRESSING. (3)

MIME 642D2 MINERAL DRESSING. (3)

MIME 650D1 ADVANCED EXTRACTIVE METALLURGY. (3) 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.

MIME 650D2 ADVANCED EXTRACTIVE METALLURGY. (3)

MIME 651 TOPICS IN CHEMICAL METALLURGY. (6)

May also be available as:
MIME 651D1, MIME 651D2.

● **MIME 652 AQUEOUS PROCESSING.** (3)

MIME 653 TRANSPORT PHENOMENA - 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.

● **MIME 655 ADV METAL. PROCESS ANALYSIS.** (3)

● **MIME 657 ADVANCED EXTRACTIVE METALLURGY.** (3)

● **MIME 660D1 APPLIED X-RAYS.** (3)

● **MIME 660D2 APPLIED X-RAYS.** (3)

● **MIME 662 CRYSTAL GROWTH AND SOLIDIFICATION.** (3)

● **MIME 663 PLASTIC INSTABILITY & FLOW LOCALIZATION.** (3)

● **MIME 664 THERMAL & A-THERMAL DEFORMATION PROC.** (3)

MIME 670 RESEARCH SEMINAR. (6) For students registered for a Master's degree in Mining and Metallurgical Engineering.

May also be available as:
MIME 670D1, MIME 670D2;
MIME 670N1, MIME 670N2.

MIME 672D1 ROCK MECHANICS SEMINAR. (3) Theoretical and practical aspects of ground control practice using the case study method.

MIME 672D2 ROCK MECHANICS SEMINAR. (3)

MIME 673 MINING ENGINEERING SEMINAR. (6) For students registered in the Graduate Diploma or Master's programs in Mining.

May also be available as:
MIME 673D1, MIME 673D2;
MIME 673N1, MIME 673N2.

MIME 675N1 APPLIED GEOPHYSICS SEMINAR. (3)

MIME 675N2 APPLIED GEOPHYSICS SEMINAR. (3)

MIME 680D1 METALLURGICAL/MATERIALS ENGINEERING PROJECT 1. (3)

MIME 680D2 METALLURGICAL/MATERIALS ENGINEERING PROJECT 1. (3)

MIME 681D1 METALLURGICAL/MATERIALS ENGINEERING PROJECT 2. (3)

MIME 681D2 METALLURGICAL/MATERIALS ENGINEERING PROJECT 2. (3)

MIME 682 METALLURGICAL/MATERIALS ENGINEERING PROJECT 3. (3)

MIME 690 THESIS RESEARCH 1. (6)

May also be available as:
MIME 690D1, MIME 690D2;
MIME 690N1, MIME 690N2.

MIME 691 THESIS RESEARCH 2. (3)

MIME 692 THESIS RESEARCH 3. (6)

May also be available as:
MIME 692D1, MIME 692D2;
MIME 692N1, MIME 692N2.

MIME 693 THESIS RESEARCH 4. (3)

May also be available as:
MIME 693D1, MIME 693D2.

MIME 694 THESIS RESEARCH 5. (6)

May also be available as:
MIME 694D1, MIME 694D2;
MIME 694N1, MIME 694N2.

MIME 695 THESIS RESEARCH 6. (3)

May also be available as:
MIME 695D1, MIME 695D2.

MIME 701 PH.D. THESIS RESEARCH PROPOSAL. (0) For students registered in a Ph.D. program in Mining and Metallurgical Engi-

neering. Student submits a document and takes an oral examination to demonstrate familiarity with relevant literature, define a methodology and describe a work plan.

MIME 765D1 TOPICS - ADVANCED PHYSICAL METALLURGY. (3)

MIME 765D2 TOPICS - ADVANCED PHYSICAL METALLURGY. (3)

MIME 766 Wk HARDENING/TEXT DEV:METALS. (3)

MIME 771 RESEARCH SEMINAR. (6) For students registered in a Ph.D. program in Metallurgy.

May also be available as:

MIME 771D1, MIME 771D2;

MIME 771N1, MIME 771N2.

MIME 775N1 GEOPHYSICS RESEARCH SEMINAR. (3)

MIME 775N2 GEOPHYSICS RESEARCH SEMINAR. (3)

MIME 776 RESEARCH SEMINAR. (6) For students registered in a Ph.D. program in Mining.

May also be available as:

MIME 776D1, MIME 776D2;

MIME 776N1, MIME 776N2.

52 Music

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Dean, Faculty of Music — Don McLean

Director, Graduate Studies — Julie Cumming

Chair, Department of Theory — Brian Cherney

Chair, Department of Performance — Gordon Foote

Associate Dean

(Administration) — Bruce Minorgan

52.1 Staff

Emeritus Professors

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

Dorothy Morton; Graduate, Conservatoire de Musique de Québec

Professors

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

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

Steven Huebner; B.A., B.Mus., L.Mus.(McG.), M.F.A., Ph.D.(Prin.)

(James McGill Professor)

alcides lanza ; Graduate, Instituto Torcuato Di Tella(Buenos Aires)

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

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

Associate Professors

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

Yehonatan Berick; B.Mus., Artist Dip.(Cinn.)

Denys Bouliane; B.Mus., M.Mus.(Laval)

Eugenia Costa-Giomi; Profesora Superior de Musica (National Cons., Buenos Aires), Ph.D.(Ohio)

Julie Cumming; B.A.(Col.), M.A., Ph.D.(Berkeley)

Kevin Dean; B.M.E.(Iowa), M.Mus.(Miami)

Philippe Depalle; B.Sc.(Paris XI and ENS Cachan), D.E.A.(Le Mans and ENS Cachan), Ph.D.(Le Mans & IRCAM)

Lucile Evans; Dip.(Vincent d'Indy)

Gordon Foote; B.Sc., M.A.(Minn.)

Kyoko Hashimoto; B.A.(Tokyo)

Alexis Hauser

Paul Helmer; B.A.(Tor.), M.A., Ph.D.(Col.)

Timothy Hutchins; Dip. L.G.S.M.(Guildhall), B.A.Hons.Mus.(Dal.),
Principal Flute, Montreal Symphony

Jan Jarczyk; B.A., M.A.(Academy of Music, Cracow),
Dip.(Berklee)

Abe Kestenberg

Hank Knox; B.Mus., M.Mus.(McG.)

Sara Laimon; B.Mus.(U.B.C.), M.Mus.(Yale), D.M.A.(SUNY,
Stony Brook)

Richard Lawton; B.Mus.(McG.), M.Mus.(Ind.)

Tamara Levitz; B.Mus.(McG.), M.A.(Technische Universität,
Berlin), Ph.D.(Eastman)

Antonio Lysy; P.P.(Royal Northern Coll.), Dip.(Menuhin Academy,
Gstaad), Performer's Dip.(Maast. Cons., Nether.)

Don McLean; Mus.Bac., M.A., Ph.D.(Tor.)

Michael McMahon; B.Mus.(McG.), Graduate, Hochschule für
Musik(Vienna)

Douglas McNabney; B.Mus.(Tor.), M.M.(W.Ont.),
Mus.Doc.(Montr.)

Marina Mdivani; Post-graduate Dip.(Moscow Cons.)

Bruce Minorgan; B.Mus.(Br.Col.), M.A.(Tor.)

William Neill; B.Mus., M.Mus.(Texas at Austin)

Tom Plaunt; B.A.(Tor.), Graduate, Nordwestdeutsche
Musikakademie (Detmold, Germany)

Richard Raymond; Premier Prix (Conservatoire de Montréal),
M.Mus.(Montr.)

Marcel Saint-Cyr; B.A.(Laval), Premier Prix(Cons.de Mus. de
Qué.), Concert Dip.(Hochschule für Musik, Karlsruhe)

Peter Schubert; B.A., M.A., Ph.D.(Col.)

Thérèse Sevadjan; B.Mus., M.Mus.(Montr.)

Jan Simons

Eleanor Stublely; B.Mus.(Tor.), M.Mus.(Bran.), Ph.D.(Illinois)

Julian Wachner; B.Mus., Mus.Doc.(Boston Univ.)

Joel Wapnick; B.A.(N.Y.), M.A.(S.U.N.Y.), M.F.A.(Sarah L.),
Ed.D.(Syr.)

Thomas Williams; B.Mus.(Bran.)

John Zirbel; B.Mus.(Wis.), Principal Horn, Montreal Symphony

Luba Zuk; L.Mus.(McG.), Graduate, Conservatoire de Musique de
Québec

Assistant Professors

Alain Cazes; Premier Prix (Conservatoire de Montréal)

Jean Gaudreault; LL.L.(Montr.), Graduate, Conservatoire de
Musique de Québec, Montreal Symphony.

Valerie Kinslow; B.A.(McG.)

John Klepko; B.F.A.(C'dia.), M.Mus., Ph.D.(McG.)

Denise Lupien; B.M., M.M.(Juilliard)

Chris McCann

Dennis Miller; Principal Tuba, Montreal Symphony

Richard Roberts; B.Mus.(Ind.); Concertmaster, Montreal
Symphony

Dixie Ross-Neill; B.Mus.(N. Carolina), M.Mus.(Texas)

André Roy; Montreal Symphony

Joe Sullivan; B.A.(Ott.), M.M.(New England Cons.)

Marcelo Wanderley; B.Sc.(UFPR), M.Sc.(UFSC), Ph.D.(Paris VI
and IRCAM)

André White; B.A.(C'dia.), M.Mus.(McG.)

Adjunct Professor

Kenneth Gilbert; D.Mus.honoris causa(McG.), O.C., F.R.S.C., Hon
RAM

52.2 Programs Offered

The Master of Arts degree (M.A.) is available as a thesis option in Music Education, Music Technology, Musicology, and Theory and as a non-thesis option in Music Education, Musicology, and Theory.

The Master of Music degree (M. Mus.) is available in Composition, Performance, and Sound Recording. Within the Performance option are offered specializations in: piano, guitar, orchestral instruments, organ, conducting, chamber music, orchestral training, piano accompaniment, vocal, opera, vocal pedagogy, early music, church music - organ, and jazz.

The Doctor of Music degree (D.Mus.) is offered in Composition and Performance Studies while the Doctor of Philosophy degree (Ph.D.) is available in Music Education, Musicology, Music Technology, Sound Recording and Theory. Interdisciplinary studies involving Musicology or Theory are encouraged.

There are opportunities for graduate students to obtain funding by being hired as assistants through the Faculty of Music. Positions are available as: teaching assistants, apprentice writers for program notes, sound recording technicians, dubbing technicians, correctors, and invigilators. Inquiries should be directed to the Chair of the Department of Theory or the Chair of the Department of Performance, as appropriate.

