



(2019)

<p>1.0 Degree Title Specify the two degrees for concurrent degree programs</p>	<p>2.0 Administering Faculty or GPS</p>																
<p>M.Eng.</p>	<p>Graduate and Postdoctoral Studies</p>																
<p>1.1 Major (Subject/Discipline) (30-char. max.)</p>	<p>Offering Faculty & Department Faculty of Engineering/Department of Electrical and Computer Engineering</p>																
<p>Electrical Engineering</p>																	
<p>1.2 Concentration (Option) If applicable (30 char. max.)</p>	<p>3.0 Effective Term of revision or retirement Please give reasons in 5.0 "Rationale" in the case of retirement (Ex. Sept. 2019 or 201909) <input type="checkbox"/> Retirement Term: 202309</p>																
<p>Non-Thesis</p>																	
<p></p>	<p>4.0 Existing Credits/CEUs Proposed Credits/CEUs 45 </p>																
<p>1.3 Category</p> <table border="0"> <tr> <td><input type="checkbox"/> Faculty Program (FP)</td> <td><input type="checkbox"/> Honours (HON)</td> </tr> <tr> <td><input type="checkbox"/> Major</td> <td><input type="checkbox"/> Joint Honours Component (HC)</td> </tr> <tr> <td><input type="checkbox"/> Joint Major</td> <td><input type="checkbox"/> Internship/Co-op</td> </tr> <tr> <td><input type="checkbox"/> Major Concentration (CON)</td> <td><input type="checkbox"/> Thesis (T)</td> </tr> <tr> <td><input type="checkbox"/> Minor</td> <td><input checked="" type="checkbox"/> Non-Thesis (N)</td> </tr> <tr> <td><input type="checkbox"/> Minor Concentration (CON)</td> <td><input type="checkbox"/> Other</td> </tr> <tr> <td></td> <td>Please specify</td> </tr> <tr> <td></td> <td></td> </tr> </table>	<input type="checkbox"/> Faculty Program (FP)	<input type="checkbox"/> Honours (HON)	<input type="checkbox"/> Major	<input type="checkbox"/> Joint Honours Component (HC)	<input type="checkbox"/> Joint Major	<input type="checkbox"/> Internship/Co-op	<input type="checkbox"/> Major Concentration (CON)	<input type="checkbox"/> Thesis (T)	<input type="checkbox"/> Minor	<input checked="" type="checkbox"/> Non-Thesis (N)	<input type="checkbox"/> Minor Concentration (CON)	<input type="checkbox"/> Other		Please specify			<p>5.0 Rationale for revised program – explain why revising</p> <p>See next page.</p>
<input type="checkbox"/> Faculty Program (FP)	<input type="checkbox"/> Honours (HON)																
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<input type="checkbox"/> Minor	<input checked="" type="checkbox"/> Non-Thesis (N)																
<input type="checkbox"/> Minor Concentration (CON)	<input type="checkbox"/> Other																
	Please specify																
<p>1.4 Complete Program Title (info from boxes 1.0+1.1+1.2+1.3)</p>																	
<p>M.Eng.; Electrical Engineering (Non-Thesis)</p>																	

6.0 Revised Program Description (Maximum 150 words) – if revising, the existing must be included

New Program Description:

The Master of Engineering in Electrical Engineering; Non-Thesis program is a professional course-based program of 45 credits. The program provides a solid background in electrical and computer engineering, both in terms of breadth across the entire field and depth in the area of specialty. The program structure allows students to complete the program in three semesters. A part-time program is possible.

Existing Program Description

The Master of Engineering degree (project option) involves an internally examined research project in addition to 27 graduate level course credits. The program is oriented more towards professional development than the thesis option. The project is of significantly less scope than a thesis, and includes options such as a technical review, a design project, or a small-scale research project. Undertaking 27 course credits provides students with a very solid background in electrical and computer engineering, both in terms of breadth across the entire field and depth in the area of specialty. Graduates frequently pursue careers in research and development. A part-time program is possible.

Rationale for revised program.

On Dec. 6, 2018, SCTP approved a related program revision by the Department of Electrical and Computer Engineering. That proposed revision was of the project-based M.Eng. program to a course-based professional master's program in Electrical Engineering. It was not reported to the Ministry of Education and Higher Education of Quebec due to budget issues. Since then, the Ministry has changed the requirements related to course-based university programs. Specifically, research content in the program is no longer required. As the 2018 approved revision program included a list of required courses with research content, this current program revision becomes necessary to remove them.

Therefore, the Department of Electrical and Computer Engineering request that the SCTP-approved revision in 2018 be disregarded in favor of this revision form.

