economic analysis including costs and benefits; special features of hydro plants; and appurtenances for hydro plants.

**303-585B GROUNDWATER HYDROLOGY.** 3(3-0-6) (Prerequisite: Permission of instructor.) Groundwater geology; steady-state and transient-state regional groundwater; infiltration and recharge; hydrological cycle; chemical constituents; adsorption/desorption processes; Groundwater exploration techniques; pumping tests; groundwater pollution; diffusion and dispersion; thermal processes; groundwater resource management. Professor Selvaldurai

● **303-586A EARTHWORK ENGINEERING.** 3(3-0-6) (Prerequisite: Permission of instructor.) Stability of natural slopes and cuts, stability analysis; design of earth and rock fills, dykes and dams; techniques to improve stability; compaction of soil, compaction control; soil improvement by in-situ processes; reinforced earth. TBA

● **303-587A PAVEMENT DESIGN.** 3(3-0-6) (Prerequisite: Permission of instructor.) Design of bituminous mixtures, construction control; evaluation of design parameters, factors controlling their variability; soil stabilization; frost effects; stresses and displacements in layered systems, analysis of rigid and flexible pavement systems; design of highway and airport pavements; pavement evaluation and strengthening; recycling. TBA

### 4.5 Department of Electrical and Computer Engineering

McConnell Engineering Building, Room 633
McGill University
3480 University Street, Montreal, QC, H3A 2K6
Telephone: (514) 398-7110 Fax: (514) 398-4470
http://www.ece.mcgill.ca

**Chair**

David A. Lowther; B.Sc.(Lond.), Ph.D.(C.N.A.A.), F.C.A.E., Eng.

**Associate Chair**

Jonathan P. Webb; B.A. Ph.D.(Canat.)

**Emeritus Professors**

Eric L. Adler; B.Sc.(Lond.), M.A.Sc.(Tor.), Ph.D.(McG.), F.I.E.E.E., Eng.


**Professors**


Clifford H. Champness; M.Sc.(Lond.), Ph.D.(McG.) (part-time)


Peter Kabal; B.A.Sc., M.A.Sc., Ph.D.(Tor.)

Theo Le-Ngoc; M.Eng.(McG.), Ph.D.(Ott.), F.I.E.E.E.


David A. Lowther; B.Sc.(Lond.), Ph.D.(C.N.A.A.), F.C.A.E., Eng.

Frank Ferrie; B.Eng., Ph.D.(McG.)

Vincent Hayward; Dip.d'Ing.(ENSM, Nantes), Doc.Ing.(Orsay), Eng.

Harry Leib; B.Sc.(Technion), Ph.D.(Tor.)

Steve McFee; B.Eng., Ph.D.(McG.)

Hanna Michalska; B.Sc., M.Sc.(Warsaw), Ph.D.(Lond.)

David V. Plant; M.S., Ph.D.(Brown)

Gordon Roberts; B.A.Sc.(Waterloo), M.A.Sc., Ph.D.(Tor.), Eng.

Ishiang Shih; M.Eng., Ph.D.(McG.)

### Assistant Professors

Jan Baijczy; B.Sc.(Harv.), M.Eng., Ph.D.(Prin.)

Benoit Boulet; B.Sc.(Laval), M.Eng.(McG.) Ph.D.(Tor.)

Benoit Champagne; B.Eng., M.Eng.(Montr.), Ph.D.(Tor.)

Jeremy R. Cooperstock; A.Sc.(U.B.C.), M.Sc., Ph.D.(Tor.)

Mourad El-Gamal; B.Sc.(Cairo), M.Sc.(Nashville), Ph.D.(McG.)

Karim Khordoc; B.Eng., M.Eng., Ph.D., Ph.D.(McG.)

Andrew Kirk; B.Sc.(Bryst.), Ph.D.(London)

Radu Negulescu; M.Sc.(Romania), M.Sc.(France), Ph.D.(Wat.)

Zilic Zejko; B.Eng.(Zagreb), M.Sc., Ph.D.(Tor.)

### Visiting Professors

Michael Kaplan; M.Sc., Ph.D.(Cornell)

Birenda Prasad; M.Sc.(Ban.), Ph.D.(Lond.)

Jean Regnier; B.Eng., M.Eng.(Montr.), Ph.D.(M.I.T.)

### Lecturers

Kenneth L. Fraser; B.Eng., M.Eng.(McG.), Eng.

Florence Danilo; M.Eng.(McG.)

Dennis Giannacopoulos; M.Eng., Ph.D.(McG.)

### Associate Members

Martin Buehler; M.Sc., Ph.D.(Yale)

Gregory Dudek; B.Sc.(Queen's), M.Sc., Ph.D.(Tor.)

Alan C. Evans; M.Sc.(Surrey), Ph.D.(Leeds)

William R. Funnell; M.Eng., Ph.D.(McG.)

Henrietta L. Galiana; M.Eng., Ph.D.(McG.)

Jean Goilman; M.E.(Dartmouth, N.S.), Ph.D.(McG.)

Robert E. Kearney; M.Eng., Ph.D.(McG.)

Bruce Pike; M.Eng., Ph.D.(McG.)

### Adjunct Professors


### General Information on Programs

The Department of Electrical and Computer Engineering offers undergraduate degree programs in Electrical Engineering, Electrical Engineering (Honours), and Computer Engineering. All programs provide students with a strong background in mathematics, basic sciences, engineering science, engineering design and complementary studies, in conformity with the requirements of the Canadian Engineering Accreditation Board (CEAB).

The program in Electrical Engineering gives students a broad understanding of the key principles that are responsible for the extraordinary advances in the technology of computers, microelectronics, automation and robotics, telecommunications and power systems. These areas are critical to the development of our industries and, more generally, to our economy. A graduate of this program is exposed to all basic elements of electrical engineering and can function in any of our client industries. This breadth is what distinguishes an engineer from, say, a computer scientist or physicist.

The program in Electrical Engineering (Honours) is designed for students who wish to pursue postgraduate work and look to a career in advanced research and development. The technical complementsaries are selected from graduate courses, facilitating the transition to postgraduate studies. Students in this curriculum benefit from smaller classes and have more contact with professorial staff and graduate students. However, the program is quite demanding. Students are expected to register for at least 14 credits per semester; they may register for a smaller number only with the permission of the Chair of this Department. Students in the Honours program must maintain a minimum GPA of 3.00. Those who fail to maintain this standard are transferred to the regular program.

The program in Computer Engineering provides students with greater depth and breadth of knowledge in the hardware and software aspects of computers. Students are exposed to both theoretical and practical issues of both hardware and software in well-equipped laboratories. Although the program is designed to meet the growing demands by industry for engineers with a strong back-
ground in modern computer technology, it also provides the underlying depth for graduate studies in all fields of Computer Engineering.

In addition to technical complementary courses, students in all three programs take general complementary courses in social sciences, administrative studies and humanities. These courses allow students to develop specific interests in areas such as psychology, economics, management or political science.

Entrance Requirements and Advanced Standing

The curricula for the various programs offered by the Department are outlined below. Students entering Electrical or Computer Engineering from CEGEP may obtain advanced credit for 189-260 Intermediate Calculus by passing the Advanced Credit examination described in section 2.3.

Entry into the Honours Program

The Honours Program is a limited enrollment program and entry is highly competitive. There is no direct entry to the Honours program in the first year. Students may enter the Honours Program in the following ways:

– Students from CEGEP (7 semester) will be admitted, on the basis of their grades, at the start of the third semester.

– Students from outside Quebec (8 semester) will be admitted, at the start of the fifth semester, on the basis of their grades.

Though not required to do so, students in the Honours Program or wishing to enter the Honours Program are encouraged to take the following math and physics courses:

189-325 Ordinary Differential Equations instead of 189-261
189-247 Linear Algebra instead of 189-270
189-248 Advanced Calculus I instead of 189-265
189-249 Advanced Calculus II instead of 189-381
198-251 Mechanics instead of 303-281

To remain in the Honours program and to be awarded the Honours Degree, a student must have completed at least 14 credits in each semester since entering Electrical Engineering and maintained a CGPA of at least 3.00 since entering Electrical Engineering. For more information, please contact the Departmental office at (514) 398-7244.

CURRICULUM FOR THE B.ENG. DEGREE IN ELECTRICAL ENGINEERING (HONOURS)

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>189-260</td>
<td>Intermediate Calculus</td>
</tr>
<tr>
<td>189-247*</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>189-248</td>
<td>Advanced Calculus I</td>
</tr>
<tr>
<td>189-249</td>
<td>Advanced Calculus II</td>
</tr>
<tr>
<td>189-325</td>
<td>Complex Variables &amp; Transforms (3)</td>
</tr>
<tr>
<td>198-251</td>
<td>Mechanics</td>
</tr>
<tr>
<td>303-281</td>
<td>Analytical Mechanics (3)</td>
</tr>
<tr>
<td>189-271</td>
<td>Quantum Physics</td>
</tr>
<tr>
<td>306-221</td>
<td>Engineering Professional Practice</td>
</tr>
<tr>
<td>306-310</td>
<td>Engineering Economy</td>
</tr>
<tr>
<td>308-202</td>
<td>Intro. to Computer Science I</td>
</tr>
<tr>
<td>455-206</td>
<td>Communication in Engineering</td>
</tr>
</tbody>
</table>

* CGPA of 3.30 is required to register for 189-247 and 189-248.

