Engineering Faculty Council
Faculty of Engineering and Applied Science

Motion EFC_2016_11
APPROVED

Motion: To approve a Major Program Modification of the Electrical and Computer Engineering MASc program to include the addition of four fields of specialization:

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

Motion moved by: Min Dong

Seconded: Ying Wang

In Favour: 31

Against: 0

Abstention: 0

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

Faculty of Engineering and Applied Science

Electrical and Computer Engineering

Major Program Modification

November 15, 2016

Prepared by:

Dr. Ying Wang, ECE Graduate Program Director

Dr. Ramiro Liscano, ECSE Department Chair

1. INTRODUCTION

Since the inception of the MAsc program in Electrical and Computer Engineering (ECE) in 2007, it has grown significantly. Faculty members with diverse areas of expertise have joined the programs, especially in areas such as software systems, 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

In addition, a new field, "Power Systems and Power Electronics", has been proposed.

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 4 fields in the ECE PhD program to the ECE MASc program. These fields:

- 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 these fields and strengthens our exiting MASc program.

2. DEGREE REQUIREMENTS

a) Program learning outcomes

There are no changes to the exiting MASc program learning outcomes:
Graduates of the engineering MASc 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, methodological, interpretive and expository skills in conducting 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 the 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

The learning outcomes for the MASc program are achieved through a combination of course work, supervised research, a research seminar, and a research thesis.

b) Admission Requirements

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

- Completion of an undergraduate engineering degree in a relevant field from an accredited engineering program at a Canadian university, or its equivalent from a recognized institution.
- Overall academic standing of at least a B (GPA: 3.0 on a 4.3 scale), with a minimum B in the last two full-time years (four semesters) of undergraduate work or equivalent. B+ is preferred for MASc applicants.
- Prior to being accepted into the program, MASc applicants must find a professor who specializes in their desired area of research and who 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 and the MASc program can specialize in one of the following four 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 these fields:

ENGR 5001G - MASc Thesis

ENGR 5002G - MEng/MEngM Project

ENGR 5003G - MASc Seminar

ENGR 5004G - MASc/MEng Directed Studies

ENGR 5005G - Special Topics

ENGR 5010G - Advanced Optimization

ENGR 5013G - Advanced Engineering Mathematics

ENGR 5263G - Advanced Control

ENGR 5605G - Convex Optimization

ENGR 5610G - Stochastic Processes

ENGR 5620G - Digital Communications

ENGR 5630G - Statistical Signal Processing

ENGR 5631G - Advanced Estimation Theory

ENGR 5632G - Advanced Detection Theory

ENGR 5640G - Advanced Wireless Communications

ENGR 5650G - Adaptive Systems and Applications

ENGR 5660G - Communication Networks

ENGR 5670G - Cryptography and Secure Communications

ENGR 5680G - Information Theory

ENGR 5690G - RF and Microwave Engineering for Wireless Systems

ENGR 5710G - Network Computing

ENGR 5720G - Pervasive and Mobile Computing

ENGR 5730G - Advanced Algorithms and Data Structures

ENGR 5740G - User Interface Design

ENGR 5750G - Software Quality Management

ENGR 5760G - Software Metrics

ENGR 5770G - Service Computing

ENGR 5775G - Knowledge Discovery and Data Mining

ENGR 5780G - Advanced Computer Architecture

ENGR 5850G - Analog Integrated Circuit Design

ENGR 5860G - Digital Integrated Circuit Design

ENGR 5910G - Embedded Real-Time Control Systems

ENGR 5915G - Discrete Time Control Systems

ENGR 5920G - Analysis and Control of Nonlinear Systems

ENGR 5925G - Control and Operation of AC Drives

ENGR 5930G - Adaptive Control

ENGR 5940G - Intelligent Control Systems

ENGR 5945G - Mobile Robotic Systems

ENGR 5950G - Computational Electromagnetics

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

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 these fields of specialization at this point in time.

Faculty Name & Rank	Home Unit	Area(s) of Specialization
Dr. Akramul Azim Assistant Professor	Faculty of Engineering and Applied Science (ECSE Dept.)	Real-time Systems, Embedded Software, Safety-Critical Systems, Internet of Things, Software verification and Validation
Dr. Michael Bennett Academic Associate	Faculty of Engineering and Applied Science (ECSE Dept.)	Teaching Only
Dr. Ming Dong Associate Professor	Faculty of Engineering and Applied Science (ECSE Dept.)	Statistical signal processing for communications, Communication systems and networks, Broadband wireless access networks
Dr. Mikael Eklund Associate Professor	Faculty of Engineering and Applied Science (ECSE Dept.)	Autonomous Systems (Robotic vehicles smart sensors for assisted living), nonlinear system identification and control medical image processing

