UNDERGRADUATE PROGRAM IN COMPUTER ENGINEERING (AECPEBASC)

FIRST YEAR COMPUTER ENGINEERING

Fall Session – Year 1		Lect.	Lab.	Tut.	Wgt.
APS100H1: Orientation to Engineering	F	1	-	1	0.25
APS110H1: Engineering Chemistry and Materials Science	F	3	1	1	0.50
APS111H1: Engineering Strategies & Practice I	F	3	1	1	0.50
CIV100H1: Mechanics	F	3	-	2	0.50
MAT186H1: Calculus I	F	3	-	1	0.50
MAT188H1: Linear Algebra	F	3	1	1	0.50
Winter Session – Year 1		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
APS105H1: Computer Fundamentals	S	3	2	1	0.50
APS112H1: Engineering Strategies & Practice II	S	2	2	-	0.50
ECE191H1: Introduction to Electrical and Computer Engineering	S	1	-	-	0.15
ECE110H1: Electrical Fundamentals	S	3	1	2	0.50
MAT187H1: Calculus II	S	3	-	1	0.50
MIE100H1: Dynamics	S	3	-	2	0.50

Approved Course Substitutions

1. Students are able to substitute MAT186H1 with the online calculus course APS162H1.
2. Students are able to substitute MAT187H1 with the online calculus course APS163H1.
3. Students are able to substitute APS110H1 with the online course APS164H1.
4. Students are able to substitute CIV100H1 with the online course APS160H1.

SECOND YEAR COMPUTER ENGINEERING

Fall Session – Year 2		Lect.	Lab.	Tut.	Wgt.
ECE201H1: Electrical and Computer Engineering Seminar	F	1	-	-	0.15
ECE231H1: Introductory Electronics	F	3	1.50	2	0.50
ECE241H1: Digital Systems	F	3	3	-	0.50
ECE244H1: Programming Fundamentals	F	3	2	1	0.50
MAT290H1: Advanced Engineering Mathematics	F	3	-	2	0.50
MAT291H1: Introduction to Mathematical Physics	F	3	-	2	0.50
Winter Session – Year 2		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
ECE212H1: Circuit Analysis	S	3	1.5	2	0.50
ECE216H1: Signals and Systems	S	3	1	2	0.50
ECE221H1: Electric and Magnetic Fields	S	3	1	2	0.50
ECE243H1: Computer Organization	S	3	3	-	0.50
One of the following:					
ECE295H1: Hardware Design and Communication	S	2	2m	2m	0.50
ECE297H1: Software Design and Communication	S	2	2m	2m	0.50

Attention: ECE students may not enroll in 300 and/or 400 level technical courses until passing the 2W term and earning credit for no less than 8 second-year core courses.

THIRD AND FOURTH YEAR COMPUTER ENGINEERING

Required Course – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
ECE472H1: Engineering Economic Analysis & Entrepreneurship	F/S	3	-	2	0.50
Required Course – Year 4		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
ECE496Y1: Design Project	Y	1	-	1	1.00

AREA 1 - PHOTONICS & SEMICONDUCTOR PHYSICS

Fall Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
KERNEL COURSES					
ECE335H1: Introduction to Electronic Devices	F	3	-	2	0.50
TECHNICAL ELECTIVES					
ECE427H1: Photonic Devices	F	3	-	2	0.50
Winter Term – Year 3 or 4		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
KERNEL COURSES					
ECE318H1: Fundamentals of Optics	S	3	1.50	1	0.50
TECHNICAL ELECTIVES					
ECE330H1: Quantum and Semiconductor Physics	S	3	-	2	0.50
ECE437H1: VLSI Technology	S	3	3	-	0.50
ECE469H1: Optical Communications and Networks	S	3	1.50	1	0.50

AREA 2 – ELECTROMAGNETICS & ENERGY SYSTEMS

Fall Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
KERNEL COURSES					
ECE314H1: Fundamentals of Electrical Energy Systems	F	3	1.50	1	0.50
ECE320H1: Fields and Waves	F	3	1.50	1	0.50
TECHNICAL ELECTIVES					
BME595H1: Medical Imaging	F	2	3	1	0.50
ECE424H1: Microwave Circuits	F	3	1.50	1	0.50
ECE520H1: Power Electronics	F	3	1.50	1	0.50
ECE526H1: Power System Protection and Automation	F	3	1	1	0.50
Winter Term – Year 3 or 4		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
KERNEL COURSES					
ECE313H1: Energy Systems and Distributed Generation	S	3.	1.50	1	0.50
TECHNICAL ELECTIVES					
ECE422H1: Radio and Microwave Wireless Systems	S	3	1.50	1	0.50
ECE463H1: Electric Drives	S	3	1.50	1	0.50