52.3 Admission Requirements

Masters' Degrees

Applicants for the Master's degree must hold a B.Mus. or a B.A. degree with a Major or Honours in Music including considerable work done in the area of specialization.

All applicants (except those for performance and sound recording) will be required to take placement examinations. Applicants found to be deficient in their background preparation may be required to take certain additional undergraduate courses.

Applicants to the Composition, Music Education, Music Technology, Musicology, Sound Recording, and Theory programs are requested to submit samples of work done in their special area.

Applicants to the Music Education program should normally have had two years of teaching experience.

All applicants to the Performance program will be required to pass an entrance audition. Only those applicants who clearly demonstrate the potential to become professional performers on their instruments will be admitted.

Applicants to the Vocal Pedagogy option should have a minimum of three to four years experience in studio teaching.

A reading knowledge of German is strongly recommended as a prerequisite for graduate work in Music Education, Musicology, and Theory.

Prerequisite Undergraduate Courses for M.Mus. – Sound Recording

In order to be considered for admission to the Master of Music in Sound Recording, students must attain a minimum grade of B in all of the courses listed below and must have a B.Mus. degree.

Faculty of Music

MUCO 260 Instruments of the Orchestra
MUMT 202 Fundamentals of New Media
MUMT 203 Introduction to Digital Audio
MUMT 232 Introduction to Electronics
MUMT 300D1 Introduction to Music Recording
MUMT 300D2 Introduction to Music Recording
MUMT 339 Introduction to Electroacoustics

One of (Complementary):

MUMT 302 New Music Production 1
MUMT 306 Music & Audio Computing 1

Faculty of Science

PHYS 224 Physics and Psychophysics of Music
PHYS 225 Musical Acoustics

Prerequisite Undergraduate Courses for M.Mus. – Performance

Piano Accompaniment

An undergraduate major in Piano.
MUHL 570 Research Methods in Music

One of:

MUHL 372 Solo Song outside Germany & Austria
MUHL 390 The German Lied

Two of:

MUPG 210 Italian Diction (or equivalent)
MUPG 211 French Diction (or equivalent)
MUPG 212 English Diction (or equivalent)
MUPG 213 German Diction (or equivalent)

Orchestral Conducting

MUCO 260 Instruments of the Orchestra
MUCO 261 Elementary Orchestration
MUCO 460D1 Orchestration
MUCO 460D2 Orchestration
MUHL 389 Orchestral Literature
MUHL 570 Research Methods in Music
MUIT 201 String Techniques
MUIT 202 Woodwind Techniques
MUIT 203 Brass Techniques
MUIT 204 Percussion Techniques
MUPG 315D1 Introduction to Orchestral Conducting (or equivalent)
MUPG 315D2 Introduction to Orchestral Conducting (or equivalent)

Choral Conducting

GERM 202 German
MUCO 260 Instruments of the Orchestra
MUCO 261 Elementary Orchestration
MUCT 415 Choral Conducting 2 (or equivalent)
MUHL 397 Choral Literature after 1750
MUHL 570 Research Methods in Music
MUIN 220 Voice Concentration

Wind Band Conducting

An undergraduate major in Wind or Percussion instruments
MUCO 260 Instruments of the Orchestra
MUCO 261 Elementary Orchestration
MUHL 398 Wind Ensemble Literature after 1750
MUHL 570 Research Methods in Music
MUIT 202 Woodwind Techniques
MUIT 203 Brass Techniques
MUIT 204 Percussion Techniques
MUIT 415 Instrumental Conducting 2 (or equivalent)

Early Music (Voice students only)

MUHL 570 Research Methods in Music

Two of:

MUPG 210 Italian Diction (or equivalent)
MUPG 211 French Diction (or equivalent)
MUPG 212 English Diction (or equivalent)
MUPG 213 German Diction (or equivalent)

Jazz Performance

MUHL 393 History of Jazz
MUJZ 440D1 Advanced Jazz Composition
MUJZ 440D2 Advanced Jazz Composition
MUJZ 461D1 Advanced Jazz Arranging
MUJZ 461D2 Advanced Jazz Arranging
MUJZ 493 Jazz Performance Practice

D.Mus. Degree

Applicants for the D.Mus. degree in Composition must hold an M.Mus. degree in Composition, or its equivalent, and must submit scores and/or tapes of their compositions at the time of application. Applicants for the D.Mus. degree in Performance Studies must hold an M.Mus. degree in Performance, or its equivalent; are required to pass an entrance audition; and must submit samples of written work and a statement of research interests.

Ph.D. Degree

Applicants for the Ph.D. degree must hold an M.A., or a Bachelor's degree equivalent to a McGill Honours degree, in Music Technology, Music Education, Music History, or Theory. Applicants with a Bachelor's degree will normally be admitted to the M.A. program for the first year and may apply for admittance to the Ph.D. program after the completion of one full year of graduate course work. Qualified applicants who have already completed an appropriate Master's degree will be admitted to the second year of the program.

52.4 Application Procedures

Applications will be considered upon receipt of:

1. application form;
2. transcripts;
3. letters of reference;
4. \$60 application fee;
5. \$50 audition fee for Performance degrees;
6. submissions appropriate to area of specialization;
7. TOEFL test results.

All information is to be submitted to Veronica Slobodian, Admissions Officer, Faculty of Music.

Deadline date for submission of application and accompanying documentation is December 15 for Composition, Music Education, Music Technology, Musicology, Sound Recording and Theory; and January 15 for Performance.

All applicants are requested to submit samples of their work completed during their previous studies. Those applying for the first time will be required to take placement examinations.

Commencing with applications for entry in January 2003, McGill's on-line application form will be available to all graduate program candidates at <http://www.mcgill.ca/applying/graduate>.

52.5 Program Requirements

Masters' Degrees

The minimum residence requirement for Masters' programs is 1½ years (3 full-time terms); for Sound Recording, 2 years (4 full-time terms). In all programs a minimum number of formal courses are prescribed. The student's major work is expected to be thesis, research, composition or performance which will be done under the supervision of an adviser. This work, as well as any additional courses and/or individual study which the Department considers necessary, constitutes the central part of each program.

Applicants who hold the equivalent of a McGill B.Mus. with Honours in the area of specialization may be able to complete the Master's degree in less than two years.

Master of Music – Composition (thesis) (48 credits)

MUCO 622D1/MUCO 622D2 Composition Tutorial.
Two of MUCO 631, MUCO 632, MUCO 633, MUCO 634, MUCO 635, MUCO 636 Seminar in 20th-Century Music.
Two approved 3-credit electives or the equivalent.
Language reading examination in one of: French, German, or Italian. Students whose mother tongue is French are exempt from the French Language Reading examination.
Thesis (30 credits). The thesis is a composition, accompanied by an analytical essay of approximately 20 to 30 pages.

M.A. in Music – Music Education (thesis) (48 credits)

Five 3-credit courses approved by the Department, normally three of these will be Seminars in Music Education.
Thesis (33 credits). The candidate will undertake supervised research leading to a thesis which will be an in-depth investigation in some specialized field of music education.

M.A. in Music – Music Technology (thesis) (48 credits)

MUMT 605 Digital Sound Synthesis & Audio Processing.
Two of MUMT 610, MUMT 611, MUMT 612, MUMT 613, MUMT 614, MUMT 615 Computer Music Seminar.
Two 3-credit electives, approved by the Department.
Thesis (33 credits). The candidate will undertake supervised research leading to a thesis which will utilize or investigate computer applications in one of the following areas of music study and practice: performance, jazz, sound recording, theory, composition, music education, musicology.

M.A. in Music – Musicology (thesis) (48 credits)

Four 3-credit courses approved by the Department, normally at least two of these will be Seminars in Musicology.
MUHL 529 Proseminar in Musicology.

Thesis (33 credits). The candidate will undertake supervised research leading to a thesis which will be an in-depth investigation in some specialized field of musicology.

Master of Music – Sound Recording (non-thesis) (60 credits)

Required Courses (51 credits)

MUMT 629D1	(2)	Technical Ear Training
MUMT 629D2	(2)	Technical Ear Training
MUMT 667	(3)	Digital Studio Technology
MUMT 668	(3)	Digital/Analog Audio Editing
MUMT 669	(3)	Topics - Classical Music Recording
MUMT 670D1	(5)	Recording Theory & Practice 1
MUMT 670D2	(5)	Recording Theory & Practice 1
MUMT 671D1	(5)	Recording Theory & Practice 2
MUMT 671D2	(5)	Recording Theory & Practice 2
MUMT 672D1	(3)	Analysis of Recordings
MUMT 672D2	(3)	Analysis of Recordings
MUMT 674	(3)	Electronic and Electroacoustic Meas.
MUMT 677D1	(3)	Audio for Video Post-Production
MUMT 677D2	(3)	Audio for Video Post-Production
MUMT 678	(3)	Advanced Digital Editing and Post-Production

Elective Courses (9 credits)

three 3-credit graduate electives

M.A. in Music – Theory (thesis) (48 credits)

Five 3-credit courses approved by the Department, normally three will be Seminars in Music Theory and either MUTH 658 History of Music Theory 1 or MUTH 659 History of Music Theory 2
Thesis (33 credits). The candidate will undertake supervised research leading to a thesis which will be an in-depth investigation in some specialized field of music theory.

Non-thesis M.A. in Music (options in Music Education, Musicology, and Theory) (45 credits)

Seven 3-credit courses approved by the appropriate Area, four of which must be in the Area itself.

For students in the Musicology Area, one of the courses must be MUHL 529 Proseminar in Musicology.

For students in the Theory Area, one of the courses must be MUTH 658 History of Music Theory 1 or MUTH 659 History of Music Theory 2.

For students in Music Education, and with the approval of the Music Education Area, two of the seven 3-credit courses may be taken in the Faculty of Education.

MUGS 614 Reading Course 1 and MUGS 615 Reading Course 2.
MUGS 635 Research Paper 1 and MUGS 636 Research Paper 2.

Master of Music – Performance

Solo – Piano, Guitar, Orchestral Instruments, Organ, Conducting (45 credits)

MUPG 620, MUPG 621, MUPG 622 Performance Tutorials.

One of MUPP 690, MUPP 691, MUPP 692, MUPP 693, MUPP 694 or MUPP 695 Performance Practice Seminar.

Electives:

One graduate 3-credit seminar with the prefix MUTH, MUCO, MUHL, MUPP, MUGS, MUGT.

