



MEMORANDUM

To: Executive Committee of Faculty Council (February 7, 2018)
 Faculty Council (February 27, 2018)

From: Professor Julie Audet
 Chair, Engineering Graduate Education Committee (EGEC)

Date: January 26, 2018

Re: **EGEC Information Update**

REPORT CLASSIFICATION

This is a routine or minor policy matter that has been approved by the Engineering Graduate Education Committee on behalf of Faculty Council¹. It will be considered by the Executive Committee for endorsing and forwarding to Faculty Council for information.

NEW COURSES APPROVED

AER1820	Directed Reading in Aerospace Studies
ECE1504	Statistical Learning
MIE1516	Structured Learning and Inference
MIE1708	Collision Reconstruction

MINOR MODIFICATIONS

APS1012-Management of Innovation in Engineering	Course name changed to APS1012-Managing Business Innovation and Transformational Change; course description not changed
Emphases in MEng ECE	Eight new emphases created in the MEng program in ECE (See Appendices A and B)

RECOMMENDATION FOR FACULTY COUNCIL

For information.

¹ As a result of the 2005 Task Force on Graduate Education at the University of Toronto, EGEC has delegated authority to “consider and approve on behalf of Faculty Council and/or recommend to Faculty Council and/or SGS, matters relating to graduate curriculum, policy, new initiatives, program and course changes”.

APPENDIX A

New Emphases in Electrical & Computer Engineering

Minor Modification: Change to an Existing Graduate Program

Program being modified:	MEng in Electrical & Computer Engineering
Graduate Unit:	Electrical & Computer Engineering, The Edward S. Rogers Sr. Department of Electrical & Computer Engineering
Faculty / Academic Division:	Applied Science & Engineering
Dean's Office Contact:	Julie Audet, Vice-Dean Graduate
Version Date:	January 26, 2018

1 Summary

	Changing admission requirements		Renaming field, concentration or emphasis
	Changing program requirements or length		Renaming of program
	Changing timing of program requirements	X	Creating a new emphasis
	Adding/removing option (i.e., part-time, flexible-time)		Changes to programs affecting an MOA

MEng students in The Edward S. Rogers Sr. Department of Electrical & Computer Engineering can earn emphases corresponding to eight technical subfields (Biomedical Engineering, Communications, Computer Engineering, Electromagnetics, Electronics, Energy Systems, Photonics, and Systems Control) by successfully completing at least four courses from the list for each corresponding subfield, as described in Appendices A and B.

2 Effective Date of Change

July 1, 2018

3 Academic Rationale

By introducing these emphases, the University will officially acknowledge certain concentrations of subject-matter within the MEng program.

4 Impact on Students

Students earning an emphasis will receive a corresponding notation on their academic transcript. Emphases will be applied for by students at the time of program completion; thus continuing students who have already completed the requirements will be accommodated automatically.

5 Consultation

The creation of these emphases was discussed at an ECE MEng town hall meeting in March 2017. The proposal was also discussed and approved by the ECE Graduate Matters Committee in April 2017. No major issues were identified. The proposal has the support of the Chair of The Edward S. Rogers Sr. Department of Electrical & Computer Engineering, and of the Dean of the Faculty of Applied Science & Engineering.

6 Resources

No resource implications are anticipated.

7 Governance Approval

STEP	DATE
Unit Sign-off	ECE Graduate Matters Committee (April 12, 2017)
Dean's Office Sign-off	Julie Audet, Vice-Dean, Graduate Studies (January 24, 2018)
Faculty/Division Council Approval	Approved by the Engineering Graduate Education Committee (EGEC) on behalf of the Council of the Faculty of Applied Science & Engineering (January 24, 2018) Received for information by the Council of the Faculty of Applied Science & Engineering (February 27, 2018)

Appendix A: Calendar Entry

By appropriate choice of technical courses, MEng students in Electrical & Computer Engineering (ECE) may qualify for one or more ECE emphases. To qualify for a particular ECE emphasis, students must take at least **four** courses from among those listed below for that particular area. Students may double-count one course at most towards any ECE emphasis, or towards any other emphasis in the Faculty.

ECE Emphasis in Biomedical Engineering

- any JEB14XXH course
- ECE1774H Sensory Cybernetics
- ECE2500Y MEng Project (topic in biomedical engineering, counts as one course towards emphasis)

Students may include other biomedical-engineering-related courses subject to the approval of the ECE Associate Chair for Graduate Studies.