Dr. Mohamed El-Attar Associate Professor	Faculty of Engineering and Applied Science (ECSE Dept.)	Software Engineering, Secure Software Engineering, Human Centered Computing in Software Engineering, Requirements Engineering, Empirical Software Engineering, Model-Based Process Improvement and Testing, Systematic Evaluation of the Cognitive Effectiveness of Visual Languages
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. Ali Grami Associate Professor	Faculty of Engineering and Applied Science (ECSE Dept.)	Satellite Communications and Systems Design, Digital Transmission Systems, Wireless Communications and Networks
Dr. Khalid Hafeez Academic Associate	Faculty of Engineering and Applied Science (ECSE Dept.)	Teaching Only
Dr. Ramiro Liscano Associate Professor and Chair of Department of Electrical , Computer and Software Engineering	Faculty of Engineering and Applied Science (ECSE Dept.)	Pervasive and Mobile Computing, Distributed Computing, Wireless Sensor Networks, Wireless Networked Cyber-physical Systems.
Dr. Lixuan Lu Associate Professor	Faculty of Engineering and Applied Science (ECSE Dept.) Faculty of Energy Systems and Nuclear Science	Networked control systems, Nuclear reactor instrumentation and control, Risk-informed maintenance, Probabilistic safety assessment, Reliability
Dr. Qusay Mahmoud Professor	Faculty of Engineering and Applied Science (ECSE Dept.)	Software systems, web engineering, mobile computing, engineering education
Dr. Masoud Makrehchi Associate Professor	Faculty of Engineering and Applied Science (ECSE Dept.)	Social Computing and Human Computation, Mining Social Media and Social Networks, Text and Data Mining, Artificial Intelligence and Machine Learning, Recommender Systems, Applications of Data Mining in Software Engineering
Dr. Ruth Milman Assistant Professor	Faculty of Engineering and Applied Science (ECSE Dept.)	Systems Control Theory, Model Predictive Control Systems, Optimization, Nonlinear Control, Constrained Systems
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. Shahryar Rahnamayan Associate Professor	Faculty of Engineering and Applied Science (ECSE Dept.)	Software Engineering, Machine Intelligence, Opposition-Based Computation, Metaheuristics, Image Processing and Computer Vision, Parallel Processing, Multi-Objective and Large-Scale Optimization, Simulation of Discrete and Continuous Systems
Dr. Jing Ren Assistant Professor	Faculty of Engineering and Applied Science (ECSE Dept.)	Haptics and virtual reality, robotics and control, image processing, soft computing
Dr. Langis Roy Professor and Dean of Graduate Studies	Faculty of Engineering and Applied Science (ECSE Dept.)	High-Performance Electronic Circuit Packaging, Integrated Active Antennas, Microwave Electronics (Si GaN GaAs), System-on-Package Design, System-on-Chip Design, Low Temperature Co-Fired Ceramics, Reconfigurable Microwave Components, Wireless Sensors
Dr. Namdar Saniei Senior Lecturer	Faculty of Engineering and Applied Science (ECSE Dept.)	Teaching Only
Dr. Shahram ShahbazPanahi Professor	Faculty of Engineering and Applied Science (ECSE Dept.)	Array processing, Co-operative communications, Detection and estimation, Dynamic spectrum access, Smart antennas, Statistical signal processing, Wireless communications
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. Ying Wang Associate Professor and ECSE Graduate Program Director	Faculty of Engineering and Applied Science (ECSE Dept.)	RF/Microwave Engineering, Computer Aided Design, Millimetre-Wave Technology, Computational Electromagnetics, Satellite and Wireless Communications, Radio Wave Propagation Modeling for Wireless Communication 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

Dr. Ying Zhu Associate Professor	Faculty of Engineering and Applied Science (ECSE Dept.) Faculty of Business and Information Technology	Network optimization, overlay networks over heterogeneous substrates (wired and wireless networks), peer-to-peer networks
Dr. Khalil El-Khatib Associate Professor	Faculty of Business and Information Technology	Biometrics, cloud computing, e-health, feature interaction for VoIP, IP telephony, personal and service mobility, QoS for multimedia applications, security and privacy issues in wireless sensor network and in mobile wireless ad-hoc networks (MANET), ubiquitous computing environments (smart spaces)
Dr. Patrick Hung Associate Professor	Faculty of Business and Information Technology	Mobile Services for Toy Computing, Dynamic Workflow Exception Handling System
Dr. Shahram Heydari Associate Professor	Faculty of Business and Information Technology	Critical infrastructure protection and failure recovery, MANET design and modelling, network design, network security, QoS and traffic modelling, Software-Defined Networking (SDN, telecommunication protocols and services
Dr. Xiaodong Lin Associate Professor	Faculty of Business and Information Technology	Information security, privacy-enhancing technologies, digital forensics, and applied cryptography
Dr. Carolyn McGregor Associate Professor and Canada Research Chair in Health Informatics	Faculty of Business and Information Technology	Business process performance management, data stream event correlation, data warehousing, health informatics, intelligent agents, intelligent decision support systems, multi-agent data mining, patient journey modelling, service computing in healthcare, web services, women in computing and IT, workflow
Dr. Miguel Vargas Martin Associate Professor	Faculty of Business and Information Technology	Information Security, Optimization of websites and virtual learning environments
Dr. George Bereznai Professor and Director of Industry Training Program	Faculty of Energy Systems and Nuclear Science	Computer control of nuclear power plants, Educational technology and Real-time simulation.
Dr. Ibrahim Dincer Professor	Faculty of Engineering and Applied Science (AMME Dept.)	Drying, Energy and exergy analyses, Energy conversion and management, Heat and mass transfer, Hydrogen and fuel cell systems, Refrigeration, Renewable energies, Thermal energy storage, Thermodynamics
Dr. Ebrahim Esmailzadeh Professor	Faculty of Engineering and Applied Science (AMME Dept.)	Vibrations of Machines and Flexible and Distributed Systems, Nonlinear Dynamical Systems, Vehicle Dynamics, Nonlinear Adaptive and Optimal Control Systems, Active vibration control, Intelligent and electric vehicles.

