

Engineering Science

UNDERGRADUATE PROGRAM IN ENGINEERING SCIENCE (AEESCBASE)

www.engsci.utoronto.ca

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Engineering Science is an enriched program that provides excellent preparation for postgraduate studies in engineering and science as well as for other professional degree programs such as business, law and medicine. Graduates of the program are also well qualified to immediately embark on professional engineering-related careers.

The courses offered are of high standard; only students with superior ability in, and aptitude for mathematics and science can expect to succeed in this program.

Transfers in First Year from Engineering Science to other Engineering programs are permitted early in the Fall Session (up until September 26th), at the end of the Fall session, and at the end of the Winter Session. Continuation into the Winter Session of First Year requires a minimum average of 55% in the Fall Session and continuation into Second Year requires a minimum average of 65% in the Winter Session of First Year. Students who do not meet these requirements are permitted to transfer into other Engineering programs, subject to the requirements and provisions of the Academic Regulations. (See Chapter 6 for details.)

THE ENGINEERING SCIENCE CURRICULUM

The first two years of the curriculum focus on the foundations of both engineering and science. The curricula for the first two years of the program are common for all students and are only offered to students in the program. At the end of Second Year, each student selects one of the following Options to pursue in their final two years and this represents their Major field of specialization:

Aerospace

Biomedical

Electrical and Computer

Energy Systems

Engineering Mathematics, Statistics & Finance

Infrastructure

Nanoengineering

Physics

The curriculum for the first two years and the curricula for the eight Options are presented on the pages that follow.

Degree Designation

Engineering Science students graduate with the degree "Bachelor of Applied Science in Engineering Science". On the official transcript, their chosen Option will be indicated as their Major, e.g. Major in Aerospace Engineering.

Degree Requirements

In order to graduate, students must meet all of the degree requirements outlined in Chapter 6 (page 96) of this Calendar. In addition to these requirements, students must also successfully complete their chosen Program of Study in Engineering Science as described on the following pages of this Calendar, as well as the curriculum requirements of the Canadian Engineering Accreditation Board (CEAB).

To complete their chosen Program of Study, students are responsible for ensuring that they have taken all of the required courses and the correct number of technical electives for their Option. Requests for elective course substitutions will be considered but must be approved in advance by the Division through their counsellor.

To satisfy the CEAB requirements, students must accumulate during their program of study a minimum total number of accreditation units (AU)

as well as a minimum number of AU in six categories: complementary studies, mathematics, natural science, engineering science, engineering design, and combined engineering science and design. The Division provides students with a planning tool called the AU Tracker to help students ensure that they satisfy these requirements.

Students entering their final year of study are required to submit a completed Program of Study Checklist and a completed AU Tracker to their counsellor at the beginning of the fall session. The Program of Study Checklist confirms whether students are on track to complete their chosen Program of Study during their final year. The AU Tracker, which lists all successfully completed courses as well as all of the courses they are enrolled in for the current academic year, confirms whether students are on track to meet or exceed the CEAB requirements. If a student is deficient in terms of the Program of Study or falls short in any of the CEAB categories, the student must adjust their course selection accordingly in order to graduate.

FIRST YEAR CURRICULUM- ENGINEERING SCIENCE

Fall Session - Year 1					Winter Session - Year 1						
		Lect.	Lab.	Tut.	Wgt.			Lect.	Lab.	Tut.	Wgt.
Overture Lecture					0.00	Systems Biology	BME105H1 S	2	1.25	1	0.50
Structures and Materials - An Introduction to Engineering Design	CIV102H1 F	3	-	2	0.50	Fundamentals of Electric Circuits	ECE159H1 S	3	1.50	1	0.50
Praxis I	ESC101H1 F	2	-	2	0.50	Praxis II	ESC102H1 S	2	-	2	0.50
Engineering Mathematics and Computation	ESC103H1 F	2	-	2	0.50	Linear Algebra	MAT185H1 S	3	-	1	0.50
Calculus I	MAT194H1 F	3	-	1	0.50	Calculus II	MAT195H1 S	3	-	1	0.50
Classical Mechanics	PHY180H1 F	3	1.50	1	0.50						
and one of:						and one of:					
Introduction to Computer Programming	CSC180H1 F	3	2	1	0.50	Computer Algorithms, Data Structures and Languages	CSC190H1 S	3	3	-	0.50
Computer Programming, Algorithms, Data Structures and Languages	CSC192H1 F	3	2	1	0.50	Free Elective					0.50

- Overture lectures will take place during the first week of class in the fall term.
- Students choosing to take CSC180H1 F are required to take CSC190H1 S in the following term.
- Free elective is only available to students who have taken CSC192H1 F.

SECOND YEAR CURRICULUM - ENGINEERING SCIENCE

Fall Session - Year 2					Winter Session - Year 2						
		Lect.	Lab.	Tut.	Wgt.			Lect.	Lab.	Tut.	Wgt.
Vector Calculus & Fluid Mechanics	AER210H1 F	3	0.50	2	0.50	Engineering Design	AER201H1 S	1	5	-	0.50
Thermodynamics and Heat Transfer	CHE260H1 F	3	0.50	1	0.50	Electromagnetism	ECE259H1 S	3	-	1	0.50
Digital and Computer Systems	ECE253H1 F	3	3	-	0.50	Molecules & Materials	MSE260H1 S	3	-	1	0.50
Engineering, Society & Critical Thinking	ESC203H1 F	3	-	1	0.50	Modern Physics	PHY294H1 S	3	1	1	0.50
Calculus III	MAT292H1 F	3	-	2	0.50	Probability and Statistics	STA286H1 S	3	-	1	0.50
Particles & Waves	PHY293H1 F	3	1	1	0.50	Complementary Studies Elective					0.50

- All students must graduate with 1.0 credits in Humanities & Social Sciences. You will gain 0.5 credit from ESC203
- Please note that additional lectures may be scheduled for AER201 in place of laboratory time in the first few weeks of the semester.