One additional graduate 3-credit seminar.

Recitals:

MUPG 660 Solo Recital 1 and MUPG 667 Solo Recital 2 (one of these could optionally include some chamber music).

Master of Music – Performance

Chamber Music (48 credits)

(All instruments except Early Music Instruments, Organ, Harp and Double Bass.)

MUPG 620, MUPG 621, MUPG 622 Performance Tutorials.

One of MUPP 690, MUPP 691, MUPP 692, MUPP 693, MUPP 694 or MUPP 695 Performance Practice Seminar.

Electives:

One graduate 3-credit seminar with the prefix MUTH, MUCO, MUHL, MUPP, MUGS, MUGT.

One additional graduate 3-credit seminar.

Recitals:

MUPG 661 Chamber Music Recital 1 and MUPG 668 Chamber Music Recital 2 (one of these could optionally include some solo music).

Ensembles:

Three terms of MUEN 660 Chamber Music Ensemble.

Master of Music – Performance**Orchestral Training** (45 credits)

(all orchestral instruments except Harp.)

MUPG 620, MUPG 621, MUPG 622 Performance Tutorials.

One of MUPP 690, MUPP 691, MUPP 692, MUPP 693, MUPP 694 or MUPP 695 Performance

Practice Seminar.

Electives:

One graduate 3-credit seminar with the prefix MUTH, MUCO, MUHL, MUPP, MUGS, MUGT.

One additional graduate 3-credit seminar.

Recital/Exam:

MUPG 660 Solo Recital 1 and MUPG 664 Repertoire Examination.

Ensembles:

Three terms of MUEN 697 Orchestra.

Master of Music – Performance**Piano Accompaniment** (45 credits)

MUPG 620, MUPG 621, MUPG 622 Performance Tutorials.

One of MUPP 690, MUPP 691, MUPP 692, MUPP 693, MUPP 694 or MUPP 695 Performance

Practice Seminar or MUPG 690 Vocal Styles & Conventions.

Electives:

One graduate 3-credit seminar with the prefix MUTH, MUCO, MUHL, MUPP, MUGS, MUGT.

One additional graduate 3-credit seminar.

Recital/Exam:

MUPG 665 Accompanying Recital 1 and MUPG 663 Quick Study (to be successfully completed before the first recital is performed).

Ensembles:

Two terms of MUEN 679 Song Interpretation and MUEN 684 Studio Accompanying or **three terms** of MUEN 596 Opera Repetiteur.

Master of Music – Performance**Vocal Performance** (49 credits)

MUPG 620, MUPG 621, MUPG 622 Performance Tutorials.

One of MUPP 690, MUPP 691, MUPP 692, MUPP 693, MUPP 694 or MUPP 695 Performance Practice Seminar or MUPG 690 Vocal Styles and Conventions.

Electives:

One graduate 3-credit seminar with the prefix MUTH, MUCO, MUHL, MUPP, MUGS, MUGT.

One additional graduate 3-credit seminar (this must be one of MUPG 690, MUPG 691, MUPG 692, MUPG 693 or MUPG 694).

Recitals:

MUPG 660 Solo Recital 1 and MUPG 667 Solo Recital 2. MUPG 600 and MUIN 601 Vocal Repertoire Coaching.

Master of Music – Performance**Opera Performance** (45 credits)

MUPG 620, MUPG 621, MUPG 622 Performance Tutorials.

One of MUPP 690, MUPP 691, MUPP 692, MUPP 693, MUPP 694 or MUPP 695 Performance Practice Seminar or MUPG 690 Vocal Styles and Conventions.

Electives:

One graduate 3-credit seminar with the prefix MUTH, MUCO, MUHL, MUPP, MUGS, MUGT.

One additional graduate 3-credit seminar (this must be one of MUPG 690, MUPG 691, MUPG 692, MUPG 693 or MUPG 694).

Recital:

MUPG 660 Solo Recital 1 and MUPG 658 Opera Performance Examination.

Ensembles:

Three terms of MUEN 696 Opera Theatre.

Master of Music – Performance**Vocal Pedagogy** (47 credits)

MUPG 620, MUPG 621, MUPG 622 Performance Tutorials.

One of MUPP 690, MUPP 691, MUPP 692, MUPP 693, MUPP 694 or MUPP 695 Performance Practice Seminar or MUPG 690 Vocal Styles and Conventions.

Electives:

One graduate 3-credit seminar with the prefix MUTH, MUCO, MUHL, MUPP, MUGS, MUGT.

One additional graduate 3-credit seminar (this must be one of MUPG 690, MUPG 691, MUPG 692, MUPG 693 or MUPG 694).

Recital:

MUPG 660 Solo Recital 1.
MUPG 611, MUPG 612, MUPG 613 Directed Teaching
MUPG 650D1/MUPG 650D2 Pedagogy Workshop.
MUIN 600 or MUIN 601 Vocal Repertoire Coaching.

Master of Music – Performance**Early Music** (48 credits)

(Voice, baroque flute, recorder, baroque oboe, baroque violin, baroque viola, baroque cello, viola da gamba, harpsichord)

MUPG 620, MUPG 621, MUPG 622 Performance Tutorials.

One of MUPP 690, MUPP 691, MUPP 692, MUPP 693, MUPP 694 or MUPP 695 Performance Practice Seminar.

Electives:

One graduate 3-credit seminar with the prefix MUTH, MUCO, MUHL, MUPP, MUGS, MUGT.

One additional graduate 3-credit seminar.

Recitals:

MUPG 660 Solo Recital 1 and MUPG 662 Solo and Chamber Music Recital.

Ensembles:

Three terms of MUEN 661 Early Chamber Music Ensemble (harpsichord players must satisfy the corequisite of 242-372D Continuo).

Master of Music – Performance**Church Music - Organ** (45 credits)

MUPG 620, MUPG 621, MUPG 622 Performance Tutorials.

One of MUPP 690, MUPP 691, MUPP 692, MUPP 693, MUPP 694 or MUPP 695 Performance Practice Seminar.

Electives:

One graduate 3-credit seminar with the prefix MUTH, MUCO, MUHL, MUPP, MUGS, MUGT.

One additional graduate 3-credit seminar.

Recital:

MUPG 660D Solo Recital 1.

Courses:

MUPG 676D Special Project in Performance 2

Ensembles:

Three terms of MUEN 693 Choral Ensemble.

Master of Music – Performance**Jazz Performance** (47 credits)

(Saxophone, Trumpet, Trombone, Drums, Piano, Guitar, Bass, Voice)

MUPG 620, MUPG 621, MUPG 622 Performance Tutorials

Recital:

MUPG 660 Solo Recital 1
MUPG 659D1/MUPG 659D1 Performance in Recording Media

Ensemble:

Two terms of MUEN 695 Jazz Ensemble

Courses:

- MUJZ 601 Jazz Pedagogy
 MUJZ 640D Jazz Composition & Arranging

Courses approved as electives for M.Mus. students in Performance:

MUTH 652 Seminar in Music Theory 1
 MUTH 653 Seminar in Music Theory 2
 MUTH 654 Seminar in Music Theory 3
 MUTH 655 Seminar in Music Theory 4
 MUTH 656 Seminar in Music Theory 5
 MUTH 657 Seminar in Music Theory 6
 MUTH 658 History of Music Theory 1
 MUTH 659 History of Music Theory 2
 MUCO 552 Computer Applications in Music
 MUCO 623 Electronic Music Seminar 1
 MUCO 624 Electronic Music Seminar 2
 MUCO 631 Seminar in 20th-Century Music 1
 MUCO 632 Seminar in 20th-Century Music 2
 MUCO 633 Seminar in 20th-Century Music 3
 MUCO 634 Seminar in 20th-Century Music 4
 MUCO 635 Seminar in 20th-Century Music 5
 MUCO 636 Seminar in 20th-Century Music 6
 MUHL 591D1 Paleography
 MUHL 591D2 Paleography
 MUHL 653 Music Aesthetics and Criticism
 MUHL 680 Seminar in Musicology 1
 MUHL 681 Seminar in Musicology 2
 MUHL 682 Seminar in Musicology 3
 MUHL 683 Seminar in Musicology 4
 MUHL 684 Seminar in Musicology 5
 MUHL 685 Seminar in Musicology 6
 MUHL 692 Seminar in Music Literature 1
 MUHL 693 Seminar in Music Literature 2
 MUHL 694 Seminar in Music Literature 3
 MUHL 695 Seminar in Music Literature 4
 MUHL 696 Seminar in Music Literature 5
 MUHL 697 Seminar in Music Literature 6
 MUPP 690 Performance Practice Seminar 1
 MUPP 691 Performance Practice Seminar 2
 MUPP 692 Performance Practice Seminar 3
 MUPP 693 Performance Practice Seminar 4
 MUPP 694 Performance Practice Seminar 5
 MUPP 695 Performance Practice Seminar 6
 MUGT 610 Seminar in Music Education 1
 MUGT 611 Seminar in Music Education 2
 MUGT 612 Seminar in Music Education 3
 MUGT 613 Seminar in Music Education 4

Doctor of Music (D.Mus.) Degree Requirements - Composition

A minimum of two years' residence is required beyond the M.Mus. in Composition, or its equivalent.

MUCO 722D1/MUCO 722D2 Doctoral Composition Tutorial (for two years).

Four approved 3-credit electives or the equivalent.

MUGS 701 Doctoral Oral Comprehensive Examination and MUGS 702 Doctoral Written Comprehensive Examination.

Composition Performance. The candidate must present a concert of his/her compositions. With the permission of the Committee on Graduate Studies, the compositions may be presented as parts of two or three concerts.

Thesis. A musical composition of major dimensions together with a written analysis of the work. The thesis must be defended in an oral examination.

Details concerning the comprehensive examinations, composition performance, thesis and academic regulations are available from the Admissions Officer, Faculty of Music or the Secretary for Graduate Studies, Faculty of Music.

Doctor of Music (D.Mus.) Degree Requirements - Performance

A minimum of two years' residence is required beyond the M.Mus. in Performance, or its equivalent.

Performance Tutorial (6 terms of 1 hour per week, or 4 terms of 1.5 hours per week):

MUPG 720, MUPG 721, MUPG 722, MUPG 723, MUPG 724, MUPG 725

OR MUPG 730, MUPG 731, MUPG 732, MUPG 733

Vocal Repertoire Coaching (4 terms, voice candidates only):

MUIN 700, MUIN 701, MUIN 702, MUIN 703

Four graduate level courses (3 credits each) to be chosen from among the Faculty's course offerings in consultation with the advisory committee. Three of the four courses should be in the Department of Theory; one of the four may be replaced with a supervised special project approved by the advisory committee and the performance graduate subcommittee.