The rationale for the revised program is presented in the Executive Summary document, along with potential pathways for students enrolled in this program.

7.0 List of existing program and proposed program

Existing program (list courses as follows: Subj Code/Crse Num, Title, Credit Weight, under the headings of: Required Courses, Complementary Courses, Elective Courses)

M.Eng.; Electrical Engineering (Non-Thesis) (45 credits)

Research Project (18 credits)

- ECSE 651 M. Eng. Project 1 (1)
- ECSE 652 M. Eng. Project 2 (2)
- ECSE 653 M. Eng. Project 3 (3)
- ECSE 654 M. Eng. Project 4 (4)
- ECSE 655 M. Eng. Project 5 (5)
- ECSE 656 M. Eng. Project 6 (5)

~~Students who choose the non-thesis option must register for the project courses during the three required terms of residency.~~

Complementary Courses (27 credits)

27 credits of 500-, or 600-, 700-level courses of which no more than 9 credits may be outside the Department.

* Non-departmental courses require Departmental approval. Students may be ~~allowed~~ to take more than 9 credits of non-Departmental courses; ~~a letter of recommendation from their supervisor outlining the reason for such an action is required.~~

Proposed program (list courses as follows: Subj Code/Crse Num, Title, Credit Weight, under the headings of: Required Courses, Complementary Courses, Elective Courses)

M.Eng.; Electrical Engineering (Non-Thesis) (45 credits)

Full-time students must complete the program in three years.

Complementary Courses (45 credits)

45 credits of 500- or 600- courses, of which no more than 16 credits may be outside the Department.

Students may not take Thesis Research courses - ECSE 691 to ECSE 697.

* Non-departmental courses require Departmental Approval. In exceptional circumstances and with proper justification, students may be permitted to take more than 16 credits of non-Departmental courses; approval from the Graduate Program Director or delegate is required.

8.0 Consultation with
Related Units

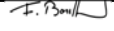
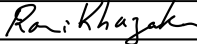
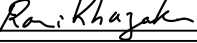
Yes No

Financial Consult

Yes No

Attach list of consultations

9. Approvals

Routing Sequence	Name	Signature	Meeting Date
Department	François Bouffard		2022/11/22
Curric/Acad Committee	Roni Khazaka		2022/11/30
Faculty 1	Roni Khazaka		2022/12/13
Faculty 2			
Faculty 3			
CGPS			
SCTP			
APC			
Senate			

Submitted by

Name
Phone
Email
Submission Date

To be completed by ES:

CIP Code

Executive Summary

Name and grade of the program	M.Eng.; Electrical Engineering (Non-Thesis)
Offering and administering unit	Graduate and Postdoctoral Studies Faculty of Engineering/Electrical and Computer Engineering
Credit weight	Forty-five (45) credits
Funding model: regulated vs. self-funded	Regulated
Mode of delivery (full time vs. part time, online vs. hybrid vs. on campus)	Full-time

As noted in the program revision form, we propose a change in the focus of the Master of Engineering in Electrical Engineering; Non-Thesis program, from a project-based orientation to a stronger course-based orientation.

Program rationale

The proposed course-based Master of Engineering in Electrical Engineering purposefully offers students the opportunity to tailor their program of study to their specific education needs and career aspirations, by striking the desired balance between breadth and depth in their studies. Primarily through coursework, students in the program will enhance their engineering knowledge as well as their problem solving and design skills to a level significantly higher than that attained with an undergraduate degree. Students can improve their engineering competency in specific core areas of Electrical, Computer and Software Engineering through the course groupings described in this document. On the opposite end of the spectrum, students who wish to improve their ability to work between fields may seek permission to take courses in core areas from other engineering departments, with future approval by the departments involved. Finally, interested students can gain research skills by completing a research project in a specialized field of study under the supervision of a professor, through the project courses, which are not retired (ECSE 651-ECSE 656).

Course groupings

This program offers students the ability to choose the courses across the department that suit their pathway. However, the ECE unit will provide students with four course groupings, based on the departmental research areas, to help guide their course selection.

1. Integrated Circuits and Systems AND/OR Telecommunications and Signal Processing AND/OR Systems and Control
2. Intelligent Systems AND/OR Bioelectrical Engineering AND/OR Computational Electromagnetics
3. Systems and Control AND/OR Power Engineering AND/OR Software Engineering
4. Photonic Systems AND Nano-electronic Devices and Materials

The strength of the proposed program lies in the core competencies of the department. These four course groupings were created based on the number of common courses in the related research areas. Other

universities also help their students by grouping course bundles together. Concordia calls their classifications topic “areas,” the University of Waterloo calls them “specializations” and the University of Toronto call them “emphases.” Whatever their names, these groupings help students in identifying courses that are related to specific research topics. The McGill program offers fewer but larger course groupings that will give students greater flexibility in their academic path and will allow them to specialize in one or multiple related research areas.