ECE Emphasis in Communications

- ECE537H Random Processes
- any ECE15XXH course
- ECE2500Y MEng Project (topic in communications, counts as one course towards emphasis)

ECE Emphasis in Computer Engineering

- ECE516H Intelligent Image Processing
- ECE532H Digital Systems Design
- ECE540H Optimizing Compilers
- ECE552H Computer Architecture
- ECE568H Computer Security
- any ECE17XXH course
- ECE 2500Y MEng Project (topic in computer engineering, counts as one course towards emphasis)

ECE Emphasis in Electromagnetics

- any ECE12XXH course

- ECE 2500Y MEng Project (topic in electromagnetics, counts as one course towards emphasis)

ECE Emphasis in Electronics

- ECE530H Analog Integrated Circuits
- any ECE13XXH course
- ECE2500Y MEng Project (topic in electronics, counts as one course towards emphasis)

ECE Emphasis in Energy Systems

- ECE510H Introduction to Lighting Systems
- ECE514H Power Electronics: Converter Topologies
- ECE533H Power Electronics
- any ECE10XXH course
- ECE2500Y MEng Project (topic in energy systems, counts as one course towards emphasis)

ECE Emphasis in Photonics

- ECE527H Photonic Devices
- any ECE14XXH course
- ECE2500Y MEng Project (topic in photonics, counts as one course towards emphasis)

ECE Emphasis in Systems Control

- ECE557H Systems Control
- any ECE16XXH course
- ECE2500Y MEng Project (topic in systems control, counts as one course towards emphasis)

M.Eng. Emphases within ECE

Frank R. Kschischang

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The Edward S. Rogers Sr. Department
of Electrical & Computer Engineering

January 24, 2018

1 The M.Eng. Program

The Master of Engineering (M.Eng.) in Electrical and Computer Engineering (ECE) is designed to provide professional training beyond the undergraduate level and to accelerate careers with specialized engineering expertise needed in business, government, and industry.

Students enroll in one of eight ECE fields of specialization:

- Biomedical Engineering
- Communications
- Computer Engineering
- Electromagnetics
- Electronics
- Energy Systems
- Photonics
- Systems Control

Students must complete nine approved graduate courses, at least six of which must be technical courses. At least five of the six technical courses must be ECE courses. At least three of the six technical courses must be in the student's field of specialization.

Students may choose to complete a project (ECE2500Y “M.Eng. Project”) with a value equivalent to three ECE 1000-level courses. Students choosing the project option will be required to complete a total of six courses in addition to the project.

2 Emphases

A graduate emphasis “is associated with an identified set and sequence of graduate courses or other academic activity completed on an optional basis in partial fulfillment of the requirements for a graduate degree program”¹, and is recorded on the graduate’s academic record.

The Faculty of Applied Science and Engineering (FASE) currently offers M.Eng. students a number of emphases (formerly called “certificates”):

- Advanced Manufacturing
- Advanced Water Technologies
- Analytics
- Engineering and Globalization
- Entrepreneurship, Leadership, Innovation & Technology in Engineering (ELITE)
- Identity, Privacy and Security
- Robotics and Mechatronics
- Sustainable Aviation
- Sustainable Energy

An FASE emphasis typically requires a student to successfully complete four one-term graduate courses in a given area. Upon completion of these requirements, students receive an official notation on their graduate record, so that they may claim to have earned, say, an M.Eng. in Electrical & Computer Engineering with an emphasis in Identity, Privacy and Security. Some emphases (notably the ELITE emphasis) requires that students complete an additional (tenth) course beyond the nine stipulated by ECE. For reference, the requirements for the emphasis in Identity, Privacy and Security and the emphasis in Robotics and Mechatronics are listed in the Appendices. Some courses may satisfy the requirements of more than one emphasis; normally students may double-count a maximum of one course towards the requirements of any two emphases.

¹ Graduate Program Definitions, School of Graduate Studies (November 2013)
<http://www.sgs.utoronto.ca/facultyandstaff/Pages/Graduate-Program-Definitions.aspx>.

Note that existing emphases have tended to focus on topics represented by various Institutes within the university. For example, the emphases on Identity, Privacy and Security and on Robotics and Mechatronics were defined by corresponding Institutes having the same name. However there is no requirement that emphases be limited to those proposed by Institutes; indeed, graduate departments are free to propose emphases as appropriate for their individual disciplines.

3 Proposal to Create Emphases Within ECE

ECE proposes to create eight new emphases, corresponding to the eight ECE fields of specialization listed above. These emphases would be open only to M.Eng. students registered in ECE. To earn an emphasis, a student would need to complete four technical courses in the given area, as detailed below. One of the four courses is permitted to be the project course, ECE2500, when the project is undertaken in the given area, but the project would only count as *one* course towards the emphasis, even if it otherwise has a weight of three technical courses.

By introducing such emphases, the university would officially acknowledge a certain concentration of subject-matter within the M.Eng. program, allowing students to claim to have earned, say, an M.Eng. in ECE, with an emphasis in Communications. Note that an “emphasis” entails just one more course in a given technical area than is already required under our current program regulations. Thus it is expected that the majority of ECE M.Eng. students would be able to satisfy the requirements for an emphasis.

Students earning an emphasis would receive a corresponding notation on their graduate transcript. There is no plan to issue separate certificates.

Emphases will not be awarded “automatically;” instead, students applying to graduate will indicate that they have fulfilled the requirements for an emphasis. This will be checked by the ECE graduate office, and the information forwarded to the person responsible for entering this information onto the transcript.