AREA 3 – ANALOG & DIGITAL ELECTRONICS

Fall Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
KERNEL COURSES					
ECE331H1: Analog Electronics	F	3	1.50	1	0.50
ECE334H1: Digital Electronics	F	3	1.50	1	0.50
TECHNICAL ELECTIVES					
ECE424H1: Microwave Circuits	F	3	1.50	1	0.50
ECE430H1: Analog Integrated Circuits	F	3	1.50	1	0.50
ECE446H1: Sensory Communication	F	3	1.50	-	0.50
Winter Term – Year 3 or 4		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
KERNEL COURSES					
ECE334H1: Digital Electronics	S	3	1.50	1	0.50

Winter Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
TECHNICAL ELECTIVES					
ECE412H1: Analog Signal Processing Circuits	S	3	-	2	0.50
ECE437H1: VLSI Technology	S	3	3	-	0.50
ECE532H1: Digital Systems Design	S	3	3	-	0.50

AREA 4 – CONTROL, COMMUNICATIONS & SIGNAL PROCESSING

Fall Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
KERNEL COURSES					
ECE311H1: Introduction to Control Systems	F	3	1.50	1	0.50
ECE316H1: Communication Systems	F	3	1.50	1	0.50
TECHNICAL ELECTIVES					
BME445H1: Neural Bioelectricity	F	3	1.50	1	0.50
BME595H1: Medical Imaging	F	2	3	1	0.50
ECE302H1: Probability and Applications	F	3	-	2	0.50
ECE410H1: Linear Control Systems	F	3	1.50	1	0.50
ECE417H1: Digital Communication	F	3	1.50	1	0.50
ECE421H1: Introduction to Machine Learning	F	3	-	2	0.50
ECE431H1: Digital Signal Processing	F	3	1.50	1	0.50
ECE441H1: Interfacing & Modulating the Nervous System	f	3	3	2	0.50
ECE446H1: Sensory Communication	F	3	1.50	-	0.50
ECE470H1: Robot Modeling and Control	F	3	1.50	1	0.50
ECE537H1: Random Processes	F	3	-	2	0.50
Winter Term – Year 3 or 4		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
KERNEL COURSES					
ECE311H1: Introduction to Control Systems	S	3	1.50	1	0.50
ECE316H1: Communication Systems	S	3	1.50	1	0.50
TECHNICAL ELECTIVES					
ECE302H1: Probability and Applications	S	3	-	2	0.50
ECE368H1: Probabilistic Reasoning	S	3	1.50	3	0.50
ECE411H1: Adaptive Control and Reinforcement Learning	S	3	1.50	1	0.50
ECE421H1: Introduction to Machine Learning	S	3	-	2	0.50
ECE422H1: Radio and Microwave Wireless Systems	S	3	1.50	1	0.50
ECE462H1: Multimedia Systems	S	3	2	-	0.50
ECE464H1: Wireless Communication	S	3	1.50	1	0.50
ECE469H1: Optical Communications and Networks	S	3	1.50	1	0.50
ECE516H1: Intelligent Image Processing	S	3	1.50	1	0.50
BME331H1: Physiological Control Systems	S	3	1	1	0.50

AREA 5 – COMPUTER HARDWARE & COMPUTER NETWORKS

Fall Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
KERNEL COURSES					
ECE361H1: Computer Networks I	F	3	1.50	1	0.50
TECHNICAL ELECTIVES					
ECE302H1: Probability and Applications	F	3	-	2	0.50
ECE461H1: Internetworking	F	3	1.50	0.50	0.50
ECE537H1: Random Processes	F	3	-	2	0.50
ECE552H1: Computer Architecture	F	3	1.50	1	0.50
ECE568H1: Computer Security	F	3	3	-	0.50

Winter Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
KERNEL COURSES					
ECE342H1: Computer Hardware	S	3	3	-	0.50
ECE361H1: Computer Networks I	S	3	1.50	1	0.50
TECHNICAL ELECTIVES					
ECE302H1: Probability and Applications	S	3	-	2	0.50
ECE462H1: Multimedia Systems	S	3	2	-	0.50
ECE464H1: Wireless Communication	S	3	1.50	1	0.50
ECE466H1: Computer Networks II	S	3	1.50	1	0.50
ECE469H1: Optical Communications and Networks	S	3	1.50	1	0.50
ECE532H1: Digital Systems Design	S	3	3	-	0.50
ECE568H1: Computer Security	S	3	3	-	0.50

