

Faculty of Engineering

Professor and Dean H.T. Saliba

MSCENG (CONTROL ENGINEERING)

Graduate Co-ordinator A. Tayebi

**Core: Master's Thesis
Supervisory**

D. Alexandrov (Electrical Engineering),
H. Bai (Mechanical Engineering),
R. Benlamri (Software Engineering),
C.E. Christoffersen (Electrical Engineering),
A.F. Gilbert (Chemical Engineering),
B. Ismail (Mechanical Engineering),
K. Liu (Mechanical Engineering),
M. Liu (Mechanical Engineering),
X. Liu (Electrical Engineering),
H. Naser (Software Engineering),
K. Natarajan (Electrical Engineering),
S.A.Q. Siddiqui (Mechanical Engineering),
A. Tayebi (Electrical Engineering),
M.N. Uddin (Electrical Engineering),
W.Q. Wang (Mechanical Engineering)

MSCENG (ELECTRICAL AND COMPUTER ENGINEERING)

Graduate Co-ordinator C.E. Christoffersen

**Core: Master's Thesis
Supervisory**

D. Alexandrov (Electrical Engineering),
R. Benlamri (Software Engineering),
C.E. Christoffersen (Electrical Engineering),
H. El-Ocla (Computer Science)

R Khoury (Software Engineering),
A. Manzak (Electrical
Engineering),
H. Naser (Software Engineering),
K. Natarajan (Electrical
Engineering),
M.N. Uddin (Electrical
Engineering),

MSCENG (ENVIRONMENTAL ENGINEERING)

Graduate Co-ordinator

B. Liao

Core: Master's Thesis

Supervisory

L.J.J. Catalan (Chemical
Engineering),
A. Chen (Chemistry),
P. Fralick (Geology),
W. Gao (Civil Engineering),
A.F. Gilbert (Chemical
Engineering),
C. Gottardo (Chemistry),
P. Hollings (Geology),
B. Ismail (Mechanical
Engineering),
S. Kinrade (Chemistry),
B. Kjartanson (Civil Engineering),
P. Lee (Biology),
K. Leung (Biology),
B. Liao (Chemical Engineering),
A. Mallik (Biology),
E. Mohamedelhassan (Civil
Engineering),
I. Nirdosh (Chemical Engineering),
U.S. Panu (Civil Engineering),
E. Prepas (Forestry),
H. Schraft (Biology),
C. Xu (Chemical Engineering)

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Master of Science in Engineering (MSc Eng) Degree

The Faculty of Engineering at Lakehead University offers three graduate programs at the MSc Eng level: in Control Engineering (interdisciplinary), in Electrical and Computer Engineering and in Environmental Engineering (interdisciplinary).

MSc ENG IN CONTROL ENGINEERING

At the MSc Eng program in Control Engineering graduates from Chemical, Electrical and Mechanical Engineering are trained in a joint fashion to promote the effective practice of control systems technology. The program emphasizes through course and thesis work, the application of control principles and theory to industrial problems.

MSc ENG IN ELECTRICAL AND COMPUTER ENGINEERING

The MSc Eng in Electrical and Computer Engineering satisfies the demand in academia and industry for highly qualified personnel in the field of Electrical and Computer Engineering. The program is directed to graduates from the existing undergraduate Electrical Engineering and Software Engineering programs at Lakehead University and graduates from undergraduate programs at other universities. The program fosters independent research abilities of students. These objectives are achieved through a combination of course work and research towards the completion of a thesis.

MSc ENG IN ENVIRONMENTAL ENGINEERING

The MSc Eng in Environmental Engineering provides a common curriculum to graduates from Engineering and related Natural Sciences in providing effective solutions to environmental challenges faced by industries and communities. This unique interdisciplinary program brings together faculty members from the disciplines of Chemical, Civil and Mechanical Engineering, Biology, Chemistry, Forestry and Geology to enable students to carry out multidisciplinary course and thesis work. This approach helps students achieve an integrated understanding of the multifaceted components of environmental issues.

ADMISSION REQUIREMENTS

Candidates are accepted under the general University regulations governing the graduate degrees (see **pages 267-269**) provided that the requirements of the Faculty of Engineering are also satisfied.

Normal admission to the Master's program in **Control Engineering** requires a Bachelor's Degree in Chemical, Computer, Electrical, Mechanical or Software Engineering (four year program), with at least 70% average, or equivalent.

