



## ENEL Graduate Program Doctoral Candidacy Requirements

The University of Calgary [Graduate Candidacy Regulations](#) (“the Regulations”) govern the conduct of admission to graduate candidacy at the University of Calgary. This document presents the implementation of the *Regulations* in the Department of Electrical and Computer Engineering, hereafter referred to as the ENEL Graduate Program.

### A. Statement of Purpose

The Candidacy requirements in the ENEL Graduate Program test the student’s preparation to successfully complete the research, writing, and defending of her or his dissertation. Admission into candidacy indicates that students have a solid foundation not just in their particular fields of research but also in Electrical, Computer, and Software Engineering generally. Therefore, it requires that students have a well-developed plan for thesis research that includes a complete proposal with a well-motivated research question and statement on the potential contribution to the discipline of Electrical, Computer, and Software Engineering. It also requires that students have the necessary technical skills and background preparation to be judged able to follow through successfully on their proposed research plan.

### B. All doctoral students in the ENEL Graduate Program must successfully complete the following components:

1. PhD Coursework
2. Written Field of Study examination in Electrical, Computer, and Software Engineering
3. Written thesis proposal
4. Oral thesis proposal examination

Normally, the components are completed according to the order listed above.

### C. PhD Coursework

The PhD Coursework enables students to acquire advanced theoretical knowledge of topics needed for their research and, consequently, improve their fundamental knowledge. In addition, the Coursework provides students with the “know-how” to conduct research, basic scientific methods needed for research, and transferrable skills. Students must successfully complete the PhD Coursework within the first year of initial registration. The PhD Coursework consists of graduate course and professional development (PD) course requirements.

*Graduate Course Requirement:* 6 units (1 full-course equivalent) at the graduate level beyond the Master’s degree, or 18 units (3 full-course equivalents) at the graduate level beyond the Bachelor’s degree, with at least half the courses taken in the Departmental program. Students are advised to consult their Supervisor in selecting their graduate courses.

*PD Course Requirement:* Engineering 601 (1.5 units) and Engineering 603 (1.5 units). Students in the PhD program who completed Engineering 601 and Engineering 603 while in the MSc program will not be required to take the courses for the second time.



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### **D. Written Field of Study (FoS) Examination in Electrical, Computer, and Software Engineering**

The purpose of the FoS examination is to test a student's basic and fundamental knowledge in Electrical, Computer, and Software Engineering. It is recommended that students successfully complete the FoS examination within 14 months of initial registration in the PhD program.

#### *Scheduling of the Written FoS Examination*

The FoS examination is scheduled by the Graduate Program Director (GPD) twice a year: in February and in June.

#### *Format of the Written FoS Examination*

The FoS examination is a three hour, closed-book, on-site written examination. Only non-programmable calculators may be used. The FoS examination is a single examination common for all students in the Department. It is open to all eligible PhD students as well as currently enrolled MSc students in the Department planning to transfer to PhD without completing their MSc.

The FoS examination will test the student's knowledge at a level equivalent to 3<sup>rd</sup> and 4<sup>th</sup> year undergraduate courses in Electrical, Computer, and Software Engineering.

The questions in the FoS examination will be organized into seven sections, one per the subject group areas of Electrical, Computer, and Software Engineering: (1) biomedical engineering; (2) circuits and electronics; (3) computer engineering; (4) power and control; (5) radio frequency systems and applied electromagnetics; (6) software engineering; and (7) telecommunications, image, and signal processing.

Students are required to answer a total of four questions, which they select from at least two sections, answering a minimum of one question and at most three questions from any section (see "Process of the Written FoS Examination" below.) A separate answer booklet must be used for each section.

Answers to questions will involve explanation of concepts, analytical derivations, and numerical calculations. For each of the seven sections in the FoS examination, the study material, number of questions, sample questions, as well as the exact date for the FoS examination will be posted on the Department website at least three months before the examination date.

#### *Process of the Written FoS Examination*

Students should inform the GPD in writing of their intention to sit for the FoS examination, by submitting a completed and signed *Application Form for FoS Examination*, approved by their Supervisor. Students must specify on their Application Form the sections (approved by their Supervisor) they have selected to answer questions from during the FoS examination. The deadline is January 31 for the February examination and May 31 for the June examination. It is recommended that PhD students who enroll in September take their FoS examination in February (i.e. six months in program), and those who begin their program in January take theirs in June (i.e. six months in program).