Departmental Courses

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>304-200</td>
<td>Fundamentals of Electrical Engineering</td>
</tr>
<tr>
<td>304-210</td>
<td>Circuit Analysis</td>
</tr>
<tr>
<td>304-221</td>
<td>Intro to Computer Engineering I</td>
</tr>
</tbody>
</table>

304-222 | Intro to Computer Engineering II | 3 |
304-303 | Signals & Systems I | 3 |
304-304 | Signals & Systems II | 3 |
304-305 | Probability & Random Sig. I | 3 |
304-323 | Digital System Design | 5 |
304-330 | Electronic Circuits I | 3 |
304-334 | Electronic Circuits II | 5 |
304-351 | Electromagnetic Fields | 3 |
304-352 | EM Waves and Optics | 3 |
304-361 | Power Engineering | 3 |
304-498 | Honours Thesis I | 3 |
304-499 | Honours Thesis II | 3 |

COMPLEMENTARY COURSES

Technical Complementaries 15

Five technical complementary courses (15 credits), which must be Electrical Engineering Courses at the 500-level (or 304-427, 304-428). Students must choose their technical complementary courses so that they complete at least 9 credits in one of the following concentrations. However, with Departmental approval, the Honours Thesis I and II (304-498 and 304-499) can count as 6 of the 9 credits.

Computer Systems Technology

304-427 | Operating Systems | 3 |
304-428 | Software Engineering Practice | 3 |
304-525 | Computer Architecture | 3 |
304-532 | Computer Graphics | 3 |
304-548 | Introduction to VLSI | 3 |

Control and Automation

304-502 | Control Engineering | 3 |
304-503 | Linear Stochastic Systems I | 3 |
304-504 | Computer Control | 3 |
304-505 | Nonlinear Control Systems | 3 |
304-507 | Optimization and Optimal Control | 3 |
304-512 | Digital Signal Processing I | 3 |
304-529 | Image Processing & Communication | 3 |
304-531 | Real Time Systems | 3 |

Integrated Circuits and Electronics

304-522 | Asynchronous Circuits and Systems | 3 |
304-527 | Optical Engineering | 3 |
304-530 | Logic Synthesis | 3 |
304-533 | Physical Basis of Semiconductors | 3 |
304-534 | Analog Microelectronics | 3 |
304-545 | Microelectronics Technology | 3 |
304-548 | Introduction to VLSI | 3 |
304-571 | Optoelectronic Devices | 3 |
304-573 | Microwave Electronics | 3 |

Power Engineering

304-502 | Control Engineering | 3 |
304-549 | Expert Systems in Electrical Design | 3 |
304-559 | Flexible AC Transmission Systems | 3 |
304-560 | Power Systems II | 3 |
304-563 | Power Systems Operation and Planning | 3 |
304-565 | Power Electronics | 3 |

Telecommunications

304-509 | Probability and Random Sig. II | 3 |
304-511 | Intro. to Digital Comm. | 3 |
304-512 | Digital Signal Processing I | 3 |
304-521 | Digital Communications I | 3 |
304-523 | Speech Communications | 3 |
304-527 | Optical Engineering | 3 |
304-528 | Telecom. Network Architecture | 3 |
304-571 | Optoelectronic Devices | 3 |
304-592 | Microwave Theory and Techniques | 3 |
304-593 | Antennas and Propagation | 3 |
304-596 | Optical Waveguides | 3 |

Laboratory Complementaries 4

Two 400-level laboratory courses in Electrical Engineering.
### General Complementaries
Two courses (6 credits) in Social Sciences, Administrative Studies or Humanities, selected from an approved list (category ii - section 3.3) and one course (3 credits) on the impact of technology (category i - section 3.3) in consultation with an academic advisor. At least one 3-credit course must be from category A (Humanities and Social Sciences) in section 3.3.

**TOTAL CREDITS** 110

### CURRICULUM FOR THE B.ENG. DEGREE IN ELECTRICAL ENGINEERING (REGULAR)

#### REQUIRED COURSES

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>304-200</td>
<td>Intermediate Calculus 3</td>
</tr>
<tr>
<td>304-210</td>
<td>Circuit Analysis 5</td>
</tr>
<tr>
<td>304-221</td>
<td>Intro to Computer Engineering I 3</td>
</tr>
<tr>
<td>304-222</td>
<td>Intro to Computer Engineering II 3</td>
</tr>
<tr>
<td>304-303</td>
<td>Signals &amp; Systems I 3</td>
</tr>
<tr>
<td>304-304</td>
<td>Signals &amp; Systems II 3</td>
</tr>
<tr>
<td>304-305</td>
<td>Probability &amp; Random Sig. I 3</td>
</tr>
<tr>
<td>304-323</td>
<td>Digital System Design 5</td>
</tr>
<tr>
<td>304-330</td>
<td>Electronic Circuits I 3</td>
</tr>
<tr>
<td>304-334</td>
<td>Electronic Circuits II 5</td>
</tr>
<tr>
<td>304-351</td>
<td>Electromagnetic Fields 3</td>
</tr>
<tr>
<td>304-352</td>
<td>EM Waves and Optics 3</td>
</tr>
<tr>
<td>304-361</td>
<td>Power Engineering 3</td>
</tr>
<tr>
<td>304-494</td>
<td>Design Project 3</td>
</tr>
</tbody>
</table>

**COMPLEMENTARY COURSES** 48

#### Technical Complementaries
Six courses (18 credits) from the list of 400-level courses in Electrical Engineering that must include 9 credits (3 courses) from one of the areas of concentration listed below:

#### Computer Systems Technology
<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>304-424</td>
<td>Human Computer Interaction 9</td>
</tr>
<tr>
<td>304-425</td>
<td>Computer Organization and Architecture 3</td>
</tr>
<tr>
<td>304-427</td>
<td>Operating Systems 3</td>
</tr>
<tr>
<td>304-428</td>
<td>Software Engineering Practice 3</td>
</tr>
</tbody>
</table>

#### Control & Automation
<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>304-404</td>
<td>Control Systems 3</td>
</tr>
<tr>
<td>304-412</td>
<td>Discrete Time Signal Processing 3</td>
</tr>
<tr>
<td>304-426</td>
<td>Microprocessor Systems 3</td>
</tr>
</tbody>
</table>

#### Integrated Circuits & Electronics
<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>304-425</td>
<td>Computer Organization and Architecture 3</td>
</tr>
<tr>
<td>304-431</td>
<td>Electronic Design 3</td>
</tr>
<tr>
<td>304-432</td>
<td>Physical Basis of Transistor Devices 3</td>
</tr>
</tbody>
</table>

**TOTAL CREDITS** 110

### Laboratory Complementaries
Two 400-level laboratory courses in Electrical Engineering

### COMPLEMENTARY COURSES
18

#### General Complementaries
Two courses (6 credits) in Social Sciences, Administrative Studies or Humanities, selected from an approved list (category ii - section 3.3) and one course (3 credits) on the impact of technology (category i - section 3.3) in consultation with an academic advisor. At least one 3-credit course must be from category A (Humanities and Social Sciences) in section 3.3.

**TOTAL CREDITS** 110

### CURRICULUM FOR THE B.ENG. DEGREE IN COMPUTER ENGINEERING

#### REQUIRED COURSES

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>304-260</td>
<td>Intermediate Calculus 3</td>
</tr>
<tr>
<td>189-261</td>
<td>Differential Equations 3</td>
</tr>
<tr>
<td>189-325</td>
<td>Ordinary Differential Equations (3)</td>
</tr>
<tr>
<td>189-265</td>
<td>Advanced Calculus 3</td>
</tr>
<tr>
<td>189-248*</td>
<td>Advanced Calculus (3)</td>
</tr>
<tr>
<td>189-270</td>
<td>Applied Linear Algebra 3</td>
</tr>
<tr>
<td>189-247*</td>
<td>Linear Algebra (3)</td>
</tr>
<tr>
<td>189-381</td>
<td>Complex Variables &amp; Transforms 3</td>
</tr>
<tr>
<td>189-271</td>
<td>Quantum Physics 3</td>
</tr>
<tr>
<td>198-251</td>
<td>Mechanics (3)</td>
</tr>
<tr>
<td>189-247*</td>
<td>Linear Algebra (3)</td>
</tr>
<tr>
<td>189-363</td>
<td>Discrete Mathematics 3</td>
</tr>
<tr>
<td>189-381</td>
<td>Complex Variables &amp; Transforms 3</td>
</tr>
<tr>
<td>303-281</td>
<td>Mechanics (3)</td>
</tr>
<tr>
<td>306-221</td>
<td>Engineering Professional Practice 1</td>
</tr>
</tbody>
</table>

---

*Enhanced ITT Concentration in Telecommunications*

The International Institute of Telecommunications (IIT) was recently established in Montreal as a center for telecommunications education. It is funded by government and industry, and provides state-of-the-art laboratory facilities and a point of contact between local telecommunications industries and universities. Students in the Electrical Engineering B.Eng. program, who have achieved a grade of B- or better in 304-411, can enter an Enhanced (ITT) Concentration in Telecommunications, as an alternative to the regular, 3-course concentration. The benefits of the Concentration are:

- a guaranteed project lab (304-494) in telecommunications, at IIT or with an IIT company; and
- permission to take a 500-level course in Telecommunications Management at IIT.

To complete the Concentration, students must take these six courses as Technical Complementaries:

- 304-411 Communications Systems I
- 304-412 Discrete Time Signal Processing
- 304-413 Communications Systems II
- 304-414 Introduction to Telecommunications Networking
- 304-451 EM Signal Transmission and Radiation
- 304-5xx Telecommunications Management

In addition, students must take 304-491 (Communications Systems Lab) and complete 304-494 (Design Project) in telecommunications, at IIT or with an IIT company.

There may be an enrolment limitation in this concentration in any given semester.