PROFESSIONAL EXPERIENCE YEAR

Students registered within this program, and all other undergraduate programs within the Faculty of Applied Science and Engineering, may elect to enrol and participate in the Professional Experience Year (PEY) program. The PEY 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. For more information, consult the Professional Experience Year Office, 45 Willcocks Street 2nd Floor, early in session 2H1 F or 3H1 F.

Curriculum & Programs

OPTION AEROSPACE (AEESCBASEA)

YEAR 3 AEROSPACE

Fall Session - Year 3					Winter Session - Year 3						
		Lect.	Lab.	Tut.	Wgt.		Lect.	Lab.	Tut.	Wgt.	
Dynamics	AER301H1 F	3	-	1	0.50	Aircraft Flight	AER302H1 S	3	-	1	0.50
Aerospace Laboratory I	AER303H1 F	-	1	-	0.15	Aerospace Laboratory II	AER304H1 S	-	1	-	0.15
Aerodynamics	AER307H1 F	3	-	1	0.50	Gasdynamics	AER310H1 S	3	-	1	0.50
Combustion Processes	AER315H1 F	3	-	1	0.50	Scientific Computing	AER336H1 S	3	-	1	0.50
Economic Analysis and Decision Making	CHE374H1 F	3	-	1	0.50	Control Systems	AER372H1 S	3	1.50	1	0.50
Partial Differential Equations	APM384H1 F	3	-	1	0.50	Mechanics of Solids and Structures	AER373H1 S	3	-	1	0.50
Complex Analysis	MAT389H1 F	3	-	1	0.50	Engineering Science Option Seminar	ESC301Y1 Y	-	-	0.50	0.10
Engineering Science Option Seminar	ESC301Y1 Y	-	-	0.50	0.10						

YEAR 4 AEROSPACE

Fall Session - Year 4					Winter Session - Year 4						
		Lect.	Lab.	Tut.	Wgt.		Lect.	Lab.	Tut.	Wgt.	
Space Systems Design	AER407H1 F	-	3	-	0.50	Aircraft Design	AER406H1 S	-	-	3	0.50
Advanced Mechanics of Structures	AER501H1 F	3	-	1	0.50	Complementary Studies Elective					0.50
Complementary Studies Elective					0.50	and three of:					
and two of:						Thesis	ESC499H1 S	3	2	-	0.50
Thesis	ESC499H1 F	3	2	-	0.50	Thesis	ESC499Y1 Y	3	2	-	1.00
Thesis	ESC499Y1 Y	3	2	-	1.00	Aeroelasticity	AER503H1 S	3	-	1	0.50
Spacecraft Dynamics and Control	AER506H1 F	3	-	1	0.50	Aerospace Propulsion	AER510H1 S	3	-	1	0.50
Introduction to Fusion Energy	AER507H1 F	3	-	1	0.50	Electronic Circuits	ECE354H1 S	3	1.50	0.50	0.50
Robotics	AER525H1 F	3	1.50	1	0.50	Electromagnetic Fields	ECE357H1 S	3	1.50	1	0.50
Electronics	ECE360H1 F	3	1.50	1	0.50	Heat and Mass Transfer	MIE313H1 S	3	1.50	2	0.50
Systems Control	ECE557H1 F	3	1.50	1	0.50	Materials Design and Engineering	MSE350H1 S	3	1.50	1	0.50
Quantum Mechanics I (formerly PHY355H1)	PHY356H1 F	2	-	1	0.50	Other Technical Elective					0.50
Advanced Atmospheric Physics (formerly PHY498H1)	PHY492H1 F	2	-	-	0.50						
Applied Nonlinear Equations	APM446H1 F	-	-	-	0.50						

1. Students must take a half-year thesis in term 4F or 4S, or take a full-year thesis.
2. Students must take at least two of AER503, AER506 or AER510.
3. For your Complementary Studies Electives, you require 1.0 Humanities and Social Sciences credits in order to graduate.

OPTION BIOMEDICAL (AEESCBASEB)

YEAR 3 BIOMEDICAL

Fall Session - Year 3		Lect.	Lab.	Tut.	Wgt.	Winter Session - Year 3		Lect.	Lab.	Tut.	Wgt.
Organic Chemistry and Biochemistry	CHE391H1 F	3	1	1	0.50	Physiological Control Systems	BME350H1 S	3	0.25	1	0.50
Economic Analysis and Decision Making	CHE374H1 F	3	-	1	0.50	Cellular Molecular Bioengineering I	BME395H1 S	3	-	2	0.50
Engineering Science Option Seminar	ESC301Y1 Y	-	-	0.50	0.10	Biomedical Engineering Instrumentation and Technology	BME340H1 S	2	4	-	0.50
and one of:						Complementary Studies Elective					0.50
Biotransport Phenomena	CHE393H1 F	3	1	1	0.50	Engineering Science Option Seminar	ESC301Y1 Y	-	-	0.50	0.10
Electronics	ECE360H1 F	3	1.50	1	0.50	and one of:					
Partial Differential Equations	APM384H1 F	3	-	1	0.50	Chemical Reaction Engineering	CHE333H1 S	3	-	2	0.50
Complex Analysis	MAT389H1 F	3	-	1	0.50	Electronic Circuits	ECE354H1 S	3	1.50	0.50	0.50
and one of:						Linear Systems and Control	ECE356H1 S	3	1.50	1	0.50
Physical and Inorganic Chemistry	CHE390H1 F	3	-	1	0.50	Materials Design and Engineering	MSE350H1 S	3	1.50	1	0.50
Signal Analysis and Communication	ECE355H1 F	3	-	2	0.50	Other Technical Elective					0.50

1. All students must graduate with 1.0 credits in Humanities & Social Sciences. You have gained 0.5 credit from ESC203.

2. Other Technical Elective: Any Engineering or Arts & Science course relevant to the student's future career plans. Approval of the Option Chair and the Division of Engineering Science required.