Market demand

This revision is rooted in changing market demands. From a survey of existing M.Eng. electrical engineering programs in Canadian universities, the McGill M.Eng. project-based program occupies a place at the far end of the program spectrum with its eighteen (18) credits of project-based courses, or 40 percent of the program curriculum. Programs at other Quebec universities also require students to take a project or internship course but the number of credits for these courses vary from zero to fifteen. Elsewhere in Canada, a typical M.Eng. program in Electrical Engineering is entirely primarily course based. Some programs have a project component, but this makes up at most a quarter of the program requirements by credit. By realigning the M.Eng. Non-Thesis program to a greater course-based orientation, this program will be more in step with the offerings of other Canadian academic institutions and with the needs of prospective students. This change does not eliminate project-based courses from the McGill program curriculum; instead, it gives prospective students more options and makes taking these project-based courses a choice rather than a requirement.

University	Credits for project-based courses (or equivalent)	Total program credits (or equivalent)	Percentage of total courses in the program
McGill (Non-Thesis)	18	45	40%
Polytechnique Montreal	6-15	45	13.3-33.3%
ETS	6-15	45	13.3-33.3%
Concordia	0-9	45	0-20%
Ottawa/Carleton	6	27	22.2%
Queen’s	0-6	24	0-25%
University of Toronto	0	27	0%
University of Waterloo	0	24	0%
Western	Project is in addition to 10 courses in Project-Based M.Eng. program	30	-
University of Calgary	0	30	0%
University of Alberta	3	27	11.1%
University of British Columbia	6	30	20%

Table 1: Comparison of project-based course credits in master’s programs in selected Canadian EE/ECE departments (data compiled from university websites)

Based on the enrolment numbers obtained for competing Canadian programs, the students have shown a preference for the more flexible course-based programs. Most universities have a greater number of students in non-thesis master’s programs than in thesis master’s programs; the exceptions being McGill and the University of British Columbia.

	FT Faculty	Thesis Masters	PhD	Course/project masters	Research masters/prof	PhD/prof	Course masters/prof
Concordia	44	107	158	255	2.4	3.6	5.8
McGill	44	104	180	25	2.4	4.1	0.6
Ottawa	67	76	102	291	1.1	1.5	4.3
Toronto	75	158	221	249	2.1	2.9	3.3
UBC	60	98	181	60	1.6	3.0	1.0
Waterloo	92	160	250	170	1.7	2.7	1.8
Average					1.9	3.0	2.8

Table 2: Comparison of graduate enrollments in selected Canadian EE/ECE departments (data obtained from Canadian Electrical and Computer Engineering Departments Heads Association)

Academic resources

The McGill program is constrained by the limited supply of academic faculty advisers that function as project supervisors for the program. The suggested change in the program will remove this constraint to growth and allow for the influx of a larger number of students into the program. Changing the nature of the M.Eng. program has additional benefits. It would also allow for the better use of academic resources in the future. The switch will reduce the burden of the full-time academic faculty for project supervision duties. Graduate supervisors, who often need to meet the requirements of their research programs, are more likely to accept candidates that applied to the thesis program versus those that applied to the non-thesis one. By making the change in the focus of the program, this can eliminate the bottleneck that kept the non-thesis program enrolment low.

Application data shows that there is a great demand for students to register for a master's program at McGill. The department received a total of 764 applications to start the master's program in September 2022. Of this number, 415 (or 59%) applied for the non-thesis program but very few received an offer of admission due to the lack of academic staff to function as project supervisors. Fall 2022 numbers are not available but only twenty-two (22) students were registered in the non-thesis program in Fall 2021, relative to 141 in the Master of Science thesis program. While not all applicants would have been offered a place in the program, it is still obvious that candidates that would have met the program's eligibility requirements were turned away due to the insufficient number of available supervisors. By making the change to the program, McGill will be able to attract and retain more high-quality candidates to the master's program. Additionally, this change to a course-based focus does not necessarily mean the end of student research projects. By making project work a choice by students, there will be a higher level of enthusiasm on their part.

Benefits of the program

As shown above, there is a large pool of students who would like to register for a master's degree in Electrical Engineering at McGill, but who currently do not obtain admission. The experience in Ontario suggests that most (but not all) of these will be international students. Expanding our program to be able admit some of these students could bring several advantages to McGill and to the ECE Department:

1. We further our academic mission by providing education to a greater number of students
2. Many of these students will go on to work in industry, thus will be great ambassadors for McGill in local, national, and international industry
3. Academically strong students may be able to transfer to the MSc. program, or potentially fast-track to PhD, thus increasing the pool of high-quality PhD applicants.

