ADMISSION – JOINT PH.D.

Candidates will normally hold an M.B.A. or other related Master’s level degree, with a strong academic record from a recognized university. In certain cases, candidates without related Master’s degree but with exceptional backgrounds may be considered for the program. Experience judged relevant to the course of study will be considered a desirable feature of the applicant’s background. A recent GMAT score (within 5 years) and two recent letters of recommendation are required as part of the application.

Students may apply for admission to one or more of the participating universities. These applications will be processed by both the individual university and the joint committee of the four schools. Students’ preferences will prevail when more than one participating university is prepared to accept them. The Ph.D. degree will be granted by the university that admits the student. The program requires a minimum full-time residency of six semesters.

These applications must be completed by February 1st for September admission. January admissions are exceptional and subject to the approval of the Program Director.

Completed McGill application forms should be sent to:

Program Coordinator, Ph.D. Program
Faculty of Management
McGill University
1001 Sherbrooke Street West
Montreal, QC H3A 1G5
Telephone: (514) 398-4074
Fax: (514) 398-3876
E-mail: phd@mg.mcgill.ca

The addresses of the three other institutions are:

Concordia University, Faculty of Commerce and Administration,
1455 de Maisonneuve Blvd West, Montreal, QC H3G 1M8

École des Hautes Études Commerciales, 3000 Chemin de la Cote Ste-Catherine, Montréal, QC H3T 2A7

Université du Québec à Montréal, Département des Sciences Administratives, 315 Ste-Catherine Est, Montréal, Québec H5C 1R2

46 Mathematics and Statistics

Department of Mathematics and Statistics
Burnside Hall
805 Sherbrooke Street West
Montreal, QC H3A 2K6
Canada
Telephone: (514) 398-3800
Fax: (514) 398-3899
E-mail: gradprog@math.mcgill.ca
Website: http://www.math.mcgill.ca

Chair — K. Gowrisankaran
Chair of Committee on Graduate Affairs — K. Peter Russell

46.1 Staff

Emeritus Professors
J. Lambek; M.Sc., Ph.D.(McG.), F.R.S.C., (Peter Redpath Emeritus Professor of Pure Mathematics)
W.O.J. Moser; B.Sc.,(Manit.), M.A.(Minn.), Ph.D.(Tor.)

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.)
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. Khislamipovitch; M.A., (Ural State), Ph.D.(Lenin.), Dr. of Sc., (Steklov Inst.)
Applications wishing to concentrate in pure mathematics should have a strong background in linear algebra, abstract algebra, and real and complex analysis.

Applications 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.

Applications 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 register for a Qualifying Year.

Ph.D. Degree
Students normally enter the Ph.D. program after completing a Master's degree program with high standing.

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.

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 Chair of the Committee on Graduate Affairs.

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: 189-487 and 189-560; 189-578 and 189-579; 189-586 and 189-585.
- For students in pure mathematics: at least two of the following course sequences: 189-564, 189-565 and 189-566; 189-570 and 189-571; 189-576 and 189-577.
- Students in statistics are required to take 189-556 and 189-557 and, if they intend to continue in a doctoral program, they should also take 189-587 and 189-589.

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
- Denotes not offered in 2000-01.
This Calendar is prepared long before it is known precisely which courses will be offered. In 2000-01 most 500-level and approximately 15 of the 600- and 700-level courses will be given. Students should consult the Departmental website for an updated list of offerings.

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


189-556B Mathematical Statistics II. (4) (Prerequisite: 189-556) Sampling theory (including large-sample theory). Likelihood functions and information matrices. Hypothesis testing, estimation theory, and decision theory. Regression and correlation theory.


189-564A Advanced Real Analysis I. (4) (Prerequisites: 189-354, 189-355 or equivalents.) Review of theory of measure and integration; product measures, Fubini's theorem; L spaces; basic principles of Banach spaces; Riesz representation theorem for C(X); Hilbert spaces; part of the material of 189-565B may be covered as well.