MUGS 701 Oral Comprehensive Examination and MUGS 702 Written Comprehensive Examination.

Recitals:

MUPG 760 Doctoral Recital 1

MUPG 767 Doctoral Recital 2

MUPG 770 Lecture-Recital Project

The lecture-recital includes the presentation and submission of a research paper on its subject.

Details concerning the comprehensive examinations, composition performance, thesis and academic regulations are available from the Admissions Officer, Faculty of Music or the Secretary for Graduate Studies, Faculty of Music.

Ph.D. Degree Requirements

The Ph.D. requires a minimum of three years of full-time resident study (6 full-time terms) beyond a Bachelor's degree. A candidate who holds a Master's degree in the area of specialization may, on the recommendation of the Department, be permitted to count the work done for the Master's degree as the first year of resident study.

Ten 3-credit courses approved by the Department (the Doctoral Tutorial will be considered a course for purposes of this requirement). Applicants who have completed an M.A. degree before entering the Ph.D. program will be required to complete at least five approved 3-credit courses beyond the M.A. requirements. Language reading examinations in two foreign languages (one foreign language for students in music education; none required for students in sound recording and music technology). Normally, one of these will be German and the other related to the candidate's field of research. A third language may be required if considered necessary for the candidate's research. Students whose mother tongue is French are exempt from the French Language Reading examination.

Comprehensive examinations, both written and oral. The language reading examinations must be passed before a candidate will be permitted to sit the Comprehensive Examinations. Participation in MUGS 705 Colloquium.

Doctoral Dissertation. All courses and language requirements and the comprehensive examinations must be successfully completed before the dissertation is submitted.

52.6 Graduate Courses

For the term (Fall and/or Winter), days, and times when courses will be offered, please refer to the 2002-2003 Class Schedule on the Web, <http://www.mcgill.ca/minerva-students/class/>. Class locations and names of instructors are also provided.

Students preparing to register are advised to consult the Class Schedule website for the most up-to-date list of courses available. New courses may have been added or courses rescheduled after this Calendar went to press.

Note the following course prefix changes:

MUTH has replaced 211 for Music Theory and Analysis.

MUCO has replaced 213 for Composition.

MUHL has replaced 214 for Music History and Performance.

MUPP has replaced 215 for Performance Practice.

MUMT has replaced 216 for Music Technology.

MUGS has replaced 219 Graduate Music Courses.

MUCT has replaced 221 for Choral Techniques.
 MUGT has replaced 222 for General Music Techniques.
 MUIJN has replaced 253 for Vocal Repertoire Coaching.
 MUIT has replaced 223 for Instrumental Techniques.
 MUJZ has replaced 240 for Jazz Studies.
 MUPG has replaced 242 for Performance.
 MUEN has replaced 243 for Ensemble.

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

- Denotes courses not offered in 2002-03

SEMINARS

Topics for graduate seminars vary from year to year and are normally chosen according to the individual instructor's areas of research expertise. A list of detailed seminar descriptions can be found on the Faculty of Music website prior to fall registration. The following sampling of seminars given in recent years (though not necessarily to be offered in the upcoming year) indicate the scope of course offerings. (Enrolment in seminars will normally be limited to 10.)

Seminar in Music Literature: The Music of Bela Bartok; The Symphonies of Beethoven; The Nineteenth-century French Symphony; The Choral Music of Johannes Brahms; French opera from Carmen to Pelléas; The Music of Ockeghem and Busnoys.

Seminar in Music Theory: Theory and Analysis of Classical Form; Mathematical Set and Group Theory Models; Theories of Musical Rhythm and Meter; The Late Music of Igor Stravinsky.

Seminar in Musicology: Beethoven Style Periods; The "Roman de Fauvel"; The German Lied; Problems in Verdi Studies; Studies in the Wagner Operas.

Seminar in Performance Practice: Performance Practice of the Beethoven Piano Sonatas; Performance Practice and the Standard Repertoire (18th and early 19th century); 20th-century Performance Practice.

Seminar in Music Education: Music Criticism and Music Education; Musical Ability; Aesthetics, Music, and Music Education.

Seminar in Twentieth Century Music: Music After 1945; The Symphony in the Twentieth Century; The Music of Olivier Messiaen.

MUCO 622D1 COMPOSITION TUTORIAL. (3)

MUCO 622D2 COMPOSITION TUTORIAL. (3)

● **MUCO 623 ELECTRONIC MUSIC SEMINAR 1.** (3) (3 hours seminar, 6 hours studio time)

● **MUCO 624 ELECTRONIC MUSIC SEMINAR 2.** (3) (3 hours seminar, 6 hours studio time)

● **MUCO 625D1 MUSIC NOTATION SEMINAR.** (3) (3 hours)

● **MUCO 625D2 MUSIC NOTATION SEMINAR.** (3)

MUCO 631 SEMINAR IN 20TH-CENTURY MUSIC 1.

TO MUCO 636 SEMINAR IN 20TH-CENTURY MUSIC 6. Each: (3 credits) (3 hours)

MUCO 722D1 DOCTORAL COMPOSITION TUTORIAL. (3)

MUCO 722D2 DOCTORAL COMPOSITION TUTORIAL. (3)

MUCT 602 SEMINAR IN CHORAL TECHNIQUES. (3) (3 hours)

MUCT 603 SEMINAR IN CHORAL TECHNIQUES. (3) (3 hours)

MUEN 660 CHAMBER MUSIC ENSEMBLE. (1)

MUEN 661 EARLY CHAMBER MUSIC ENSEMBLE. (1) (1 hour) (Prerequisite: Audition) Chamber music of the Medieval, Renaissance and Baroque periods.

MUEN 672 CAPPELLA ANTICA. (2) (4 hours) (Prerequisite: Audition) An ensemble of 8 to 12 voices specializing in early music.

MUEN 673 COLLEGIUM MUSICUM. (2) (4 hours) (Prerequisites: Audition AND MUEN 480 AND MUPP 381; Additional prerequisite for keyboard players: MUPG 372 with a grade of A-) Open to singers and instrumentalists, this ensemble specializes in chamber music primarily of the Baroque era.

● **MUEN 678 CHAMBER WINDS.** (2) (4 hours) (Prerequisite: Audition. Corequisite for wind players: MUEN 697)

MUEN 679 SONG INTERPRETATION. (1) (Prerequisite: Audition; 2 hours) Study of the standard song repertoire with emphasis on the singer and pianist as partners. The student will be assigned to work with two singers. A public recital will be given at the end of each term.

MUEN 680 EARLY MUSIC ENSEMBLE. (1) (2 hours) (Prerequisite: Audition. Prerequisite or corequisite for keyboard players: MUPG 272) An ensemble of 4-6 vocalists and instrumentalists which performs music of the Medieval, Renaissance and Baroque periods.

MUEN 684 STUDIO ACCOMPANYING. (2) (Prerequisite: Audition; 2 hours) Students will be assigned to work as accompanists with performance teachers and their students.

MUEN 690 MCGILL WINDS. (2) (4 - 6 hours) (Prerequisite: Audition)

MUEN 693 CHORAL ENSEMBLE. (2) (4 hours) (Prerequisite: Audition) (Chamber Singers: a group of approximately 24 mixed voices which explores the a capella repertoire of all periods as well as works with chamber accompaniment. Section 01) (Concert Choir: an ensemble of approximately 60 voices (S.A.T.B.) which performs the repertoire from all periods appropriate to a group of this size. Section 02) (University Chorus: a mixed chorus of approximately 100 which performs a variety of choral material including both traditional and popular selections. Section 03) (Women's Chorale: an ensemble of approximately 40 women stressing the fundamentals of singing and ensemble participation. Works are chosen from the substantial repertoire available for women's voices. Section 04) Students enrolling in Choral Ensembles will be assigned to one of the above groups.

MUEN 694 CONTEMPORARY MUSIC ENSEMBLE. (2) (4 hours) (Prerequisite: Audition) An ensemble of approximately 15 performers which will explore 20th-century ensemble repertoire.

MUEN 695 JAZZ ENSEMBLE. (2) (3-4 hours) (Prerequisite: Audition)

MUEN 696 OPERA THEATRE. (2) (3-6 hours) (Prerequisite: open to all Graduate Performance and Artist Diploma students who have completed MUEN 496 or its equivalent.) Individual coaching in acting, movement and role preparation; possibility for roles in Opera McGill productions (by audition).

MUEN 697 ORCHESTRA. (2) (Prerequisite: Audition. Corequisite for wind players: MUEN 678.) (6-7 hours) A full orchestra of approximately 90 which performs the symphonic repertoire. N.B. Woodwind and brass players will take one hour per week of Repertoire Class as a part of Orchestra.

MUGS 614 READING COURSE 1. (3) Independent study of an approved topic or topics under the guidance of a supervisor. Topics will be chosen to suit individual needs and interests. The extent of reading, synthesis, and reporting will be agreed upon by the supervisor and the student at the beginning of the course.

MUGS 615 READING COURSE 2. (3) Independent study of an approved topic or topics under the guidance of a supervisor. Topics will be chosen to suit individual needs and interests. The extent of reading, synthesis, and reporting will be agreed upon by the supervisor and the student at the beginning of the course.

MUGS 635 RESEARCH PAPER 1. (9)

May also be available as:

MUGS 635D1, MUGS 635D2.

MUGS 636 RESEARCH PAPER 2. (9)

May also be available as:

MUGS 636D1, MUGS 636D2.

MUGS 675 SPECIAL PROJECT. (3) (Requires Departmental approval.)

May also be available as:

MUGS 675D1, MUGS 675D2.

MUGS 676 SPECIAL PROJECT. (6) (Requires Departmental approval.)

May also be available as:

MUGS 676D1, MUGS 676D2.

MUGS 683 MASTER'S THESIS RESEARCH 1. (3)

MUGS 684 MASTER'S THESIS RESEARCH 2. (6)

MUGS 685 MASTER'S THESIS RESEARCH 3. (9)

MUGS 686 MASTER'S THESIS RESEARCH 4. (12)

MUGS 687 MASTER'S THESIS. (12)

● **MUGS 694 SPECIAL TOPIC SEMINAR.** (3) (3 hours)

● **MUGS 695 SPECIAL TOPIC SEMINAR.** (3) (3 hours)

MUGS 701 COMPREHENSIVE EXAMINATION PART 1. (0)

May also be available as:

MUGS 701D1, MUGS 701D2.

