

Appendix E: Draft Calendar Entry (as of January 9th, 2013)

**Doctor of Philosophy (PhD)
in Electrical and Computer Engineering**

Graduate Co-ordinator: R. Khoury

Core: Doctoral Supervisory: A. Tayebi (Electrical Engineering)
M. N. Uddin (Electrical Engineering)
X. P. Liu (Electrical Engineering)
D. Alexandrov (Electrical Engineering)
C. Christoffersen (Electrical Engineering)
H. Naser (Software Engineering)
R. Benlamri (Software Engineering)
N.-Y. Yu (Electrical Engineering)
A. Manzak (Electrical Engineering)
E. Atoofian (Electrical Engineering)
R. Khoury (Software Engineering)
K. Liu (Mechanical Engineering)
W. Wang (Mechanical Engineering)
S. Pichardo (Adjunct, Electrical Engineering)
L. Curiel (Adjunct, Electrical Engineering)

**DOCTOR OF PHILOSOPHY (PHD) IN ELECTRICAL AND COMPUTER
ENGINEERING**

The PhD 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 Master's **programs** in Engineering ~~programs~~ at Lakehead University and outstanding graduates at the post graduate level from other universities.

The objective of the program is to foster students' scholarly skills and independent research abilities through a combination of formal course work and dissertation (research) work.

The areas of specialization in the proposed program are Electrical Engineering, Computer Engineering, Software Engineering, and Mechatronics. The first three are well-established disciplines. The fourth, Mechatronics, is a new but increasingly important area that overlaps the three first disciplines and Mechanical Engineering.

ADMISSION REQUIREMENTS

Candidates are accepted under the ~~general~~ **Faculty of Graduate Studies doctoral** ~~University~~ regulations governing the graduate degrees, provided that the requirements

of the Faculty of Engineering are also satisfied.

The applicant must hold an MSc degree in Electrical and Computer Engineering or a closely-related area with ~~at least~~ a **minimum** 70% average. Admission is dependent on the past academic history of the candidate and the assessment of the referees, the availability of space in the program and the availability and willingness of a suitable faculty member to supervise the applicant. A supervisor must be identified before the student is admitted to the program.

ACADEMIC REGULATIONS

In addition to the Faculty of Graduate Studies PhD regulations, the following regulations apply to the PhD in Electrical and Computer Engineering program.

(a) Course Requirements

It is expected that the student will maintain a minimum cumulative average of **70% (B) B** in the course work and a minimal final mark of 70% in each individual course.

The student choice of courses must be approved by the graduate supervisor and the Engineering Graduate Studies Committee.

A minimum of three half-credit graduate courses beyond the Master's level are normally completed within the first year of registration. To satisfy the program requirements, the three half-credit courses must comply with the following regulations:

1. They must be three half-credit graduate-level ~~Electrical and Computer Engineering~~ courses that have not been taken previously ~~at the Master's level~~.
2. No more than one course can be a relevant graduate-level course selected from outside the List of Electrical and Computer Engineering Graduate Courses.
3. No more than one "Advanced Topics in Electrical and Computer Engineering" (ENGI 5631) course with the student's supervisor will be accepted as a half-credit course.

In addition to the three half-credit courses, students must take the "PhD Seminar" (ENGI 6710) course. This seminar is normally taken in the second year of the PhD program.

List of Electrical and Computer Engineering Graduate Courses:

ENGI 5131: Microelectronics

ENGI 5132: Digital Communication Systems

ENGI 5231: Computer Architecture

ENGI 5232: Software Construction and Evolution

ENGI 5431: Advanced Power Electronics

ENGI 5432: Semiconductor devices
ENGI 5433: Design of RF ICs
ENGI 5434: Wireless Communication Systems
ENGI 5331: Digital ASIC Design
ENGI 5332: Advanced Computer Engineering
ENGI 5333: Computer Networks
ENGI 5334: Web Engineering
ENGI 5111: Control Engineering Concepts
ENGI 5211: Robust Control
ENGI 5411: Intelligent Control
ENGI 5631: Advanced Topics in Electrical and Computer Engineering
ENGI 5732: Nonlinear Control
ENGI 5733: Robotics
ENGI 5734: Natural Language Processing
ENGI 5735: Advances in Semiconductor Materials
ENGI 5736: Nanostructured Materials
ENGI 5273: Mechatronics
CS COMP 5313: Artificial Intelligence

(b) Research Supervision

Each student will be assigned a supervisor, (and optionally a co-supervisor) at the point of admission by the Engineering Graduate Studies and Research Committee. Supervision of all graduate students will be provided by their supervisor. Students are required to report their progress to their supervisor on a mutually agreed upon basis.

