DEPARTMENT OF
ELECTRICAL AND COMPUTER ENGINEERING

Faculty

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WALAA HAMOUDA, PhD *Queen's University*, PEng
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LUIZ A. LOPES, PhD *McGill University*, ing.
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ROBERT PAKNYS, PhD *Ohio State University*, ing.
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MOHAMMED REZA SOLEYMANI, PhD *Concordia University*, ing.
SOFIÈNE TAHAR, PhD *University of Karlsruhe*, ing.
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CHUNYAN WANG, PhD *Université Paris Sud*, ing.
JOHN X. ZHANG, PhD *Technical University of Denmark*, PEng
WEIPING ZHU, PhD *Southeast University*, PEng

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JEREMIAH F. HAYES, PhD *University of California, Berkeley*
EUGENE I. PLOTKIN, PhD *Electrical Engineering Institute of Communication Engineering, St. Petersburg*

Professors Emeriti
AHMED K. ELHAKEEM, PhD *Southern Methodist University*, PEng
J. CHARLES GIGUÈRE, PhD *Nova Scotia Technical College*
OTTO SCHWELB, PhD *McGill University*
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AISHY AMER, PhD *Université du Québec*, ing.
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YAN LIU, PhD *University of Sydney*
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LESLIE M. LANDSBERGER, PhD *Stanford University*
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MOHAMMAD REZA CHAHARMIR, PhD *University of Manitoba*
KE-LIN DU, PhD *Huazhong University of Science and Technology*
SIAMAK TAFAZOLI, PhD *Concordia University*
MARIA TOEROE, PhD *Technical University of Budapest*
OLIVIER TOUSIGNANT, PhD *Université de Montréal*
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NADER MESKIN, PhD *Concordia University*
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For the complete list of faculty members, please consult the Department website.

Location

Sir George Williams Campus
Engineering, Computer Science and Visual Arts Complex, Room: EV 005.139
514-848-2424, ext. 3100

Department Objectives

The Department of Electrical and Computer Engineering offers three distinct undergraduate programs: BEng in Electrical Engineering, BEng in Computer Engineering, and BEng in Aerospace Engineering*.
Electrical Engineering is concerned primarily with energy and information, their conversion and transmission in the most efficient and reliable manner. This vast field of endeavour includes many specialties and electrical engineers may be involved in one or more of these throughout their careers. A partial list includes electronics, integrated circuit design, very large scale integrated (VLSI) circuit design, layout and testing, controls, robotics, system simulation, telecommunications, signal processing, computer hardware design, software design, power devices, power and control systems, electromechanical systems, micro electromechanical devices, electromagnetics, antennas, waveguides, lasers, and optoelectronics.
Computer Engineering is the driving force of the information revolution and its transformation of society. Over the course of their careers, computer engineers will be called upon to meet a number of challenges, most of which cannot be imagined today. A partial list of current specialties includes computer architecture, digital electronics, digital circuits, very large scale integrated (VLSI) circuit design, layout and testing, digital circuit testing and reliability, software systems engineering, embedded systems, digital communication and computer networks.
The Aerospace Engineering program is offered jointly with the Department of Mechanical and Industrial Engineering. It is concerned with the engineering science that governs the design and construction of aircraft and spacecraft. This includes the mechanisms behind flight and propulsion in the atmosphere and space, including aerodynamics, lift and draft, as well as the design and control of aircrafts. Aerospace systems rely significantly on electrical and computer engineering content, including topics such as avionic navigation systems, communication networks, and flight control systems. More details about the Aerospace Engineering program can be found in §71.55.
The four-year programs consist of the Engineering Core, taken by all Engineering students, program cores and electives. The Electrical Engineering Core provides a solid introduction to all aspects of the discipline, to programming methodology and to the design of large software systems. Technical electives are scheduled to enable students to register for sets of related technical courses. Current sets of electives include: Communications and Signal Processing, Computer Systems, Electronics and VLSI, Power, Control Systems and Avionics, and Waves and Electromagnetics. The Computer Engineering Core provides a thorough grounding in all aspects of computer hardware and software. Technical electives allow students to acquire further knowledge in

various aspects of hardware or software. The Aerospace Engineering Core provides a solid introduction to Flight and Aerospace Systems, Modelling and Control Systems, Mechanics of Materials, Thermodynamics, and Fluid Mechanics. Technical electives allow students to gain more knowledge in a variety of topics related to flight control and navigation systems. A mandatory final-year design project gives students in all three programs the opportunity to apply the knowledge they have acquired to the design and testing of a working prototype.