### CURRICULUM FOR THE B.ENG. DEGREE IN COMPUTER ENGINEERING

#### REQUIRED COURSES

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>304-260</td>
<td>Intermediate Calculus 3</td>
</tr>
<tr>
<td>189-261</td>
<td>Differential Equations 3</td>
</tr>
<tr>
<td>189-325</td>
<td>Ordinary Differential Equations (3)</td>
</tr>
<tr>
<td>189-265</td>
<td>Advanced Calculus 3</td>
</tr>
<tr>
<td>189-248*</td>
<td>Advanced Calculus (3)</td>
</tr>
<tr>
<td>189-270</td>
<td>Applied Linear Algebra 3</td>
</tr>
<tr>
<td>189-247*</td>
<td>Linear Algebra (3)</td>
</tr>
<tr>
<td>189-363</td>
<td>Discrete Mathematics 3</td>
</tr>
<tr>
<td>189-381</td>
<td>Complex Variables &amp; Transforms 3</td>
</tr>
<tr>
<td>303-281</td>
<td>Mechanics (3)</td>
</tr>
<tr>
<td>306-221</td>
<td>Engineering Professional Practice 1</td>
</tr>
</tbody>
</table>
Courses with laboratory components:
- The average number of hours per week of scheduled lab time is indicated by the second of the three bracketed numbers after the course title, e.g. (1-3-2) means 3 hours per week. Lab schedules are determined at the start of classes.

**Courses Offered by the Department**

- Denotes courses not offered in 2000-01
- Denotes courses with limited enrolment

All courses with limitations listed for section A01 have a section A02 open to other students but with password control.
gration, test planning, and maintenance. The course involves a group project. Professors Negulescu / Cooperstock

304-323A,B DIGITAL SYSTEM DESIGN. 5(3-6-6) (Prerequisites: 304-210, 304-221, and 455-206) Minimization and synthesis of combinational logic and finite state machines. Synthesis of synchronous and asynchronous sequential circuits. Principles of control design. Basic concepts in design for testability. The laboratory experiments involve the design and testing of digital systems using small and medium scale integrated circuits. CAD software is used in the design process. Professor Clark

For A Term: Section A01: Limited to Regular Electrical Engineering students only.

For B Term: Section A01: Limited to Electrical Honours and Computer Engineering students only.

304-330A,B ELECTRONIC CIRCUITS I. 3(3-0-6) (Prerequisite: 304-210) Operational amplifier circuits; conduction in semiconductors, PN junction diodes, diode circuit applications; JFET, MOSFET and BIPOLAR transistors, terminal characteristics, small and large signal models; simple amplifier configurations, three-terminal properties of small-signal models; frequency response of simple amplifier configurations; simple multistage amplifiers. Professor Plant

Section A01: Limited to Electrical Honours, Regular, and Computer Engineering students only.

304-334A,B ELECTRONIC CIRCUITS II. 5(3-6-6) (Prerequisite: 304-330, 304-334, and 455-206) Differential and multistage amplifiers, power amplifiers, feedback amplifiers, active filters, tuned amplifiers, oscillators; MOS and BIPOLAR digital circuits including gates, latches and multivibrators; A/D and D/A conversion techniques. Professor Roberts

For A Term: Section A01: Limited to Electrical Honours and Computer Engineering students only.

For B Term: Section A01: Limited to Regular Electrical Engineering students only.

304-351A,B ELECTROMAGNETIC FIELDS. 3(3-1-5) (Prerequisites: 304-200 and 189-265) Maxwell's equations, electrostatics, magnetostatics and induction for power-frequency electrical engineering problems. Professor Kirk

Section A01: Limited to Electrical Honours, Regular, and Computer Engineering students only.

304-352A EM WAVES AND OPTICS. 3(3-1-5) (Prerequisite: 304-351) Transient and steady state wave propagation in transmission lines. Telephone and radio frequency lines. Smith's chart and impedance matching. Maxwell's equations, Helmholtz's equations, Pooynting's theorem. Plane waves, polarization, Snell's law, critical and Brewster's angle. Rectangular waveguides, optical fibres, dispersion. Radiation and antennas. Professor Kirk

Section A01: Limited to Electrical Honours, Regular, and Computer Engineering students only.

304-353A ELECTROMAGNETIC FIELDS AND WAVES. 3(3-1-5) (Prerequisites: 304-210 and 189-265) Maxwell’s equations. Waves in free space and on transmission lines. Electric and magnetic force and energy. Magnetic materials. Faraday’s law. Applications to engineering problems. Professor Webb


304-411A COMMUNICATIONS SYSTEMS I. 3(3-0-6) (Prerequisite: 304-304 and 304-305) Communication system models; AM and FM modulation, performance of AM and FM systems in noise; sampling, PCM and DPCM techniques; FDM and TDM multiplexing systems; baseband digital transmission over bandlimited channels, digital modulation and detection techniques; illustrative examples of subscriber loop telephone systems, cable TV systems and broadcasting systems. Professor Leib

304-412B DISCRETE TIME SIGNAL PROCESSING. 3(3-0-6) (Prerequisite: 304-304) Discrete-time signals and systems; Fourier and Z-transforms analysis techniques, the discrete Fourier transform; elements of FIR and IIR filter design, filter structures; FFT techniques for high speed convolution; quantization effects. Professor Kabal

304-413B COMMUNICATIONS SYSTEMS II. 3(3-0-6) (Prerequisite: 304-411) Introduction to radio communications; satellite communication systems; the cellular concept; fading channel models, digital modulation techniques over fading channels, diversity systems, spread spectrum techniques; fixed assignment multiple access (FDMA, TDMA, CDMA), duplexing methods (FDD, TDD); illustrative examples of terrestrial mobile systems, fixed wireless systems, LOEs, etc.; overview of standardization activities. Staff

304-414B INTRO. TO TELECOM. NETWORKS. 3(3-0-6) (Prerequisites: 304-411 and 304-222) Introduction to physical and software architecture of modern networks and to network control and signalling systems; multiplexing and the multiplexing hierarchy, links and link formatting (SONET), circuit and packet switching, protocol stack, network resource management, switches, and router architecture, local-area networking, examples (ATM, frame relay, IP overlays, Ethernet). Professor Regnier

304-424A HUMAN-COMPUTER INTERACTION. 3(3-4-2) (Prerequisite: 304-222) The course highlights human-computer interaction strategies from an engineering perspective. Topics include user interfaces, novel paradigms in human-computer interaction, affordances, ecological interface design, ubiquitous computing and computer-supported cooperative work. Attention will be paid to issues of safety, usability, and performance. Professor Cooperstock

304-425A COMPUTER ORGANIZATION AND ARCHITECTURE. 3(3-0-6) (Prerequisites: 304-222 and 304-323) Design of instruction sets, data path, hard-wired control and microprogramming, Memory hierarchy, Virtual memory organization and management, paging and segmentation. Associative memories and caches. Look ahead systems and pipeline computers. Systolic arrays. Case studies of advanced system organization. Professor Hayward

304-426A,B MICROPROCESSOR SYSTEMS. 3(1-3-5) (Prerequisites: 304-323 and 455-206) Introduction to current microprocessors, their architecture, programming, interfacing and operating systems. The course includes lectures, use of crossassemblers, and simulators as well as laboratory experiments on actual microprocessor hardware. (This course may be counted as a technical complementary or a lab complementary.) Limited Enrolment (50).

Professor Zilic

304-427B OPERATING SYSTEMS. 3(3-3-3) (Prerequisite: 304-222) Operating system services, file system organization, disk and cpu scheduling, virtual memory management, concurrent processing and distributed systems, protection and security. Aspects of the DOS and UNIX operating systems and the C programming language. Programs that communicate between workstations across a network. Professor Khordoc

304-428B SOFTWARE ENGINEERING PRACTICE. 3(3-4-2) (Prerequisite: 304-321) Software engineering practice in industry, related to the design and commissioning of large software systems. Ethical, social, economic, safety and legal issues. Metrics, project management, costing, marketing, control, standards, CASE tools and bugs. The course involves a large team project.

Professor Negulescu

304-431A ELECTRONIC DESIGN. 3(2-4-3) (Prerequisites: 304-323 and 304-330) The computer-aided design of digital circuits. Hardware description languages, automatic synthesis, design for testability, technology mapping, simulation, timing analysis, generation of test vectors and fault coverage analysis. CAE tools supporting this design methodology are presented in the laboratory. The course includes a design project based on the gate ar-
ray technology. This course may be counted as a technical complementary or a lab complementary. Limited enrolment (30).

Professor El-Gamal

304-432B PHYSICAL BASIS OF TRANSISTOR DEVICES. 3(3-0-6) (Prerequisites: 304-330, 304-351 and 198-271) Quantitative analysis of diodes and transistors. Semiconductor fundamentals, equilibrium and non-equilibrium carrier transport, and Fermi levels. PN junction diodes, the ideal diode, and diode switching. Bipolar Junction Transistors (BJT), physics of the ideal BJT, the Ebers-Moll model. Field effect transistors, metal-oxide semiconductor structures, static and dynamic behaviour, small-signal models.

Professor Plant

304-435B MIXED-SIGNAL TEST TECHNIQUES. 3 (3-4-2) (Prerequisites: 304-304, 304-305, and 304-334) Purpose and economics of mixed-signal test, DC measurements. Accuracy and repeatability. DSP-based theory and its applications to parametric testing of analog filters, DACs, and ADC. Timing and PLL measurements. Design for Testability. Laboratory experiments will be performed using a Teradyne A567 mixed-signal production tester.