Normal admission to the Master's program in **Electrical and Computer Engineering** requires a Bachelor's Degree in Electrical, Computer or Software Engineering (four year program), with at least 70% cumulative average, or equivalent, in addition to all other general admission requirements of the university. A make-up period of study may be required where the student is deficient in background undergraduate level courses.

To be considered for admission to the MScEng program in **Environmental Engineering**, the candidate must normally hold a four-year degree in the disciplines of Engineering or Natural Science (including, but not restricted to, Biology, Chemistry, Geology, Physics), with at least 70% average, or equivalent.

A make-up period of study, as recommended by the Engineering Graduate Studies Committee, may be required where the student is deficient in background undergraduate level courses. Proficiency in the English language is required. Meeting the minimum requirements does not necessarily lead to automatic admission, but depends on the availability of places in the program and on an assessment by the Engineering Graduate Studies Committee of the applicant's aptitude for graduate studies and research.

Application deadline is **February 1**. Late applications will be considered for admission, but may not be eligible for funding.

ACADEMIC REGULATIONS

In addition to the Graduate Studies Regulations outlined on **pages 267-269** of this calendar, Engineering students are also bound by the regulations listed below.

Course Substitution

For MSc Eng in **Control Engineering** and MSc Eng in **Environmental Engineering**, one of the four half-courses of the program can be a senior undergraduate elective course, providing it has not been taken before and providing it is approved by the Engineering Graduate Studies Committee.

Minimum Satisfactory Academic Standing

All graduate students must obtain a minimum mark of 70% (B) in each half-course. A score of less than 70% will constitute a failure. A failed half-course may be repeated or replaced by another course specified by the supervisor only once. Any student with more than one half-course failure on his/her record must withdraw from the program.

Thesis Supervision and Examination

The thesis for the MSc Eng must show that the student is able to work in a scholarly manner.

The student will be guided by a thesis supervisor and a supervisory committee to be established by the end of the first term after enrolment. A research thesis topic should be submitted to the student's thesis supervisor by the end of the second term of studies. When completed the thesis will be examined under university regulations (see Graduate Studies Regulations, page 268).

PROGRAMS

MSc ENG IN CONTROL ENGINEERING

The requirements for the MSc Eng in Control Engineering degree (total 5 FCEs) are:

- (a) four half-courses of which at least three must be chosen from core courses in Control Engineering, listed below
- (b) one half-course graduate seminar, Engineering 5711

(c) the thesis, Engineering 5901 (carries 2.5 FCE credit weight)

Control Engineering Core Courses

Engineering 5111 - Control Engineering Concepts
Engineering 5211 - Robust Control
Engineering 5311 - Process Control
Engineering 5411 - Intelligent Control
Engineering 5511 - Adaptive Control
Engineering 5611 – Advanced Topics in Control Applications

MSc ENG IN ELECTRICAL AND COMPUTER ENGINEERING

The requirements for the MSc Eng in Electrical and Computer Engineering (total 5 FCEs) are:

- (a) four half-courses (2 FCEs) as specified below
- (b) the graduate seminar, Engineering 5731 (carries 0.5 FCE credit weight)
- (c) the graduate thesis, Engineering 5901 (carries 2.5 FCE credit weight)

Electrical and Computer Engineering Core Courses

All students must take 2 of the following 4 core half-courses:

Engineering 5131: Microelectronics
Engineering 5132: Digital Communication Systems
Engineering 5231: Computer Architecture
Engineering 5232: Software Construction and Evolution

Electrical and Computer Engineering Elective Courses

Of the remaining two half-courses, at least one must be from the following list of elective half-courses:

Engineering 5431: Advanced Power Electronics
Engineering 5432: Semiconductor Devices
Engineering 5433: Design of RF Ics
Engineering 5434: Wireless Communication Systems
Engineering 5531: Digital ASIC Design
Engineering 5532: Advanced Computer Engineering
Engineering 5533: Computer Networks
Engineering 5534: Web Engineering
Engineering 5631: Advanced Topics in Electrical and Computer Engineering

The student choice of courses must be approved by the graduate supervisor and Engineering Graduate Studies Committee. One of the four half-courses may be a senior undergraduate half-course from a department different from Electrical or Software Engineering that was not previously taken or a graduate half-course from another graduate program such as Control Engineering, Computer Science or Mathematical Sciences.