MUGS 702 COMPREHENSIVE EXAMINATION PART 2. (0)

May also be available as:

MUGS 702D1, MUGS 702D2.

MUGS 705 COLLOQUIUM. (0)

May also be available as:

MUGS 705D1, MUGS 705D2.

MUGS 749 DOCTORAL TUTORIAL 1. (3)

MUGS 750 DOCTORAL TUTORIAL 2. (3)

MUGT 610 SEMINAR - MUSIC EDUCATION 1.

TO MUGT 613 SEMINAR - MUSIC EDUCATION 4. Each: (3 credits)
(3 hours)

MUGT 618 MUSIC EDUCATION TUTORIAL 1. (3)

MUGT 619 MUSIC EDUCATION TUTORIAL 2. (3) (3 hours)

● **MUHL 653 MUSIC AESTHETICS AND CRITICISM.** (3) (3 hours)

MUHL 678 MUSICOLOGY TUTORIAL. (3)

MUHL 679 MUSICOLOGY TUTORIAL. (3)

MUHL 680 SEMINAR IN MUSICOLOGY 1.

TO MUHL 685 SEMINAR IN MUSICOLOGY 6. Each: (3 credits)
(3 hours)

MUHL 692 SEMINAR IN MUSIC LITERATURE 1.

TO MUHL 697 SEMINAR IN MUSIC LITERATURE 6. Each: (3 credits)
(3 hours)

MUIN 600 VOCAL REPERTOIRE COACHING 1. (2) (1 hour) A course in which the performer will have individual coaching sessions on repertoire, with emphasis on musical and linguistic nuance.

MUIN 601 VOCAL REPERTOIRE COACHING 2. (2) (1 hour)

MUIN 700 DOCTORAL REPERTOIRE COACHING 1. (2) Individual tutorial coaching sessions in repertoire, with emphasis on musical and linguistic nuance.

MUIN 701 DOCTORAL REPERTOIRE COACHING 2. (2) Individual tutorial coaching sessions in repertoire, with emphasis on musical and linguistic nuance.

MUIN 702 DOCTORAL REPERTOIRE COACHING 3. (2) Individual tutorial coaching sessions in repertoire, with emphasis on musical and linguistic nuance.

MUIN 703 DOCTORAL REPERTOIRE COACHING 4. (2) Individual tutorial coaching sessions in repertoire, with emphasis on musical and linguistic nuance.

● **MUIT 606 SEMINAR IN ORCHESTRA/BAND TECHNIQUES.** (3)
(3 hours)

● **MUIT 607 SEMINAR IN ORCHESTRA/BAND TECHNIQUES.** (3)
(3 hours)

MUJZ 601 JAZZ PEDAGOGY. (3) (3 hours) A course designed to prepare students to teach jazz-related subjects at the university and professional level, with emphasis on ensemble direction and the instruction of improvisation, as well as course and curriculum development. Various pedagogical methods, philosophies, rehearsal techniques, and materials will be investigated.

MUJZ 640 JAZZ COMPOSITION AND ARRANGING. (4) (2 hours) A course intended to guide the student towards an individual musical style. A variety of jazz compositional and arranging techniques will be explored.

May also be available as: **MUJZ 640D1, MUJZ 640D2.**

MUMT 605 DIGITAL SOUND SYNTHESIS AND AUDIO PROCESS. (3) Basic principles of digital sound synthesis including techniques such as additive synthesis, frequency modulation, tuned resonators, waveshaping and digital audio processing techniques including simple delay systems, filters, reverberators, spatial controllers, etc. will be explored.

MUMT 609 MUSIC, MEDIA AND TECHNOLOGY PROJECT. (3) (3 research/project hours) Independent music technology project. Students will prepare a statement of objectives, a comprehensive project design and a schedule of work, and will undertake the project on appropriate music technology platforms.

MUMT 610 COMPUTER MUSIC SEMINAR 1.

TO MUMT 615 COMPUTER MUSIC SEMINAR 6. Each: (3 credits)
(3 hours) Advanced topics in computer applications in music will be examined. Students will be expected to 1) present critical analyses of current research and 2) develop and implement software demonstrations.

MUMT 629D1 TECHNICAL EAR TRAINING. (2) (1 hour tutorial, 2 hours laboratory) This course will, through a sequence of specific auditory exercises, develop and improve students' aural sensitivity to small changes in sound quality. Students train to identify spectral variables in sound, develop stable reference of sound quality and learn about spectral characteristics of musical instruments.

MUMT 629D2 TECHNICAL EAR TRAINING. (2)

MUMT 631D1 ADVANCED TECHNICAL EAR TRAINING. (2) (1 hour tutorial, 2 hours laboratory) (Prerequisite: MUMT 629) Included in this course are exercises for developing some of the following aural skills: identification and quantification of spatial parameters of sound image, nonlinear and transient distortion audibility, identification of coherent and incoherent noise, sound source identification in complex textures, sound enhancement and reconstruction.

MUMT 631D2 ADVANCED TECHNICAL EAR TRAINING. (2)

MUMT 667 DIGITAL STUDIO TECHNOLOGY. (3) (3 hours lecture) Technical and operational characteristics of different digital recording systems currently employed by the recording industry.

MUMT 668 DIGITAL/ANALOG AUDIO EDITING. (3) (1 hour tutorial, 3 hours studio time) Using analog and digital record/playback equipment, students learn, through practice, the art of replacing, patching, rebalancing, reconstructing, or generally speaking, improving recorded music through editing. Teaching will include cut and splice editing, disk-based editing, and editing by transfer and mixing.

MUMT 669 TOPICS: CLASSICAL MUSIC RECORDING. (3) (3 hours lecture) Issues involving classical music recording. Topics may include: analysis of performance styles, acoustics of concert halls, production of music videos, seminars with recording producers, tonmeisters, classical music in multimedia, and others.

May also be available as: **MUMT 669D1, MUMT 669D2.**

MUMT 670D1 RECORDING THEORY AND PRACTICE 1. (5) (3 hours seminar, 6 hours studio time) (Prerequisite: MUMT 300) Theoretical and practice study of recording equipment, procedures and techniques. Recording sessions and live stereo recording, using the recording studio, concert hall and portable equipment for on-location recording. Also included will be an introduction to the areas of radio drama, broadcast recording and radio commercials.

MUMT 670D2 RECORDING THEORY AND PRACTICE 1. (5)

MUMT 671D1 RECORDING THEORY AND PRACTICE 2. (5) (3 hours seminar, 6 hours studio time) (Prerequisite: MUMT 670) Emphasis on multi-track recording theory and practice. The course will also concentrate on expanded multi-track procedures: signal processing, overdubbing, mixing, editing, and producing.

MUMT 671D2 RECORDING THEORY AND PRACTICE 2. (5)

MUMT 672D1 ANALYSIS OF RECORDINGS. (3) (3 hours) The analysis of recording engineering, production, performance, aesthetics and technical quality of selected recordings.

MUMT 672D2 ANALYSIS OF RECORDINGS. (3)

MUMT 674 ELECTRONIC AND ELECTROACOUSTIC MEASUREMENT. (3) (1 1/2 hours lecture, 1 1/2 hours laboratory) This course demonstrates the instruments, measurement procedures, and techniques used in a recording studio to determine the acoustical properties of a room and the transfer functions of devices used in a studio. Theoretical lectures on electronic test instrumentation and measurement methods are combined with practical application.

May also be available as: MUMT 674D1, MUMT 674D2.

MUMT 676 AUDIO INDUSTRY EXPERIENCE. (3)

MUMT 677D1 AUDIO FOR VIDEO POST-PRODUCTION. (3) (3 hours seminar, 4 hours studio time) Theoretical study includes historical analysis of sound for image, audio post-production process for film and video, aesthetic and technical considerations in sound design, time code and synchronization, and final mix formats. Practical skills include field recording, sound library management, sound design, dialog, effects and music editing, and final mix process.

MUMT 677D2 AUDIO FOR VIDEO POST-PRODUCTION. (3)

MUMT 678 ADVANCED DIGITAL EDITING AND POST-PRODUCTION. (3) (3 hours) (Prerequisite: MUMT 668) This course covers advanced concepts and techniques of audio post-production using digital workstations. Students practise the assembly of raw material into a complete final product through editing, signal processing, mixing, sound restoration and pre-mastering.

MUMT 690 MEDIA THEORY AND PRACTICE SEMINAR 1.

TO MUMT 695 MEDIA THEORY AND PRACTICE SEMINAR 6. Each: (3 credits) (3 hours) Topics vary from year to year and are normally chosen according to the individual instructor's area of expertise. Topics to be covered may include the following: Media Technology, Digital Restoration of Archival Recordings, Communications Systems and Standards, Audio Aesthetics of Video Musicals, Classical Music and the Television Medium, etc.

● **MUPG 603 BRASS INSTRUMENT PERFORMANCE AND REPERTOIRE.** (3) (3 hours)

MUPG 611 DIRECTED TEACHING 1.

TO MUPG 614 DIRECTED TEACHING 4. Each: (2 credits) (1 hour)

● **MUPG 615 MASTER CLASS-ORCHESTRAL CONDUCTING.** (3) (3 hours)

● **MUPG 616 MASTER CLASS-CHORAL CONDUCTING.** (3) (3 hours)

● **MUPG 617 MASTER CLASS - WIND BAND CONDUCTING.** (3)

MUPG 620 PERFORMANCE TUTORIAL 1.

TO MUPG 624 PERFORMANCE TUTORIAL 5. (4 credits each)

● **MUPG 630 PERFORMANCE TUTORIAL 6.**

TO ● MUPG 633 PERFORMANCE TUTORIAL 9. (6 credits each)

MUPG 650D1 PEDAGOGY WORKSHOP. (3) (1 1/2 hours) Teaching of one or more students chosen in consultation with the respective area, and a presentation on an approved topic of the candidate's choice.

MUPG 650D2 PEDAGOGY WORKSHOP. (3)

● **MUPG 651D1 PEDAGOGY COMPREHENSIVE EXAMINATION.** (3)

● **MUPG 651D2 PEDAGOGY COMPREHENSIVE EXAMINATION.** (3)

MUPG 658 OPERA PERFORMANCE EXAMINATION. (6) The student performs a major role in a public performance of a full-length opera. To be marked on a pass-fail basis.

May also be available as: MUPG 658D1, MUPG 658D2.