Professor Roberts

304-451B EM TRANSMISSION & RADIATION. 3(3-0-6) (Prerequisite: 304-352) Microwave transmission through waveguides: impedance matching, microwave devices, filters and resonators; microwave transmission though free space; near and far field behaviour of electromagnetic radiators, simple antennas, antenna arrays, practical antenna parameters; the physics of the radio communication channel: reflection, diffraction and scattering and their macroscopic impact (multipath, fading).

Professor Webb

304-461A ELECTRIC MACHINERY. 3(3-0-6) (Prerequisite: 305-383) (Not open to students in Electrical Engineering.) Electric and magnetic circuits. Notions of electromechanical energy conversion applied to electrical machines. Basic electrical machines - transformers, direct-current motors, synchronous motors and generators, three phase and single phase induction machines. Elements of modern electronically controlled electric drive systems.

Professor Galiana


Professor Ooi

304-464B POWER SYSTEMS ANALYSIS I. 3(3-0-6) (Prerequisite: 304-361) Basic principles of planning and operating interconnected power systems with emphasis on Canadian conditions. Mathematical models for system. Steady-state analysis of power systems with emphasis on Canadian conditions. MATHEMATICAL MODELS FOR SYSTEMS. LEAST SQUARES AND OPTIMIZATION. POWER SYSTEMS ANALYSIS. MATHEMATICAL PROGRAMMING.

Professor Shih


Professor Shih

304-486B POWER LABORATORY. 2(1-3-2) (Prerequisites: 455-206, 304-361 and 304-334) Techniques of electric power, efficiency, torque, speed measurements. Starting, running and control of electronic machines: dc, synchronous, induction types. Power electronic controllers. Each group of students has access to a compact experiment bench containing a set of micro-machines and all the necessary equipment. Limited Enrolment (14).

Professor Ooi

304-487A,B COMPUTER ARCHITECTURE LABORATORY. 2(0-3-3) (Prerequisite: 455-206. Corequisite: 304-425 or 304-525) Basic software tools used in the design, synthesis and analysis of computer and communication systems such as data-paths, switching circuits, and arithmetic and logic circuits. Behavioral and structural modeling of hardware designs in the IEEE standard hardware description language VHDL. Synthesis and implementation of hardware designs using Programmable Logic Devices. Limited enrolment (50).

Professor Hayward


Mr. Fraser

304-490A,B DIGITAL SIGNAL PROCESSING LABORATORY. 2(0-3-3) (Prerequisite: 455-206. Corequisite: 304-412 or 304-512) Experiments involving the digital processing of signals using computer-aided design tools for design, processing and visualization and real-time processing using DSP chips. Filter structures and design, multi-rate signal processing, filter banks, fast transforms, adaptive filtering, signal detection and quantization. Limited Enrolment (30). Password card required.

Professor Kabal

304-491A,B COMMUNICATION SYSTEMS LABORATORY. 2(0-3-3) (Prerequisite: 455-206. Corequisite: 304-411 or 304-511) Experimental studies and simulation of analog and digital transmission techniques. Performance of AM and FM systems. FSK and PSK modulation techniques and spectra. Sampling of analog signals, PCM and TDM techniques. Limited Enrolment (30). Password card required.

Professor Leib

304-493B CONTROL AND ROBOTICS LABORATORY. 2(0-3-3) (Prerequisite: 455-206. Corequisite: 304-404 or 304-502) Experimental studies for the design of control systems, with particular emphasis on motion control as applicable to robotics. Fundamentals of sensors and actuators. Linear compensator specification and design in the time and the frequency domain. Pole placement. Effect of model uncertainty on performance. Limited Enrolment (18).

Professor Hayward

304-494A,B ELECTRICAL ENGINEERING DESIGN PROJECT. 3(0-5-4) (Prerequisites: 455-206 and at least 42 Departmental credits.) A laboratory design project undertaken with close supervision by a staff member. The project consists of defining an engineering problem and seeking the solution through experimental investigation. Results are reported in a seminar at the end of term and in a technical paper. Limited Enrolment (50).

Mr. Fraser

304-498A,B,C HONOURS THESIS I. 3(0-3-6) (Prerequisite: 455-206 and at least 42 Departmental credits.) A research project undertaken with close supervision by a staff member. The work consists of defining an engineering problem, reviewing the associated literature, and seeking the solution through experimental investigation. A literature review and a written thesis proposal are required along with a seminar presentation at end of term.

Mr. Fraser

304-499A,B,C HONOURS THESIS II. 3(0-3-6) (Prerequisite: 455-498) A research project undertaken with close supervision by a staff member. A staff member. Limited Enrolment (70).

Mr. Fraser


Staff

304-502A CONTROL ENGINEERING. 3(0-3-6) (Prerequisites: 304-303, 304-305) Modeling of engineering systems, simulation. Linear systems theory. Performance limitations. Stability of single-input-single-output closed-loop systems. Classical design in the
frequency domain. Sampled-data implementation of continuous-time design.

304-503B LINEAR STOCHASTIC SYSTEMS I. (3(3-0-6)) (Prerequisites: 189-587 or 304-510) Stochastic processes; stationary processes, the Wold decomposition. The spectral representation theorem. Linear stochastic systems. Estimation Theory: Wiener-Kolmogorov prediction theory, Kalman filtering. Stochastic realization theory. Linear quadratic control theory.

Professor Bélanger

304-504B COMPUTER CONTROL. 3(3-0-6) (Prerequisites: 304-404 or 304-502 and 304-305) Sampling and aliasing. Conversion of continuous-time controllers using s-to-z transformations; pre- and post-filtering, discrete time state representation and z-transform function of sampled linear, time-invariant systems. Correspondence between system theoretic results for continuous- and discrete-time systems. Sampled-data design, including deadbeat and LQG control. Quantization. Specification of computer system. Study of control system design through case studies.

Staff

304-505B NONLINEAR CONTROL SYSTEMS. 3(3-0-6) (Prerequisite: 304-501) Basic ODE formulation of non-linear systems; structural properties; Lyapunov and LaSalle stability theory and nonlinear and multivariable controller design; time and output stability; sampling and quantization, conservation, passivity; system linearization, zero and inverse dynamics and regulator design; discontinuous and sliding mode control; applications to deterministic adaptive control.

Professors Caines and Michalska

304-507A OPTIMIZATION AND OPTIMAL CONTROL. 3(3-0-6) (Prerequisites: 189-265 or 189-248 and 189-270 or 189-247) General Introduction to optimization methods including steepest descent, conjugate gradient, Newton algorithms. Generalized matrix inverses and the least squared error problem. Introduction to constrained optimality; convexity and duality; interior point methods. Introduction to dynamic optimization; existence theory, relaxed controls, the Pontryagin Maximum Principle. Sufficiency of the Maximum Principle.

Professor Michalska

304-509A PROBABILITY AND RANDOM SIG. II. 3(3-0-6) (Prerequisites: 304-304 and 304-305) Multivariate Gaussian distributions; finite-dimensional mean-square estimation (multivariate case); principal components; Introduction to random processes; weak stationarity: correlation functions, spectra, linear processing and estimation; Poisson processes and Markov chains; state processes, invariant distributions; stochastic simulation.

Staff

304-510B RANDOM PROCESSES. 3(3-0-6) (Prerequisite: 304-509) Finite-dimensional distribution functions. Estimation, Orthogonal Projection Theorem. Linear stochastic systems; Kalman filtering. Stationary stochastic processes: spectral Representation Theorem; Wiener filtering, Wold decomposition; ARMA processes; Brownian Motion; Ito integral and stochastic differential equations; forward and backward equations for diffusions. Ergodic theorems. Stochastic dynamic programming. Applications to communication and control systems.

Professor Caines

304-511A INTRO. TO DIGITAL COMM. 3(3-0-6) (Prerequisite: 304-304. Corequisite: 304-509.) (An advanced version of 304-411.) Amplitude and angle modulation including AM, FM, FDM and television systems; introduction to random processes; sampling and quantization, PCM systems, TDM; digital modulation techniques, Maximum-Likelihood receivers, synchronization issues; elements of information theory including information sources, source coding and channel capacity.

Professor Leib

304-512A DIGITAL SIGNAL PROCESSING I. 3(3-0-6) (Prerequisite: 304-304 and 304-305) Review of discrete-time transforms, sampling and quantization, frequency analysis. Structures for IIR and FIR filters, coefficient quantization, roundoff noise. The DFT, its properties, frequency analysis and filtering using DFT methods; the FFT and its implementation. Multirate processing, subsampling and interpolation, oversampling techniques.

Professor Kabal


Staff


Professor Kabal


Professor Negulescu

304-523B SPEECH COMMUNICATIONS. 3(3-0-6) (Prerequisite: 304-412 or 304-512) Articulatory and acoustic descriptions of speech production, speech production models, speech perception, digital processing of speech signals, vocoders using formant, linear predictive and cepstral techniques, overview of automatic speech recognition systems, speech synthesis systems and speaker verification systems.

Dr. O'Shaughnessy


Staff

304-526B ARTIFICIAL INTELLIGENCE. 3(3-0-6) (Prerequisite: 304-222) Fundamentals of automated reasoning in expert systems: Semantics and satisfaction, inference procedures, logical implication, proofs, unification, resolution, soundness and completeness. Searching strategies and problem solving. Limits of monotonic logic; forms of non-monotonic reasoning. The course includes a term project which consists of writing a small inference engine in Lisp.

Professor Cooperstock

304-527A,B OPTICAL ENGINEERING. 3(3-0-6) (Prerequisites: 304-304 and 304-352) A structure introduction to modern optical engineering. Topic covered include the propagation of light through space, refraction, diffraction, polarization, lens systems, ray-tracing, aberrations, computer-aided design and optimization techniques, Gaussian beam analysis, micro-optics and computer generated diffractive optical elements. Systems and applications will be stressed throughout.