189-565B Advanced Real Analysis II. (4) (Prerequisite: 189-564) Continuation of topics from 189-564. Signed measures,
Hahn and Jordan decompositions. Radon-Nikodým theorems, complex measures, differentiation in $\mathbb{R}^N$, Fourier series and integrals, additional topics.

189-566A ADVANCED COMPLEX ANALYSIS. (4) (Prerequisites: 189-466, 189-564) 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.

189-570A HIGHER ALGEBRA I. (4) (Prerequisite: 189-371 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 189-571B may be covered as well.

189-570B HIGHER ALGEBRA II. (4) (Prerequisite: 189-570 or consent of instructor.) Completion of the topics of 189-570. 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. Cohomology of finite groups if time permits.

189-574 ORDINARY DIFFERENTIAL EQUATIONS. (4) (Prerequisites: 189-325, 354)

189-575 PARTIAL DIFFERENTIAL EQUATIONS. (4) (Prerequisite: 189-375A)

189-576A GEOMETRY AND TOPOLOGY I. (4) (Prerequisite: 189-354) 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 189-577B may be covered as well.


189-578A NUMERICAL ANALYSIS. (4) (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.

189-579 NUMERICAL DIFFERENTIAL EQUATIONS. (4) (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 equations, hyperbolic equations and elliptical equations, consistency, convergence and stability of numerical schemes. Explicit and implicit methods, alternating direction explicit and alternating direction implicit methods.


189-589B ADVANCED PROBABILITY THEORY II. (4) (Prerequisite: 189-587 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.

189-591B MATHEMATICAL LOGIC I. (4) (Prerequisites: 189-488 or equivalent or consent of instructor.) Propositional logic and first order logic, completeness, compactness and Löwenheim-Skolem theorems. Introduction to axiomatic set theory. In the remaining time, a selection from the following topics: introduction to model theory, Herbrand's and Gentzen's theories, Lindström's characterization of first order logic.

189-600A,B,C,L,T MASTER'S THESIS RESEARCH I. (6) (Not open to students who have taken or are taking 189-640.) Thesis research under supervision.


189-605A,B,C,L,T MASTER'S THESIS RESEARCH IV. (6) Thesis research under supervision.

189-606 ALGEBRAIC TOPOLOGY. (4) (Prerequisite: 189-577B) Homology and Cohomology theories. Higher homotopy groups.


189-609 LIE GROUPS AND LIE ALGEBRAS II. (4) A continuation of the topics listed in the description of 189-608.

189-612 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.


189-622 CATEGORIES I. (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.

189-623 CATEGORIES II. (4) A continuation of the topics listed in the description of 189-622.


189-625 APPLIED CATEGORY THEORY II. (4) A continuation of the topics listed in the description of 189-624.

189-626 ADVANCED GROUP THEORY I. (4) The structure of groups. Special classes of groups. Representation theory. Additional topics to suit the class.

189-627 ADVANCED GROUP THEORY II. (4) A continuation of the topics listed in the description of 189-626.

189-628 MATHEMATICAL LINGUISTICS. (4) (Given in collaboration with the Department of Linguistics. Prerequisites: 189-328 or 104-560A, or equivalent.) Phrase structure, production, categorial and transformational grammars, with applications to fragments of English and French and to kinship systems. Machines for generating and recognizing sentences; parsers. Introduction to lambda calculus and type theory; logical form and Montague semantics.

189-631 COMPLEX FUNCTION THEORY I. (4) (Prerequisite 189-564, -565, and -566 or equivalent.) Advanced topics in one complex variable, and some topics in several complex variables.

189-632 COMPLEX FUNCTION THEORY II. (4) (Prerequisite 189-631) Topics in the theory of functions of several complex variables.

189-633 HARMONIC ANALYSIS I. (4) (Prerequisite 189-564, -565, and -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.