Nine Quebec universities have joined together with Hydro-Québec to create the Institute for Electrical Power Engineering whose primary mission is to meet the anticipated shortfall in this area. Students accepted by the Institute are expected to complete six courses offered by participating universities. Some of these courses are offered in English and others in French. Students register for courses at their home universities.

*Note: The BEng in Aerospace Engineering program is subject to the approval of the Bureau de Coopération Interuniversitaire (BCI, formerly CREPUQ), and the Ministère de l'Enseignement supérieur, de la Recherche et de la Science (MESRS).

71.30.1 Course Requirements (BEng in Electrical Engineering)

The program in Electrical Engineering consists of the Engineering Core, the Electrical Engineering Core, and one of five choices as set out below. The normal length of the program is 120 credits.

Engineering Core (30.5 credits)
See §71.20.5.

Electrical Engineering Core		*Credits*
COEN 212	Digital Systems Design I	3.50
COEN 231	Introduction to Discrete Mathematics	3.00
COEN 243	Programming Methodology I	3.00
COEN 244	Programming Methodology II	3.00
COEN 311	Computer Organization and Software	3.50
ELEC 251	Fundamentals of Applied Electromagnetics	3.00
ELEC 264	Signals and Systems I	3.00
ELEC 311	Electronics I	3.50
ELEC 312	Electronics II	3.50
ELEC 321	Introduction to Semiconductor Materials and Devices	3.50
ELEC 331	Fundamentals of Electrical Power Engineering	3.50
ELEC 351	Electromagnetic Waves and Guiding Structures	3.00
ELEC 363	Fundamentals of Telecommunications Systems	3.50
ELEC 364	Signals and Systems II	3.50
ELEC 365	Complex Variables and Partial Differential Equations	3.00
ELEC 372	Fundamentals of Control Systems	3.50
ELEC 390	Electrical Engineering Product Design Project	3.00
ELEC 490	Capstone Electrical Engineering Design Project	4.00
ENGR 290	Introductory Engineering Team Design Project	3.00
		62.50

Students may choose one of the following options:
I.   Electronics/VLSI Option
II. Telecommunications Option
III. Power and Renewable Energy Option
IV. Avionics and Control Option

Otherwise, students must follow V.

I. Electronics/VLSI Option		*Credits*
COEN 315	Digital Electronics	3.50
COEN 451	VLSI Circuit Design	4.00
	Minimum number of Elective credits:	19.50
	at least 7.5 of these 19.5 credits must be taken from the Electronics/VLSI Option Electives list. The rest may be chosen from the Electrical Engineering Electives list.	
		27.00

Electronics/VLSI Option Electives
Credits

COEN 313	Digital Systems Design II	3.50
COEN 413	Hardware Functional Verification	3.00
ELEC 421	Solid State Devices	3.50
ELEC 422	Design of Integrated Circuit Components	3.50
ELEC 423	Introduction to Analog VLSI	4.00
ELEC 424	VLSI Process Technology	3.50
ELEC 425	Optical Devices for High-Speed Communications	3.50
ELEC 433	Power Electronics	3.50
ELEC 441	Modern Analog Filter Design	3.50
ELEC 442	Digital Signal Processing	3.50

II. Telecommunications Option
Credits

ELEC 442	Digital Signal Processing	3.50
ELEC 462	Introduction to Digital Communications	3.50
ELEC 463	Telecommunication Networks	3.00
	Minimum number of Elective credits:	17.00
	at least 6 of these 17 credits must be taken from the Telecommunications Option Electives list. The rest may be chosen from the Electrical Engineering Electives list.	

27.00

Telecommunications Option Electives
Credits

ELEC 425	Optical Devices for High-Speed Communications	3.50
ELEC 453	Microwave Engineering	3.50
ELEC 456	Antennas	3.50
ELEC 457	Design of Wireless RF Systems	3.00
ELEC 464	Wireless Communications	3.00
ELEC 465	Networks Security and Management	3.50
ELEC 466	Introduction to Optical Communication Systems	3.50
ELEC 472	Advanced Telecommunication Networks	3.50

III. Power and Renewable Energy Option
Credits

ELEC 433	Power Electronics	3.50
ELEC 437	Renewable Energy Systems	3.00
ELEC 440	Controlled Electric Drives	3.50
ELEC 481	Linear Systems	3.50
	Minimum number of Elective credits:	13.50
	at least 3 of these 13.5 credits must be taken from the Power and Renewable Energy Option Electives list. The rest may be chosen from the Electrical Engineering Electives list.	