AREA 6 – SOFTWARE

Fall Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
KERNEL COURSES					
ECE344H1: Operating Systems	F	3	3	-	0.50
ECE345H1: Algorithms and Data Structures	F	3	-	2	0.50
TECHNICAL ELECTIVES					
APS360H1: Applied Fundamentals of Deep Learning	F	3	1	-	0.50
CSC343H1: Introduction to Databases	F	2	-	1	0.50
CSC317H1: Computer Graphics	F	2	-	1	0.50
ECE326H1: Programming Languages	F	3	1.50	1	0.50
ECE444H1: Software Engineering	F	3	3	-	0.50
ECE454H1: Computer Systems Programming	F	3	3	-	0.50
ECE461H1: Internetworking	F	3	1.50	0.50	0.50
ECE467H1: Compilers & Interpreters	F	3	1.50	1	0.50
ECE568H1: Computer Security	F/S	3	3	-	0.50
Winter Term – Year 3 or 4		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
KERNEL COURSES					
ECE344H1: Operating Systems	S	3	3	-	0.50
ECE345H1: Algorithms and Data Structures	S	3	-	2	0.50
TECHNICAL ELECTIVES					
APS360H1: Applied Fundamentals of Deep Learning	F	3	1	-	0.50
CSC343H1: Introduction to Databases	S	2	-	1	0.50
CSC317H1: Computer Graphics	S	2	-	1	0.50
ECE419H1: Distributed Systems	S	3	1.50	1	0.50
ECE448H1: Biocomputation	S	3	-	2	0.50
ECE568H1: Computer Security	S	3	3	-	0.50

SCIENCE/MATH ELECTIVES

Fall Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
BME440H1: Biomedical Engineering Technology and Investigation	F	2	4	-	0.50
BME455H1: Cellular and Molecular Bioengineering II	F	3	1.50	1	0.50
CHE353H1: Engineering Biology	F	2	-	2	0.50
CIV220H1: Urban Engineering Ecology	F	3	-	1	0.50
CIV300H1: Terrestrial Energy Systems	F	3	-	2	0.50
ECE302H1: Probability and Applications	F	3	-	2	0.50

Fall Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
ECE367H1: Matrix Algebra and Optimization	F	3	-	2	0.50
ECE537H1: Random Processes	F	3	-	2	0.50
ESC384H1: Partial Differential Equations	F	3	-	1	0.50
Winter Term – Year 3 or 4		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
BME331H1: Physiological Control Systems	S	3	1	1	0.50
CHE354H1: Cellular and Molecular Biology	S	3	1	2	0.50
CIV300H1: Terrestrial Energy Systems	S	3	-	2	0.50
ECE302H1: Probability and Applications	S	3	-	2	0.50
ECE368H1: Probabilistic Reasoning	S	3	-	1	0.50
ECE448H1: Biocomputation	S	3	-	2	0.50
PHY365H1: Quantum Information	S	2	-	1	0.50

PROFESSIONAL EXPERIENCE YEAR

Students registered within this program, and all other undergraduate programs within the Faculty of Applied Science and Engineering, may elect to enroll and participate in the Professional Experience Year Co-Op Program (PEY Co-Op). The PEY Co-op program requires that qualified students undertake a paid, full-time 12-16 month continuous work period with a cooperating industry. Details are described in the beginning of this chapter. More information can be found in the PEY Co-op section of the calendar.

ECE Program Requirements

There are nine requirements:

1. **BREADTH REQUIREMENT**: A minimum of four kernel courses, each in a different area, must be chosen.
2. **DEPTH REQUIREMENT**: Select at least two areas from which one kernel course has been chosen. In each of these two areas, two additional technical courses must be chosen. Kernel courses may also be chosen to meet this requirement.
3. **ENGINEERING ECONOMICS REQUIREMENTS**: ECE472H1 must be chosen. Course can be taken in either third or fourth year.
4. **CAPSTONE REQUIREMENT**: The Design Project, ECE496Y1, must be taken in fourth year. To be eligible to register for the capstone course, you must have at least 7 technical electives or 6 technical electives plus ECE472H1.
5. **MATH/SCIENCE REQUIREMENT**: At least one course from the Math/Science area must be chosen.
6. **TECHNICAL ELECTIVE REQUIREMENT**: A minimum of three additional ECE technical courses must be chosen from any of the six areas of study. With approval from ECE, one of the technical electives can be taken from another department. Only 300, 400 and 500 level courses can be used as a technical elective.
7. **FREE ELECTIVE REQUIREMENT**: One is required, and may be a technical or a non-technical course.
8. **COMPLEMENTARY STUDIES REQUIREMENT:** In each of terms 3F, 3S, 4F, and 4S, a complementary studies course must be taken. Of the four complementary studies courses, a minimum of two must be humanities and social science (HSS) courses chosen from an approved list on the Registrar's website: http://www.undergrad.engineering.utoronto.ca/Office_of_the_Registrar/Electives.htm
9. **PRACTICAL EXPERIENCE REQUIREMENT:** Students are required to have completed a total of 600 hours of acceptable practical experience before graduation (normally during their summer vacation periods). Students registered within this program, may elect to enrol and participate in the Professional Experience Year (PEY Co-op) program.

A sample course selection arrangement for third and fourth year is shown in the table below.

3F	Technical Elective	Other Science/Math	Area Kernel	Area Kernel	Complementary Studies
3S	Engineering Economics	Depth	Area Kernel	Area Kernel	Complementary Studies

4F	Technical Elective	Depth	Depth	4th Year Design Project	Humanities & Social Science
4S	Free Elective	Technical Elective	Depth	4th Year Design Project	Humanities & Social Science

Degree Designation

If, among the eight courses required to satisfy the Breadth requirement (1) and the Depth requirement (2), at least four are selected from Areas 5 and 6, then the student is eligible for the B.A.Sc. degree in Computer Engineering. If, among these eight courses, at least five are selected from Areas 1 to 4, then the student is eligible for the B.A.Sc. degree in Electrical Engineering. By appropriate choice of kernel courses as technical or free electives, it may be possible to satisfy these requirements simultaneously; in this case, the student must choose one of the two designations.

In addition to the above program requirements, all CEAB requirements, including the minimum number of accreditation units (AU's) in the various CEAB categories, must be met in order to graduate.

CEAB Requirements

To satisfy CEAB requirements, students must accumulate, during four years of study, a minimum number of academic units in six categories: complementary studies, mathematics, basic science, engineering science, engineering design, combined engineering science and design. For details on how to verify satisfaction of CEAB requirements, students are referred to the ECE Undergraduate website:
https://magellan.ece.toronto.edu.

It is recognized that the course selection process can be complex in the flexible curriculum for third and fourth year. Students are advised to consult the ECE Undergraduate Office on questions related to course selection. In addition, tools will be provided to assist students to ensure satisfaction of all requirements in their course selection. For complete details, students are referred to the ECE Department Undergraduate Studies office at askece@utoronto.ca.

A student who selects a course of study that does not meet ECE and CEAB requirements will not be eligible to graduate.

UNDERGRADUATE PROGRAM IN ELECTRICAL ENGINEERING (AEELEBASC)

FIRST YEAR ELECTRICAL ENGINEERING

Fall Session – Year 1		Lect.	Lab.	Tut.	Wgt.
APS100H1: Orientation to Engineering	F	1	-	1	0.25
APS110H1: Engineering Chemistry and Materials Science	F	3	1	1	0.50
APS111H1: Engineering Strategies & Practice I	F	3	1	1	0.50
CIV100H1: Mechanics	F	3	-	2	0.50
MAT186H1: Calculus I	F	3	-	1	0.50
MAT188H1: Linear Algebra	F	3	1	1	0.50
Winter Session – Year 1		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
APS105H1: Computer Fundamentals	S	3	2	1	0.50
APS112H1: Engineering Strategies & Practice II	S	2	2	-	0.50
ECE191H1: Introduction to Electrical and Computer Engineering	S	1	-	-	0.15
ECE110H1: Electrical Fundamentals	S	3	1	2	0.50
MAT187H1: Calculus II	S	3	-	1	0.50
MIE100H1: Dynamics	S	3	-	2	0.50

Approved Course Substitutions

1. Students are able to substitute MAT186H1 with the online calculus course APS162H1.
2. Students are able to substitute MAT187H1 with the online calculus course APS163H1.
3. Students are able to substitute APS110H1 with the online course APS164H1.
4. Students are able to substitute CIV100H1 with the online course APS160H1.