Professor Kirch


Dr. Kaplan

304-529A IMAGE PROCESSING & COMMUNICATION. 3(3-0-6) (Prerequisite: 304-304) Introduction to vision in man and machine; computer vision systems; biological vision systems; biological signal processing; edge detection; spatial- and frequency-domain processing; color. Low-level visual processing for computer vision, psychophysics, and neurobiology, and their similarities and differences.

Professor Levine

304-530B LOGIC SYNTHESIS. 3(3-2-4) (Prerequisite: 304-323) The place of logic synthesis in microelectronics. Representations of Boolean functions: logic covers, binary decision diagrams.

**Professor Zilic**

**304-531B REAL TIME SYSTEMS.** 3(3-3-3) (Prerequisites: 304-222 and 304-323) Real-time engineering applications of computers to on-line control, communication systems and data acquisition. Aspects of hardware, software, interfacing, operating systems, and their integration into a complete system are addressed.

**Professor Khordoc**

**304-532A COMPUTER GRAPHICS.** 3(3-3) (Prerequisite: 304-222) Introduction to computer graphics systems and display devices: raster scan, scan conversion, graphical input and interactive techniques - window environments; display files: graphics languages and data structures: 2D transformations; 3D computer graphics, hidden line removal and shading; graphics system design; applications. Laboratory project involving the preparation and running of graphics programs.

**Ms. Leszkowicz**

**304-533B PHYSICAL BASIS OF SEMICONDUCTOR DEVICES.** 3(3-0-6) (Prerequisites: 304-330, 304-351 and 198-271) Quantitative analysis of diodes and transistors. Semiconductor fundamentals, equilibrium and non-equilibrium carrier transport, and Fermi levels. PN junction diodes, the ideal diode, and diode switching. Bipolar Junction Transistors (BJT), physics of the ideal BJT, the Ebers-Moll model. Field effect transistors, metal-oxide semiconductor structures, static and dynamic behaviour, small-signal models.

**Professor Plant**

**304-534A ANALOG MICROELECTRONICS.** 3(3-0-6) (Prerequisite: 304-334) Design of analog ICs using specialized analog CAD tools such as SPICE. Voltage and current amplifier design which encompasses the study of biasing circuits, current sources and mirrors, input and output stages, and frequency compensation; precision reference sources; analog multipliers; oscillators; waveform generators and shaping circuits, and analog switches.

**Professor Roberts**


**Professor Webb**

**304-545A MICROELECTRONICS TECHNOLOGY.** 3(3-0-6) (Prerequisite: 304-432 or 304-533) Basic techniques in the fabrication of microelectronic circuits. Four-point probe, alloyed contacts, diffusion processes, ion implantation epitax, silicon dioxide, photolithography, selected diffusion and metallization, transistor fabrication, dry etching, monolithic integrated circuits, isolation, mask making, thin and thick film components, MOS gate voltage and integrated circuits.

**Professor Champness**


**Professor McFee**

**304-548A INTRODUCTION TO VLSI SYSTEMS.** 3(2-2-5) (Prerequisites: 304-334 and 304-323) An interdisciplinary course for electrical engineering and computer science students. A structured design methodology for managing the complexity of VLSI system design. Sufficient information on integrated devices, circuits, digital subsystems and system architecture is presented to enable students to span the range of abstractions from device physics to VLSI digital systems. Limited enrolment (20). Password card required.

**Professor Rumin**


**Professor Lotherwiciel**

**304-559X FLEXIBLE AC TRANSMISSION SYSTEMS.** 3(3-0-6) (Prerequisite: 304-361 and 304-334) Operating principles of controllers of flexible AC transmission systems (FACTS). Transformer, thyristor and gate- turn-off thyristor (GTO) technologies. Modulation methods: harmonic elimination, pulse width modulation. Applications in: shunt and series advanced static VAR Controllers (ASVC), phase shifters, unified power flow controllers (UPFC).

**Professor Ooi**

**304-560A POWER SYSTEMS ANALYSIS II.** 3(3-0-6) (Prerequisite: 304-464) Main power system analysis tools for system and component design. Balanced and unbalanced operation of three-phase systems, symmetrical components, fault analysis, transient behaviour due to switching and lightning. Applications for a wide range of typical situations such as line design, circuit breaker rating, protective relaying, and insulation coordination are covered.

**Professor Galana**

**304-565A INTRODUCTION TO POWER ELECTRONICS.** 3(3-0-6) (Prerequisite: 304-334) Semiconductor power switches – thyristors, GTO’s, bipolar transistors, MOSFET’s. Switch mode power amplifiers. Buck and boost principles. Modulation methods: Pulse-width, delta, hysteresis current control. Rectifiers, inverters, choppers.

**Professor Ooi**

**304-571A OPTOELECTRONIC DEVICES.** 3(3-0-6) (Prerequisites: 304-304, 304-305, 304-352 and 304-533) Physical basis of optoelectronic devices including Light Emitting Diodes, semiconductor optical amplifiers, semiconductor lasers, quantum well devices, and solid state lasers. Quantitative description of detectors, optical modulation, optical logic devices, optical interconnects, and optomechanical hardware. Throughout the course, photonic systems applications will be addressed.

**Professor Plant**

**304-573A MICROWAVE ELECTRONICS.** 3(3-0-6) (Prerequisite: 304-432 or 304-533) Physical basis of modern microwave devices and circuits. Microwave transistors and tunnel diodes, transferred electron devices, transit time devices and infra red devices. Microwave generation and amplification, microwave FET circuits. Noise and power amplification.

**Professor Shih**

**304-578A CRYSTALS AND CONDUCTION.** 3(3-0-6) (Prerequisite: 304-432 or 304-533) Crystal lattices, point symmetry operations, Miller indices, important crystal structures, lattice matrix, reciprocal matrix, characteristics of X-rays, diffraction theory, structure factor, Kinetic theory of gases review, free electron theory of metals, mobility, classical theory anomalies, quantum treatment, density of states, Fermi Dirac distribution, Kronig Penney model, Brillouin zones, band filling, thermionic emission.

**Professor Champness**

**304-592A MICROWAVE THEORY AND TECHNIQUES.** 3(3-0-6) (Prerequisite: 304-352) Transmission lines, waveguides and surface waveguides for large capacity guided microwave trunk communications, microwave circuit theory. Smith’s chart, impedance matching and transformation, passive microwave devices, resonators, periodic structures and filters, microwave antennas for satellite communications.

**Professor Ooi**

**304-593A ANTENNAS & PROPAGATION.** 3(3-0-6) (Prerequisite: 304-352) Near and far field behaviour of radiators; antennas as a boundary value problem; practical antenna parameters; wire antennas, antenna arrays, aperture methods of antenna analysis;
measurement of input impedance, field patterns, gain and noise; point-to-point propagation, fading beyond the horizon and long distance propagation, ionospheric, atmospheric and earth’s surface considerations; tropospheric scatter. 

**304-596B Optical Waveguides.** 3(3-0-6) (Prerequisite: 304-352) Introduction to wave and ray optics, ray equation. Kirchhoff-Huygens diffraction theory, Fourier optics, Gaussian beams, propagation characteristics of optical fibers and dielectric waveguides for wideband optical fiber communication systems, waveguide group velocity and dispersion, thin-film waveguides. Discussion of optical fiber communication systems and guided-wave photonic devices.

**Staff**

**Graduate 600-Level Courses**

Generally, undergraduate students are not permitted to enroll in graduate 600-level courses. However, in exceptional circumstances, the Faculty of Graduate Studies and Research does grant this permission upon the request of the Department on behalf of the student. Please consult the Faculty of Graduate Studies and Research Calendar for 600-level courses.

4.6 Department of Mechanical Engineering

Macdonald Engineering Building, Room 351

McGill University

817 Sherbrooke Street West, Montreal, QC, H3A 2K6

Phone: (514) 398-6296 Fax: (514) 398-7365

http://www.mecheng.mcgill.ca

**Chair**

Stuart J. Price; B.Sc., Ph.D.(Bristol), P.Eng.

**Emeritus Professors**

William Bruce; B.A.Sc., M.A.Sc.(Toronto), Eng.

John C. Chena; Dipl.-Ing. (Swiss Fed. Inst.), Eng., F.E.I.C.


**Professors**

Abdul M. Ahmed; B.Sc.(Dhaka), M.Eng., Ph.D.(McG.), Eng.


Bantwal R. Baliga; B.Tech.(IIT, Kanpur), M.Sc.(Case), Ph.D.(Minnesota)

John H.S. Lee; B.Eng.(McG.), M.Sc.(M.I.T.), Ph.D.(McG.), Eng.


(Thomas Workman Professor of Mechanical Engineering)

**Associate Professors**

Martin Buchler; M.Sc., Ph.D.(Yale)

Luca Cortelezzi; M.Sc., Ph.D.(Caltech)

David L. Frost; B.A.Sc.(UBC), M.S., Ph.D.(Caltech), Eng.

(Undergraduate Program Coordinator)

Larry B. Lessard; B.Eng.(McG.), M.Sc., Ph.D.(Stanford), Eng.


James A. Nemes; B.Sc.(Maryland), M.S., D.Sc.(GWU) (Graduate Program Coordinator)

Alvin Post; B.S.(Ariz.), M.I.M.(A.G.S.I.M.), M.S.(Stanford), Ph.D.(Hawaii)

Vince Thomson; B.Sc.(Windor), Ph.D.(McMaster) (Werner Groupe Professor of Manufacturing Automation)


**Assistant Professors**

Andrew J. Higgins, B.Sc.(III.), M.S., Ph.D.(Wash.)