MUPG 659 PERFORMANCE IN RECORDING MEDIA. (12) The candidate must submit a 60-75 minute audio and/or video document of his or her performances, compiled from various media sources. This might include radio, television, and/or studio recordings. All of the music must be composed and arranged by the candidate.

May also be available as: MUPG 659D1, MUPG 659D2.

MUPG 660 SOLO RECITAL 1. (12)

May also be available as: MUPG 660D1, MUPG 660D2.

MUPG 661 CHAMBER MUSIC RECITAL 1. (12)

May also be available as: MUPG 661D1, MUPG 661D2.

MUPG 662 SOLO AND CHAMBER MUSIC RECITAL. (12)

May also be available as: MUPG 662D1, MUPG 662D2.

MUPG 663 QUICK STUDY EXAMINATION. (6) (To be successfully completed before the first recital is performed)

May also be available as: MUPG 663D1, MUPG 663D2.

MUPG 664 REPERTOIRE EXAMINATION. (6)

May also be available as: MUPG 664D1, MUPG 664D2.

MUPG 665D1 ACCOMPANYING RECITAL 1. (6)

MUPG 665D2 ACCOMPANYING RECITAL 1. (6)

MUPG 667 SOLO RECITAL 2. (12)

May also be available as: MUPG 667D1, MUPG 667D2.

MUPG 668 CHAMBER MUSIC RECITAL 2. (12)

May also be available as: MUPG 668D1, MUPG 668D2.

MUPG 672D1 LITURGICAL IMPROVISATION. (1.5) (1 1/2 hours) The study and practice of cantus firmus-based improvisation according to selected stylistic models so as to provide diversity of techniques, styles and tonalities. Free improvisation is studied in conjunction with C.F. improvisation. Modulation is taught in both C.F.-based and free improvisation; emphasis being placed on clarity and liturgical appropriateness.

MUPG 672D2 LITURGICAL IMPROVISATION. (1.5)

● **MUPG 673 20TH-CENTURY ORGAN IMPROVISATION.** (3) (3 hours seminar)

● **MUPG 674 SEMINAR IN ORGAN REGISTRATION.** (3) (3 hours)

MUPG 675 SPECIAL PROJECT IN PERFORMANCE 1. (3) (Requires departmental approval)

May also be available as: MUPG 675D1, MUPG 675D2.

MUPG 676D1 SPECIAL PROJECT IN PERFORMANCE 2. (3)

MUPG 676D2 SPECIAL PROJECT IN PERFORMANCE 2. (3)

MUPG 677 SEMINAR IN PERFORMANCE TOPICS 1. (3) (3 hours)

MUPG 678 SEMINAR IN PERFORMANCE TOPICS 2. (3) (3 hours)

● **MUPG 683 THE PIANIST AS PARTNER.** (3) (3 hours)

MUPG 685 MASTER CLASS - 20TH-CENTURY PIANO MUSIC. (3) (3 hours) Students will explore the piano repertoire of the 20th century. Repertoire will include such diverse music as that of Milhaud, Ives, Boulez, Berio, etc., as well as the recent Canadian music of Tremblay, Mather, etc. Performance of work(s) studied is a requirement for the course.

● **MUPG 686 MASTER CLASS - STRING CHAMBER MUSIC.** (3) (3 hours)

● **MUPG 687 DEVELOPMENT - WOODWIND INSTRUMENTS.** (3) (3 hours)

MUPG 690 VOCAL STYLES AND CONVENTIONS. (3) (3 hours)

Emphasis on vocal performance practices through practical application: text, language, inflection, pronunciation and interpretation considered with individuality of each student's voice and technical development. After examining historical treatises, students will discuss and present musical selections utilizing modern performance standards yet remaining true to stylistic demands of each period.

MUPG 691 VOCAL SEMINAR 1. (3) (3 hours) (Open to singers, pianists, and conductors, with permission of instructor.)

MUPG 692 VOCAL SEMINAR 2. (3) (3 hours) (Open to singers, pianists, and conductors, with permission of instructor.)

● **MUPG 693 VOCAL TREATISES AND METHODS.** (3) (3 hours)

● **MUPG 694 VOCAL PHYSIOLOGY FOR SINGERS.** (3) (3 hours)

● **MUPG 696 TECHNICAL LITERATURE FOR PIANO.** (3) (3 hours)

● **MUPG 698 20TH-CENTURY WIND REPERTOIRE.** (3) (3 hours)

● **MUPG 699D1 CHURCH SERVICE PLAYING.** (2) (3 hours)

● **MUPG 699D2 CHURCH SERVICE PLAYING.** (2)

MUPG 720 D.MUS. PERFORMANCE TUTORIAL 1.

TO MUPG 726 D.MUS. PERFORMANCE TUTORIAL 7. (4 credits each) Individual instrumental or vocal tutorial. Advanced technical and interpretive training as well as recital preparation.

MUPG 730 D.MUS. PERFORMANCE TUTORIAL 8.

TO MUPG 734 D.MUS. PERFORMANCE TUTORIAL 12. (6 credits each) Individual instrumental or vocal tutorial. Advanced technical and interpretive training as well as recital preparation.

MUPG 760 DOCTORAL RECITAL 1. (12) A full-length public recital which includes a minimum of 60 minutes of music.

MUPG 767 DOCTORAL RECITAL 2. (12) A full-length public recital which includes a minimum of 60 minutes of music.

MUPG 770 DOCTORAL LECTURE - RECITAL PROJECT. (12) The lecture-recital comprises a minimum of 35 minutes of music and 25 to 35 minutes of oral presentation. The examiners and audience may question the candidate following the lecture-recital. The subject and repertoire will also be treated in a project paper, submitted within two months of the lecture-recital.

MUPP 690 PERFORMANCE PRACTICE SEMINAR 1.

TO MUPP 695 PERFORMANCE PRACTICE SEMINAR 6. Each: (3 credits) (3 hours)

MUTH 648 THEORY TUTORIAL. (3)**MUTH 649 THEORY TUTORIAL.** (3)**MUTH 652 SEMINAR IN MUSIC THEORY 1.**

TO MUTH 657 SEMINAR IN MUSIC THEORY 6. Each: (3 credits) (3 hours)

MUTH 658 HISTORY OF MUSIC THEORY 1. (3) (3 hours) Selected topics in the history of music theory from Greek antiquity to 1700 through readings of primary and secondary literature.

MUTH 659 HISTORY OF MUSIC THEORY 2. (3) (3 hours) Selected topics in the history of music theory from 1700 to the present through readings of primary and secondary literature.

ADVANCED UNDERGRADUATE COURSES

Students deficient in their background preparation may be required to take some of the following undergraduate courses in addition to their required graduate courses.

With the exception of MUTH 501, MUTH 502 and MUTH 503, all 500-level courses are available as elective courses to graduate students.

MUCT 315 Choral Conducting 1

MUCT 415 Choral Conducting 2

MUEN 494 Contemporary Music Ensemble

MUGT 402D1/MUGT 402D2 Principles and Processes of Music Education

MUGT 403 Selected Topics in Music Education

MUGT 404 Selected Topics in Music Education

MUHL 366 The Era of the Fortepiano

MUHL 372 Solo Song Outside Germany and Austria

MUHL 377 Baroque Opera

MUHL 379 Solo Song 1100-1700

MUHL 380 Medieval Music

MUHL 381 Renaissance Music

MUHL 382 Baroque Music

MUHL 383 Classical Music

MUHL 384 Romantic Music

MUHL 385 Early Twentieth-Century Music

MUHL 386 Chamber Music Literature

MUHL 387 Opera from Mozart to Puccini

MUHL 388 Twentieth-Century Opera

MUHL 389 Orchestral Literature

MUHL 390 The German Lied

MUHL 391 Canadian Music

MUHL 392 Music since 1945

MUHL 395 Keyboard Literature before 1750.

MUHL 396 Era of the Modern Piano.

MUHL 397 Choral Literature after 1750.

MUHL 398 Wind Ensemble Literature after 1750.

MUHL 570 Research Methods in Music

MUHL 591D1/MUHL 591D2 Paleography

MUIT 315 Instrumental Conducting

MUIT 415 Advanced Instrumental Conducting

MUMT 306 Music and Audio Computing 1

MUMT 307 Music and Audio Computing 2

MUPG 372D1/MUPG 372D2 Continuo

MUPP 381 Topics: Performance Practice before 1800

MUPP 385 Topics: Performance Practice after 1800

MUTH 301 Modal Counterpoint 1

MUTH 302 Modal Counterpoint 2

MUTH 303 Tonal Counterpoint 1

MUTH 304 Tonal Counterpoint 2

MUTH 327D1/MUTH 327D2 19th-Century Analysis

MUTH 427D1/MUTH 427D2 20th-Century Analysis

MUTH 501 Theory Review 1

MUTH 502 Theory Review 2

MUTH 503 Theory Review 3

MUTH 522D1/MUTH 522D2 Advanced Counterpoint

MUTH 523D1/MUTH 523D2 Advanced Harmony.

MUTH 528 Schenkerian Techniques

MUTH 529 Proseminar in Music Theory 1

MUTH 538 Mathematical Models/Musical Analysis

53 Natural Resource Sciences

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Canada

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Fax: (514) 398-7990

Email: info@nrs.mcgill.ca

Website: <http://www.nrs.mcgill.ca>

Chair — B. Côté

Graduate Program Director — R.D. Titman

53.1 Staff*Emeritus Professors*

A.C. Blackwood; B.Sc., M.Sc.(Alta.), Ph.D.(Wis.), F.R.S.C.;
Microbiology

R. Knowles; B.Sc.(Birm.), Ph.D., D.Sc.(Lond.); F.R.S.C.;
Microbiology

A.F. MacKenzie; B.S.A., M.Sc.(Sask.), Ph.D.(C'nell); Soil Science
R.A. MacLeod; B.A., M.A.(Br.Col.), Ph.D.(Wis.), F.R.S.C.;