27.00

Power and Renewable Energy Option Electives
Credits

ELEC 430	Electrical Power Equipment*	3.50
ELEC 431	Electrical Power Systems	3.50
ELEC 432	Control of Electrical Power Conversion Systems*	3.50
ELEC 434	Behaviour of Power Systems*	3.50
ELEC 435	Electromechanical Energy Conversion Systems	3.50
ELEC 436	Protection of Power Systems*	3.50
ELEC 438	Industrial Electrical Systems*	3.50
ELEC 439	Hybrid Electric Vehicle Power System Design and Control	3.00
ELEC 442	Digital Signal Processing	3.50
ELEC 482	System Optimization	3.50
ELEC 483	Real-Time Computer Control Systems	3.50

*Note: ELEC 430, 432, 434, 436, and 438 are usually offered in the French language.

IV. Avionics and Control Option   *Credits*

AERO 417	Standards, Regulations and Certification	3.00
AERO 480	Flight Control Systems	3.50
AERO 482	Avionic Navigation Systems	3.00
AERO 483	Integration of Avionics Systems	3.00
ELEC 483	Real-Time Computer Control Systems	3.50
	Minimum number of Elective credits:	11.00
	Electives must be chosen from the	
	Electrical Engineering Electives list.	

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                                                                      27.00

V. For students NOT selecting an option
A minimum of 27 credits must be chosen from the Electrical Engineering Electives list.

Electrical Engineering Electives
Courses are listed in groups to facilitate course selection.

A. Communications and Signal Processing   *Credits*

ELEC 441	Modern Analog Filter Design	3.50
ELEC 442	Digital Signal Processing	3.50
ELEC 462	Introduction to Digital Communications	3.50
ELEC 463	Telecommunication Networks	3.00
ELEC 464	Wireless Communications	3.00
ELEC 465	Networks Security and Management	3.50
ELEC 466	Introduction to Optical Communication Systems	3.50
ELEC 472	Advanced Telecommunication Networks	3.50

B. Computer Systems   *Credits*

COEN 313	Digital Systems Design II	3.50
COEN 316	Computer Architecture and Design	3.50
COEN 317	Microprocessor Systems	4.00
COEN 320	Introduction to Real-Time Systems	3.00
COEN 345	Software Testing and Validation	4.00
COEN 346	Operating Systems	4.00
COEN 352	Data Structures and Algorithms	3.00
COEN 421	Embedded Systems and Software Design	4.00
COEN 432	Applied Genetic and Evolutionary Systems	3.00
SOEN 341	Software Process	3.00
SOEN 342	Software Requirements and Specifications	3.00
SOEN 343	Software Architecture and Design I	3.00

C. Electronics/VLSI   *Credits*

COEN 315	Digital Electronics	3.50
COEN 413	Hardware Functional Verification	3.00
COEN 451	VLSI Circuit Design	4.00
ELEC 421	Solid State Devices	3.50
ELEC 422	Design of Integrated Circuit Components	3.50
ELEC 423	Introduction to Analog VLSI	4.00
ELEC 424	VLSI Process Technology	3.50
ELEC 425	Optical Devices for High-Speed Communications	3.50

D. Power   *Credits*

ELEC 430	Electrical Power Equipment*	3.50
ELEC 431	Electrical Power Systems	3.50
ELEC 432	Control of Electrical Power Conversion Systems*	3.50
ELEC 433	Power Electronics	3.50
ELEC 434	Behaviour of Power Systems*	3.50
ELEC 435	Electromechanical Energy Conversion Systems	3.50
ELEC 436	Protection of Power Systems*	3.50

ELEC 437	Renewable Energy Systems	3.00
ELEC 438	Industrial Electrical Systems*	3.50
ELEC 439	Hybrid Electric Vehicle Power System Design and Control	3.00
ELEC 440	Controlled Electric Drives	3.50

*Note: ELEC 430, 432, 434, 436, and 438 are usually offered in the French language.

E. Control Systems and Avionics		*Credits*
AERO 417	Standards, Regulations, and Certification	3.00
AERO 480	Flight Control Systems	3.50
AERO 482	Avionic Navigation Systems	3.00
AERO 483	Integration of Avionics Systems	3.00
ELEC 481	Linear Systems	3.50
ELEC 482	System Optimization	3.50
ELEC 483	Real-Time Computer Control Systems	3.50
ENGR 472	Robot Manipulators	3.50

F. Waves and Electromagnetics		*Credits*
ELEC 453	Microwave Engineering	3.50
ELEC 455	Acoustics	3.00
ELEC 456	Antennas	3.50
ELEC 457	Design of Wireless RF Systems	3.00
ELEC 458	Techniques in Electromagnetic Compatibility	3.00

G. Other		*Credits*
ELEC 498	Topics in Electrical Engineering	3.00
ENGR 411	Special Technical Report	1.00

71.30.2 Course Requirements (BEng in Computer Engineering)

The program in Computer Engineering consists of the Engineering Core, the Computer Engineering Core, and one of the two choices as set out below. The normal length of the program is 120 credits.

