



**Engineering Faculty Council
Faculty of Engineering and Applied Science**

**Motion EFC_2016_10
APPROVED**

Motion: To approve a Major Program Modification of the Electrical and Computer Engineering PhD program to include the addition of “Power Systems and Power Electronics” as an additional field of specialization.

Motion moved by: Min Dong

Seconded: Ying Wang

In Favour: 31

Against: 0

Abstention: 0



**Faculty of Engineering and Applied Science
Electrical and Computer Engineering**

Major Program Modification

November 10, 2016

Prepared by:

Dr. Ying Wang, ECE Graduate Program Director
Dr. Hossam Gaber, ECSE faculty member
Dr. Walid Morsi Ibrahim, ECSE faculty member
Dr. Vijay Sood, ECSE faculty member
Dr. Sheldon Williamson, ECSE faculty member
Dr. Mohamed Youssef, ECSE faculty member

1. INTRODUCTION

Since the inception of the PhD program in Electrical and Computer Engineering (ECE) in 2009, it has grown significantly. Faculty members with diverse areas of expertise have joined the programs, especially in areas such as electric power systems and smart electric grid, including a Tier 2 Canada Research Chair in Electric Energy Storage Systems for Transportation Electrification.

Current students in the ECE PhD program can specialize in one of the three fields:

- Communications and Signal Processing
- Control Systems
- Software Systems

Alternatively, a student can choose to cover many facets of the broad discipline of electrical, computer and software engineering (ECSE).

The proposed change is to add the “Power Systems and Power Electronics” field in the list of fields. This additional field, together with our existing fields, will:

- reflect the research expertise of the faculty members,
- echo the government priorities,
- address general interests of the local industry, and
- highlight the university strategic research plan.

This addition further attracts students in this field and strengthens our exiting PhD program.

2. DEGREE REQUIREMENTS

a) Program learning outcomes

There are no changes to the exiting PhD program learning outcomes:

Graduates of the engineering PhD programs shall be able to:

1. Demonstrate specialized knowledge and understanding of essential facts, concepts, principles, and theories in a specific area of advanced study.
2. Recognize and be guided by social, professional, and ethical expectations and concerns involved in advanced education and research.
3. Effectively use advanced tools for research.
4. Apply the principles of effective data management, information organization, and information retrieval skills to data of various types.
5. Utilize analytical, numerical, experimental, interpretive and expository skills in conducting projects and research.
6. Expand and enhance the application of specific and well-concentrated research to engineering problems and practice.
7. Critically evaluate advanced information and knowledge and examine their application in engineering practice.
8. Identify problems and opportunities for system analysis, design, improvement, and optimization.
9. Understand, explain, and solve problems using quantitative and qualitative methods.
10. Appreciate the importance of and develop strategies for further education and lifelong learning.
11. Design and conduct experiments and analyze and interpret experimental data and computational results.

12. Demonstrate effective oral and written communication skills.
13. Understand the basics of Intellectual Property (IP) and its management.
14. Develop effective project management and teamwork skills.
15. Create grant proposals.
16. Develop an appreciation for other disciplines and the important issues that face society.

The objectives of the PhD program are achieved through a combination of advanced course work, independent research, research seminars, mandatory workshops, research publication, and a novel research dissertation. The research dissertation must comprise a new contribution, yet significant, to the field of study.

b) Admission Requirements

The admission requirements are consistent with current ECE PhD program admission requirements, which are summarized below. There are no additional requirements or procedures.

- The minimum admission requirement for the PhD program is completion of a MASc level degree in engineering at a Canadian university or its equivalent, with a minimum of a B+ average.
- Under exceptional circumstances, MASc students may transfer directly to the PhD program after completing one academic year in the MASc program if a number of conditions are met.
- Prior to being accepted into the program, PhD students must find a professor who specializes in the applicant's desired area of research and is willing to act as a supervisor.
- All applicants are required to give evidence of their oral and written proficiency in English.

c) Program Structure

The following section is from the current Graduate Academic Calendar, Program information for ECE graduated programs, **with changes highlighted**:

“The Master of Applied Science (MASc) and Master of Engineering (MEng) programs in Electrical and Computer Engineering allow a student to study in all major areas associated with electrical, computer and software systems engineering. These areas include electronics, intelligent systems, communications, control, biomedical, power electronics, power generation, software engineering, mobile systems and embedded software systems. These disciplines are expected to be in high demand by employers.

In addition, students in the Doctor of Philosophy (PhD) program can specialize in one of the following three fields:

- Communications and Signal Processing
- Control Systems
- Software Systems
- **Power Systems and Power Electronics**

Alternatively, a student can choose to cover many facets of the broad discipline of electrical, computer and software engineering. Topics can vary widely and may include

communications, networking, intelligent control systems, robotics, computer vision, health informatics, mobile systems, power systems and smart power grids.”