189-634 HARMONIC ANALYSIS II. (4) (Prerequisites: 189-633 and -635.) The contents of this course will consist of further topics in classical harmonic analysis and a more detailed study of abstract harmonic analysis on locally compact groups.


189-636 FUNCTIONAL ANALYSIS II. (4) (Prerequisites: 189-635 and -636.) A continuation of the topics listed in the description of 189-635.


189-640A,B,C,L,T PROJECT I. (6) (Not open to students who have taken or are taking 189-600) Project research under supervision.

189-641A,B,C,L,T PROJECT II. (9) Project research under supervision.


189-671 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.

189-674 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.


189-677 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.

189-678 APPLIED STATISTICAL METHODS AND DATA ANALYSIS I. (4) Statistical data analysis, with special reference to applications of the main statistical methods to problems in medicine, biology, chemistry, etc. Extensive use of computer methods, especially subroutine packages for statistical data description, display and analysis.

189-679 APPLIED STATISTICAL METHODS AND DATA ANALYSIS II. (4) Same emphasis as 189-678 but with a different selection of statistical methods.

189-680 COMPUTATION INTENSIVE STATISTICS. (4) (Prerequisites: 189-556, 189-557 or permission of instructor) (Not open to students who have taken or are taking 513-680.) 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.


189-683 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.

189-686 Survival Analysis. (4) (Prerequisites: 189-556, 189-557 or permission of instructor.) (Not open to students who have taken or are taking 513-686.) 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.

189-687 Reading Course in Mathematical Logic I. (4) A highly specialized study.

189-688 Reading Course in Mathematical Logic II. (4) (A highly specialized study.

189-689 Reading Course in Algebra I. (4) A highly specialized study.

189-690 Reading Course in Algebra II. (4) A highly specialized study.

189-691 Reading Course in Geometry and Topology I. (4) A highly specialized study.

189-692 Reading Course in Geometry and Topology II. (4) A highly specialized study.

189-693 Reading Course in Analysis I. (4) A highly specialized study.

189-694 Reading Course in Analysis II. (4) A highly specialized study.

189-695 Reading Course in Applied Mathematics I. (4) A highly specialized study.

189-696 Reading Course in Applied Mathematics II. (4) A highly specialized study.


189-698 Reading Course in Statistics and Probability II. (4) A highly specialized study.

189-699 Reading Course in Optimization. (4) A highly specialized study.

189-700A,B Comprehensive Examination: Part A. – Written

189-701A,B Comprehensive Examination: Part B. – Oral

189-704 Topics in Mathematical Logic I. (4)

189-705 Topics in Mathematical Logic II. (4)

189-706 Topics in Geometry and Topology I.

189-707 Topics in Geometry and Topology II.

189-708 Topics in Geometry and Topology III.

189-709 Topics in Geometry and Topology IV.

189-710 Topics in Algebra I.

189-711 Topics in Algebra II.

189-712 Topics in Algebra III.

189-713 Topics in Algebra IV.

189-714 Topics in Algebra V.

189-715 Topics in Algebra VI.

189-716 Topics in Number Theory I.

189-717 Topics in Number Theory II.

189-718 Topics in Number Theory III.

189-719 Topics in Number Theory IV.

189-720 Topics in Analysis I.

189-721 Topics in Analysis II.

189-722 Topics in Analysis III.

189-723 Topics in Analysis IV.

189-724 Topics in Analysis V.

189-725 Topics in Analysis VI.

189-726 Topics in Number Theory I.

189-727 Topics in Number Theory II.

189-728 Topics in Number Theory III.

189-729 Topics in Number Theory IV.

189-730 Topics in Probability.

189-731 Topics in Statistics.

189-732 Topics in Stochastic Processes.

189-733 Topics in Applied Mathematics.

189-734 Topics in Optimization.

189-735 Topics in Game Theory.