Venkat N. Krovi; B.Tech.(I.I.T., Madras), Ph.D.(Penn.)

Timothy Lee; M.S.(Portland State), Ph.D.(Idaho)

Laurent Mydlarski; B.A.Sc.(Waterloo), Ph.D.(Cornell)

**Laboratory Superintendents**

G. Dedic, A. Hueppin, G. Savard

**Associate Members**

R.E. Kearney; B.Eng., M.Eng., Ph.D.(McG.), Biomedical Engineering Unit

B.H.K. Lee; B.Eng., M.Eng., Ph.D.(McG.)

M. Tanzer; M.D., Orthopaedic Surgery

**Adjunct Professors**


Mechanical engineers are traditionally concerned with the conception, design, implementation and operation of mechanical systems. Typical fields of work are aerospace, energy, manufacturing, machinery, and transportation. Because of the very broad nature of the discipline there is usually a high demand for mechanical engineers. A recent study indicated that 39% of all engineering openings were for graduates of mechanical engineering.

Many mechanical engineers follow other career paths. Graduate studies are useful for the specialists working in research establishments, consulting firms or in corporate research and development.

To prepare the mechanical engineer for a wide range of career possibilities, there is a heavy stress in our curriculum on the fundamental analytical disciplines. This is balanced by a sequence of experimental and design engineering courses which include practice in design, manufacture and experimentation. In these courses students learn how to apply their analytical groundwork to the solution of practical problems.

Specialist interests are satisfied by selecting appropriate complementary courses from among those offered with a specific subject concentration, such as management, industrial engineering, computer science, controls and robotics, bio-engineering, aeronautics, combustion, systems engineering, etc.

The Department offers an Honours Program which is particularly suitable for those with a high aptitude in mathematics and physics and which gives a thorough grounding in the basic engineering sciences. The complementary courses in this program can be utilized to take courses with applied engineering orientation, such as those offered in the regular program, or if preferred, to obtain an even more advanced education in engineering science.

Options in Aeronautical Engineering, Automation and Design are available for students in either the Regular or Honours Programs who wish to specialize in these areas.

While the program is demanding, there is time for many extracurricular activities. Students are active in such professional societies as the CASI (Canadian Aeronautics and Space Institute), and the SAE (Society of Automotive Engineers), and the ASME (American Society of Mechanical Engineers) and in various campus organizations.

Relations between faculty and students are extremely close. Social functions, at which students and professors meet to exchange views and get to know each other better, are organized frequently.

**Curriculum for the B.Eng. Degree in Mechanical Engineering (Regular)**

**Required Courses**

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>189-260A, B Intermediate Calculus</td>
<td>3</td>
</tr>
<tr>
<td>189-261A, B Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>189-265A, B Advanced Calculus</td>
<td>3</td>
</tr>
<tr>
<td>189-266A, B Linear Algebra and BVP</td>
<td>4</td>
</tr>
<tr>
<td>303-207A, B Solid Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>304-461A Electric Machinery</td>
<td>3</td>
</tr>
<tr>
<td>306-221A, B Engineering Professional Practice</td>
<td>1</td>
</tr>
<tr>
<td>306-260A, B Materials Science and Engineering</td>
<td>3</td>
</tr>
<tr>
<td>306-310A, B Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>308-208A, B Computers in Engineering</td>
<td>3</td>
</tr>
<tr>
<td>455-206A, B Communication in Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

**Departmental Courses**

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>305-201A Intro. to Mechanical Engineering</td>
<td>2</td>
</tr>
</tbody>
</table>
CURRICULUM FOR THE B.ENG. DEGREE IN MECHANICAL ENGINEERING (HONOURS)

REQUIRED COURSES

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Departmental Subjects</td>
<td></td>
</tr>
<tr>
<td>189-260A,B Intermediate Calculus</td>
<td>3</td>
</tr>
<tr>
<td>189-261A,B Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>189-265A,B Advanced Calculus</td>
<td>3</td>
</tr>
<tr>
<td>189-266A,B Linear Algebra and BVP</td>
<td>4</td>
</tr>
<tr>
<td>303-207A,B Solid Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>306-221A,B Engineering Professional Practice</td>
<td>1</td>
</tr>
<tr>
<td>308-310A,B Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>308-208A,B Computers in Engineering</td>
<td>3</td>
</tr>
<tr>
<td>455-206A,B Communication in Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

Departmental Courses

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>305-201A Intro. to Mechanical Engineering</td>
<td>2</td>
</tr>
<tr>
<td>305-210A,B Mechanics I</td>
<td>4</td>
</tr>
<tr>
<td>305-220A,B Mechanics II</td>
<td>3</td>
</tr>
<tr>
<td>305-240A,B Thermodynamics I</td>
<td>3</td>
</tr>
<tr>
<td>305-260A,C Machine Tool Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>305-261B,C Measurement Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>305-291B Graphics</td>
<td>3</td>
</tr>
<tr>
<td>305-292A,B Design I</td>
<td>3</td>
</tr>
<tr>
<td>305-319B,B Mechanics of Systems</td>
<td>3</td>
</tr>
<tr>
<td>305-321B Mechanics of Deformable Solids</td>
<td>3</td>
</tr>
<tr>
<td>305-331A,B Fluid Mechanics I</td>
<td>3</td>
</tr>
<tr>
<td>305-343A Energy Conversion</td>
<td>3</td>
</tr>
<tr>
<td>305-341A,B Fluid Mechanics II</td>
<td>3</td>
</tr>
<tr>
<td>305-345A Fluid Mechanics II</td>
<td>3</td>
</tr>
<tr>
<td>305-346A,B Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>305-362A,B Mechanical Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>305-383A,B Applied Electronics and Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td>305-393B,B Design II</td>
<td>3</td>
</tr>
<tr>
<td>305-409B,B Numerical Methods in Mechanical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>305-412B,B Dynamics of Systems</td>
<td>3</td>
</tr>
<tr>
<td>305-415A,B Mechanics of Deformable Solids</td>
<td>3</td>
</tr>
<tr>
<td>305-430A,B Fluid Mechanics II</td>
<td>3</td>
</tr>
<tr>
<td>305-434A,B Turbomachinery</td>
<td>3</td>
</tr>
<tr>
<td>305-432A,B Aircraft Structures</td>
<td>3</td>
</tr>
<tr>
<td>305-445A,B Kinematic Synthesis</td>
<td>3</td>
</tr>
<tr>
<td>305-452A,B Mechanical Engineering Project</td>
<td>3</td>
</tr>
<tr>
<td>305-455A,B Fluid Mechanics I</td>
<td>3</td>
</tr>
<tr>
<td>305-457A,B Mechanics of Robotic Systems I</td>
<td>3</td>
</tr>
<tr>
<td>305-458A,B Mechanics of Robotic Systems II</td>
<td>3</td>
</tr>
<tr>
<td>305-459A,B Optimum Design</td>
<td>3</td>
</tr>
</tbody>
</table>

And any three of four below: 9 68

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>305-545A,B Advanced Stress Analysis</td>
<td>3</td>
</tr>
<tr>
<td>305-552A,B Advanced Applied Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>305-562A,B Advanced Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>305-578A,B Advanced Thermodynamics</td>
<td>3</td>
</tr>
</tbody>
</table>

COMPLEMENTARY COURSES 15

3 courses (9 credits) to be selected from those offered by the Department or from other suitable graduate or undergraduate courses.

2 courses (6 credits), 1 course from the Impact of Technology on Society and 1 course from Humanities and Social Sciences selected from an approved list (see section 3.3).

TOTAL CREDITS 110

Students entering in September or January must plan their program of studies in accordance with the regulations described in the "Welcome" book. After registering by MARS, students must consult with their academic adviser.

In addition students admitted to the 8-semester program (see section 3.1.2), must take note of the additional courses that are specified in the "Welcome" book. These can also be found on the Faculty website (http://www.engineering.mcgill.ca).

LIST OF COMPLEMENTARY COURSES (DEPARTMENTAL)

(Each is 3 credits)

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>305-343A Energy Conversion</td>
<td></td>
</tr>
<tr>
<td>305-413A Control Systems</td>
<td></td>
</tr>
<tr>
<td>305-432A,B Aircraft Structures</td>
<td></td>
</tr>
<tr>
<td>305-434A,B Turbomachinery</td>
<td></td>
</tr>
<tr>
<td>305-445A,B Combustion</td>
<td></td>
</tr>
<tr>
<td>305-471A,B Industrial Engineering</td>
<td></td>
</tr>
<tr>
<td>305-472A,B Case Studies in Project Mgmt</td>
<td></td>
</tr>
</tbody>
</table>

If advanced credit is given for 189-260 Intermediate Calculus (see section 2.3), the total number of credits is reduced by three.

Students entering in September or January must plan their program of studies in accordance with the regulations described in the "Welcome" book. After registering by MARS, students must consult with their academic adviser.

In addition students admitted to the 8-semester program (see section 3.1.2), must take note of the additional courses that are specified in the "Welcome" book. These can also be found on the Faculty website (http://www.engineering.mcgill.ca).
AERONAUTICAL ENGINEERING OPTION

Students in this option should take five courses in the area of Aeronautical Engineering. Specifically they must take the following two required courses:

- 305-532B Aircraft Performance, Stability and Control
- 305-533A Subsonic Aerodynamics

and at least one of the following:

- 305-432A Aircraft Structures
- 305-434A Turbomachinery

The remaining two courses may be chosen from the above or from the following courses:

- 305-533A Subsonic Aerodynamics
- 305-538B Unsteady Aerodynamics
- 305-537B High Speed Aerodynamics
- 305-536A Computational Aerodynamics

All courses must be passed at a level C or better.