SECOND YEAR ELECTRICAL ENGINEERING

Fall Session – Year 2		Lect.	Lab.	Tut.	Wgt.
ECE201H1: Electrical and Computer Engineering Seminar	F	1	-	-	0.15
ECE231H1: Introductory Electronics	F	3	1.50	2	0.50
ECE241H1: Digital Systems	F	3	3	-	0.50
ECE244H1: Programming Fundamentals	F	3	2	1	0.50
MAT290H1: Advanced Engineering Mathematics	F	3	-	2	0.50
MAT291H1: Introduction to Mathematical Physics	F	3	-	2	0.50
Winter Session – Year 2		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
ECE212H1: Circuit Analysis	S	3	1.50	2	0.50
ECE216H1: Signals and Systems	S	3	1	2	0.50
ECE221H1: Electric and Magnetic Fields	S	3	1	2	0.50
ECE243H1: Computer Organization	S	3	3	-	0.50
One of the following:					
ECE295H1: Hardware Design and Communication	S	2	2m	2m	0.50
ECE297H1: Software Design and Communication	S	2	2m	2m	0.50

Attention: ECE students may not enroll in 300 and/or 400 level technical courses until passing the 2W term and earning no less than 8 second-year core courses.

THIRD AND FOURTH YEAR ELECTRICAL ENGINEERING

Required Course – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
ECE472H1: Engineering Economic Analysis & Entrepreneurship	F/S	3	-	2	0.50
Required Course – Year 4		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
ECE496Y1: Design Project	Y	1	-	1	1.00

AREA 1 - PHOTONICS & SEMICONDUCTOR PHYSICS

Fall Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
KERNEL COURSES					
ECE335H1: Introduction to Electronic Devices	F	3	-	2	0.50
TECHNICAL ELECTIVES					
ECE427H1: Photonic Devices	F	3	-	2	0.50
Winter Term – Year 3 or 4		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
KERNEL COURSES					
ECE318H1: Fundamentals of Optics	S	3	1.50	1	0.50
TECHNICAL ELECTIVES					
ECE330H1: Quantum and Semiconductor Physics	S	3	-	2	0.50
ECE437H1: VLSI Technology	S	3	3	-	0.50
ECE469H1: Optical Communications and Networks	S	3	1.50	1	0.50

AREA 2 - ELECTROMAGNETICS & ENERGY SYSTEMS

Fall Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
KERNEL COURSES					
ECE314H1: Fundamentals of Electrical Energy Systems	F	3	1.50	1	0.50
ECE320H1: Fields and Waves	F	3	1.50	1	0.50
TECHNICAL ELECTIVES					
BME595H1: Medical Imaging	F	2	3	1	0.50
ECE424H1: Microwave Circuits	F	3	1.50	1	0.50
ECE520H1: Power Electronics	F	3	1.50	1	0.50
ECE526H1: Power System Protection and Automation	F	3	1.50	1	0.50
Winter Term - Year 3 or 4		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
KERNEL COURSES					
ECE313H1: Energy Systems and Distributed Generation	S	3	1.50	1	0.50
TECHNICAL ELECTIVES					
ECE422H1: Radio and Microwave Wireless Systems	S	3	1.50	1	0.50
ECE463H1: Electric Drives	S	3	1.50	1	0.50

AREA 3 – ANALOG & DIGITAL ELECTRONICS

Fall Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
KERNEL COURSES					
ECE331H1: Analog Electronics	F	3	1.50	1	0.50
ECE334H1: Digital Electronics	F	3	1.50	1	0.50
TECHNICAL ELECTIVES					
ECE424H1: Microwave Circuits	F	3	1.50	1	0.50
ECE430H1: Analog Integrated Circuits	F	3	1.50	1	0.50
ECE446H1: Sensory Communication	F	3	1.50	-	0.50
Winter Term – Year 3 or 4		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
KERNEL COURSES					
ECE334H1: Digital Electronics	S	3	1.50	1	0.50
TECHNICAL ELECTIVES					
ECE412H1: Analog Signal Processing Circuits	S	3	-	2	0.50
ECE437H1: VLSI Technology	S	3	3	-	0.50
ECE532H1: Digital Systems Design	S	3	3	-	0.50