MSc ENG IN ENVIRONMENTAL ENGINEERING

The requirements for the MSc Eng in Environmental Engineering (total 5 FCEs) are:

- (a) four (4) half-courses, of which three must be chosen from core courses in Environmental Engineering, listed below
- (b) the graduate seminar, Engineering 5811
- (c) the graduate thesis, Engineering 5901 (carries 2.5 FCE credit weight)

Environmental Engineering Core Courses

Engineering 5151 - Geoenvironmental Engineering
 Engineering 5251 - Environmental Chemistry
 Engineering 5351 - Experimental Design and Analysis for Environmental Engineers
 Engineering 5451 - Physicochemical Treatment Processes
 Engineering 5551 - Biological Treatment Processes

GRADUATE COURSES

Courses not offered this academic year (fall/winter terms) are indicated by the words "NOT OFFERED THIS YEAR" below the course description. Nevertheless, students should refer to the Timetable as a final check.

The following courses are offered for the Master's program.

(Information about Course Numbering System)

Engineering 5111

Control Engineering Concepts

3-0; or 3-0

Introductory digital control, z-transforms, random variables and stochastic processes, filtering, Kalman filtering, harmonic analysis.

Engineering 5131

Microelectronics

3-1.5; or 3-1.5

CMOS integrated circuit design; layout and fabrication; digital and analog circuit blocks; computer aided design, testing and verification.

Engineering 5132

Digital Communication Systems

3-1.5; or 3-1.5

Analysis and design of digital communication systems. Characterization of communication signals and systems. Modulation techniques and their performance in AWGN and dispersive channels. Channel equalization, carrier and symbol synchronization.

Engineering 5151

Geoenvironmental Engineering

3-0; or 3-0

Prerequisite: Engineering 4050, or permission of the instructor

Sources of waste and soil and groundwater contamination, environmental regulations; soil classification

and soil weight-volume relationships; permeability and seepage; Geoenvironmental site characterization technologies and methodologies; contaminant fate and transport; groundwater monitoring technologies and strategies; introduction to remediation of contaminated sites.

Engineering 5211

Robust Control

3-1.5; or 3-1.5

State space representation and analysis; singular value analysis; H₂ and H_{inf} methods of controller design with applications.

Engineering 5231

Computer Architecture

3-1.5; or 3-1.5

Overview of CISC/RISC microprocessors; performance metrics; instruction set design; microprogramming and hardwired control; cache and virtual memory organizations; protection and sharing; I/O architectures; multithreaded architectures; symmetric multiprocessors, DSP processors, and other parallel computers.

Engineering 5232

Software Construction and Evolution

3-1.5; or 3-1.5

Construction of software components identified and described in design documents. Code implementation and reuse. Unit, integration, system and acceptance testing. Methods and techniques to allow a software system to evolve, and survive.

Engineering 5251

Environmental Chemistry

3-0; or 3-0

Prerequisite: Chemistry 2111 and either Chemistry 2411 or Engineering 4534, or permission of the instructor

The emphasis of this course is on understanding the chemical mechanisms that control the behaviour of inorganic contaminants in aquatic systems, including surface waters, groundwater, and pore water in solid waste. Topics include chemical thermodynamics, reaction kinetics, acid-base equilibria, alkalinity and acidity, speciation, mineral precipitation/dissolution, sorption, ion exchange, complexation, and oxidation-reduction reactions. Standard software packages for predicting chemical equilibria among dissolved, adsorbed, solid, and gas phases will be presented.

Engineering 5311

Process Control

3-1.5; or 3-1.5

Characterization and modelling of industrial processes. Process control strategies, feedforward control, multiloop control structures, interaction and decoupling; distributed control systems; examples of industrial process control loops.

Engineering 5351

Experimental Design and Analysis for Environmental Engineers

3-0; or 3-0

The content of this course will first focus on the description of the static and dynamic characteristics of measuring systems. Secondly, concepts such as probability, random variables, stationary and ergodic random processes, correlations, and power spectra will be discussed. Finally, data processing techniques

including programming of time series statistical analysis, fast-Fourier transforms and spectra will be visited. Also, description of linear and non-linear regression methods and computation of measurement uncertainty will be covered.

Engineering 5411

Intelligent Control

3-0; or 3-0

Knowledge representation; inference engines; approximate reasoning methods; fuzzy logic control; expert tuners and machine learning. Applications.

Engineering 5431

Advanced Power Electronics

3-1.5; or 3-1.5

Rectifiers and inverters. Harmonic generation by solid-state power converters. Minimization of harmonic generation. Design of control circuits for rectifiers and inverters. Applications of microprocessors to machine drives.