Students should also discuss the matter with their adviser and complete a special form indicating their intention to take this Option.

DESIGN OPTION

The Design Option Program is comprised of six courses as follows:

- 305-495A Design III
- 305-496B Design IV

Plus any four below:

- 305-497A Value Engineering
- 305-540B Design: Modelling and Decision
- 305-541B Kinematic Synthesis
- 305-543A Design with Composite Materials
- 305-557B Mechatronic Design
- 305-565B Fluid Flow & Heat Transfer Equipment
- 305-576A Computer Graphics and Geometric Modelling
- 305-577A Optimum Design

MECHATRONICS OPTION

Students in this option should take six courses in the area of Control, Robotics and/or CAD/CAM. They must take the following four required courses:

- 305-413A Control Systems
- 305-557B Mechatronic Design
- 305-572A Mechanics of Robotic Systems I

and two of the following:

- 305-528A Production Design
- 305-541B Kinematic Synthesis
- 305-573B Mechanics of Robotic Systems II
- 305-576A Computer Graphics and Geometric Modelling
- 304-502A Control Engineering

COURSES OFFERED BY THE DEPARTMENT

- Denotes courses not offered in 2000-01
- Complementary courses
- Courses with Limited Enrolment

305-201A INTRODUCTION TO MECHANICAL ENGINEERING. 2(3-0-3)

The practice of Mechanical Engineering: its scope and context. The role of Design. Introduction to the Design process. The role of engineering analysis and socio-economic factors in Design. Introduction to the individual mechanical engineering subjects and their role in Design. Case studies. **Professor Ahmed and Staff**

305-210A,B MECHANICS I. 4(4-1-7) Basic principles of Newtonian mechanics. Kinematics, relative motion, momentum, forces (gravity, friction, elastic, etc.), pseudo-forces, impulse, energy (kinetic and potential) and mechanical work. Conservation of momentum and angular momentum, central force motion, centre of mass and moment of inertia. Engineering applications including beams, trusses, frames, mechanisms. (Course description change Awaiting University Approval) **Professors J. Lee and Zsombor-Murray**

305-220A,B MECHANICS II. 3(3-1-5) (Prerequisites: 305-210 and 189-260. Corequisite: 189-261) Newtonian and Lagrangian formulations of mechanics. Solution of equations of motion for simple systems. Degrees of freedom, generalized coordinates and con-
strains. Energy methods. Equilibrium and stability of mechanical systems. 3-dimensional rigid-body dynamics; Euler’s equations. Gyroscopic motion. (Course description change Awaiting University Approval)

Professors J.Lee, Frost, Mydlarski and Baliga

305-240A, B THERMODYNAMICS I. 3(3-1-5) Thermodynamic systems and properties. First law of thermodynamics: energy, work and heat. State principle, p-v-T surfaces, phase equilibrium, ideal gas model. Second law of thermodynamics, entropy, exergy analysis. Energy analysis applied to steady and transient engineering systems including heat engines, refrigerators and heat pumps, air compressors. (Course description change Awaiting University Approval)

Professors J.Lee, Frost, Mydlarski and Baliga

☐ 305-260A, C MACHINE TOOL LAB. 2(1-3-2) Basic machine tool operations, numerical control of machine tools, and metrology. The use of hand tools, and sheet metal work. Introduction to rapid prototyping and nontraditional machining methods. Extensive laboratory hands-on exercises. Professor Buehler and R. Sumner

305-261B, C MEASUREMENT LAB. 2(2-3-1) Basic experimental laboratory measurements, such as measurement of strain, pressure, force, position, and temperature. D. Zorbas and Staff

305-290A GRAPHICS. 3(3-3-0) (This course is intended for Civil Engineering students.) Traditional Frequent practices in the geometry of points, lines and planes, done with modern tools. Constructed solutions with vector diagram projection; comparison with equivalent vector algebraic methods. Graphical statics, concurrent force problems including pure axial force plane structure. Structural drafting pertaining to steel, concrete and timber construction, standards and conventions. Drafting room and computer lab exercises are assigned.

Professor Zsombor-Murray

305-291B GRAPHICS. 3(3-3-3) Descriptive geometry of points, lines and planes, intersection and developments, auxiliary view and direct methods. Drawing standards. Working drawings and conventions, fits and tolerances, representation of welding, surface finish, threaded fasteners, standard mechanical components: motors, cylinders, bearings, gears and other elements. Sections and pictorials. Bills of material and cataloging. Computer lab exercises are assigned.

Professor Zsombor-Murray

305-292A DESIGN I. 3(1-3-5) (Prerequisites: 305-260 and 305-291. Pre- or Co-requisites: 303-207, 455-206) Introduction to design. Problem formulation; idea generation; feasibility study; preliminary design; design; optimal design. The student’s creative ability will be developed by having to participate in a number of design projects. Case-study methods will be used to analyse actual design projects.

Professor Post

305-314A DYNAMICS OF MECHANISMS. 3(3-1-5) (Prerequisite: 305-210) First principles of motion; motion; position; displacement; velocity; acceleration; force; inertia and its effects. Kinematic and dynamic analysis of rigid bodies in pure rotation and in pre-connected systems; dynamic balance. Rigid bodies in rolling contact; planetary gear trains. Bodies in sliding contact; lower and higher sliding pairs.

Professor Ahmed


Professor Misra


Professors Poidoussis and Lessard


Professors Lesard and Nemes

305-331A, B FLUID MECHANICS I. 3(3-1-5) (Prerequisite: 305-210. Pre- or Co-requisites: 305-220, 305-240 and 189-266) Physical properties of fluids. Kinematics and dynamics of fluid flow: stress in a continuum, rates of strain, rotation. Control volume analysis; conservation of mass, linear momentum and energy; Euler and Bernoulli equations; Flow measurement. Dimensional analysis and dynamical similarity. Laminar and turbulent flow in pipes and boundary layers. (Course description change Awaiting University Approval)

Professors Price and T. Lee


Professors J. Lee and Frost

305-346A, B HEAT TRANSFER. 3(3-1-5) (Prerequisites: 305-331 and 189-266) Basic concepts and overview. Steady and unsteady heat conduction. Finite Theory. Convective heat transfer: governing equations; dimensionless parameters; analogy between momentum and heat transfer. Design correlations for forced, natural, and mixed convection. Heat exchangers. Radiative heat transfer: black- and gray-body radiation; shape factors; enclosure theory. Thermal engineering design project. (Course description change Awaiting University Approval)

Professors Baliga and Mydlarski

305-362A B MECHANICAL LABORATORY. 2(3-3-3) (Prerequisite: 305-261) Experiments will be performed in four areas: 305-240 Thermodynamics, 305-315 Vibrations, 305-331 Fluid Mechanics I, and 305-346 Heat Transfer. Students should sign up to do experiments in one or more areas the term following the completion of one or more of the above courses. Students will not formally register for this course until the term in which they will complete all of the experiments.

Professors Frost and Lessard


Mr. Zorbas

305-393B DESIGN II. 3(3-3-3) (Prerequisites: 305-292 and 306-260. Pre- or co-requisite: 305-314) The design of machine elements for strength requirements in consideration of various methods of manufacture. Synthesis of mechanical systems to fulfill performance requirements, following the engineering design process. Failure theory and fatigue life determination. Students form groups to work on a design project.

Professor T. Lee

305-403D N THESIS (HONOURS). 6(0-6-12) (Prerequisite: Candidates must have completed courses in the Mechanical Engineering Program weighted at a minimum of 60 credits.) This course, together with course 305-404B, involves a research or design project undertaken by each student, encompassing interrelated aspects of engineering theory and requiring a theoretical and/or experimental investigation. Students will work under the supervision of one or more staff members; completed work will be submitted in the form of a thesis. The grade awarded for this part of the course depends on the assessment of the quality of theoretical and/or experimental work undertaken by the students.

Professor Price and Staff
305-404A,B THESIS (HONOURS). 2(0-3-3) (Corequisite: 305-403) This course is part of the same thesis project as course 305-404D. The grade for this part of the course covers the orderly development and presentation of ideas, and their incorporation in the thesis.

Professor Price and Staff

305-409B NUMERICAL METHODS IN MECH. ENG. 3(3-1-5) (Prerequisites: 189-261, 189-266 and 308-208) Numerical techniques for problems commonly encountered in Mechanical Engineering are presented. Chebyshev interpolation, quadratic, roots of one or more variables, matrices, curve fitting, splines and ordinary differential equations. The emphasis is on the analysis and understanding of the problem rather than the details of the actual numerical program.

Professor Cortelezzi


Professor Kroviri


Staff


Professors J. Lee and Higgins


Mr. Edwards

305-434A TURBOMACHINERY. 3(3-0-6) (Prerequisite: 305-331) A broad general treatment of energy transfer between a fluid and a rotor, velocity vector diagrams, and non-dimensional characteristics. Applications to hydraulic pumps and turbines. Two dimensional cascade theory leading to study of axial gas compressors and turbine stages. Three dimensional free and forced vortex configurations. Centrifugal compressors and radial inflow turbines.

Dr. Moustapha

305-447A COMBUSTION. 3(3-0-6) (Prerequisite: 305-240) Equilibrium analysis of reacting systems, Hugoniot analysis, flame propagation mechanisms, introduction to chemical kinetics, models for laminar flame propagation, ignition, quenching, flammability limits, turbulent flames, flame instability mechanisms, detonations, solid and liquid combustion.

Professors J. Lee and Frost

305-452A MATHEMATICAL METHODS IN ENGINEERING. 3(3-1-5) (Prerequisite: Candidates must have completed courses in the Mechanical Engineering Program weighted at 60 credits (minimum).) The underlying theory and application of mathematical methods in fluid dynamics, vibration, stress and strain analysis, heat transfer, etc. The eigenvalue problem, methods in analysis.