AREA 4 – CONTROL, COMMUNICATIONS & SIGNAL PROCESSING

Fall Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
KERNEL COURSES					
ECE311H1: Introduction to Control Systems	F	3	1.50	1	0.50
ECE316H1: Communication Systems	F	3	1.50	1	0.50
TECHNICAL ELECTIVES					
BME445H1: Neural Bioelectricity	F	3	1.50	1	0.50
BME595H1: Medical Imaging	F	2	3	1	0.50
ECE302H1: Probability and Applications	F	3	-	2	0.50
ECE410H1: Linear Control Systems	F	3	1.50	1	0.50
ECE417H1: Digital Communication	F	3	1.50	1	0.50
ECE421H1: Introduction to Machine Learning	F/S	3	-	2	0.50
ECE431H1: Digital Signal Processing	F	3	1.50	1	0.50
ECE441H1: Interfacing & Modulating the Nervous System	F	3	3	2	0.50
ECE446H1: Sensory Communication	F	3	1.50	-	0.50
ECE470H1: Robot Modeling and Control	F	3	1.50	1	0.50

Fall Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
ECE537H1: Random Processes	F	3	-	2	0.50
Winter Term – Year 3 or 4		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
KERNEL COURSES					
ECE311H1: Introduction to Control Systems	S	3	1.50	1	0.50
ECE316H1: Communication Systems	S	3	1.50	1	0.50
TECHNICAL ELECTIVES					
ECE302H1: Probability and Applications	S	3	-	2	0.50
ECE368H1: Probabilistic Reasoning	S	3	1.50	1	0.50
ECE411H1: Adaptive Control and Reinforcement Learning	S	3	1.50	1	0.50
ECE421H1: Introduction to Machine Learning	F/S	3	-	2	0.50
ECE422H1: Radio and Microwave Wireless Systems	S	3	1.50	1	0.50
ECE462H1: Multimedia Systems	S	3	2	-	0.50
ECE464H1: Wireless Communication	S	3	1.50	1	0.50
ECE469H1: Optical Communications and Networks	S	3	1.50	1	0.50
ECE470H1: Robot Modeling and Control	S	3	1.50	1	0.50
ECE516H1: Intelligent Image Processing	S	3	1.50	1	0.50
BME331H1: Physiological Control Systems	S	3	1	1	0.50

AREA 5 – COMPUTER HARDWARE & COMPUTER NETWORKS

Fall Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
KERNEL COURSES					
ECE361H1: Computer Networks I	F	3	1.50	1	0.50
TECHNICAL ELECTIVES					
ECE302H1: Probability and Applications	F	3	-	2	0.50
ECE461H1: Internetworking	F	3	1.50	0.50	0.50
ECE537H1: Random Processes	F	3	-	2	0.50
ECE552H1: Computer Architecture	F	3	1.50	1	0.50
ECE568H1: Computer Security	F	3	3	-	0.50
Winter Term – Year 3 or 4		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
KERNEL COURSES					
ECE342H1: Computer Hardware	S	3	3	-	0.50
ECE361H1: Computer Networks I	S	3	1.50	1	0.50
TECHNICAL ELECTIVES					
ECE302H1: Probability and Applications	S	3	-	2	0.50
ECE462H1: Multimedia Systems	S	3	2	-	0.50
ECE464H1: Wireless Communication	S	3	1.50	1	0.50
ECE466H1: Computer Networks II	S	3	1.50	1	0.50
ECE469H1: Optical Communications and Networks	S	3	1.50	1	0.50
ECE532H1: Digital Systems Design	S	3	3	-	0.50
ECE568H1: Computer Security	S	3	3	-	0.50

AREA 6 – SOFTWARE

Fall Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
KERNEL COURSES					
ECE344H1: Operating Systems	F	3	3	-	0.50
ECE345H1: Algorithms and Data Structures	F	3	-	2	0.50
TECHNICAL ELECTIVES					
APS360H1: Applied Fundamentals of Deep Learning	F	3	1	-	0.50

Fall Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
CSC343H1: Introduction to Databases	F	2	-	1	0.50
CSC317H1: Computer Graphics	F	2	-	1	0.50
ECE326H1: Programming Languages	F	3	1.50	1	0.50
ECE444H1: Software Engineering	F	3	3	-	0.50
ECE454H1: Computer Systems Programming	F	3	3	-	0.50
ECE461H1: Internetworking	F	3	1.50	0.50	0.50
ECE467H1: Compilers & Interpreters	F	3	1.50	1	0.50
ECE568H1: Computer Security	F/S	3	3	-	0.50
Winter Term – Year 3 or 4		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
KERNEL COURSES					
ECE344H1: Operating Systems	S	3	3	-	0.50
ECE345H1: Algorithms and Data Structures	S	3	-	2	0.50
TECHNICAL ELECTIVES					
APS360H1: Applied Fundamentals of Deep Learning	S	3	1	-	0.50
CSC343H1: Introduction to Databases	S	2	-	1	0.50
CSC317H1: Computer Graphics	S	2	-	1	0.50
ECE419H1: Distributed Systems	S	3	1.50	1	0.50
ECE448H1: Biocomputation	S	3	-	2	0.50
ECE568H1: Computer Security	S	3	3	-	0.50