Engineering Core: (30.5 credits)
See §71.20.5.

Computer Engineering Core		*Credits*
COEN 212	Digital Systems Design I	3.50
COEN 231	Introduction to Discrete Mathematics	3.00
COEN 243	Programming Methodology I	3.00
COEN 244	Programming Methodology II	3.00
COEN 311	Computer Organization and Software	3.50
COEN 313	Digital Systems Design II	3.50
COEN 316	Computer Architecture and Design	3.50
COEN 317	Microprocessor Systems	4.00
COEN 346	Operating Systems	4.00
COEN 352	Data Structures and Algorithms	3.00
COEN 390	Computer Engineering Product Design Project	3.00
COEN 490	Capstone Computer Engineering Design Project	4.00
ELEC 264	Signals and Systems I	3.00
ELEC 311	Electronics I	3.50
ELEC 321	Introduction to Semiconductor Materials and Devices	3.50
ELEC 353	Transmission Lines, Waves and Signal Integrity	3.00
ELEC 364	Signals and Systems II	3.50
ELEC 372	Fundamentals of Control Systems	3.50
ENGR 290	Introductory Engineering Team Design Project	3.00
SOEN 341	Software Process	3.00
		67.00

Students may choose the Avionics and Embedded Systems option; otherwise, students must follow II.

I. Avionics and Embedded Systems Option Core   *Credits*

AERO 480	Flight Control Systems	3.50
AERO 482	Avionic Navigation Systems	3.00
AERO 483	Integration of Avionics Systems	3.00
COEN 320	Introduction to Real-Time Systems	3.00
COEN 421	Embedded Systems and Software Design	4.00
	Minimum number of Elective credits	6.00
	must be chosen from the Computer Engineering Electives list	
		22.50

II. For Students NOT Selecting an Option:
A minimum of 22.5 credits must be chosen from the Computer Engineering Electives list. No more than 16 of these credits may be chosen from topic area C – Computer Science and Software Engineering.

Computer Engineering Electives
Courses are listed in groups to facilitate course selection.

A. Hardware/Electronics/VLSI   *Credits*

COEN 315	Digital Electronics	3.50
COEN 413	Hardware Functional Verification	3.00
COEN 451	VLSI Circuit Design	4.00
ELEC 312	Electronics II	3.50
ELEC 423	Introduction to Analog VLSI	4.00
ELEC 458	Techniques in Electromagnetic Compatibility	3.00

B. Real-Time and Software Systems   *Credits*

COEN 320	Introduction to Real-Time Systems	3.00
COEN 345	Software Testing and Validation	4.00
COEN 421	Embedded Systems and Software Design	4.00
COEN 432	Applied Genetic and Evolutionary Systems	3.00

C. Computer Science and Software Engineering   *Credits*

COMP 335	Introduction to Theoretical Computer Science	3.00
COMP 353	Databases	4.00
COMP 371	Computer Graphics	4.00
COMP 426	Multicore Programming	4.00
COMP 428	Parallel Programming	4.00
COMP 442	Compiler Design	4.00
COMP 451	Database Design	4.00
COMP 465	Design and Analysis of Algorithms	3.00
COMP 472	Artificial Intelligence	4.00
COMP 474	Intelligent Systems	4.00
SOEN 342	Software Requirements and Specifications	3.00
SOEN 343	Software Architecture and Design I	3.00
SOEN 344	Software Architecture and Design II	3.00
SOEN 357	User Interface Design	3.00
SOEN 448	Management of Evolving Systems	3.00

D. Telecommunications, Networks and Signal Processing   *Credits*

COEN 445	Communication Networks and Protocols	4.00
ELEC 363	Fundamentals of Telecommunications Systems	3.50
ELEC 442	Digital Signal Processing	3.50
ELEC 462	Introduction to Digital Communications	3.50
ELEC 465	Networks Security and Management	3.50
ELEC 472	Advanced Telecommunication Networks	3.50

E. Control Systems   *Credits*

ELEC 481	Linear Systems	3.50
ELEC 482	System Optimization	3.50
ELEC 483	Real-Time Computer Control Systems	3.50
ENGR 472	Robot Manipulators	3.50

F. Avionics   *Credits*

AERO 417	Standards, Regulations and Certification	3.00
AERO 480	Flight Control Systems	3.50
AERO 482	Avionic Navigation Systems	3.00
AERO 483	Integration of Avionics Systems	3.00

G. Other   *Credits*

| COEN 498 | Topics in Computer Engineering | 3.00 |
| ENGR 411 | Special Technical Report | 1.00 |