Engineering 5432

Semiconductor Devices

3-1.5; or 3-1.5

Review of current device technologies. Theory of operation, modeling, parameter extraction, scaling issues, and higher order effects of active and passive semiconductor devices. Physical device modeling CAD tools.

Engineering 5433

Design of RF Ics

3-1.5; or 3-1.5

Transistor models, small-signal analysis, amplifier design, biasing, noise analysis. Examples of Radio Frequency Integrated Circuits (RF ICs): amplifiers, filters, oscillators, PLL and frequency synthesizers. Evaluation of circuit performance.

Engineering 5434

Wireless Communication Systems

3-1.5; or 3-1.5

Cellular system design fundamentals, propagation in mobile radio channels: large and small scale effects, modulation techniques for mobile radio, diversity and diversity combining techniques, multiple access techniques.

Engineering 5451

Physicochemical Treatment Processes

3-0; or 3-0

Theory and design of chemical and physical processes utilized in the treatment of water and wastewater, sedimentation, flotation, coagulation, precipitation, filtration, membrane separations, disinfection, ion exchange, adsorption, and gas transfer.

Engineering 5511

Adaptive Control

3-1.5; or 3-1.5

Parameter estimation, filtering and prediction algorithms; adaptive minimum variance, model reference and generalized predictive control. Applications of adaptive control.

Engineering 5531

Digital ASIC Design

3-1.5; or 3-1.5

Digital Application-Specific Integrated Circuit (ASIC) Design Flow, hardware description language, synthesis of CMOS logic, standard cell libraries, verification, simulation, and testing, IC packaging, field programmable gate arrays and mask programmable gate arrays. Computer Aided Design algorithms.

Engineering 5532

Advanced Computer Engineering

3-1.5; or 3-1.5

Advanced aspects of computer architecture or digital hardware: parallel systems, memory systems, design of digital systems for testability.

Engineering 5533

Computer Networks

3-1.5; or 3-1.5

Layered network architectures; multiplexing and switching; delay and loss performance; medium access control; local area networks; wireless/optical access networks; mobility management; network layer: routing, flow control; ATM networks; internetworking: Internet protocol; transport layer: transmission control protocol; differentiated services IP.

Engineering 5534

Web Engineering

3-1.5; or 3-1.5

Basic technologies for Web Engineering: client-side scripting and server-side programming languages, software architectures and components for engineering web applications, and web services. Web modeling languages and the Semantic Web: metadata, ontologies, inferencing, Web ontology languages, context-awareness and adaptive information delivery.

Engineering 5551

Biological Treatment Processes

3-0; 3-0

Emphasizing the fundamentals and applications of biological processes for water and wastewater treatment, air pollution control, bioremediation of contaminated soils and ground water. Specific topics include basic microbiology, kinetics, bioenergetics, stoichiometry, activated sludge process, fixed-biofilm process, anaerobic treatment and frontiers in biological treatment processes.

Engineering 5611 (ST)

Advanced Topics in Control Applications

3-0; or 3-0

The course content will vary, but will deal with advanced automation and control in selected industries.

ENGI 5631 (ST)

Advanced Topics in Electrical and Computer Engineering

3-0; or 3-0

Current developments and specialized topics in Electrical and Computer Engineering.

Engineering 5651 (ST)

Advanced Topics in Environmental Engineering

3-0; or 3-0

Topics will vary, depending on the research interests of the instructor. Topics which may be covered include: mine waste management, pulp and paper industrial waste management, assessment and remediation of contaminated sites, engineering hydrology, groundwater hydrology, emerging topics in aquatic science, experimental methods and information management, and turbulent transport.

Engineering 5711

Seminar Control Engineering

1-0; or 1-0

An ordered and critical exposition of the literature on an appropriate topic in Control Engineering.
May only be taken by students in Control Engineering.

ENGI 5731

Seminar Electrical and Computer Engineering

1-0; or 1-0

An ordered and critical exposition of the literature on an appropriate topic in electrical and computer engineering.
May only be taken by students in Electrical and Computer Engineering.

Engineering 5811

Seminar Environmental Engineering

1-0; or 1-0

An ordered and critical exposition of the literature on an appropriate topic in Environmental Engineering.
May only be taken by students in Environmental Engineering.

Engineering 5901 (9901)

Master's Thesis

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