189-736 Topics in Geometry and Topology.

189-737 Topics in Algebra.

189-738 Topics in Logic.

189-739 Topics in Analysis.

189-740 Topics in Probability.

189-741 Topics in Statistics.

189-742 Topics in Number Theory.

189-743 Topics in Applied Mathematics.

189-744 Topics in Optimization.

189-745 Topics in Analysis VI. (4 credits each) Each of these courses covers an advanced topic in some branch of analysis.

189-756 Topics in Optimization I.

189-757 Topics in Optimization II.

189-758 Topics in Optimization III.

189-759 Topics in Optimization IV.

189-760 Topics in Applied Mathematics I.

189-761 Topics in Applied Mathematics II.

189-762 Topics in Applied Mathematics III.

189-763 Topics in Applied Mathematics IV.

189-764 Topics in Applied Mathematics V.

189-765 Topics in Applied Mathematics VI.

189-766 Topics in Applied Mathematics VII.

189-767 Topics in Applied Mathematics VIII.

189-768 Topics in Applied Mathematics IX.

189-769 Topics in Applied Mathematics X.

189-770 Topics in Applied Mathematics XI.

189-771 Topics in Stochastic Processes I.

189-772 Topics in Stochastic Processes II.

189-773 Topics in Stochastic Processes III.

189-774 Topics in Stochastic Processes IV.

189-775 Topics in Stochastic Processes V.

189-776 Topics in Stochastic Processes VI.

189-777 Topics in Stochastic Processes VII.

189-778 Topics in Stochastic Processes VIII.

189-779 Topics in Stochastic Processes IX.

189-780 Topics in Stochastic Processes X.

189-781 Topics in Stochastic Processes XI.

189-782 Topics in Statistics and Probability I.

189-783 Topics in Statistics and Probability II.

189-784 Topics in Statistics and Probability III.

189-785 Topics in Statistics and Probability IV.

189-786 Topics in Statistics and Probability V.

189-787 Topics in Statistics and Probability VI.

189-788 Topics in Statistics and Probability VII.

189-789 Topics in Statistics and Probability VIII.

189-790 Ph.D. Language Requirements.

189-791D Seminars in Mathematical Logic. (6)

189-792D Seminars in Algebra. (6)

189-794D Seminars in Geometry and Topology. (6)

189-796D Seminars in Analysis. (6)

189-797D Seminars in Applied Mathematics. (6)

189-798D Seminars in Statistics and Probability. (6)

47 Mechanical Engineering

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Website: http://www.mecheng.mcgill.ca
Chair — S.J. Price
Chair of Graduate Program — J.A. Nemes

47.1 Staff

Emeritus Professors
W. Bruce; B.A.Sc., M.A.Sc.(Tokyo), Eng.
J. Chena; Dipl.Eng.(Swiss Fed. Inst.), Eng., F.E.I.C.

Professors
A.M. Ahmed; B.Sc.(Dhaka), Ph.D.(McG.), Eng.
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)
J.H.S. Lee; B.Eng.(McG.), M.Sc.(M.I.T.), Ph.D.(McG.), Eng.
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:
- January 1st for Spring admission;
- May 1st for Fall admission.

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)

305-608 (1) Seminar
305-691* (3) M.Eng. Thesis Literature Review
305-692 (4) M.Eng. Thesis Research Proposal
305-693 (3) M.Eng. Thesis Progress Report I
305-694 (6) M.Eng. Thesis Progress Report II
305-695 (12) M.Eng. Thesis

305-691 is to be completed in the first semester of the student's program.

Complementary Courses (16 credits)
a set of courses to be selected from the list below, or approved courses offered by other engineering departments, to a minimum of 16 credits.

Students who do not hold an undergraduate engineering (or equivalent) degree and who are accepted into a Master's program will register for the M.Sc. degree in Mechanical Engineering. This applies particularly to students engaged in interdisciplinary research.