Following are the proposed definitions of the eight emphases.

3.1 Emphasis in Biomedical Engineering

Students must complete four courses from the following list:

- any JEB14XX courses
- ECE1774 – Sensory Cybernetics
- ECE2500 – M.Eng. Project (topic in biomedical engineering, counts as one course towards emphasis)

Students may include other biomedical-engineering-related courses subject to the approval of the Associate Chair for Graduate Studies.

3.2 Emphasis in Communications

Students must complete four courses from the following list:

- ECE537 – Random Processes
- any ECE15XX courses
- ECE2500 – M.Eng. Project (topic in communications, counts as one course towards emphasis)

3.3 Emphasis in Computer Engineering

Students must complete four courses from the following list:

- ECE516 – Intelligent Image Processing
- ECE532 – Digital Systems Design
- ECE540 – Optimizing Compilers
- ECE552 – Computer Architecture
- ECE568 – Computer Security
- any ECE17XX courses
- ECE2500 – M.Eng. Project (topic in computer engineering, counts as one course towards emphasis)

3.4 Emphasis in Electromagnetics

Students must complete four courses from the following list:

- any ECE12XX courses
- ECE2500 – M.Eng. Project (topic in electromagnetics, counts as one course towards emphasis)

3.5 Emphasis in Electronics

Students must complete four courses from the following list :

- ECE530 – Analog Integrated Circuits
- any ECE13XX courses
- ECE2500 – M.Eng. Project (topic in electronics, counts as one course towards emphasis)

3.6 Emphasis in Energy Systems

Students must complete four courses from the following list:

- ECE510 – Introduction to Lighting Systems
- ECE514 – Power Electronics: Converter Topologies
- ECE533 – Power Electronics
- any ECE10XX courses
- ECE2500 – M.Eng. Project (topic in energy systems, counts as one course towards emphasis)

3.7 Emphasis in Photonics

Students must complete four courses from the following list:

- ECE527 – Photonic Devices
- any ECE14XX courses
- ECE2500 – M.Eng. Project (topic in photonics, counts as one course towards emphasis)

3.8 Emphasis in Systems Control

Students must complete four courses from the following list:

- ECE557 – Systems Control
- any ECE16XX courses
- ECE2500 – M.Eng. Project (topic in systems control, counts as one course towards emphasis)

A Requirements for the Emphasis in Identity, Privacy and Security

General M.Eng. requirements apply. To earn an emphasis in IPS, students must complete:

- the seminar course JIE1001H/ECE1518 – Seminar in Identity, Privacy, and Security
- two courses from among the following:
 - ECE568 – Computer Security
 - ECE1517 – Biometric Systems
 - ECE1529 – Adaptive Systems for Communication & Signal Processing
 - ECE1776 – Computer Security, Cryptography and Privacy
 - ECE1778 – Creative Applications for Mobile Devices
- one course from among the following (offered through the Faculty of Information):
 - INF2124 – Surveillance and Identity
 - INF2818 – Information Policy, Regulation, and Law
 - INF2165 – Social Issues in Information and Communications Technologies
 - INF2241 – Critical Making

B Requirements for the Emphasis in Robotics and Mechatronics

A student must complete at least four courses from at least three out of four distinct Groups:

1. Control

- ECE1617 – Linear Geometric Control Theory
- ECE1636 – Control of Discrete Event Systems I
- ECE1647 – Introduction to Nonlinear Control Systems
- ECE1653 – Hybrid Systems and Control Applications
- ECE1657 – Game Theory and Evolutionary Games
- ECE557 – Systems Control (exclusion: ECE410)
- MIE1064 – Control Analysis Methods with Applications to Robotics

- MIE1068 – Applied Nonlinear Control

2. Signal and Image Processing

- AER1513 – State Estimation for Aerospace Vehicles
- CSC2503 – Foundations of Computer Vision
- CSC2515 – Introduction to Machine Learning
- CSC2506 – Probabilistic Learning and Reasoning
- ECE1511 – Signal Processing
- ECE1512 – Digital Image Processing and Applications
- ECE516 – Intelligent Image Processing
- JEB1433 – Medical Imaging

3. Dynamics

- AER1503 – Spacecraft Dynamics and Control II
- AER1512 – Multibody Dynamics
- AER506 – Spacecraft Dynamics and Control
- JEB1444 – Neural Engineering
- MIE1001 – Advanced Dynamics

4. Systems Integration

- AER525 – Robotics (exclusion: ECE470)
- AER1514 – Mobile Robotics
- ECE1373 – Digital Design for Systems-on-Chip
- ECE1460 – Special Topics in Photonics: Introduction to Micro/Nano-Fabrication
- ECE532 – Digital Systems Design
- MIE1070 – Intelligent Robots for Society
- MIE1809 – Advanced Mechatronics
- MIE506 – MEMS Design and Microfabrication
- MIE1071 – Advanced Robotics
- MIE505 – Micro/Nano Robotics