SCIENCE/MATH ELECTIVES

Fall Term – Year 3 or 4		Lect.	Lab.	Tut.	Wgt.
BME440H1: Biomedical Engineering Technology and Investigation	F	2	4	-	0.50
BME455H1: Cellular and Molecular Bioengineering II	F	3	1.50	1	0.50
CHE353H1: Engineering Biology	F	2	-	2	0.50
CIV220H1: Urban Engineering Ecology	F	3	-	1	0.50
CIV300H1: Terrestrial Energy Systems	F	3	-	2	0.50
ECE302H1: Probability and Applications	F	3	-	2	0.50
ECE357H1: Electromagnetic Fields	S	3	1.50	1	0.50
ECE367H1: Matrix Algebra and Optimization	F	3	-	2	0.50
ECE537H1: Random Processes	F	3	-	2	0.50
ESC384H1: Partial Differential Equations	F	3	-	1	0.50
Winter Term – Year 3 or 4		**Lect.**	**Lab.**	**Tut.**	**Wgt.**
BME331H1: Physiological Control Systems	S	3	1	1	0.50
CHE354H1: Cellular and Molecular Biology	S	3	1	2	0.50
CIV300H1: Terrestrial Energy Systems	S	3	-	2	0.50
ECE302H1: Probability and Applications	S	3	-	2	0.50
ECE368H1: Probabilistic Reasoning	S	3	-	1	0.50
ECE448H1: Biocomputation	S	3	-	2	0.50
PHY365H1: Quantum Information	S	2	-	1	0.50

PROFESSIONAL EXPERIENCE YEAR

Students registered within this program, and all other undergraduate programs within the Faculty of Applied Science and Engineering, may elect to enroll and participate in the Professional Experience Year Co-Op Program (PEY Co-Op). The PEY Co-op program requires that qualified students undertake a paid, full-time 12-16 month continuous work period with

a cooperating industry. Details are described in the beginning of this chapter. More information can be found in the PEY Co-op section of the calendar.

ECE Program Requirements

There are nine requirements:

1. **BREADTH REQUIREMENT:** A minimum of four kernel courses, each in a different area, must be chosen.
2. **DEPTH REQUIREMENT:** Select at least two areas from which one kernel course has been chosen. In each of these two areas, two additional technical courses must be chosen. Kernel courses may also be chosen to meet this requirement.
3. **ENGINEERING ECONOMICS REQUIREMENTS:** ECE472H1 must be chosen. Course can be taken in either third or fourth year.
4. **CAPSTONE REQUIREMENT:** The Design Project, ECE496Y1, must be taken in fourth year. To be eligible to register for the capstone course, you must have at least 7 technical electives or 6 technical electives plus ECE472H1.
5. **MATH/SCIENCE REQUIREMENT:** At least one course from the Math/Science area must be chosen.
6. **TECHNICAL ELECTIVE REQUIREMENT:** A minimum of three additional ECE technical courses must be chosen from any of the six areas of study. With approval from ECE, one of the technical electives can be taken from another department. Only 300, 400 and 500 level courses can be used as a technical elective.
7. **FREE ELECTIVE REQUIREMENT:** One is required and may be a technical or a non-technical course.
8. **COMPLEMENTARY STUDIES REQUIREMENT**: In each of terms 3F, 3S, 4F, and 4S, a complementary studies course must be taken. Of the four complementary studies courses, a minimum of two must be humanities and social science (HSS) courses chosen from an approved list on the Registrar's website: http://www.undergrad.engineering.utoronto.ca/Office_of_the_Registrar/Electives.htm
9. **PRACTICAL EXPERIENCE REQUIREMENT**: Students are required to have completed a total of 600 hours of acceptable practical experience before graduation (normally during their summer vacation periods). Students registered within this program, may elect to enrol and participate in the Professional Experience Year (PEY Co-op) program.

A sample course selection arrangement for third and fourth year is shown in the table below.