M.Eng. Aerospace Degree
Applicants would normally hold a B.Eng. in Mechanical Engineering, however students with an undergraduate degree in engineering other than Mechanical Engineering are also eligible to apply.

47.6 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)

305-608 (1) Seminar
305-691* (3) M.Eng. Thesis Literature Review
305-692 (4) M.Eng. Thesis Research Proposal
305-693 (3) M.Eng. Thesis Progress Report I
305-694 (6) M.Eng. Thesis Progress Report II
305-695 (12) M.Eng. Thesis

305-691 is to be completed in the first semester of the student's program.

Complementary Courses (16 credits)
a set of courses to be selected from the list below, or approved courses offered by other engineering departments, to a minimum of 16 credits.

Students who do not hold an undergraduate engineering (or equivalent) degree and who are accepted into this option will register for the M.Eng. 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 rules of the Faculty 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)

305-605A (4) Applied Mathematics I
305-610B (4) Fundamentals of Fluid Mechanics
305-632A (4) Stress Analysis
305-642B (4) Advanced Dynamics
305-603* (6) Design Project I
305-604* (6) Design Project II
305-609* (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 five 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 courses, although it is not necessary that students confine their choice to one of these groups.
M.Eng. Aerospace Degree (minimum 45 credits)

The M.Eng. Aerospace Degree is offered to 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 and Université de Sherbrooke. 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)
- 305-687 (3) Aerospace Case Studies
- 305-688 (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 Management program (M.M.M.) is offered to students who wish to have a career as manufacturing managers. The program sets a curriculum in manufacturing and management subjects as well as providing exposure to industry through case studies, seminars and a paid industry internship.

The M.M.M. program is a 12-month academic program starting in September followed by a 4-month industrial internship. The program is offered in collaboration with the Faculty of Management, and the Master in Management (Manufacturing) degree is granted jointly by the Faculties of Engineering and Management.

Students should hold an undergraduate degree in engineering or science. Two to five years industrial experience is preferred, but not mandatory. Students with other academic backgrounds and appropriate industrial experience will be considered. The program is intended for full time as well as part time students. Enrollment is limited.

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

Management Segment – Required Courses (14 credits)
- 277-608 (3) Data, Decisions and Models
- 279-603 (3) Industrial Relations
- 280-611 (2) Financial Accounting
- 280-612 (2) Organizational Behaviour
- 280-616 (2) Marketing
- 280-641 (2) Elements of Modern Finance I

Management Segment – Complementary Courses (3 credits)
one of the following two courses:
- 272-632 (3) Group Dynamics and Interpersonal Behaviour
- 272-640 (2) Leadership, Power and Influence

A background in statistics is a prerequisite for the program; otherwise 277-671 Statistics for Business Decisions is required.

Manufacturing Segment – Required Courses (18 credits)
- 277-601 (3) Management of Technology in Manufacturing
- 277-603 (3) Logistics Management
- 277-605 (3) Total Quality Management
- 277-631 (3) Analysis of Manufacturing Systems
- 305-524 (3) Computer Integrated Manufacturing
- 305-526 (3) Manufacturing and the Environment

Manufacturing Segment – Complementary Courses (9 credits)
one of the following two courses:
- 277-602 (3) Manufacturing Strategies

MET 6.904 (3) Strategic Planning and Technological Forecasting

and one of the following two options:
- Discrete Manufacturing Option
  - 305-528 (3) Product Design
  - 305-529 (3) Discrete Manufacturing Systems
- Process Manufacturing Option
  - 302-572 (3) Process Dynamics and Control
  - 302-653 (3) Advanced Process Design

Industrial Segment – Required Courses (12 credits)
- 305-627 (9) Manufacturing Industrial Stage
- 305-628 (2) Manufacturing Case Studies
- 305-629 (1) Manufacturing Industrial Seminar

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 Calendar of the Faculty.