After completion of the course work and before taking the comprehensive examination, the student, in consultation with his/her supervisor, will form a Supervisory Committee consisting of at least three, and normally no more than six, faculty members as follows:

- The supervisor, along with the co-supervisor if there is one.
- Two faculty members **with approved membership status in the Faculty of Graduate Studies**, ~~from Lakehead University~~ knowledgeable in the student's research area, no more than one of whom can be external to the Electrical and Computer Engineering Doctoral Supervisory list.
- In addition, at a later time but before the doctoral defence, one external member from outside Lakehead University will be added to the committee. This external member should have expertise in the area of research of the thesis and not be acquainted with the student. Selection of the external examiner will be made by

the Supervisor, in consultation with the Graduate Coordinator, **and approved by the Faculty of Graduate Studies.**

(c) ENGI 6701 Comprehensive Examination

The comprehensive examination experience serves two main purposes. First, it allows the Supervisory Committee to examine and approve the student's dissertation proposal. Second, it allows the Supervisory Committee to verify that the student has a broad knowledge of the general foundations of the chosen field.

The comprehensive examination should ~~be taken~~ **take place** after the completion of course work, **within** 8 to 12 months, and no later than 16 months, after the beginning of the doctoral program. **The Comprehensive Examination will be an oral examination conducted by the Supervisory Committee.** ~~It takes place in front of the Supervisory Committee.~~

To accomplish the first purpose **of the Comprehensive Examination**, the student must produce a dissertation proposal **that will be** submitted to each member of the Supervisory Committee at least one month prior to the examination. This proposal will present the proposed research project, a background review, and all research work done to date. At the beginning of the comprehensive examination, the student will make a 30-minute presentation of the proposal and this will be followed by a question period related to the proposal before the Supervisory Committee.

To accomplish the second purpose **of the Comprehensive Examination**, each Supervisory Committee member will ask questions related to the student's research area. The questions will be asked orally during the examination.

At the end of the Comprehensive Examination, the Supervisory Committee must decide whether the student passes the examination, fails the examination, or must be re-examined.

If the student fails the comprehensive examination, the student will be withdrawn from the Doctoral program. Students admitted to a Doctoral program without completion of a Master's program who fail the Comprehensive Examination will be permitted, at the discretion of the academic unit, to change their program to the Master's **degree** in Electrical and Computer Engineering.

(d) ENGI 6710 PhD Seminar

The PhD seminar experience serves two main purposes. First, it allows the candidate to describe his/her research progress. Second, it allows the candidate to become familiar with research done in other areas of Electrical and Computer Engineering.

The Seminar should be taken after the successful completion of the comprehensive exam, **within** 20 to 24 months, and no later than 28 months, after **initial registration in the beginning** of the doctoral program. ‡ **The Seminar** is chaired by the Supervisor.

To accomplish the first purpose **of the PhD Seminar**, the candidate will prepare and make a 30-minute presentation on his/her research work, which will include a comprehensive background of the research area, the objectives of the research project, the latest progress since the comprehensive exam, and the planned work leading to the defence.

To accomplish the second purpose **of the PhD Seminar**, the candidate will attend the seminar presentations of other students in the PhD program in Electrical and Computer Engineering. Prior to registering for his/her own seminar, the candidate must have attended at least 6 seminars or acceptable alternatives.

(e) Dissertation and Oral Defence

The doctoral defence is the final evaluation of a doctoral candidate's work. ‡ **The defence** must take place at most three years after the comprehensive examination. Please see the Faculty of Graduate Studies PhD regulations regarding the preparation of the dissertation and oral defence for general information.

The dissertation must be received and reviewed by the Supervisory Committee before the oral defence can take place. Based on their review of the dissertation, the Supervisory Committee will decide among the four possible outcomes:

- Dissertation Accepted.
- Dissertation Accepted with Minor Revisions.
- Dissertation Accepted with Major Revisions.
- Dissertation Rejected.

The dissertation must be either “accepted”, “accepted with minor revisions” or “accepted with major revisions” before the student is allowed to proceed to the oral defence. **In cases where major revisions are required, the revisions must be completed and reviewed by the Supervisory Committee before the candidate advances to the oral defence.**

After the oral defence, the Supervisory Committee will decide among the four possible outcomes:

- Oral Defence Accepted.

- Oral Defence Accepted with Minor Revisions.
- Oral Defence Accepted with Major Revisions.
- Oral Defence Rejected.

(f) Period of Studies

The typical full-time student is expected to complete the doctoral program in 4 years (twelve terms). As shown in the following timeline, the first year (three terms) would be spent doing coursework and preparing for the comprehensive exam. The next two years (six terms) would be spent doing research and satisfying the other requirements. The final year (three terms) would be used to write the dissertation and prepare the defence.