The FoS examination will be proctored by the FoS Examination Committee (FEC), which is common for the two exams scheduled during a calendar year.

The FEC, formed by the GPD, shall consist of seven members with one representative from each of the seven subject group areas of Electrical, Computer, and Software Engineering. The FEC will elect its own Chair. Each member will grade the questions in her or his subject area and submit the scores to the



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Chair, who will then collate and submit the final scores to the GPD. The FEC will score the FoS exam out of 100 (i.e., each question is scored out of 25).

The outcome of the FoS examination is pass/fail. To receive a pass, students must demonstrate a good understanding of basic and fundamental knowledge in Electrical, Computer, and Software Engineering by achieving a minimum of 70% of the maximum score of the questions answered in each section selected. For example, a student who answers three questions in one section and one question in another must receive at least 52.5 and 17.5, respectively to pass the FoS examination.

The GPD will communicate in writing the result of the examination to the student and Supervisor within two weeks of the date of the examination. A student who fails her or his FoS examination will be allowed to re-take the examination at the next-scheduled Department-wide FoS examination. A second failure of a FoS examination will result in a PhD student being required to withdraw from the ENEL graduate program.

### *Appeal of Failed FoS Examination*

In the case of a failed FoS examination, students may appeal the decision in writing to the Faculty of Graduate Studies (FGS). Please see *Academic Regulations in the Faculty of Graduate Studies Calendar*, section O. *Appeals – Appeals Against Faculty of Graduate Studies Rulings*.

## **E. Written Thesis Proposal**

The written thesis proposal shall include both a written Research Review and a written Research Proposal.

The written Research Review enables students to acquire and demonstrate in-depth understanding and knowledge of the relevant literature and current state of the art in their research topic. The purpose of the written Research Proposal is to assess a student's readiness and potential to successfully conduct independent and high-quality research. (See "Format of the Written Thesis Proposal" below.)

The recommended deadline to successfully complete the written thesis proposal is 22 months from initial registration. The written thesis proposal is due at the end of the 21<sup>st</sup> month in the program to allow for one month of evaluation. A hardcopy and a softcopy of the written thesis proposal must be submitted to the Candidacy Examination Committee (CEC) and the Graduate Program Administrator (GPA).

The CEC is formed by the Supervisor, in consultation with the student, no later than 8 months after the student's initial registration. The CEC shall consist of the Supervisory Committee plus two additional members: one internal and one internal/external examiner where the latter may also be from the Department but outside of the subject area of the student's thesis. The Supervisor will chair the CEC.

### *Format of the Written Thesis Proposal*

The written thesis proposal must be a maximum of 30 typewritten, single-column pages of text (excluding references, tables, and diagrams), using double-line spacing, and font size 12. The document must be organized into two distinct sections: section 1 is the Research Review (maximum length of 20 pages) and Section 2 is the Research Proposal (maximum length of 10 pages). Each section must conform to the scope specified as follows:



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Scope of the Research Review: The scope of the research review must cover and address three key elements:

- 1) Critical assessment of the relevant literature, i.e., critical evaluation, synthesis, interpretation, and inter-relationships among major publications in the existing literature;
- 2) Gaps in knowledge: What are not yet known and/or needed, for example, models, methodologies, and techniques; and
- 3) Open problems: Outline of research challenges to bridge the identified gaps in knowledge.

Scope of the Research Proposal: consists of and shall address five key elements listed as follows:

- 1) Research Questions and Motivation: What research questions will be answered and why? How do these questions fit into the current state of the art?
- 2) Potential Methodology: How will the research questions be answered? What potential techniques and methods will be used to answer the research questions?
- 3) Potential Contributions: What potential value and novelty will successful completion of elements (1) and (2) contribute and advance the state of the art of research area?
- 4) Preliminary Results: Briefly describe the achieved tangible evidence to demonstrate preliminary research progress.
- 5) Research Plan: What are the next steps following successful candidacy? What are the milestones, resource requirements, and timeline (i.e., schedule)?