47.6 Courses
- Denotes not offered in 2000-01.
- Denotes limited enrolment.

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

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.

305-413A CONTROL SYSTEMS. (3)
305-432A AIRCRAFT STRUCTURES. (3)

COURSES OPEN TO GRADUATE AND TO QUALIFIED UNDERGRADUATE STUDENTS

305-500A, B SELECTED TOPICS IN MECHANICAL ENGINEERING. (3) A course to allow the introduction of new topics in Mechanical Engineering as needs arise, by regular and visiting staff. Staff
305-501A, B SELECTED TOPICS IN MECHANICAL ENGINEERING. (3) A course to allow the introduction of new topics in Mechanical Engineering as needs arise, by regular and visiting staff. Staff
305-522B PRODUCTION SYSTEMS. (3) 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,
Method. Unsteady compressible flow past oscillating aerofoils.

305-526C MANUFACTURING AND THE ENVIRONMENT. (3) Course topics include: clean manufacturing, product and process design for minimizing materials and energy use, the product life cycle, impact of technology on the environment, environmental impact assessment, regulatory process, and managing the "political" process.


305-529C DISCRETE MANUFACTURING SYSTEMS. (3) 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.

305-530B MECHANICS OF COMPOSITE MATERIALS. (3) (Instructor's permission)

305-531B AEROELASTICITY. (3) (Prerequisite: 305-533A)

305-532B AIRCRAFT PERFORMANCE, STABILITY AND CONTROL. (3) (Prerequisite: 305-533A) Aircraft performance criteria such as range, endurance, max. fuel efficiency, max. 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.

305-533A SUBSONIC AERODYNAMICS 3. (3) Kinematics; equations of motion; vorticity and circulation; conformal mapping and flow around simple bodies. Two dimensional flow around aerfoils. Three dimensional flows; high and low aspect-ratio wings; airfoils. Wind tunnel interference. Similarity rules for subsonic irrotational flow.

305-534B AIR POLLUTION ENGINEERING. (3) (Consent of instructor)


305-538B UNSTEADY AERODYNAMICS. (3) (Prerequisite: 305-533A) Fundamental equations of unsteady compressible flows in fixed or moving reference frames. Unsteady flows past translating bodies having oscillatory motions. Oscillations of cylindrical pipes or shells subjected to internal flows. Vortex theory of oscillating aerfoils in incompressible flows. Theodorsen's method. Unsteady compressible flow past oscillating aerfoils.


305-540B DESIGN: MODELLING AND DECISION. (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 directions. Use of modern software for design decision making. Introduction to mechanism animation. Introduction to design for NC production.


305-542B SPACECRAFT DYNAMICS. (3) Review of central force motion; Hohmann and other coplanar transfers, rotation of the orbital plane, patched conic methods. 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 manoeuvres; large space structures.

305-543A DESIGN WITH COMPOSITE MATERIALS. (3) (Prerequisite: 305-530)

305-545A ADVANCED STRESS ANALYSIS. (3) (Not open to students who are taking or have taken 305-632.) Tensor Analysis: Review of continuum mechanics. Equilibrium and constitutive equations in tensor form. Finite elements methods. Torsion of non-circular cross-sections; spherical problems; advanced air stress function problems. Introduction to plates and shells. Thermal deformations and stresses. Introduction to plasticity and viscoelasticity.


305-555B APPLIED PROCESS CONTROL. (3) (Prerequisite: 305-554)

305-557B MECHATRONIC DESIGN, (3)


305-562A ADVANCED FLUID MECHANICS. (3)


Professor Baliga
305-572A INTRODUCTION TO ROBOTICS. (3) (Prerequisite: Permission of the instructor. Not open to students who have taken 305-573.) 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. Professor Angeles.

- 305-573B MECHANICS OF ROBOTIC SYSTEMS. (3) (Prerequisite: Consent of the instructor.)