Current enrolment numbers in the project-based master's program varies between 20 and 25 annually. The target enrolment in the program is 45 students in the Electrical Engineering Non-Thesis program.

Number of ECSE courses in common with other research areas

	Intelligent Systems	Integrated Circuits	Telecom.	Systems & Control	Photonic Systems	Bioelec. Eng.	Comput. Electromag.	Power Eng.	Software Eng.	Nano-electronic Devices
Intelligent Systems	-	6	4	4	5	14	6	0	0	4
Integrated Circuits and Systems	6	-	24	17	6	3	1	6	1	6
Telecommunications & Signal Processing	4	24	-	14	4	3	3	5	1	6
Systems & Control	4	17	14	-	4	4	2	16	7	3
Photonic Systems	5	6	4	4	-	1	0	2	1	9
Bioelectrical Engineering	14	3	3	4	1	-	7	1	0	1
Computational Electromagnetics	6	1	3	2	0	7	-	1	1	1
Power Engineering	0	6	5	16	2	1	1	-	6	2
Software Engineering	0	1	1	7	1	0	1	6	-	0
Nano-electronic Devices & Materials	4	6	6	3	9	1	1	2	0	-

Proposed course groupings:

1. Integrated Circuits and Systems AND/OR Telecommunications and Signal Processing AND/OR Systems and Control
2. Intelligent Systems AND/OR Bioelectrical Engineering AND/OR Computational Electromagnetics
3. Systems and Control AND/OR Power Engineering AND/OR Software Engineering
4. Photonic Systems AND Nano-electronic Devices and Materials

In each group, we share examples of pathways that students can take, based on their interests and career trajectory.

ECE Groupings

1. Integrated Circuits and Systems / Telecommunications and Signal Processing / Systems and Control

COURSES:

ECSE 500	Mathematical Foundations of Systems	3 credits	Fall
ECSE 501	Linear Systems	3 credits	Fall
ECSE 506	Stochastic Control and Decision Theory	3 credits	Not offered
ECSE 507	Optimization and Optimal Control	3 credits	Winter
ECSE 508	Multi-Agent Systems	3 credits	Winter
ECSE 509	Probability and Random Signals 2	3 credits	Fall
ECSE 510	Filtering and Prediction for Stochastic Systems	3 credits	Not offered
ECSE 511	Introduction to Digital Communication	3 credits	Not offered
ECSE 512	Digital Signal Processing 1	3 credits	Fall
ECSE 513	Robust Control Systems	3 credits	Not offered
ECSE 515	Optical Fibre Communications	3 credits	Not offered
ECSE 516	Nonlinear and Hybrid Control Systems	3 credits	Winter
ECSE 517	Neural Prosthetic Systems	3 credits	Not offered
ECSE 518	Telecommunication Network Analysis	3 credits	Winter
ECSE 521	Digital Communications 1	3 credits	Fall
ECSE 522	Nonlinear Phenomena in Power Systems Dynamics	4 credits	Winter
ECSE 523	Speech Communication	3 credits	Winter
ECSE 524	Interconnects and Signal Integrity	3 credits	Not offered
ECSE 527	Optical Engineering	4 credits	Winter
ECSE 533	Physical Basis of Semiconductor Devices	3 credits	Not offered
ECSE 534	Analog Microelectronics	3 credits	Fall
ECSE 536	RF Microelectronics	3 credits	Winter
ECSE 537	Advanced Digital Integrated Circuits	3 credits	Not offered
ECSE 538	Safety-Critical Embedded Software	3 credits	Not offered
ECSE 540	Photonic Devices and Applications	3 credits	Fall
ECSE 541	Design of Multiprocessor Systems-on-Chip	3 credits	Fall
ECSE 543	Numerical Methods in Electrical Engineering	3 credits	Fall
ECSE 544	Computational Photography	4 credits	Winter
ECSE 546	Advanced Image Synthesis	4 credits	Fall
ECSE 549	Expert Systems in Electrical Design	3 credits	Not offered
ECSE 551	Machine Learning for Engineers	4 credits	Fall/Winter
ECSE 553	Critical Systems	4 credits	Not offered
ECSE 554	Applied Robotics	4 credits	Fall
ECSE 557	Introduction to Ethics of Autonomous Intelligent Sys	3 credits	Winter
ECSE 563	Power Systems Operation and Planning	3 credits	Fall
ECSE 564	Power Systems Dynamics and Control	4 credits	Not offered
ECSE 565	Introduction to Power Electronics	3 credits	Not offered
ECSE 570	Automatic Speech Recognition	3 credits	Not offered
ECSE 571	Optoelectronic Devices	3 credits	Not offered
ECSE 574	CMOS Sensor Microsystems	3 credits	Not offered
ECSE 575	Heterogeneous Integration Systems	3 credits	Winter
ECSE 593	Antennas and Propagation	3 credits	Fall
ECSE 596	Optical Waveguides	3 credits	Winter
ECSE 597	Circuit Simulation and Modelling	4 credits	Fall
ECSE 610	Wireless Communications	4 credits	Winter
ECSE 611	Software Analytics	4 credits	Not offered
ECSE 612	Multi-User Communications	4 credits	Not offered