YEAR 4 BIOMEDICAL

Fall Session - Year 4		Lect.	Lab.	Tut.	Wgt.	Winter Session - Year 4		Lect.	Lab.	Tut.	Wgt.
Thesis	ESC499Y1 Y	3	2	-	1.00	Thesis	ESC499Y1 Y	3	2	-	1.00
Complementary Studies Elective					0.50	and four of:					
and three of:						Regenerative Medicine	BME510H1 S	4	-	-	0.50
Biochemistry I: Proteins, Lipids and Metabolism	BCH210H1 F	3	-	2	0.50	Medical Imaging	BME595H1 S	2	1.50	1	0.50
Cellular Molecular Bioengineering II	BME496H1 F	3	3	1	0.50	Data-based Modelling for Prediction and Control	CHE507H1 S	3	-	1	0.50
Bioprocess Engineering	CHE466H1 F	3	0.66	1	0.50	Chemical Properties of Polymers	CHE562H1 S	2	-	1	0.50
Mechanical Properties of Bio-Composites and Biomaterials	CHE575H1 F	3	-	1	0.50	Communication Systems	ECE316H1 S	3	1.50	1	0.50
Communication Systems	ECE316H1 F	3	1.50	1	0.50	Fundamentals of Optics	ECE318H1 S	3	1.50	1	0.50
Sensory Communication	ECE446H1 F	3	1.50	-	0.50	Real-Time Computer Control	ECE411H1 S	3	1.50	-	0.50
Neural Bioelectricity	ECE445H1 F	3	1.50	1	0.50	Digital Signal Processing	ECE362H1 S	3	1.50	1	0.50
Engineering Science Capstone Design	ESC471H1 F	-	-	5	0.50	Biomaterials and Biocompatibility	MSE452H1 S	3	-	1	0.50
Biomechanics I	MIE439H1 F	3	2	-	0.50	General and Human Genetics	HMB265H1 S	2	-	1	0.50
Systems Control	ECE557H1 F	3	1.50	1	0.50	Introduction to Pharmacology and Pharmacokinetic Principles	PCL201H1 S	3	-	0.50	0.50
Biocomputation	ECE448H1 F	3	-	2	0.50	Healthcare Systems	MIE561H1 S	3	-	2	0.50
Human Physiology I	PSL300H1 F	3	-	1	0.50	Surgical and Dental Implant Design	MSE442H1 S	3	-	1	0.50
						Introduction to Neuroscience	HMB200H1 S	2	-	1	0.50
						Other Technical Elective					0.50

Curriculum & Programs

1. For your Complementary Studies Electives, you require 1.0 Humanities and Social Sciences credits in order to graduate.
2. Prerequisite course for Cellular & Molecular Bioengineering II is successful completion of Cellular & Molecular Bioengineering I.
3. Other Technical Elective: Approval of the Option Chair and the Division of Engineering Science required. A BME course is recommended; see list of BME graduate courses.
4. Students must take at least two of the courses BME496, MSE452, MIE439, BME595 and at least one, but no more than two of BCH210, PSL300, HMB265, PCL201 and HMB200H1.
5. HMB200H1 is limited enrolment and is first offered to human biology students. Students interested in this course should contact the Division of Engineering Science in August.
6. Students must take at least one of MIE439 or ESC471.

OPTION COMPUTER (AEESCBASEC)

Please note that the Computer Option is being phased out starting in 2009-2010. The Computer Option has been replaced with the Electrical and Computer Option (AEESCBASER). For more information contact the Division of Engineering Science.

YEAR 4 COMPUTER

Year 4		Lect.	Lab.	Tut.	Wgt.
Thesis	ESC499Y1 Y 3	3	2	-	1.00
Two (2) Complementary Studies Electives					1.00
Three (3) ECE Electives					1.50
Two (2) Technical Electives					1.00
and one of:					
Energy Systems Capstone Design	ESC470H1 S	-	-	5	0.50
Engineering Science Capstone Design	ESC471H1 F/S	-	-	5	0.50
Digital Systems Design	ECE532H1 S	2	3	-	0.50

1. While a full-year thesis is recommended, students may substitute with a half-year thesis and an ECE or Technical elective.
2. For a list of ECE and Technical electives, please see the Electrical and Computer Option.
3. For your Complementary Studies Electives, you require 1.0 Humanities and Social Sciences credits in order to graduate.

OPTION ELECTRICAL (AEESCBASEE)

Please note that the Electrical Option is being phased out starting in 2009-2010. The Electrical Option has been replaced with the Electrical and Computer Option (AEESCBASER). For more information contact the Division of Engineering Science.

Year 4 Electrical

Year 4		Lect.	Lab.	Tut.	Wgt.
Thesis	ESC499Y1 Y 3	3	2	-	1.00
Two (2) Complementary Studies Electives					1.00
Three (3) ECE Electives					1.50
Two (2) Technical Electives					1.00
and one of:					
Energy Systems Capstone Design	ESC470H1 S	-	-	5	0.50
Engineering Science Capstone Design	ESC471H1 F/S	-	-	5	0.50
Digital Systems Design	ECE532H1 S	2	3	-	0.50

1. While a full-year thesis is recommended, students may substitute with a half-year thesis and an ECE or Technical elective.
2. For a list of ECE and Technical electives, please see the Electrical and Computer Option.
3. For your Complementary Studies Electives, you require 1.0 Humanities and Social Sciences credits in order to graduate.

OPTION ELECTRICAL AND COMPUTER (AEESCBASER)

YEAR 3 ELECTRICAL AND COMPUTER

Fall Session-Year 3						Winter Session-Year 3					
		Lect.	Lab.	Tut.	Wgt.			Lect.	Lab.	Tut.	Wgt.
Economic Analysis and Decision Making	CHE374H1 F	3	-	1	0.50	Systems Software	ECE353H1 S	3	3	-	0.50
Introduction to Energy Systems	ECE349H1 F	3	1.50	1	0.50	Linear Systems and Control	ECE356H1 S	3	1.50	1	0.50
Computer Organization	ECE352H1 F	3	3	-	0.50	Electromagnetic Fields	ECE357H1 S	3	1.50	1	0.50
Signal Analysis and Communication	ECE355H1 F	3	-	2	0.50	Digital Signal Processing	ECE362H1 S	3	1.50	1	0.50
Electronics	ECE360H1 F	3	1.50	1	0.50	Engineering Science Option Seminar	ESC301Y1 Y	-	-	0.50	0.10
Engineering Science Option Seminar	ESC301Y1 Y	-	-	0.50	0.10	One ECE elective					0.50
Complex Analysis	MAT389H1 F	3	-	1	0.50						

1. You must take ECE362 in order to graduate. If you take this course in 4th year, you must ensure that you enrol in another ECE elective in Year 3.