Year 1 Fall: Initial registration, course work and background review

Year 1 Winter: Course work, background review, and selection of the committee

Year 1 Spring/Summer: Preliminary research work and thesis proposal redaction

Year 2 Fall: Comprehensive examination and research work

Year 2 Winter: Research work

Year 2 Spring/Summer: Research work and ~~research~~ **PhD** seminar

Year 3 Fall: Research work

Year 3 Winter: Research work

Year 3 Spring/Summer: Research work

Year 4 Fall: Dissertation writing

Year 4 Winter: Dissertation writing and defence

Year 4 Spring/Summer: Corrections to dissertation and final submission

(g) Residency Requirements

Doctoral candidates in this program are expected to be on campus at Lakehead University for the duration of their doctoral program. Exceptions are allowed if:

- The candidate needs to take a course that is offered at another university but not at Lakehead University and that cannot be taken through distance education. (Given the geographic distance between Lakehead University and other Ontario universities, it is accepted that the candidate will not reside at our campus during the ~~semester~~ **term in which** that course is taking place.)
- The research project requires using equipment or facilities not available at Lakehead University. (The candidate thus needs to work on-site at an off-campus location to do their research.)

PROGRAM

To fulfill the degree requirements, students must complete a total of eight (8) full course equivalents (FCE) at the graduate level consisting of the following components:

- (a) Three half-credit graduate-level courses (worth 0.5 FCE each) (see: Academic Regulations (a) Course Requirements)
- (b) PhD Seminar (ENGI 6710) (worth 0.5 FCE)
- (c) Comprehensive Examination (ENGI 6701) (worth 1.0 FCE)
- (d) ~~Thesis Proposal and Seminar~~ **PhD Dissertation** (ENGI 6901) (ENGI 9900) (worth 5.0 FCE)

DESCRIPTION OF NEW COURSES

ENGI 5732

Nonlinear Control

Credit weight: 0.5

Description: Students will learn about nonlinear models and nonlinear phenomena, Lyapunov stability, input-output stability, passivity, advanced stability analysis, stability of perturbed systems, feedback linearization, and nonlinear design tools.

Offering: 3-1.5; or 3-1.5

ENGI 5733

Robotics

Credit weight: 0.5

Description: Students will learn about D-H representation, forward kinematics, inverse kinematics, jacobian, Euler-Lagrange method, and Newton Euler method. This knowledge will be applied to the design of controls for robot manipulators.

Offering: 3-1.5 or 3-1.5

ENGI 5734

Natural Language Processing

Credit weight: 0.5

Description: Students will learn about the fundamentals of linguistics and of statistical inference in language, and how to apply statistical methods to basic tasks such as word sense disambiguation, part-of-speech tagging, and parsing. Students will explore recent work in advanced topics such as machine translation, information retrieval from text, and text categorization.

Offering: 3-1.5 or 3-1.5

ENGI 5735

Advances in Semiconductor Materials

Credit weight: 0.5

Description: Students will study advanced semiconductor materials based on compound alloys such as arsenides, phosphides, and nitrides. The properties of semiconductor materials - electrical and optical - will be determined on the basis of their electron band structures. Special attention will be given to calculation of the electron band structures on the ternary and quaternary semiconductor compound alloys and determination of the properties. New phenomena in the disordered alloys such as tunnel optical absorption and excitons of the structure will be studied.

Notes: Students who have successfully taken CHMS 5111 cannot register for this course.

Offering: 3-1.5 or 3-1.5

ENGI 5736

Nanostructured Materials

Credit weight: 0.5

Description: Students will study the properties of the nanostructures determined on the basis of their electron band structures, which will be calculated on the basis of Linear Combination of Atomic Orbitals (LCAO) method. Special attention will be given to calculation of the electron band structures of two-dimensional nanostructures and the related new phenomena connected with obtaining of relativistic particles in these structures.

Offering: 3-1.5 or 3-1.5

ENGI 6710

PhD Seminar

Credit weight: 0.5

Description: Students will gain experience in organizing and presenting the results of their scientific research to an audience of fellow scholars, and will become familiar with other scientific research in Electrical and Computer Engineering by attending the seminars of other students.

Notes: May only be taken by PhD students in Electrical and Computer Engineering. Must be taken no later than the seventh ~~semester~~ **term** of ~~their~~ **the** PhD program.

Grade Scheme: Pass/Fail

Offering: ~~1-0~~ or ~~1-0~~

ENGI 6701**PhD Comprehensive Examination**

Credit weight: 1.0

Description: The comprehensive examination will assess the student's general preparedness for the PhD degree and specific areas in his or her chosen area of study and research. The exam will also assess the student's ability to integrate material from divergent areas, to reconcile theoretical, methodological and empirical issues, and to think critically and creatively.

Notes: May only be taken by PhD students in Electrical and Computer Engineering. Must be taken no later than the fourth semester of their PhD program.

Grade Scheme: Pass/Fail

Offering: ~~1-0 or 1-0~~

ENGI 6901 (9900)**PhD Dissertation**

Credit weight: 5.0

Grade Scheme: Pass/Fail