ECSE 615	Digital Signal Processing 2	4 credits	Not offered
ECSE 620	Information Theory and Coding	4 credits	Not offered
ECSE 621	Statistical Detection and Estimation	4 credits	Winter
ECSE 623	Digital Communications 2	4 credits	Not offered
ECSE 626	Statistical Computer Vision	4 credits	Fall
ECSE 634	Analog Integrated Circuits Signal Processing	4 credits	Not offered
ECSE 635	Printed Electronics	4 credits	Winter
ECSE 648	VLSI Design	4 credits	Not offered
ECSE 682	Topics in Computers and Circuits	4 credits	Fall
ECSE 686	Topics: Communication Systems	4 credits	Not offered
ECSE 689	Recent Advances: Electrical Engineering 2	4 credits	Winter

Pathway #1 - Integrated Circuits and Systems ONLY (3 semesters, 46 credits)

Integrated Circuits and Systems	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 509 (3) ECSE 512 (3) ECSE 534 (3) ECSE 597 (4) Complementary (3)	ECSE 536 (3) ECSE 575 (3) ECSE 635 (4) ECSE 689 (4)	ECSE 540 (3) ECSE 541 (3) ECSE 543 (3) ECSE 682 (4) Complementary (3)	
TOTAL CREDITS	16	14	16	

Pathway #2 – Integrated Circuits and Systems ONLY (4 semesters, 47 credits)

Integrated Circuits and Systems	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 509 (3) ECSE 512 (3) ECSE 534 (3) ECSE 543 (3)	ECSE 621 (4) ECSE 635 (4) ECSE 689 (4)	ECSE 540 (3) ECSE 541 (3) ECSE 597 (4) ECSE 682 (4)	ECSE 507 (3) ECSE 536 (3) ECSE 575 (3)
TOTAL CREDITS	12	12	14	9

Pathway #3 – Telecommunications and Signal Processing ONLY (3 semesters, 45 credits)

Telecommunications and Signal Processing	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 500 (3) ECSE 509 (3) ECSE 512 (3) ECSE 521 (3) Complementary (3)	ECSE 507 (3) ECSE 518 (3) ECSE 523 (3) ECSE 610 (4) ECSE 621 (4)	ECSE 543 (3) ECSE 551 (4) ECSE 593 (3) Complementary (3)	
TOTAL CREDITS	15	17	13	

Pathway #4 – Telecommunications and Signal Processing ONLY (4 semesters, 46 credits)

Telecommunications and Signal Processing	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 500 (3) ECSE 509 (3) ECSE 512 (3) ECSE 543 (3)	ECSE 507 (3) ECSE 518 (3) ECSE 523 (3) ECSE 621 (4)	ECSE 551 (4) ECSE 593 (3) ECSE 626 (4) Complementary (3)	ECSE 508 (3) ECSE 610 (4)
TOTAL CREDITS	12	13	14	7

Pathway #5 – Systems and Control ONLY (3 semesters, 45 credits)

Systems and Control	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 500 (3) ECSE 501 (3) ECSE 509 (3) ECSE 543 (3) Complementary (3)	ECSE 507 (3) ECSE 508 (3) ECSE 516 (3) ECSE 557 (3) Complementary (3)	COMP 512 (4) ECSE 512 (3) ECSE 522 (4) ESCE 554 (4)	
TOTAL CREDITS	15	15	15	

Pathway #6 – Systems and Control (4 semesters, 47 credits)

Systems and Control	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 500 (3) ECSE 501 (3) ECSE 509 (3) Complementary (3)	ECSE 507 (3) ECSE 508 (3) ECSE 516 (3) MECH 513 (3)	ECSE 512 (3) ECSE 522 (4) ECSE 543 (3) Complementary (3)	ECSE 575 (3) ECSE 557 (3) Complementary (3)
TOTAL CREDITS	12	12	14	9

2. Intelligent Systems / Bioelectrical Engineering / Computational Electromagnetics

COURSES:

ECSE 500	Mathematical Foundations of Systems	3 credits	Fall
ECSE 507	Optimization and Optimal Control	3 credits	Winter
ECSE 508	Multi-Agent Systems	3 credits	Winter
ECSE 517	Neural Prosthetic Systems	3 credits	Not offered
ECSE 523	Speech Communication	3 credits	Winter
ECSE 526	Artificial Intelligence	3 credits	Fall
ECSE 532	Computer Graphics	4 credits	Fall
ECSE 540	Photonic Devices and Applications	3 credits	Fall
ECSE 542	Human Computer Interaction	4 credits	Fall
ECSE 543	Numerical Methods in Electrical Engineering	3 credits	Fall
ECSE 544	Computational Photography	4 credits	Winter
ECSE 546	Advanced Image Synthesis	4 credits	Fall
ECSE 551	Machine Learning for Engineers	4 credits	Fall/Winter
ECSE 552	Deep Learning	4 credits	Winter
ECSE 553	Critical Systems	4 credits	Not offered
ECSE 554	Applied Robotics	4 credits	Fall
ECSE 555	Advanced Topics in Artificial Intelligence	4 credits	Not offered
ECSE 556	Machine Learning in Network Biology	4 credits	Fall
ECSE 557	Introduction to the Ethics of Intelligent Systems	3 credits	Winter
ECSE 570	Automatic Speech Recognition	3 credits	Not offered
ECSE 571	Optoelectronic Devices	3 credits	Not offered
ECSE 572	Nonlinear Optics	3 credits	Fall
ECSE 593	Antennas and Propagation	3 credits	Fall
ECSE 597	Circuit Simulation and Modelling	4 credits	Fall
ECSE 608	Machine Learning	4 credits	Not offered
ECSE 618	Haptics	4 credits	Winter
ECSE 621	Statistical Detection and Estimation	4 credits	Winter

ECSE 626	Statistical Computer Vision	4 credits	Winter
ECSE 680	Topics in Photonics	4 credits	Not offered
ECSE 683	Topics in Vision and Robotics	4 credits	Winter

Pathway #7 – Intelligent Systems ONLY (3 semesters, 45 credits)

Intelligent Systems	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 509 (3) ECSE 526 (3) ECSE 551 (4) ECSE 556 (4)	ECSE 552 (4) ECSE 557 (3) ECSE 618 (4) Complementary (4)	ECSE 532 (4) ECSE 542 (4) ECSE 544 (4) ECSE 554 (4)	
TOTAL CREDITS	14	15	16	

Pathway #8 – Intelligent Systems ONLY (4 semesters, 45 credits)

Intelligent Systems	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 551 (4) ECSE 556 (4) COMP 611 (4)	ECSE 552 (4) ECSE 618 (4) ECSE 626 (4)	ECSE 526 (3) ECSE 544 (4) ECSE 554 (4) Complementary (3)	ECSE 557 (3) ECSE 683 (4)
TOTAL CREDITS	12	12	14	7

Pathway #9 – Bioelectrical Engineering ONLY (3 semesters, 45 credits)

Bioelectrical Engineering	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 542 (4) ECSE 546 (4) ECSE 551 (4) Complementary (3)	ECSE 544 (4) ECSE 552 (4) ECSE 618 (4) Complementary (3)	ECSE 532 (4) ECSE 554 (4) ECSE 556 (4) Complementary (3)	
TOTAL CREDITS	15	15	15	

Pathway #10 – Bioelectrical Engineering ONLY (4 semesters, 45 credits)

Bioelectrical Engineering	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 542 (4) ECSE 546 (4) ECSE 551 (4)	ECSE 544 (4) ECSE 552 (4) ECSE 618 (4)	ECSE 526 (3) ECSE 554 (4) ECSE 556 (4) Complementary (3)	ECSE 683 (4) Complementary (3)
TOTAL CREDITS	12	12	14	7

Pathway #11 – Intelligent Systems / Computational Electromagnetics (3 semesters, 45 credits)

	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 532 (4) ECSE 543 (3) ECSE 551 (4) ECSE 597 (4)	ECSE 508 (3) ECSE 552 (4) ECSE 544 (4) Complementary (4)	ECSE 546 (4) ECSE 554 (4) ECSE 556 (4) ECSE 593 (3)	
TOTAL CREDITS	15	15	15	

Pathway #14 – Intelligent Systems / Computational Electromagnetics (4 semesters, 45 credits)

	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 551 (4) ECSE 556 (4) ECSE 597 (4)	ECSE 552 (4) ECSE 544 (4) Complementary (4)	COMP 546 (4) ECSE 543 (3) ECSE 546 (4) Complementary (3)	ECSE 593 (3) ECSE 618 (4)
TOTAL CREDITS	12	12	14	7