2. CHE374H1: Students may also take this course in 4F but are recommended to take in 3F.

YEAR 4 ELECTRICAL AND COMPUTER

Year 4					
		Lect.	Lab.	Tut.	Wgt.
Thesis	ESC499Y1 Y	3	2	-	1.00
Two (2) Complementary Studies Electives					1.00
Three (3) ECE Electives					1.50
Two (2) Technical Electives					1.00
and one of:					
Digital Systems Design	ECE532H1 S	2	3	-	0.50
Energy Systems Capstone Design	ESC470H1 S	-	-	5	0.50
Engineering Science Capstone Design	ESC471H1 F/S	-	-	5	0.50

1. While a full-year thesis is recommended, students may substitute with a half-year thesis and an ECE or Technical elective.

2. ECE electives or Technical electives can be taken in third or fourth year provided that course pre-requisites have been met. For more information, please contact the Division of Engineering Science.

3. For your Complementary Studies Electives, you require 1.0 Humanities and Social Sciences credits in order to graduate.

Curriculum & Programs

ECE Electives for AEESCBASER, AEESCBASEC, AEESCBASEE

ECE Electives for AEESCBASER, AEESCBASEC, AEESCBASEE					ECE Electives for AEESCBASER, AEESCBASEC, AEESCBASEE						
		Lect.	Lab.	Tut.	Wgt.		Lect.	Lab.	Tut.	Wgt.	
Photonics and Semiconductor Physics						Control, Communications, Signal Processing continued					
Fundamentals of Optics	ECE318H1 S	3	1.50	1	0.50	Medical Imaging	BME595H1 S	2	1.50	1	0.50
Physical Electronics	ECE350H1 S	3	1.50	1	0.50	Communication Systems	ECE316H1 F/S	3	1.50	1	0.50
Introduction to Micro- and Nano-Fabrication Technologies	ECE442H1 F	3	2	1	0.50	Digital Signal Processing	ECE362H1 S	3	1.50	1	0.50
Optical Communications and Networks	ECE469H1 S	3	1.50	1	0.50	Real-Time Computer Control	ECE411H1 S	3	1.50	-	0.50
Lasers and Detectors	ECE525H1 S	3	-	1	0.50	Digital Communication	ECE417H1 S	3	1.50	1	0.50
Passive Photonic Devices	ECE527H1 F	2	-	1	0.50	Neural Bioelectricity	ECE445H1 F	3	1.50	1	0.50
Quantum Mechanics I (formerly PHY355H1)	PHY356H1 F	2	-	1	0.50	Sensory Communication	ECE446H1 F	3	1.50	-	0.50
Condensed Matter Physics	PHY487H1 F	2	-	-	0.50	Multimedia Systems	ECE462H1 S	3	2	-	0.50
Quantum Mechanics II (formerly PHY457H1)	PHY456H1 F	3	-	-	0.50	Wireless Communication	ECE464H1 S	3	1.50	1	0.50
Electromagnetics and Energy Systems						Robot Modeling and Control					
Energy Systems and Distributed Generation	ECE413H1 S	3	1.50	1	0.50	Intelligent Image Processing	ECE516H1 S	2	3	-	0.50
Radio and Microwave Wireless Systems	ECE422H1 S	3	1.50	1	0.50	Systems Control	ECE557H1 F	3	1.50	1	0.50
Electric Drives	ECE463H1 S	3	1.50	1	0.50	Computer Hardware & Computer Networks					
Introduction to Lighting Systems	ECE510H1 F	2	-	1	0.50	Computer Organization	ECE352H1 F	3	3	-	0.50
Microwave Circuits	ECE524H1 F	2	1.50	1	0.50	Computer Networks I	ECE361H1 F/S	3	1.50	0.50	0.50
Advanced Power Electronics	ECE533H1 F	3	-	1	0.50	Computer Architecture	ECE452H1 F	3	-	1	0.50
Analog and Digital Electronics						Internetworking					
Digital Electronics	ECE334H1 F/S	3	1.50	1	0.50	Computer Networks II	ECE466H1 S	3	1.50	1	0.50
Physical Electronics	ECE350H1 S	3	1.50	1	0.50	Digital Systems Design	ECE532H1 S	2	3	-	0.50
Electronic Circuits	ECE354H1 S	3	1.50	0.50	0.50						
VLSI Systems and Design	ECE451H1 S	3	3	-	0.50						
Analog Signal Processing Circuits	ECE512H1 F	3	-	2	0.50						
Analog Integrated Circuits	ECE530H1 S	2	1.50	1	0.50						
Integrated Circuit Engineering	ECE534H1 F	2	3	-	0.50						
Advanced Electronic Devices	ECE535H1 F	2	-	-	0.50						

ECE Electives for AEESCBASER, AEESCBASEC, AEESCBASEE (continued)