305-577A OPTIMUM DESIGN. (3) The role of optimization within the design process; Design methodology and philosophy. Constrained optimization: The Kuhn-Tucker conditions. Techniques of linear and nonlinear programming. The simplex and the complex methods. Sensitivity of the design to manufacturing errors. Robustness of the design to manufacturing and operation errors. Professor Angeles.

- 305-578B ADVANCED THERMODYNAMICS. (3)
- 305-581A NONLINEAR DYNAMICS AND CHAOS. (3)

COURSES FOR GRADUATE STUDENTS ONLY

305-602A,B SPECIAL TOPICS IN MECHANICAL ENGINEERING. (4) New developments related to Mechanical Engineering will be presented either by staff or by visiting professors. Staff.

- 305-603A,B OR C DESIGN PROJECT I. (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. Staff.

- 305-604A,B OR C DESIGN PROJECT II. (6) A continuation of 305-603A, B or C. Staff.


- 305-606B APPLIED MATHEMATICS II. (4) (Prerequisite: 305-605A)
- 305-608B NUMERICAL ANALYSIS FOR COMPUTER USERS II. (4) (Evening course)

305-609A,B,C 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. Staff.


- 305-615A,B GAS DYNAMICS I. (4)
- 305-617A,B GAS DYNAMICS II. (4)

305-620A,B ADVANCED COMPUTATIONAL AERODYNAMICS. (4) (Evening course)

- 305-626B ADVANCED CONCEPTS OF ENGINEERING DESIGN. (4) (Evening course)

305-627A 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. Staff.

305-628A,B,C 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. Staff.

305-629A,B,C 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. Staff.


- 305-634B NONLINEAR CONTINUUM MECHANICS. (4)
- 305-635B FRACTURE AND FATIGUE. (4) (Evening course) (Prerequisite: 305-632A)


- 305-643B VIBRATIONS IN ENGINEERING SYSTEMS. (4) (Evening course) (Prerequisite: 305-642B)

305-645B FINITE ELEMENTS IN DYNAMIC SYSTEMS. (4) (Evening course) (Prerequisite: 305-642B)


- 305-652A DYNAMICS OF COMBUSTION. (4)

305-654B COMPUTER FLUID DYNAMICS AND HEAT TRANSFER. (4) (Evening course)

305-681 A,B,C AERONAUTICS PROJECT I. (3) (Open to students in the Aeronautical Option only.) The project is undertaken under the direct supervision of at least one staff member. Examination entails the writing of a report which is examined internally within the Mechanical Engineering Department. Staff.

- 305-682 A,B,C AERONAUTICS PROJECT II. (3) (Restricted to students in the Aeronautical Option only.) A continuation of 305-681. Staff.

305-683 A,B,C AERONAUTICS PROJECT III. (3) (Open to students in the Aeronautical Option only.) A continuation of 305-682. Staff.

305-687A,B,C AEROSPACE CASE STUDIES. (3) (Restricted to students in the Aerospace Engineering Option/Programs at McGill, Concordia or Ecole Polytechnique.) 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. Staff.

305-688A,B,C 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. Staff.
The research interests of members of the Unit include various aspects of medical imaging, including 3D imaging, the development of new imaging modalities and applications of imaging in radiation therapy; radiation dosimetry, especially solid state, electret and NMR systems; nuclear cardiology; and applications of radiation biology to therapy.

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

48.3 Admission Requirements

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

48.4 Application Procedures

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

Only complete applications will be considered. Interested candidates should (a) ask their university(ies) to send two originals of each transcript, and (b) request that original confidential letters of recommendation be sent by professors familiar with their work.

The application fee of $60 CDN should be remitted in Canadian funds in negotiable form, such as a bank draft, money order, etc. payable to McGill University.

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

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

48.5 Program Requirements

M.Sc. in Medical Radiation Physics

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

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

48.6 Graduate Level Courses

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

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

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