3. Systems and Control AND/OR Power Engineering AND/OR Software Engineering

COURSES:

ECSE 500	Mathematical Foundations of Systems	3 credits	Fall
ECSE 501	Linear Systems	3 credits	Fall
ECSE 506	Stochastic Control and Decision Theory	3 credits	Not offered
ECSE 507	Optimization and Optimal Control	3 credits	Winter
ECSE 508	Multi-Agent Systems	3 credits	Winter
ECSE 509	Probability and Random Signals 2	3 credits	Fall
ECSE 510	Filtering and Prediction for Stochastic Systems	3 credits	Not offered
ECSE 511	Introduction to Digital Communication	3 credits	Not offered
ECSE 512	Digital Signal Processing 1	3 credits	Fall
ECSE 513	Robust Control Systems	3 credits	Not offered
ECSE 515	Optical Fibre Communications	3 credits	Not offered
ECSE 516	Nonlinear and Hybrid Control Systems	3 credits	Winter
ECSE 517	Neural Prosthetic Systems	3 credits	Not offered
ECSE 518	Telecommunication Network Analysis	3 credits	Winter
ECSE 522	Nonlinear Phenomena in Power Systems Dynamics	4 credits	Winter
ECSE 524	Interconnects and Signal Integrity	3 credits	Not offered
ECSE 527	Optical Engineering	4 credits	Winter
ECSE 538	Safety-Critical Embedded Software	3 credits	Not offered
ECSE 539	Advanced Software Language Engineering	4 credits	Winter
ECSE 540	Photonic Devices and Applications	3 credits	Fall
ECSE 541	Design of Multiprocessor Systems-on-Chip	3 credits	Fall
ECSE 543	Numerical Methods in Electrical Engineering	3 credits	Fall
ECSE 549	Expert Systems in Electrical Design	3 credits	Not offered
ECSE 551	Machine Learning for Engineers	4 credits	Fall/Winter
ECSE 553	Critical Systems	4 credits	Not offered
ECSE 554	Applied Robotics	4 credits	Fall
ECSE 557	Introduction to the Ethics of Intelligent Systems	3 credits	Winter
ECSE 562	Low-Carbon Power Generation Engineering	4 credits	Not offered
ECSE 563	Power Systems Operation and Planning	3 credits	Fall
ECSE 564	Power Systems Dynamics and Control	4 credits	Not offered
ECSE 565	Introduction to Power Electronics	3 credits	Not offered
ECSE 575	Heterogeneous Integration Systems	3 credits	Winter
ECSE 593	Antennas and Propagation	3 credits	Fall
ECSE 597	Circuit Simulation and Modelling	4 credits	Fall
ECSE 611	Software Analytics	4 credits	Not offered
ECSE 615	Digital Signal Processing 2	4 credits	Not offered
ECSE 621	Statistical Detection and Estimation	4 credits	Winter
ECSE 626	Statistical Computer Vision	4 credits	Winter
ECSE 688	Recent Advances in Electrical Engineering	4 credits	Fall

Pathway #15 – Systems and Control ONLY (3 semesters, 46 credits)

Systems and Control	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 500 (3) ECSE 501 (3) ECSE 509 (3) ECSE 543 (3) Complementary (3)	ECSE 507 (3) ECSE 508 (3) ECSE 516 (3) ECSE 621 (4) Complementary (3)	ECSE 512 (3) ECSE 551 (4) ECSE 554 (4) Complementary (3)	
TOTAL CREDITS	15	16	14	

Pathway #16 – Systems and Control ONLY (4 semesters, 45 credits)

Systems and Control	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 500 (3) ECSE 501 (3) ECSE 509 (3) ECSE 551 (4)	ECSE 507 (3) ECSE 508 (3) ECSE 516 (3) Complementary (3)	ECSE 508 (3) ECSE 512 (3) ECSE 554 (4) Complementary (3)	ECSE 557 (3) ECSE 621 (4)
TOTAL CREDITS	13	12	13	7

Pathway #17 – Systems and Control / Power Engineering (3 semesters, 45 credits)

	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 500 (3) ECSE 501 (3) ECSE 509 (3) ECSE 543 (3) ECSE 563 (3)	ECSE 507 (3) ECSE 508 (3) ECSE 516 (3) ECSE 522 (4) Complementary (3)	ECSE 551 (4) ECSE 597 (3) ECSE 688 (4) Complementary (3)	
TOTAL CREDITS	15	16	14	

Pathway #18– Systems and Control / Power Engineering (4 semesters, 46 credits)