ECE Electives for AEESCBASER, AEESCBASEC, AEESCBASEE		Lect.	Lab.	Tut.	Wgt.	ECE Electives for AEESCBASER, AEESCBASEC, AEESCBASEE		Lect.	Lab.	Tut.	Wgt.
Software						Software (continued)					
Programming Languages	CSC326H1 F	2	-	1	0.50	Programming on the Web	CSC309H1 F/S	2	-	1	0.50
Introduction to Databases	CSC343H1 F/S	2	-	1	0.50	The Design of Interactive Computational Media	CSC318H1 F/S	2	-	1	0.50
Computer Graphics	CSC418H1 F/S	2	-	1	0.50	Introduction to Artificial Intelligence	CSC384H1 F/S	2	-	1	0.50
Software Engineering I	CSC444H1 F	2	-	1	0.50	Natural Language Computing	CSC401H1 S	2	-	1	0.50
Compilers and Interpreters	CSC467H1 F	2	-	1	0.50	Machine Learning and Data Mining	CSC411H1 F	2	-	1	0.50
Computer Systems Modelling and Analysis	CSC470H1 F	3	2	-	0.50	Human-Computer Interaction	CSC428H1 F/S	2	-	1	0.50
Distributed Systems	ECE419H1 S	3	1.50	-	0.50	Database System Technology	CSC443H1 F/S	2	-	1	0.50
Software Engineering II	ECE450H1 S	3	1.50	1	0.50	Foundations of Computer Vision	CSC487H1 F	2	-	1	0.50
Computer Systems Programming	ECE454H1 F	3	3	-	0.50	Systems Software	ECE353H1 S	3	3	-	0.50
Internetworking	ECE461H1 F	3	1.50	0.50	0.50	Foundations of Computing	ECE358H1 S	3	-	1	0.50
Computer Security	ECE568H1 S	3	3	-	0.50	Optimizing Compilers	ECE540H1 S	2	3	-	0.50

Technical Electives for AEESCBASER, AEESCBASEC, AEESCBASEE

Technical Electives for AEESCBASER, AEESCBASEC, AEESCBASEE		Lect.	Lab.	Tut.	Wgt.
ECE Electives, or any of the following:					
Scientific Computing	AER336H1 S	3	-	1	0.50
Introduction to Fusion Energy	AER507H1 F	3	-	1	0.50
Robotics	AER525H1 F	3	1.50	1	0.50
Partial Differential Equations	APM384H1 F	3	-	1	0.50
Groups and Symmetries	MAT301H1 F	3	-	-	0.50
Structure and Characterization of Nanostructured Materials	MSE358H1 S	3	1.50	1	0.50
Physics of the Earth (formerly PHY359H1)	PHY395H1 S	2	-	-	0.50

Curriculum & Programs

OPTION ENERGY SYSTEMS (AEESCBASEJ)

YEAR 3 ENERGY SYSTEMS

Fall Session - Year 3					Winter Session - Year 3						
		Lect.	Lab.	Tut.	Wgt.		Lect.	Lab.	Tut.	Wgt.	
Chemical Processes for Energy Generation and Storage	CHE308H1 F	3	-	1	0.50	Control Systems	AER372H1 S	3	1.50	1	0.50
Economic Analysis and Decision Making	CHE374H1 F	3	-	1	0.50	Energy Policy	APS305H1 S	3	-	1	0.50
Terrestrial Energy Systems	ENV346H1 F	3	-	2	0.50	Design of Hydro and Wind Electric Plants	CIV301H1 S	3	-	2	0.50
Energy Conversion	ECE359H1 F	3	1.50	1	0.50	Energy Systems and Distributed Generation	ECE413H1 S	3	1.50	1	0.50
Mechanical and Thermal Energy Conversion Processes	MIE303H1 F	3	1.50	1	0.50	Electric Drives	ECE463H1 S	3	1.50	1	0.50
Engineering Science Option Seminar	ESC301Y1 Y	-	-	0.50	0.10	Engineering Science Option Seminar	ESC301Y1 Y	-	-	0.50	0.10

YEAR 4 ENERGY SYSTEMS

Fall Session - Year 4					Winter Session - Year 4						
		Lect.	Lab.	Tut.	Wgt.		Lect.	Lab.	Tut.	Wgt.	
Thesis	ESC499Y1 Y	3	2	-	1.00	Thesis	ESC499Y1 Y	3	2	-	1.00
Introduction to Lighting Systems	ECE510H1 F	2	-	1	0.50	Energy Systems Capstone Design	ESC470H1 S	-	-	5	0.50
Free Elective					0.50	Complementary Studies Elective					0.50
and two of:						and two of:					
Introduction to Fusion Energy	AER507H1 F	3	-	1	0.50	Advanced Reactor Design	CHE412H1 S	3	-	1	0.50
Modelling in Chemical Engineering	CHE471H1 F	3	-	1	0.50	Fuel Cells and Electrochemical Conversion Devices	CHE469H1 S	3	-	1	0.50
Electrochemistry	CHE553H1 F	3	-	1	0.50	Nuclear Engineering	CHE568H1 S	3	-	1	0.50
Aqueous Process Engineering	CHE565H1 F	3	-	1	0.50	Environmental Impact and Risk Assessment	CIV440H1 S	3	-	1	0.50
Petroleum Processing	CHE451H1 F	3	-	1	0.50	Bioenergy from Sustainable Forest Management	FOR310H1 S	2	-	1	0.50
Building Science	CIV575H1 F	3	1	2	0.50	Bioenergy and Biorefinery Technology	FOR410H1 S	2	-	2	0.50
Fundamentals of Geomatics Engineering I	CIV427H1 F	3	-	1	0.50	Design for the Environment	MIE315H1 S	3	-	1	0.50
Advanced Power Electronics	ECE533H1 F	3	-	1	0.50	Nuclear Engineering II: Thermal and Mechanical Design of Nuclear Power Reactors	MIE408H1 S	3	-	2	0.50
Passive Photonic Devices	ECE527H1 F	2	-	1	0.50	Fuel Cell Systems	MIE517H1 S	3	-	-	0.50
Nuclear Engineering I: Reactor Physics and the Nuclear Fuel Cycle	MIE407H1 F	3	-	2	0.50	Nanotechnology in Alternate Energy Systems	MSE558H1 S	3	0.50	1	0.50
Machine Design	MIE442H1 F	3	1.50	3	0.50	Physics of the Earth (formerly PHY359H1)	PHY395H1 S	2	-	-	0.50
Alternative Energy Systems	MIE515H1 F	3	-	1	0.50						
Combustion and Fuels	MIE516H1 F	3	-	-	0.50						

1. For your Complementary Studies Electives, you require 1.0 Humanities and Social Sciences credits in order to graduate. Year 3 and Year 4 Energy major students, who have successfully completed, APS305H1 in Year 3, a core course within the Energy curriculum, will use this course as one of their CS courses towards fulfilling the CS graduation requirement.