The following courses listed in the Graduate Academic Calendar are already being offered in the field:

- ENGR 5004G: MASc/MEng Directed Studies
- ENGR 5005G: Special Topics
- ENGR 5925G: Control and Performance of AC Drives
- ENGR 5960G: Power System Operations, Analysis and Planning
- ENGR 5970G: Advanced Power Electronics
- ENGR 5975G: Electrical Power Distribution Systems
- ENGR 5980G: Advances in Nuclear Power Plant Systems
- ENGR 5985G: Advanced Power Plant Technologies
- ENGR 5990G: Utility Applications of Static Converters
- ENGR 5995G: Grid Integration of Renewable Energy Systems
- ENGR 6004G: PhD Directed Studies

A number of Special Topics courses (ENGR 5005G) have been offered in the field, for example Electric Energy Storage Systems. In addition, a number of MASc/MEng and PhD Directed Studies courses (ENGR 5004G and ENGR 6004G) have been offered in the field, for example Socio-Economic Evaluation of PV Installations, Electric Traction Machine Design and Emulation, and Fuzzy Systems for Smart Grid Applications.

d) Program Content

No new courses are being added.

3. RESOURCE REQUIREMENT

a) Faculty members

The following is a table of Graduate faculty members in the ECE Graduate Program sorted Alphabetical. No additional faculty members are required to support this field of specialization at this point in time.

Faculty Name & Rank	Home Unit	Area(s) of Specialization
Dr. Hossam Gaber Professor	Faculty of Engineering and Applied Science (ECSE Dept.) Faculty of Energy Systems and Nuclear Science	Resilient Smart Energy Grids and Micro Energy Grids Planning, Control, and Protection Plasma Generation and Applications on Clean Energy and Nuclear Fusion Advanced Safety and Control Systems for Nuclear Power Plants and Energy and Transportation Infrastructures Risk-Based Energy Conservation, Smart Green Buildings
Dr. Walid Morsi Ibrahim Associate Professor	Faculty of Engineering and Applied Science (ECSE Dept.)	Smart Grid: Design, analysis, operation management and control, Signal Processing and data analytics of power systems, Automation, protection and management of power systems
Dr. Tarlochan Sidhu Professor and Dean	Faculty of Engineering and Applied Science (ECSE Dept.)	Power systems

Dr. Vijay Sood Associate Professor	Faculty of Engineering and Applied Science (ECSE Dept.)	HVDC and FACTS Controllers for Power transmission systems, Smart Grid and microgrid implementation, Grid integration of renewable energy systems, Control and protection of power systems
Dr. Sheldon Williamson Associate Professor	Faculty of Engineering and Applied Science (ECSE Dept.)	Power electronics, motor drives, electric energy storage systems, and transportation electrification.
Dr. Mohamed Youssef Assistant Professor	Faculty of Engineering and Applied Science (ECSE Dept.)	Propulsion Systems for the Automotive and Railway Electromagnetic Compatibility (EMC) for the Automotive and Railways Traction Substation Design, Planning and Commissioning, Power Electronics Applications for the Information Technology, Power Electronics Applications in Renewable Energy Resources, Power Systems Operation and Stability

The following is a table of graduate supervision, including master's major research papers/projects (MRP), master's thesis, doctoral dissertations, and post-doctoral student (PDF), by each faculty member.

Graduate Supervision								
Faculty Member	Completed				In Progress			
	MRP	Thesis	Dissertation	PDF	MRP	Thesis	Dissertation	PDF
Hossam Gaber	50	42	6	15	10	4	5	2
Walid Morsi Ibrahim	3	6	0	1	4	3	5	0
Tarlochan Sidhu**			2					
Vijay Sood**		6	6	1	1		2	1
Sheldon S. Williamson	62	25	6	5		3	5	2
Mohamed Youssef	2	2	0	1	1	1	2	0

** Data compiled from graduates of the ECE program.

b) Additional academic and non-academic human resources

There will be no additional administrative requirements for the new field. All graduate students have access to an extensive support system that already exists and ensures a quality student experience.

c) Physical resource requirements

The resources required for the new field already exist. There will be no additional physical resource requirements. The following existing labs are dedicated to the new field: Power Systems Protection and Automation Laboratory, Advanced Storage Systems and Electric Transportation (ASSET) Laboratory, Power Electronics and Drives Applications Lab (PEDAL), and Electrical Power Laboratory.

4. BUSINESS PLAN

a) Statement of funding requirements

There are five faculty members (plus the Dean of FEAS) in the Department of Electrical, Computer and Software Engineering, who are currently working in the field and they will be supporting the new field of specialization and teaching all the courses. No additional faculty members are required to support this field of specialization at this point in time.

b) Statements of resource availability

The physical resources required for this new specialization already exist within the Department of Electrical, Computer and Software Engineering. Existing labs and lab equipment will be supporting this new specialization.

5. TIMELINE/DATE OF IMPLEMENTATION

The field of specialization will be included in the Graduate Calendar in Fall 2017. No transition plan is needed as the faculty members are already supervising graduate students and teaching graduate courses in the field.

APPROVAL DATES

ECSE Department Council approval	November 16, 2016
FEAS Graduate Committee approval	November 28, 2016
Engineering Faculty Council approval	December 6, 2016
GSC approval	