Microbiology

P.H. Schuepp; Dipl.Sc.Nat.(Zür.), Ph.D.(Tor.); Agricultural Physics

R.K. Stewart; B.Sc.(Agr.), Ph.D.(Glas.); Entomology

Professors

D.M. Bird; B.Sc.(Guelph), M.Sc., Ph.D.(McG.); Wildlife Biology

W.H. Hendershot; B.Sc.(Tor.), M.Sc.(McG.), Ph.D.(Br.Col.); Soil
Science

Associate Professors

B. Côté; B.Sc., Ph.D.(Laval); Forest Resources

M.A. Curtis; B.Sc., M.Sc., Ph.D.(McG.); Wildlife Biology

B.T. Driscoll; B.Sc., Ph.D.(McM.); Microbiology

G.B. Dunphy; B.Sc.(U.N.B.), M.Sc., Ph.D.(Mem.); Entomology

J.W. Fyles; B.Sc., M.Sc.(Vic., B.C.), Ph.D.(Alta.); Forest

Resources

D.J. Lewis; B.Sc., M.Sc., Ph.D.(Mem.); Entomology

G.R. Mehuys; B.Sc., Ing.Agron.(Gembloux), Ph.D.(Calif.); Soil
Science

D.F. Niven; B.Sc., Ph.D.(Aber.); Microbiology

M.E. Rau; B.Sc.(Purdue), M.Sc., Ph.D.(McG.); Entomology

R.D. Titman; B.Sc.(McG.), M.Sc.(Bishop's), Ph.D.(U.N.B.);
Wildlife Biology
T.A. Wheeler; B.Sc.(Mem.), M.Sc., Ph.D.(Guelph); Entomology

Assistant Professors

C. Hamel; B.Sc., Ph.D.(McG.); Soil Science
I. Strachan; B.Sc.(Tor), M.Sc., Ph.D.(Queen's); Micrometeorology
J. Whalen; B.Sc.(Agr.)(Dal.), M.Sc.(McG.), Ph.D.(Ohio St.); Soil Science

Adjunct Professors

R. Anderson, F. Archibald, D. Berteaux, G. Boivin, J. Cumming,
C. Greer, T. Herman, C. Miguez, P. Mineau, E. Pattey,
M. St-Arnaud, J.P. Savard, A. Scheuhammer, N. Seymour,
C. Vincent, F.G. Whoriskey

Associate Members

L. Chan (*Dietetics and Human Nutrition*), W.D. Marshall (*Food Science and Agricultural Chemistry*), G.J. Matlashewski (*Microbiology and Immunology*), D. Smith (*Plant Science*)

Cross-Appointed Professor

P. Brown (*Geography and McGill School of Environment*)

53.2 Programs Offered

The Department of Natural Resource Sciences offers programs leading to M.Sc. and Ph.D. degrees in Entomology, Microbiology, and Renewable Resources (includes Agrometeorology, Forest Science, Neotropical Environment, Soil Science and Wildlife Biology).

The Department possesses, or has access to, excellent facilities for laboratory research and research in the field. Affiliated with the Department are the Lyman Entomological Museum and Research Laboratory, the Molson Nature Reserve, the Morgan Arboretum, the Avian Science and Conservation Centre, and the Ecomuseum of the St. Lawrence Valley Natural History Society.

53.3 Admission Requirements

General

Competency in English – Non-Canadian applicants whose mother tongue is not English and who have not completed an undergraduate degree using the English language, are required to submit documented proof of competency in oral and written English by appropriate exams, e.g. TOEFL (Test of English as a Foreign Language) with a minimum score of 550 on the paper-based test (213 on the computer-based test) or 6.5 overall band on IELTS.

The Graduate Record Exam (GRE) is not required, however, it is highly recommended.

M.Sc.

Candidates are required to have a Bachelor's degree with an equivalent cumulative grade point average of 3.0/4.0 (Second Class-Upper division) and a sufficient background in the appropriate basic sciences.

Ph.D.

Candidates, normally, are required to hold an M.Sc. Degree and will be judged primarily on their ability to conduct an original and independent research study.

53.4 Application Procedures

Applicants for graduate studies through academic units in the Faculty of Agricultural and Environmental Sciences may submit on-line applications via the Web at <http://www.mcgill.ca/applying/graduate> or printed applications. Supporting documents must be sent to:

Student Affairs Office (Graduate Studies)
Macdonald Campus of McGill University
21,111 Lakeshore
Sainte-Anne-de-Bellevue, QC H9X 3V9
Canada

Telephone: (514) 398-7925
Fax: (514) 398-7968
Email: grad@macdonald.mcgill.ca

Applications will be considered upon receipt of a signed and completed application form, \$60 application fee, all official transcripts, two signed original letters of reference on official letterhead of originating institution, and (if required) proof of competency in oral and written English by appropriate exams. DOCUMENTS SUBMITTED WILL NOT BE RETURNED.

Deadlines – Applications, including all supporting documents must reach the Student Affairs Office no later than June 15 (March 1 for International) for the *September session*; October 15 (July 1 for International) for the *January session*; February 15 (November 1 for International) for the *Summer session*. It may be necessary to delay review of the applicant's file until the following admittance period if application materials including supporting documents are received after these dates. International applicants are advised to apply well in advance of the deadline because immigration procedures may be lengthy. Applicants are encouraged to make use of the web-based application form on the McGill website <http://www.mcgill.ca/applying/graduate>.

Application Fee (non-refundable) – A fee of \$60 Canadian must accompany each application (including McGill students), otherwise it cannot be considered. This sum must be remitted using one of the following methods:

1. Credit card (by completing the appropriate section of the application form). NB: on-line applications must be paid for by credit card.
2. **Certified** cheque in Cdn.\$ drawn on a Canadian bank.
3. **Certified** cheque in U.S.\$ drawn on a U.S. bank.
4. Canadian Money order in Cdn.\$.
5. U.S. Money Order in U.S.\$.
6. An international draft in Canadian funds drawn on a Canadian bank requested from the applicant's bank in his/her own country.

Transcripts – Two official copies of all transcripts with proof of degree(s) granted are required for admission. Transcripts written in a language other than English or French must be accompanied by a certified translation. An explanation of the grading system used by the applicant's university is essential. It is the applicant's responsibility to arrange for transcripts to be sent.

It is desirable to submit a list of the titles of courses taken in the major subject, since transcripts often give code numbers only. Applicants must be graduates of a university of recognized reputation and hold a Bachelor's degree equivalent to a McGill Honours degree in a subject closely related to the one selected for graduate work. This implies that about one-third of all undergraduate courses should have been devoted to the subject itself and another third to cognate subjects.

The minimum cumulative grade point average (CGPA) is 3.0/4.0 (second-class upper) or 3.2/4.0 during the last two full-time years of university study. High grades are expected in courses considered by the academic unit to be preparatory to the graduate program.

Letters of Recommendation – Two letters of recommendation *on letterhead (official paper) or bearing the university seal* and with original signatures from two instructors familiar with the applicant's work, preferably in the applicant's area of specialization, are required. It is the applicant's responsibility to arrange for these letters to be sent.

Competency in English – Non-Canadian applicants whose mother tongue is not English and who have not completed an undergraduate degree using the English language are required to submit documented proof of competency in oral and written English, by appropriate exams, e.g. TOEFL (minimum score 550 on the paper-based test (213 on the computer-based test) or IELTS (minimum overall band 6.5). The MCHE is not considered equivalent. Results must be submitted as part of the application. The University code is 0935 (McGill University, Montreal); please use Department code 31(Graduate Schools), Biological Sciences-

Agriculture, to ensure that your TOEFL reaches this office without delay.

Graduate Record Exam (GRE) – The GRE is not required, but it is highly recommended.

Financial aid is very limited and highly competitive. It is suggested that students give serious consideration to their financial planning before submitting an application.

Acceptance to all programs depends on a staff member agreeing to serve as the student's supervisor and the student obtaining financial support. Normally, a student will not be accepted unless adequate financial support can be provided by the student and/or the student's supervisor. Academic units cannot guarantee financial support via teaching assistantships or other funds.

Qualifying Students – Some applicants whose academic degrees and standing entitle them to serious consideration for admission to graduate studies, but who are considered inadequately prepared in the subject selected may be admitted to a *Qualifying Program* if they have met the Graduate and Postdoctoral Studies Office minimum CGPA of 3.0/4.0. The course(s) to be taken in a *Qualifying Program* will be prescribed by the academic unit concerned. *Qualifying students* are registered in graduate studies, **but not as candidates for a degree**. Only one qualifying year is permitted. **Successful completion of a qualifying program does not guarantee admission to a degree program.**

53.5 Program Requirements

M.Sc. in Entomology, Microbiology or Renewable Resources (which includes Agrometeorology, Forest Science, Soil Science and Wildlife Biology)

Candidates must complete a course and research program of a minimum of 45 credits elaborated in consultation with their Supervisory Committee. Course work (6 credits minimum) will include at least two, normally graduate-level, courses and in most research areas, at least one of these courses must be a graduate-level course in statistics. Students are required to register for three 1-credit seminar courses, the last of which will consist of a formal presentation of the student's final thesis research. Candidates must also register in the three M.Sc. Thesis Research courses (NRSC 691, NRSC 692, NRSC 693; 36 credits) and present a satisfactory thesis based on their research.

M.Sc. in Renewable Resources – Neotropical Environment Option

Candidates must complete a course and research program of a minimum of 48 credits elaborated in consultation with their Supervisory Committee. Course work (9 credits minimum) will include both ENVR 610 and BIOL 640, and one of POLI 644, SOCI 565, ENVR 611, ENVR 612, ENVR 680, BIOL 553, BIOL 641, GEOG 498, AGRI 550. Students may also require a graduate-level course in statistics. Participation in the MSE-Panama Symposium Presentation in Montreal is required. Students are required to register for three 1-credit seminar courses, the last of which will consist of a formal presentation of the student's final thesis research. Candidates must also register in the three M.Sc. Thesis Research courses (NRSC 691, NRSC 692, NRSC 693; 36 credits) and present a satisfactory thesis based on their research.

Ph.D. in Entomology, Microbiology, or Renewable Resources (which includes Agrometeorology, Forest Science, Soil Science and Wildlife Biology)

Course requirements are specified by the staff in the discipline but are flexible and depend largely on the student's background, immediate interests, and ultimate objectives. Students are required to register for four 1-semester seminar courses.

Also required are satisfactory performance in the Ph.D. Comprehensive Examination (NRSC 701) and the presentation, and subsequent defence, of a satisfactory thesis based on the student's research.

Ph.D. in Renewable Resources – Neotropical Environment Option

Course requirements are specified by the staff in the discipline but are flexible and depend largely on the student's background, immediate interests, and ultimate objectives. In this program course work will include both ENVR 610 and BIOL 640, and one of POLI 644, SOCI 565, ENVR 611, ENVR 612, ENVR 680, BIOL 553, BIOL 641, GEOG 498, AGRI 550. Participation in the MSE-Panama Symposium Presentation in Montreal is required. Students are required to register for four seminar courses (NRSC 751, NRSC 752, NRSC 753 and NRSC 754).