OPTION INFRASTRUCTURE ENGINEERING (AEESCBASEI)

YEAR 3 INFRASTRUCTURE ENGINEERING

Fall Session - Year 3					Winter Session - Year 3						
		Lect.	Lab.	Tut.	Wgt.		Lect.	Lab.	Tut.	Wgt.	
Economic Analysis and Decision Making	CHE374H1 F	3	-	1	0.50	Mechanics of Solids and Structures	AER373H1 S	3	-	1	0.50
Structural Design 1	CIV352H1 F	3	-	2	0.50	Structural Design 2	CIV357H1 S	3	-	2	0.50
Urban Operations Research	CIV355H1 F	3	-	2	0.50	Intelligent Transportation Systems	CIV359H1 S	3	-	1	0.50
Transport Planning	CIV531H1 F	3	-	1	0.50	Public Transit Operations and Planning	CIV516H1 S	3	-	1	0.50
Geotechnical Engineering I	CME321H1 F	3	1.50	1	0.50	Engineering Science Option Seminar	ESC301Y1 Y	-	-	0.50	0.10
Engineering Science Option Seminar	ESC301Y1 Y	-	-	0.50	0.10	Complementary Studies Elective					0.50

- All students must graduate with 1.0 credits in Humanities & Social Sciences. You have gained 0.5 credit from ESC203.
- The Engineering Science Option Seminar is a full year course with a total weight of 0.1.

YEAR 4 INFRASTRUCTURE ENGINEERING

Fall Session - Year 4					Winter Session - Year 4						
		Lect.	Lab.	Tut.	Wgt.		Lect.	Lab.	Tut.	Wgt.	
Engineering Project Finance and Management	CIV460H1 F	3	-	1	0.50	Collaborative Design Project	CIV456H1 S	1	3	-	0.50
Thesis	ESC499H1 F	3	2	-	0.50	Specialty Elective 3					0.50
Specialty Elective 1 (see list below)					0.50	Specialty Elective 4					0.50
Specialty Elective 2 (see list below)					0.50	Specialty Elective 5					0.50
Technical Elective					0.50	Complementary Studies Elective					0.50

Transportation Specialty Take any two from the following:

Alternative Energy Systems	MIE515H1 F	3	-	1	0.50
Technology in Society and the Biosphere I	APS301H1 F	3	-	1	0.50
Management of Construction	CIV280H1 F	3	-	2	0.50

Structures Specialty Take any two from the following:

Reinforced Concrete II	CIV416H1 F	3	-	2	0.50
Concrete Technology	CIV514H1 F	3	-	2	0.50
Prestressed Concrete	CIV517H1 F	3	-	-	0.50
Building Science	CIV575H1 F	3	1	2	0.50
Mechanics of Reinforced Concrete	CIV1163H F	3	-	-	0.50

Transportation Specialty Take any three from the following:

Sustainable Energy Systems	CIV380H1 S	3	-	1	0.50
Infrastructure for Sustainable Cities	CIV577H1 S	3	-	1	0.50
Airport Planning	CIV1508H S	2	-	-	0.50
Simulation	CIV1337H S	2	-	-	0.50
Freight Transportation and ITS Applications	CIV1506H S	2	-	-	0.50
Infrastructure Economics	CIV1310H S	2	-	-	0.50
Transportation and Development	CIV1535H S	2	-	-	0.50
Transportation Demand Analysis	CIV1538H S	2	-	-	0.50

Structures Specialty Take any three from the following:

Solid Mechanics II	CIV510H1 S	3	-	2	0.50
Behaviour and Design of Steel Structures	CIV518H1 S	3	-	2	0.50
Urban Excavations	CIV523H1 S	3	-	1	0.50
Rock Engineering	CIV529H1 S	3	-	1	0.50
Sustainable Buildings	CIV576H1 S	3	-	1	0.50
Bridge Engineering	CIV1164H S	2	-	-	0.50
Structural Dynamics	CIV1171H S	3	-	-	0.50
Finite Element Methods in Structural Mechanics	CIV1174H S	3	-	-	0.50

- Students who do not wish to declare a specialty may take courses from either the Transportation or Structures List.
- Students may substitute a specialty elective in order to take a full year thesis.
- For your Complementary Studies Electives, you require 1.0 Humanities and Social Sciences credits in order to graduate.
- The technical

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elective may be freely chosen from any 400, 500, or 1000 level course offered in Engineering provided students have taken the pre-requisite course. Other courses may be taken with prior approval.

5. Consult the Department of Civil Engineering website for a description of 1000 level CIV courses.

OPTION MANUFACTURING SYSTEMS (AEESCBASEM)

The last entry into the Manufacturing System option was in the 2008-2009 academic year. This option is not available for entry. Please speak to the Division of Engineering Science for more information.