### *Evaluation of the Written Thesis Proposal*

The written thesis proposal will be evaluated by the Candidacy Examination Committee (CEC).

The two sections of the written thesis proposal, Research Review and Research Proposal, are evaluated separately.

The Research Review section is evaluated based on its scope (i.e., the three key elements of research review listed in the previous section) and the Research Proposal section is evaluated based on its five key elements.

Each member of the CEC provides to the Chair and GPD a written evaluation of the written thesis proposal and makes a pass/fail recommendation on each of the Research Review and Research Proposal sections. The outcome for each section is decided by a simple majority of the recommendations, which is communicated to the student by the Chair of the CEC.

To pass the written thesis proposal, a student must receive a “pass” on both the Research Review and Research Proposal sections. A student who receives a “fail” outcome in the written thesis proposal will be allowed to redo the failed section(s) and submit a revised version of the failed thesis proposal within three months of the failed outcome. A second failure of the written thesis proposal will result in a student being required to withdraw from the ENEL graduate program.

### *Appeal of failed Written Thesis Proposal*

In the case of a failed written thesis proposal, students may appeal the decision in writing to the Faculty of Graduate Studies (FGS). Please see *Academic Regulations in the Faculty of Graduate Studies Calendar*, section O. *Appeals – Appeals Against Faculty of Graduate Studies Rulings*.

Approved by Electrical & Computer Engineering Council: December 9, 2015

Approved by FGS Policy Committee: April 14, 2016

Effective Date: September 1, 2016



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### **F. Oral Thesis Proposal Examination**

The oral thesis proposal examination is a single examination which consists of two parts: (1) an oral examination based on the Research Review section of the written thesis proposal, and (2) an oral examination of the Research Proposal section of the written thesis proposal.

The purpose of the oral examination based on the Research Review is to further test the student's understanding of the background material and literature relevant to the student's research topic, and the student's ability to identify novelty in her/his research area. The oral examination of the Research Proposal tests the student's ability to present and defend her/his research plan.

The oral examination will also assess the student's oral communication skills and ability to respond to questions. It is recommended that students successfully pass the oral examination of the thesis proposal within 24 months of initial registration.

#### *Scheduling of the Oral Thesis Proposal Examination*

The oral thesis proposal examination must be scheduled within one month of successfully passing the written thesis proposal. The Supervisor should notify the GPD and the GPA at least three weeks before the oral examination date. The Supervisor should schedule the examination and send the GPA the details, i.e., the date, time, and information on CEC members (i.e., same members who evaluated the written thesis proposal): name, email address, and home department. The GPA will arrange a room for the examination and also prepare the *Oral Examination Notice* form, for signature of the student, supervisor, and GPD. The GPA sends the signed form to the examiners and the student.

#### *Format of the Oral Thesis Proposal Examination*

The oral examination is "open" and may be attended by other graduate students and academics, all of whom are referred to as observers and are to refrain from asking questions or providing any comments during the examination. The oral examination will be chaired by a Neutral Chair, appointed by the GPD at least three weeks before the date of the oral examination.

The scope of the oral examination is the content of the written thesis proposal, specifically (1) the written Research Review, and (2) the written Research Proposal. The oral examination will consist of a maximum 15-minute, opening presentation by the student including a summary of the five elements in her/his written research proposal. The opening presentation will then be followed by at least two rounds of questions by the CEC members (examiners). The examiners should ask clear and succinct questions. The student should be given reasonable time to answer and should feel free to ask for questions to be repeated, rephrased, or clarified. Answers provided by the student can be both verbal and in writing on a board.

The duration of the oral thesis proposal examination, including the maximum 15-minute presentation, is two hours, where the time spent on each of the Research Review and Research Proposal should not exceed 50 minutes. The two-hour duration does not include the deliberation time of the CEC. Prior to the deliberation, the Neutral Chair asks the student and all observers to leave the room.