Also required are satisfactory performance in the Ph.D. Comprehensive Examination (NRSC 701) and the presentation, and subsequent defence, of a satisfactory thesis based on the student's research.

53.6 Courses for Higher Degrees

For the term (Fall and/or Winter), days, and times when courses will be offered, please refer to the 2002-2003 Class Schedule on the Web, <http://www.mcgill.ca/minerva-students/class/>. Class locations and names of instructors are also provided.

Students preparing to register are advised to consult the Class Schedule website for the most up-to-date list of courses available. New courses may have been added or courses rescheduled after this Calendar went to press.

The schedule of courses to be offered in Summer 2003, will be available on the website in January 2003.

Please note the following course prefix changes:

AEMA has replaced 360 for Mathematics.
AEPH has replaced 338 for Agricultural Physics.
ENTO has replaced 350 for Entomology.
MICR has replaced 362 for Microbiology.
NRSC has replaced 373 for Natural Resource Sciences.
SOIL has replaced 372 for Soil Science.
WILD has replaced 375 for Resource Development.
WOOD has replaced 374 for Woodland Resources.

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

● Denotes courses not offered in 2002-03

★ Denotes courses taught only in alternate years.

★ **AEPH 510 AGRICULTURAL MICROMETEOROLOGY.** (3) (Fall) (3 lectures) Interaction between plant communities and the atmosphere. The physical processes governing the transfer of heat, mass and momentum as they relate to research and production in agricultural and environmental systems. Experimental techniques for measuring fluxes of heat, water-vapour, CO₂ and natural and man-made pollutants.

● **AEPH 602 ISOTOPIC TRACER TECHNIQUES.** (3) (3 lectures and 1 four-hour lab) (Prerequisite: AEPH 303 or equivalent.)

★ **ENTO 525 INSECT ECOLOGY.** (3) (Winter)

● ★ **ENTO 535 AQUATIC ENTOMOLOGY.** (3)

ENTO 600 INSECT PATHOLOGY. (3)

● **ENTO 610D1 ADVANCED TAXONOMY AND ZOOGEOGRAPHY.** (3)

● **ENTO 610D2 ADVANCED TAXONOMY AND ZOOGEOGRAPHY.** (3)

● **ENTO 726 INSECT POPULATION DYNAMICS.** (3)

MICR 764 READING AND CONFERENCE 1A. (3) (2 conferences) (2 hours) Student presentations, taken from current literature, concerned with various aspects of a central topic chosen for the term. Such presentations are designed to be informal and to generate discussions. Topic will change from term to term.

MICR 765 READING AND CONFERENCE 1B. (3) (2 conferences) (2 hours) Student presentations, taken from current literature, concerned with various aspects of a central topic chosen for the term. Such presentations are designed to be informal and to generate discussions. Topic will change from term to term.

MICR 772 ADVANCED MICROBIAL GENETICS. (3) (Restriction: Not open to students who have successfully completed NRSC 772)

Topics in bacterial archaeal, eucaryal, and bacteriophage genetics.

MICR 773 ADVANCED MICROBIAL PHYSIOLOGY. (3) (Not open to students who have successfully completed NRSC 773) Topics in microbial physiology and metabolism, ranging from current to classic, from biochemical to genetic aspects.

★ **NRSC 515 PARASITOID BEHAVIOURAL ECOLOGY.** (3) (Winter) (3 lectures and one 2-hour seminar) (Prerequisite: NRSC 330 or equivalent) The origin and diversity of parasitoid species will be presented. Aspects of behavioral ecology that pertain to host selection, optimal allocation of progeny and sex and host-parasitoid interactions are examined. The importance of these processes is discussed in a biological control perspective.

NRSC 520 INSECT PHYSIOLOGY. (3) (Fall and Winter) (Prerequisite: Permission of instructor) Organismal approach to insects, emphasizing the physiology and development, and the physiological relations of insects to their environment.

★ **NRSC 521 SOIL MICROBIOLOGY AND BIOCHEMISTRY.** (3) (Winter) (Prerequisite: SOIL 210) Soil environments, soil microorganisms and their function in the biogeochemical cycles of C, N, P and S. Basics of soil bioremediation.

NRSC 550 VETERINARY AND MEDICAL ENTOMOLOGY. (3) (Winter) (Prerequisite: Permission of instructor) Environmental aspects of veterinary and medical entomology. An advanced course dealing with the biology and ecology of insects and acarines as aetiological agents and vectors of disease, and their control. Integrated approaches to problem solving.

NRSC 643 GRADUATE SEMINAR 1. (1) (Section 001 Agrometeorology, Forest Science and Soil Science students) (Section 002 Entomology and Wildlife Biology students) (Section 003 Microbiology students) Open to students in the M.Sc. Program. Presentation on a selected topic, research proposal, or research results based on progress towards the M.Sc. degree.

NRSC 644 GRADUATE SEMINAR 2. (1) (Section 001 Agrometeorology, Forest Science and Soil Science students) (Section 002 Entomology and Wildlife Biology students) (Section 003 Microbiology students) Open to students in the M.Sc. Program. Presentation on a selected topic, research proposal, or research results based on progress towards the M.Sc. degree.

NRSC 651 GRADUATE SEMINAR 3. (1) (Section 001 Agrometeorology, Forest Science and Soil Science students) (Section 002 Entomology and Wildlife Biology students) (Section 003 Microbiology students) Open to students in the M.Sc. Program. Presentation of an M.Sc. student's final thesis results.

NRSC 680 SPECIAL TOPICS 1. (1) Students pursue topics not otherwise available in formal courses, under staff supervision.

NRSC 681 SPECIAL TOPICS 2. (1) Students pursue topics not otherwise available in formal courses, under staff supervision.

NRSC 682 SPECIAL TOPICS 3. (2) Students pursue topics not otherwise available in formal courses, under staff supervision.

NRSC 683 SPECIAL TOPICS 4. (2) Students pursue topics not otherwise available in formal courses, under staff supervision.

NRSC 684 SPECIAL TOPICS 5. (3) Students pursue topics not otherwise available in formal courses, under staff supervision.

NRSC 685 SPECIAL TOPICS 6. (3) Students pursue topics not otherwise available in formal courses, under staff supervision.

NRSC 691 M.Sc. THESIS RESEARCH 1. (12) Independent research under the direction of a supervisor towards the completion of the M.Sc. degree.

NRSC 692 M.Sc. THESIS RESEARCH 2. (12) Independent research under the direction of a supervisor towards the completion of the M.Sc. degree.

NRSC 693 M.Sc. THESIS RESEARCH 3. (12) Completion of the M.Sc. thesis, its approval by reviewers and acceptance by the Graduate and Postdoctoral Studies Office are all required for a pass to be granted.

NRSC 701 PH.D. COMPREHENSIVE EXAMINATION. (0)

NRSC 751 GRADUATE SEMINAR 4. (0) (Open to students in the Ph.D. Program) (Section 001 Agrometeorology, Forest Science and Soil Science students) (Section 002 Entomology and Wildlife Biology students) (Section 003 Microbiology students) Presentation on a selected topic, research proposal or research results based on progress in the Ph.D. degree.

NRSC 752 GRADUATE SEMINAR 5. (0) (Open to students in the Ph.D. Program.) (Section 001 Agrometeorology, Forest Science and Soil Science students) (Section 002 Entomology and Wildlife Biology students) (Section 003 Microbiology students) Presentation on a selected topic, research proposal or research results based on progress in the Ph.D. degree.

NRSC 753 GRADUATE SEMINAR 6. (0) (Open to students in the Ph.D. Program.) (Section 001 Agrometeorology, Forest Science and Soil Science students) (Section 002 Entomology and Wildlife Biology students) (Section 003 Microbiology students) Presentation on a selected topic, research proposal or research results based on progress in the Ph.D. degree.

NRSC 754 GRADUATE SEMINAR 7. (0) (Open to students in the Ph.D. Program.) (Section 001 Agrometeorology, Forest Science and Soil Science students) (Section 002 Entomology and Wildlife Biology students) (Section 003 Microbiology students) Presentation on a selected topic, research proposal or research results based on progress in the Ph.D. degree.

SOIL 602 ADVANCED SOIL ECOLOGY 1. (3) Discussion of significant research in soil ecology including transformations of soil organic matter and nutrients, ecological and pedological functions of soil organisms, soil food webs, plant-soil biota interactions, and analytical techniques for monitoring soil organisms.

SOIL 603 ADVANCED SOIL ECOLOGY 2. (3) Discussion of significant research in soil ecology including the occurrence and activity of soil organisms, methods of monitoring and manipulating soil biota for soil fertility management, and human impacts on soil biota at different scales in the environment.

★ **SOIL 610D1 PEDOLOGY.** (1.5) (2 lectures per week, one term) (Students must also register for SOIL 610D2) (No credit will be given for this course unless both SOIL 610D1 and SOIL 610D2 are successfully completed in consecutive terms) Processes of profile development, principles of classification, comparative taxonomy, U.S. and Canadian systems.

★ **SOIL 610D2 PEDOLOGY.** (1.5) (Prerequisite: SOIL 610D1) (No credit will be given for this course unless both SOIL 610D1 and SOIL 610D2 are successfully completed in consecutive terms) See SOIL 610D1 for course description.

● ★ **SOIL 630 SOIL MINEROLOGY.** (3) (2 lectures per week, one term)

SOIL 631 ADVANCED SOIL PHYSICS. (3) (2 lectures per week, one term) State and fluxes of matter and energy in the soil. Applications to movement of water, salts, nutrients; diffusion of gases; heat transfer. Discussion of significant research in soil physics.

WILD 605 WILDLIFE ECOLOGY. (3) (2 class hours per week) Discussion of current topics in wildlife ecology with special reference to the research interests of staff and students involved.

WILD 610 FISH ECOLOGY. (3) (3 class hours per week) A critical examination of current topics in fish ecology; discussion of migration, reproductive strategies, sex determination mechanisms, competition, communication and predator-prey relationships.

● **WILD 615 ECOLOGICAL COMMUNITIES.** (3)

WOOD 640 RECENT ADVANCES: TREE ECOPHYSIOLOGY. (3) (3 lectures per week) Discussion of the effects of environmental factors on the physiology of trees. Both anthropogenic and natural factors will be discussed.

WOOD 660 RECENT ADVANCES: FOREST ECOLOGY. (3) (2 hours seminar) Review and discussion of current literature in forest ecology. Topics covered will depend on the research interests of students and may include population biology of forest plants, forest succession, forest nutrition and nutrient cycling, computer modeling of forest systems.