YEAR 4 MANUFACTURING SYSTEMS

Fall Session - Year 4				Winter Session - Year 4							
		Lect.	Lab.	Tut.	Wgt.		Lect.	Lab.	Tut.	Wgt.	
Thesis	ESC499Y1 Y	3	2	-	1.00	Thesis	ESC499Y1 Y	3	2	-	1.00
Complementary Studies Elective					0.50	Complementary Studies Elective					0.50
and three of:						and three of:					
Robotics	AER525H1 F	3	1.50	1	0.50	Automated Manufacturing	MIE422H1 S	2	3	-	0.50
Signal Analysis and Communication	ECE355H1 F	3	-	2	0.50	Computer Aided Design I	MIE341H1 S	3	3	1	0.50
Advanced Power Electronics	ECE533H1 F	3	-	1	0.50	Design for the Environment	MIE315H1 S	3	-	1	0.50
Systems Modelling and Simulation	MIE360H1 F	3	-	2	0.50	Product Design	MIE540H1 S	2	-	1	0.50
Mechanical Design: Theory and Methodology	MIE440H1 F	2	2	1	0.50	Healthcare Systems	MIE561H1 S	3	-	2	0.50
Engineering Psychology and Human Performance	MIE448H1 F	3	3	-	0.50	Introduction to Polymer Engineering	MSE330H1 S	3	-	1	0.50
Alternative Energy Systems	MIE515H1 F	3	-	1	0.50	Materials Design and Engineering	MSE350H1 S	3	1.50	1	0.50
Decision Analysis	MIE566H1 F	3	-	2	0.50	Design Optimization	MIE441H1 S	2	2	-	0.50
Materials Selection in Design II	MSE401H1 F	2	-	3	0.50	Facility Planning	MIE468H1 S	3	1	1	0.50
Scheduling	MIE562H1 F	3	-	2	0.50	Organization Design	MIE459H1 S	4	-	-	0.50
Decision Support Systems	MIE451H1 F	3	1	1	0.50	Knowledge Modelling and Management	MIE457H1 S	3	1	1	0.50
Other Technical Elective					0.50	Plant Design for Materials Industries	MSE450H1 S	2	-	3	0.50
						Other Technical Elective					0.50

1. For your Complementary Studies Electives, you require 1.0 Humanities and Social Sciences credits in order to graduate.
2. ESC 499Y1 - While a full-year thesis is recommended, students may substitute with a half-year thesis and a technical elective.
3. MSE 330 & MSE 350 - Students may choose either MSE 330 or MSE 350 but may not repeat the course they selected in their third year.
4. Other Technical Elective (F/S) - Approval of the Option Chair and the Division of Engineering Science required.
5. Students may take only one of AER525 or MIE422.

OPTION ENGINEERING MATHEMATICS, STATISTICS & FINANCE (AEESCBASEF)

Year 3 ENGINEERING MATHEMATICS, STATISTICS & FINANCE

Fall Session - Year 3				Winter Session - Year 3							
		Lect.	Lab.	Tut.	Wgt.		Lect.	Lab.	Tut.	Wgt.	
Economic Analysis and Decision Making	CHE374H1 F	3	-	1	0.50	Engineering Finance and Economics	CHE375H1 S	3	-	1	0.50
Probability	STA347H1 F	3	-	-	0.50	Financial Principles for Actuarial Science II	ACT370H1 S	3	-	-	0.50
Financial Engineering	MIE375H1 F	3	-	1	0.50	Mathematical Programming (Optimization)	MIE376H1 S	3	2	1	0.50
Partial Differential Equations	APM384H1 F	3	-	1	0.50	Financial Optimization Models	MIE377H1 S	3	1	1	0.50
Engineering Science Option Seminar	ESC301Y1 Y	-	-	0.50	0.10	Introduction to Real Analysis	MAT337H1 S	3	-	-	0.50
Methods of Data Analysis I	STA302H1 F	3	-	-	0.50						

OPTION NANOENGINEERING (AEESCBASEO)

YEAR 3 NANOENGINEERING

Fall Session - Year 3						Winter Session - Year 3					
		Lect.	Lab.	Tut.	Wgt.		Lect.	Lab.	Tut.	Wgt.	
Economic Analysis and Decision Making	CHE374H1 F	3	-	1	0.50	Introduction to Inorganic and Polymer Materials Chemistry	CHM325H1 S	2	-	-	0.50
Physical and Inorganic Chemistry	CHE390H1 F	3	-	1	0.50	Physical Electronics	ECE350H1 S	3	1.50	1	0.50
Organic Chemistry and Biochemistry	CHE391H1 F	3	1	1	0.50	Structure and Characterization of Nanostructured Materials	MSE358H1 S	3	1.50	1	0.50
Quantum Mechanics I (formerly PHY355H1)	PHY356H1 F	2	-	1	0.50	Advanced Physics Laboratory	PHY327H1 S	-	6	-	0.50
Engineering Science Option Seminar	ESC301Y1 Y	-	-	-	0.50	Atoms, Molecules and Solids	PHY358H1 S	2	-	1	0.50
and one of:						Engineering Science Option Seminar					
Complex Analysis	MAT389H1 F	3	-	1	0.50						
Partial Differential Equations	APM384H1 F	3	-	1	0.50						

YEAR 4 NANOENGINEERING

Fall Session - Year 4						Winter Session - Year 4					
		Lect.	Lab.	Tut.	Wgt.		Lect.	Lab.	Tut.	Wgt.	
Thesis	ESC499Y1 Y	3	2	-	1.00	Thesis	ESC499Y1 Y	3	2	-	1.00
Synthesis of Nanostructured Materials	MSE459H1 F	3	2	-	0.50	Complementary Studies Elective					0.50
Engineering Science Capstone Design	ESC471H1 F	-	-	5	0.50	Materials Physics II	MSE462H1 S	2	-	1	0.50
Complementary Studies Elective					0.50	and two of:					
and one of:						Advanced Physical Properties of Structural Nanomaterials	MSE550H1 S	3	2	1	0.50
Advanced Materials Chemistry	CHM434H1 F	2	-	-	0.50	Cellular Molecular Bioengineering I	BME395H1 S	3	-	2	0.50
Neural Bioelectricity	ECE445H1 F	3	1.50	1	0.50	Polymer Chemistry	CHM426H1 S	2	-	-	0.50
Complex Analysis	MAT389H1 F	3	-	1	0.50	Fundamentals of Optics	ECE318H1 S	3	1.50	1	0.50
Micro Electro Mechanical Systems (MEMS) and Nano Electro-Opto Mechanical Systems (NEOMS)	MSE457H1 F	3	1.50	1	0.50	Linear Systems and Control	ECE356H1 S	3	1.50	1	0.50
Advanced Physics Laboratory	PHY427H1 F	-	6	-	0.50	Lasers and Detectors	ECE525H1 S	3	-	1	0.50
Lasers and Modern Optics	PHY485H1 F	2	-	-	0.50	Biomaterials and Biocompatibility	MSE452H1 S	3	-	1	0.50
Condensed Matter Physics	PHY487H1 F	2	-	-	0.50	Nanotechnology in Alternate Energy Systems	MSE558H1 S	3	0.50	1	0.50
Organic Materials Chemistry	CHM446H1 F	2	-	-	0.50	Advanced Physics Laboratory	PHY427H1 S	-	6	-	0.50
Introduction to Micro- and Nano-Fabrication Technologies	ECE442H1 F	3	2	1	0.50	Basic Statistical Mechanics (formerly PHY480H1)	PHY452H1 S	2	-	-	0.50
Environmental Engineering	CHE467H1 F	3	-	1	0.50	Other Technical Elective					0.50
Alternative Energy Systems	MIE515H1 F	3	-	1	0.50						
Other Technical Elective					0.50						