#### *Evaluation of the Oral Thesis Proposal Examination*

At the end of the oral examination and before any discussion of the student's performance, each examiner must identify, by secret ballot, which recommendation (pass or fail) she/he favors based on the student's performance in answering questions on both the Research Review and Research Proposal



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sections of the written thesis proposal. The Neutral Chair announces the result of the secret ballot. This may be followed by further discussion, moderated by the Neutral Chair, after which a final vote is called.

The outcome of the oral examination is a “pass” if the final vote by the CEC includes no more than one “fail” vote. If the final vote includes 2 or more “fail” votes, the outcome of the oral examination is a “fail.” In this case, within five working days of the examination, each CEC member must submit a confidential report to the GPD explaining the reasons for her/his vote and copy to the Supervisor. The GPD, upon careful review of the reports, may uphold the “fail” in the case of a clear fail (i.e., 3 or more “fail” votes) or refer to the FGS for decision in the case of an unclear fail (i.e., 2 “fail” votes). If the GPD upholds the “fail,” after consultation with the Supervisor, the GPD then provides an anonymized summary of the essential points from the examiners’ reports to the student, copied to the Supervisor. The GPD will also send the student the formal notice of a failed oral examination of the thesis proposal within ten working days from the date of the examination.

A student who fails the oral examination will be allowed to re-take the examination within three months of the failed examination. A second failure of an oral thesis proposal examination will result in a student being required to withdraw from the ENEL graduate program.

### *Appeal of failed Oral Thesis Proposal Examination*

The appeal process is identical to that of failed written thesis proposal (section E).

### **G. Candidacy Process for Master’s Students transferred to the PhD Program**

Master’s students in the ENEL program and transferred to the PhD program must complete the following components of the candidacy process:

1. PhD Coursework: The requirement of 18 units (3 full-course equivalents) at the graduate level beyond the Bachelor’s degree must be met.
2. A written Field of Study (FoS) examination in Electrical, Computer, and Software Engineering. Master’s students transferred to the PhD program who have not yet passed the written FoS examination must write the examination at the next scheduled Department-wide examination. A Master’s student who fails her/his first written FoS examination will be allowed to re-take the examination at the next scheduled Department-wide examination. A second failure of a written FoS examination will result in a Master’s student being required to continue in the Master’s program.
3. Written thesis proposal, as described in section E.
4. Oral thesis proposal examination, as described in section F.

The deadline to complete the above requirements is a maximum of 12 months from the transfer date: the first 8 months to complete 6 units of courses at the graduate level (additional to the 12 units of courses at the graduate level and the two PD courses completed while enrolled in the MSc program) and write the FoS examination if not yet passed, and the next 4 months to complete the thesis proposal requirement.



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### **H. Extension to FGS Candidacy Requirement Deadline**

According to the University of Calgary Doctoral Candidacy Regulations, Doctoral students must complete all candidacy requirements within 28 months of first registration. Those students who have transferred from a Master's program must complete all candidacy requirements within 36 months of the first registration in that Master's program. Students who will not complete their candidacy requirements by the above deadline must have an extension request approved by the Faculty of Graduate Studies. When requesting an extension, the student and supervisor should specify a date for the thesis proposal oral exam and plan the extension request around that date. Once a date has been decided, the extension request form ([http://grad.ucalgary.ca/sites/grad.ucalgary.ca/files/r\\_extension\\_request.pdf](http://grad.ucalgary.ca/sites/grad.ucalgary.ca/files/r_extension_request.pdf)) should be completed with an explanation of the reasons for the delay. Normally, it must be signed by the Supervisor and the GPD. The completed and signed form should be submitted to the GPA to be sent to FGS for approval. Please note that the form should be submitted by the end of the 27<sup>th</sup> month in the program for Doctoral students or the end of the 35<sup>th</sup> month in the program for Master's transfer students to allow time for processing.



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**Appendix 1: Flowchart of Recommended Maximum Timeline<sup>1</sup> for Candidacy Process in the ENEL Graduate Program.**

Month	Milestone
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12	Complete PhD course work requirement
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14	Complete written Field of Study examination in Electrical, Computer, and Software Engineering
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21	
22	Complete written thesis proposal
23	
24	Complete oral thesis proposal examination

Footnote 1: Students, with the agreement of their supervisory committee, have the option of completing the components earlier than the recommended maximum timeline.