3F	Technical Elective	Other Science/Math	Area Kernel	Area Kernel	Complementary Studies
3S	Engineering Economics	Depth	Area Kernel	Area Kernel	Complementary Studies
4F	Technical Elective	Depth	Depth	4th Year Design Project	Humanities & Social Science
4S	Free Elective	Technical Elective	Depth	4th Year Design Project	Humanities & Social Science

Degree Designation

If, among the eight courses required to satisfy the Breadth requirement (1) and the Depth requirement (2), at least four are selected from Areas 5 and 6, then the student is eligible for the B.A.Sc. degree in Computer Engineering. If, among these eight courses, at least five are selected from Areas 1 to 4, then the student is eligible for the B.A.Sc. degree in Electrical Engineering. By appropriate choice of kernel courses as technical or free electives, it may be possible to satisfy these requirements simultaneously; in this case, the student must choose one of the two designations.

CEAB Requirements

To satisfy CEAB requirements, students must accumulate, during four years of study, a minimum number of academic units in six categories: complementary studies, mathematics, basic science, engineering science, engineering design, combined engineering science and design. For details on how to verify satisfaction of CEAB requirements, students are referred to the ECE Undergraduate website:
https://magellan.ece.toronto.edu.

It is recognized that the course selection process can be complex in the flexible curriculum for third and fourth year. Students are advised to consult the ECE Undergraduate Office on questions related to course selection. In addition, tools

will be provided to assist students to ensure satisfaction of all requirements in their course selection. For complete details, students are referred to the ECE Department Undergraduate Studies office at askece@utoronto.ca.

A student who selects a course of study that does not meet ECE and CEAB requirements will not be eligible to graduate.

Electrical and Computer Engineering Courses

Applied Science and Engineering (Interdepartmental)

APS100H1 - Orientation to Engineering

Credit Value: 0.25
Hours: 12.8L/12.8T

This course is designed to help students transition into first-year engineering studies and to develop and apply a greater understanding of the academic learning environment, the field of engineering, and how the fundamental mathematics and sciences are used in an engineering context. Topics covered include: study skills, time management, problem solving, successful teamwork, effective communications, exam preparation, stress management and wellness, undergraduate research, extra- and co-curricular involvement, engineering disciplines and career opportunities, and applications of math and science in engineering.

Total AUs: 18.3 (Fall), 18.3 (Winter), 36.6 (Full Year)

APS105H1 - Computer Fundamentals

Credit Value: 0.50
Hours: 38.4L/12.8T/25.6P

An introduction to computer systems and problem solving using computers. Topics include: the representation of information, programming techniques, programming style, basic loop structures, functions, arrays, strings, pointer-based data structures and searching and sorting algorithms. The laboratories reinforce the lecture topics and develops essential programming skills.

Total AUs: 54.9 (Fall), 54.9 (Winter), 109.8 (Full Year)

APS110H1 - Engineering Chemistry and Materials Science

Credit Value: 0.50
Hours: 38.4L/12.8T/12.8P

This course is structured around the principle of the structure-property relationship. This relationship refers to an understanding of the microstructure of a solid, that is, the nature of the bonds between atoms and the spatial arrangement of atoms, which permits the explanation of observed behaviour. Observed materials behaviour includes mechanical, electrical, magnetic, optical, and corrosive behaviour. Topics covered in this course include: structure of the atom, models of the atom, electronic configuration, the electromagnetic spectrum, band theory, atomic bonding, optical transparency of solids, magnetic properties, molecular bonding, hybridized orbitals, crystal systems, lattices and structures, crystallographic notation, imperfections in solids, reaction rates, activation energy, solid-state diffusion, materials thermodynamics, free energy, and phase equilibrium.

Total AUs: 48.8 (Fall), 48.8 (Winter), 97.6 (Full Year)

APS111H1 - Engineering Strategies & Practice I

Credit Value: 0.50
Hours: 38.4L/12.8T/12.8P

This course introduces and provides a framework for the design process. Students are introduced to communication as an integral component of engineering practice. The course is a vehicle for understanding problem solving and developing communications skills. This first course in the two Engineering Strategies and Practice course sequence introduces students to the process of engineering design, to strategies for successful team work, and to design for human factors, society and the environment. Students write team and individual technical reports.

Total AUs: 48.8 (Fall), 48.8 (Winter), 97.6 (Full Year)

APS112H1 - Engineering Strategies & Practice II

Credit Value: 0.50
Hours: 25.6L/25.6P

This course introduces and provides a framework for the design process, problem solving and project management. Students are introduced to communication as an integral component of engineering practice. The course is a vehicle for practicing team skills and developing communications skills. Building on the first course, this second course in the two Engineering