1. Other Technical Elective - Approval of the Option Chair and the Division of Engineering Science required.
2. For your Complementary Studies Electives, you require 1.0 Humanities and Social Sciences credits in order to graduate.

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OPTION PHYSICS (AEESCBASEP)

It is highly recommended that students take one of ECE360, ECE318, ECE350 or MSE358 to reduce accreditation constraints in the fourth year.

YEAR 3 PHYSICS

YEAR 3		Lect.	Lab.	Tut.	Wgt.	Group A electives	Lect.	Lab.	Tut.	Wgt.	
Advanced Physics Laboratory	PHY327H1 F	-	6	-	0.50	Electronics	ECE360H1 F	3	1.50	1	0.50
Quantum Mechanics I (formerly PHY355H1)	PHY356H1 F	2	-	1	0.50	Partial Differential Equations	APM384H1 F	3	-	1	0.50
Electromagnetic Fields	ECE357H1 S	3	1.50	1	0.50	Fundamentals of Optics	ECE318H1 S	3	1.50	1	0.50
Economic Analysis and Decision Making	CHE374H1 F	3	-	1	0.50	Physical Electronics	ECE350H1 S	3	1.50	1	0.50
Engineering Science Option Seminar	ESC301Y1 Y	-	-	0.50	0.10	Groups and Symmetries	MAT301H1 F	3	-	-	0.50
Classical Mechanics	PHY354H1 S	2	-	-	0.50	Introduction to Real Analysis	MAT337H1 S	3	-	-	0.50
Two (2) courses from the Group A electives list					1.00	Complex Analysis	MAT389H1 F	3	-	1	0.50
At least one of:						Structure and Characterization of Nanostructured Materials	MSE358H1 S	3	1.50	1	0.50
Partial Differential Equations	APM384H1 F	3	-	1	0.50	Physics of Climate	PHY392H1 S	2	-	-	0.50
Complex Analysis	MAT389H1 F	3	-	1	0.50	Physics of the Earth (formerly PHY359H1)	PHY395H1 S	2	-	-	0.50
At least one of:						Times Series Analysis	PHY408H1 S	1	2	-	0.50
Electronics	ECE360H1 F	3	1.50	1	0.50	Advanced Physics Laboratory	PHY427H1 F/S	-	6	-	0.50
Times Series Analysis	PHY408H1 S	1	2	-	0.50						

1. Balance of courses from Group A to a total of 5.6 credits in Year 3 including ESC301Y1. Students may not take more than 3.0 credits in either the fall or winter semester.
2. Students may take APM346H in place of APM384H.
3. Students may take MAT334H in place of MAT389H.
4. Students must take PHY427H in 3S, 4F, or 4S.

YEAR 4 PHYSICS

YEAR 4		Lect.	Lab.	Tut.	Wgt.	YEAR 4	Lect.	Lab.	Tut.	Wgt.
Thesis	ESC499Y1 Y	3	2	-	1.00	Three (3) electives from Group B				1.50
Engineering Science Capstone Design	ESC471H1 F	-	-	5	0.50	Two (2) electives from Groups A, B or C				1.00
Two (2) Complementary Studies electives					1.00					

Group B and C Electives

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Group B						Group C					
		Lect.	Lab.	Tut.	Wgt.		Lect.	Lab.	Tut.	Wgt.	
Computational Physics	PHY407H1	F 1	3	-	0.50	Advanced Practical Physics	PHY428H1	F -	6	-	0.50
Quantum Mechanics II (formerly PHY457H1)	PHY456H1	F 3	-	-	0.50	II					
Macroscopic Physics	PHY459H1	2	-	-	0.50	Advanced Practical Physics	PHY429H1	-	6	-	0.50
	S					III	S				
Nonlinear Physics	PHY460H1	3	-	-	0.50	Relativity Theory II	PHY484H1	2	-	-	0.50
	S						S				
Basic Statistical Mechanics (formerly PHY480H1)	PHY452H1	2	-	-	0.50	Computer Hardware	ECE342H1	3	3	-	0.50
	S						S				
Relativity Theory I	PHY483H1	F 2	-	-	0.50	Digital Signal Processing	ECE362H1	3	1.50	1	0.50
Lasers and Modern Optics	PHY485H1	F 2	-	-	0.50		S				
Condensed Matter Physics	PHY487H1	F 2	-	-	0.50	Lasers and Detectors	ECE525H1	3	-	1	0.50
Introduction to High Energy Physics	PHY489H1	2	-	-	0.50		S				
Geophysical Imaging I	PHY493H1	F 2	-	-	0.50	Classical Geometries	MAT402H1	3	-	-	0.50
Geophysical Imaging II	PHY494H1	2	-	-	0.50		S				
	S					Nuclear Engineering	CHE568H1	3	-	1	0.50
Experimental Global Geophysics	PHY495H1	F 2	-	-	0.50		S				
Experimental Applied Geophysics	PHY496H1	F -	3	-	0.50	Introduction to Fusion Energy	AER507H1	F 3	-	1	0.50
Advanced Atmospheric Physics (formerly PHY498H1)	PHY492H1	2	-	-	0.50		S				
	S										
Polynomial Equations and Fields	MAT401H1	3	-	-	0.50						
	S										