	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 500 (3) ECSE 501 (3) ECSE 543 (3) ECSE 563 (3)	ECSE 507 (3) ECSE 508 (3) ECSE 516 (3) ECSE 522 (4)	BREE 504 (3) ECSE 540 (3) ECSE 597 (3) ECSE 688 (4)	COMP 579 (4) ECSE 551 (4) MECH 513 (3)
TOTAL CREDITS	12	13	13	11

Pathway #19 – Systems and Control / Software Engineering (3 semesters, 45 credits)

	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 500 (3) ECSE 508 (3) ECSE 551 (4) Complementary (6)	ECSE 507 (3) ECSE 508 (3) ECSE 516 (3) ECSE 539 (4) Complementary (3)	ECSE 541 (3) ECSE 543 (3) ECSE 688 (4) Complementary (3)	
TOTAL CREDITS	16	16	13	

Pathway #20 – Systems and Control / Software Engineering (4 semesters, 47 credits)

	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 500 (3) ECSE 508 (3) Complementary (6)	ECSE 551 (4) ECSE 507 (3) ECSE 508 (3) ECSE 539 (4)	ECSE 541 (4) ECSE 688 (4) Complementary (4)	ECSE 516 (3) ECSE 575 (3) Complementary (3)
TOTAL CREDITS	12	14	12	9

4. Photonic Systems AND Nano-electronic Devices and Materials

COURSES:

ECSE 511	Introduction to Digital Communication	3 credits	Not offered
ECSE 512	Digital Signal Processing 1	3 credits	Fall
ECSE 515	Optical Fibre Communications	3 credits	Not offered
ECSE 518	Telecommunication Network Analysis	3 credits	Winter
ECSE 519	Semiconductor Nanostructures and Nanophotonic Devices	3 credits	Fall
ECSE 521	Digital Communications 1	3 credits	Fall
ECSE 524	Interconnects and Signal Integrity	3 credits	Not offered
ECSE 527	Optical Engineering	4 credits	Winter
ECSE 533	Physical Basis of Semiconductor Devices	3 credits	Not offered
ECSE 534	Analog Microelectronics	3 credits	Fall
ECSE 535	Nanoelectronic Devices	3 credits	Not offered
ECSE 536	RF Microelectronics	3 credits	Winter
ECSE 537	Advanced Digital Integrated Circuits	3 credits	Not offered
ECSE 540	Photonic Devices and Applications	3 credits	Fall
ECSE 544	Computational Photography	4 credits	Winter
ECSE 549	Expert Systems in Electrical Design	3 credits	Not offered
ECSE 564	Power Systems Dynamics and Control	4 credits	Not offered
ECSE 565	Introduction to Power Electronics	3 credits	Not offered
ECSE 571	Optoelectronic Devices	3 credits	Not offered
ECSE 572	Nonlinear Optics	3 credits	Fall
ECSE 575	Heterogeneous Integration Systems	3 credits	Winter
ECSE 593	Antennas and Propagation	3 credits	Fall
ECSE 596	Optical Waveguides	3 credits	Winter
ECSE 615	Digital Signal Processing 2	4 credits	Not offered
ECSE 623	Digital Communications 2	4 credits	Not offered
ECSE 634	Analog Integrated Circuits Signal Processing	4 credits	Not offered
ECSE 635	Printed Electronics	4 credits	Winter
ECSE 678	Special Topics in Solids	4 credits	Not offered
ECSE 680	Topics in Photonics	4 credits	Not offered
ECSE 682	Topics in Computers and Circuits	4 credits	Fall
ECSE 686	Topics: Communication Systems	4 credits	Not offered

Pathway #21 – Photonic Systems / Nano-electronic Devices and Materials (3 semesters, 46 credits)

	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 512 (3) ECSE 519 (3) ECSE 540 (3) ECSE 572 (3) Complementary (3)	ECSE 527 (4) ECSE 536 (3) ECSE 575 (3) ECSE 596 (3) Complementary (3)	ECSE 521 (3) ECSE 534 (3) ECSE 593 (3) Complementary (6)	
TOTAL CREDITS	15	16	15	

Pathway #22 – Photonic Systems / Nano-electronic Devices and Materials (4 semesters, 47 credits)

	FALL 1	WINTER 1	FALL 2	WINTER 2
COURSES	ECSE 519 (3) ECSE 540 (3) ECSE 572 (3) Complementary (3)	ECSE 518 (3) ECSE 527 (4) ECSE 536 (3) ECSE 596 (3)	ECSE 512 (3) ECSE 534 (3) ECSE 593 (3) Complementary (3)	ECSE 575 (3) ECSE 635 (4) Complementary (3)
TOTAL CREDITS	12	13	12	10