Dr. Moustafa El-Gindy Associate Professor	Faculty of Engineering and Applied Science (AMME Dept.)	Aircraft landing dynamics, Articulated heavy vehicles, Bus testing and simulation, Crash testing and simulations, High-velocity impact and ballistics simulation, Multi wheels military vehicles dynamics, Self-steering axles simulation, Tire mechanics, Tire-soft and hard soils interaction, Vehicle dynamics and Virtual human modelling.
Dr. Yuping He Associate Professor	Faculty of Engineering and Applied Science (AMME Dept.)	Vehicle System Dynamics, Vehicle Chassis Design, Vehicle Active Safety Systems, Automated Design Synthesis, Modelling and Simulation Driver-Hardware-in-the-Loop Real-Time Simulations, Application of Multidisciplinary Design Optimization, Mechatronic Systems
Dr. Scott Nokleby Associate Professor and Associate Cameco Research Chair	Faculty of Engineering and Applied Science (AMME Dept.)	Robotics, Mechatronics, Mechanisms, Automation, Advanced Kinematics of Robots and Mechanisms, Redundant Manipulator Systems, Mobile-Manipulator Systems, Mechanism and Robot Design, Optimal Design
Dr. Bale Reddy Professor and Chair of Department of Automotive, Mechanical and Manufacturing Engineering	Faculty of Engineering and Applied Science (AMME Dept.)	Biomass Combustion and Gasification, Fluidized Bed Combustors, Combined Cycle Power Generation, Exergy Analysis, Thermal Design and Optimization, Cogeneration, Waste Heat Recovery, Heat Transfer, Advanced Energy Systems, Advanced Power Plant Cycles, Gas-Solid Flows in Advanced Combustors, Energy Conservation, Solar Energy
Dr. Jeremy Bradbury Associate Professor and Graduate Program Director	Faculty of Science	Software engineering, software quality assurance, testing and analysis, bug detection and repair, multicore software, concurrency, open source software, software visualization, human-centered software engineering, empirical software engineering, search-based software engineering.
Dr. Mark Green Professor and Associate Dean	Faculty of Science	Computer animation, formal design methods for user interfaces, graphics display hardware and VLSI design, interactive 3D graphics, automatic construction of user interfaces, authoring tools for virtual environments, and alternative viewing models for 3D graphics.

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
Mohamed Youssef	2	2	0	1	1	1	2	0
Jing Ren	0	5	0	1	0	1	4	0

Shahryar Rahnamayan	6	6	4	5	5	5	3	2
Hossam Gaber	50	42	6	15	10	4	5	2
Qusay H. Mahmoud	0	15	2	2	0	4	2	0
Ying Wang	1	4	1	2	1	0	2	0
Scott Nokleby	0	0	0	0	1	1	0	0
Miguel Vargas Martin	13	10	1	0	0	3	5	0
Jeremy Bradbury*	0	0	1	0	0	0	0	0
Ali Grami	0	5	2	0	0	0	0	0
Masoud Makrehchi	0	1	0	0	0	1	4	0
Shahram ShabazPanahi	0	18	9	5	0	2	5	0
Ramiro Liscano	16	28	3	1	0	1	2	0
Shahram S. Heydari	9	7	1	3	2	0	1	1
Ying Zhu		5				2		
Sheldon S. Williamson	62	25	6	5		3	5	2
Carolyn McGregor	2	12	7	3	1	9	4	1
Ruth Milman		4					1	
Min Dong	0	5	4	0	0	2	3	1
Walid Morsi Ibrahim	3	6	0	1	4	3	5	0
Mikael Eklund		6	1					
Lixuan Lu**	1	4						
Tarlochan Sidhu**			2					
Vijay Sood**		6	6	1	1		2	1
Khalil El-Khatib**		1						
Patrick Hung**								
Xiaodong Lin**		4						
Mark Green**		1						

* Data relevant only to student in the ECE program.

** 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 these fields already exist. There will be no additional physical resource requirements.

4. BUSINESS PLAN

a) Statement of funding requirements

The faculty members listed above are currently working in these fields and they will be supporting these fields of specialization. No additional faculty members are required to support these fields of specialization at this point in time.

b) Statements of resource availability

The physical resources required for these fields already exist within the Department of Electrical, Computer and Software Engineering.

5. TIMELINE/DATE OF IMPLEMENTATION

The fields 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 these fields.

APPROVAL DATES

Curriculum Committee approval	FEAS Graduate Committee approval: November 28, 2016
Engineering Faculty Council Approval	December 6, 2016
GSC approval	