Professor Bach

305-463D MECHANICAL ENGINEERING PROJECT. (4) (Prerequisite: 305-393) Team project work typically involving design, fabrication, performance-testing and application of a real-world mechanical device/system or experimental facility. The project work will be complemented by a scheduled set of lectures in the Fall term on topics related to formulation/management of open-ended problems.

Professor Post and Staff

© 305-471A INDUSTRIAL ENGINEERING. 3(3-1-5) Survey of industrial engineering discussing the roles of people, technology and management. Includes: design of work systems; factory planning, location, layout, and services; human factors; productivity, process management, performance management, methods engineering; quality management; systems engineering. Overviews of operations research, and production systems. Present issues for industrial competitiveness.

Professor Thomson

© 305-472A CASE STUDIES IN PROJECT MGMT. 3(3-0-6) (Prerequisite: U3 and permission of the instructor) Introduction to principles of the integrated multidisciplinary approach to project management in use by engineering firms. Working in teams students will have the opportunity to assess the real-life pressures in project management by working on an actual recent project and presenting their results to a professional evaluation panel.

Staff

© 305-474B SEL. TOPICS IN OPERATIONS RESEARCH. 3(3-0-6) (Prerequisites: 189-266 and 308-208) Introduction to the general mathematical programming problem in the context of engineering design; linear programming, queuing theory, Monte Carlo simulation. The above techniques will be used to study the optimization of engineering systems. The applications of linear programming in its various manifestations will be examined in depth.

Dr. Mackenzie

© 305-495A DESIGN III. 3(0-6-3) (Prerequisite: 305-463) A design project course of two terms together with 305-496B. Project approval required. Allows the completion of a project of greater complexity than Design II and Mechanical Engineering Project with emphasis on analytical solutions, stressing, planning for production. No lectures. Weekly consultations. Interim and final reports required.

Professor T. Lee

© 305-496B DESIGN IV. 3(0-6-3) (Prerequisite: 305-495) Continuation of 305-495A. The two together constitute a design project course of two terms. The two courses permit the completion of a project of greater complexity than Design II and Mechanical Engineering Project with emphasis on analytical solutions, stressing, planning for production. No lectures. Weekly consultations. Interim and final reports required.

Professor T. Lee

© 305-497A VALUE ENGINEERING. 3(0-8-1) (Prerequisites: 305-393 and completion of 45 credits) Value Engineering is an in-depth analysis of an industrial product or process with a view to improving its design and/or performance to increase its worth. This is a workshop type of course. Projects will be supplied by industrial firms and students will work in teams with industrial personnel.

Professor Thomson and Staff

© 305-500A,B SEL. TOPICS IN MECHANICAL ENG. 3(3-0-6) A course to allow the introduction of new topics in Mechanical Engineering as needs arise, by regular and visiting staff.

© 305-501A,B SEL. TOPICS IN MECHANICAL ENG. 3(3-0-6) A course to allow the introduction of new topics in Mechanical Engineering as needs arise, by regular and visiting staff.


Professor Kops

© 305-524B 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 system structures. Study of several types of production systems. Integration issues: inter-and intra-enterprise. Laboratory experience with manufacturing software systems.

Professor Thomson
Professor Mateescu

305-539A Computational Aerodynamics. 3(3-0-6) (Pre- or Co-requisite: 305-533 or equivalent) Fundamental equations.

Professor Mateescu

305-540B Design: Modelling & 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. Mr. Yee


Professor Angeles

305-542B Spacecraft Dynamics. 3(3-0-6) (Pre-requisite: 305-220. Corequisite: 305-519 or 305-412) 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 maneuvers; large space structures.

Professor Misra and Staff


Professor Lessard


Professors Nemes and Lessard


TBA


Professors Zsombor-Murray

305-555B Applied Process Control. 3(3-2-4) (Pre-requisite: 305-554 or equivalent) Hardware and software aspects of real time computers in process control and related applications. Fun-
damental hardware. Digital and analogue transducers, actuators, filters, interfaces and processors. Fundamental software: Process assembler language and machine architecture, real time operating systems, process oriented subsystems, interrupts, drivers, service routines.

Professor Zsombor-Murray

- **305-557B MECHATRONIC DESIGN.** 3(3-1-5) (Prerequisites: 304-461, 305-383 and 305-412) 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.

Professor Buehler


Professor Ahmed

- **305-562A 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.

Professors J. Lee and Cortezez


Professor Baliga

- **305-572A MECHANICS OF ROBOTICS SYSTEMS I.** 3(3-0-6) (Prerequisites: 189-266 and 305-220 or permission of the instructor. Not open to students who have taken 305-573.) Manipulator hardware structure, planning and control. Rigid-body three-dimensional statics, kinematics and dynamics. Direct and inverse kinematics and dynamics. Trajectory planning. Manipulator control. In-depth study of serial manipulators.

Professor Angeles

- **305-573B MECHANICS OF ROBOTIC SYSTEMS II.** 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.

Professor Angeles


Professor Zsombor-Murray

- **305-577A 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.

Professor Angeles

- **305-578B ADVANCED THERMODYNAMICS.** 3(3-0-6) Review of classical mechanics; Boltzmann statistics, thermodynamics of ideal gases; Fermi-Dirac and Bose-Einstein statistics, Gibbsian ensembles; elementary kinetic theory of transport processes, Boltzmann equation, Boltzmann H-theorem and entropy, KGB approximation, discussion on the solution of Boltzmann equation; Maxwell transport equations, derivation of Navier Stokes equations.

Professor J. Lee

- **305-581A NONLINEAR DYNAMICS AND CHAOS.** 3(3-1-5) (Prerequisite: 305-319 or 305-315) Approximate solutions to nonlinear dynamical systems: Lindstedt's, multiple-scale and averaging techniques; centre manifold, normal form theorem; applications. Transcritical, saddle-node, pitchfork, Hopf, period-doubling and homoclinic bifurcations; fractal dimensions, Lyapunov exponents and chaos. Applications to two-well potential oscillator, van der Pol, Lorenz, fluid elastic systems.

Professor Paidoussis

**GRADUATE 600-LEVEL COURSES**

Generally, undergraduate students are not permitted to enrol in graduate 600-level courses. However, in exceptional circumstances, the Faculty of Graduate Studies and Research does grant this permission upon the request of the Department on behalf of the student. A list of such courses is described in detail in the Faculty of Graduate Studies and Research Calendar.

4.7 Department of Mining and Metallurgical Engineering

Wong Bldg., Room 2160
McGill University
3610 University Street, Montreal, QC, H3A 2B2
Mining—Telephone: (514) 398-2215 Fax: (514) 398-7099
Metall. — Telephone: (514) 398-1040 Fax: (514) 398-4492
http://wisdom.mcgill.ca/wong.nsf

Chair
Robin A.L. Drew; B.Tech.(Bradford), Ph.D.(Newcastle)
Emeritus Professors
William M. Williams; B.Sc., M.Sc.(Brist.), Ph.D.(Tor.), Eng. (Henry Birks Emeritus Professor of Metallurgy)

Professors
George P. Demopoulos; Dipl. Eng.(NTU Athens), M.Sc., Ph.D.(McG.), Eng.
Robin A.L. Drew; B.Tech.(Bradford), Ph.D.(Newcastle)
James A. Finch; B.Sc.(Birm.), M.Eng., Ph.D.(McG.), Eng. (Professor of Metallurgical Engineering)
John E. Gruzleski; B.Sc., M.Sc.(Qu.), Ph.D.(Tor.), Eng. (Gerald Hatch Professor of Mining and Metallurgy)
Rod I.L. Guthrie; B.Sc., Ph.D.(Lond.), D.I.C., A.R.S.M., Eng. (William C. Macdonald Professor of Mining and Metallurgy)
Famarraz (Ferri) P. Hassani; B.Sc., Ph.D.(Nott.), C.Eng.(U.K. Reg.) (George Boyd Webster Professor of Mining Engineering)
John J. Jonas; B.Eng.(McG.), Ph.D.(Canb.), F.A.S.M., Eng. (Henry Birks Professor of Mining and Metallurgy)
Jerzy Szpunar; B.Sc., M.Sc., Ph.D., D.Sc.(Krakow)

Associate Professors
Phil A. Distin; B.Sc., Ph.D.(Lond.), D.I.C.
Ralph Harris; B.Sc.(Old), M.Eng., Ph.D.(McG.)
Mainul Hasan; B.Eng.(Dhaka), M.Sc.(Dhahran), Ph.D.(McG.)
André Laplante; B.A.Sc., M.A.Sc.(Montr.), Ph.D.(Tor.), Eng.
Hani S. Mtni; B.Sc.(Caio), M.Eng., Ph.D.(McMaster), Eng.
(MS正常使用 Phase)(Director, Mining Engineering Program)
Jacques Ouellet; B.A.Sc., M.A.Sc., Ph.D.(École Polytechnique)
Steve Yue; B.Sc., Ph.D.(Leeds)

Assistant Professor
Janusz A. Kozinski; B.A., M.Eng., D.Sc.(Krakow)
Faculty Lecturer
John Mossop; B.Eng.(McG.), Eng.

Adjunct Professors
William Caley; Wilfred Comeau, Eng., Roussos Dimitrakopoulos, Bryn Harris; Ahmad Hemami; Hani Keira, Eng., Yves Lizotte, Eng., Bibhu Mohanty; Malcolm J. Scoble, P.Eng.; William T. Thompson; Viwek Vaidya, Eng.; Albert E. Wraith