



MEMORANDUM

To: Executive Committee of Faculty Council (February 5, 2024)
Faculty Council (February 27, 2024)

From: Professor Dionne Aleman
Associate Dean, Cross-Disciplinary Programs

Date: January 23, 2024

Re: Creation of a Certificate in Electric Vehicle Design

REPORT CLASSIFICATION

This is a major policy matter that will be considered by the Executive Committee for endorsement and forwarding to Faculty Council for vote as a regular motion (requiring a simple majority of members present and voting to carry).

BACKGROUND

In recent years, electric vehicles (EVs) have become viable and popular alternatives to traditional internal combustion engines for passenger vehicles, and even for commercial applications and other motorized equipment. Engineering as a discipline is well-positioned to advance EV technology.

Mechanical, industrial, electrical, computer, chemical, and materials science engineering principles are all relevant to future development of EV technology. Creating sustainable and thriving global communities through technologies that meet the climate crisis head-on, such as new ways of reducing demand for oil and gas, relates to the academic priorities of the Faculty of Applied Science & Engineering.

PROPOSED

A certificate in EV design is proposed to provide students in the Core-8 engineering programs and Engineering Science with exposure to the numerous ways that engineering applies to EV design, batteries, manufacture, and logistics. The certificate provides an opportunity for students to learn about EVs within the context of engineering applications and expand their understanding of the technical and environmental implications of engineering in EV design.

CONSULTATION PROCESS

The proposal for a Certificate in Electric Vehicle Design was developed by the FASE Electric Vehicle working group with consultation from representatives from MIE, ECE, CHE, MSE, and

CIV/MIN. It has been reviewed by and/or received input from the Faculty's Cross Disciplinary Programs Office and members of the FASE Undergraduate Curriculum Committee.

The Undergraduate Curriculum Committee is composed of representatives from each program, the Vice-Dean, Undergraduate, the Vice-Dean, First Year Studies, the Associate Dean, Cross-Disciplinary Programs, and the Registrar. The Committee meets regularly, and reviews changes to the curriculum.

RECOMMENDATION FOR COUNCIL

THAT the Certificate in Electric Vehicle Design be approved, effective September 2024, as described in Report 3755 Revised.

University of Toronto

Proposal to Create a Certificate in Conjunction With an Undergraduate Program

For-credit undergraduate certificates (category 2) are offered in conjunction with an existing undergraduate degree program. They are governed by the [Policy for Certificates \(For-Credit and Not-For-Credit\)](#) and follow the protocols for approval and closure for [minor modifications](#) under the [University of Toronto Quality Assurance Process \(UTQAP\)](#).

Proposed certificate name:	Certificate in Electric Vehicle Design
Undergraduate degree(s) the certificate will be offered in conjunction with:	<i>Any Engineering Bachelor's Degree (BASc or BASc in Engineering Science)</i>
Faculty/academic division:	<i>Applied Science & Engineering (FASE)</i>
Unit:	<i>Cross-Disciplinary Programs Office, FASE</i>
Dean's Office contact:	<i>Dionne Aleman, Associate Dean, Cross Disciplinary Programs Caroline Ziegler, Faculty Governance and Programs Officer</i>
Version date:	<i>January 23, 2024</i>

1 Summary

In recent years, electric vehicles (EVs) have become viable and popular alternatives to traditional internal combustion engines for passenger vehicles, and even for commercial applications and other motorized equipment. Engineering as a discipline is well-positioned to advance EV technology. A Category 2 certificate in EV design is proposed to provide students in the Core-8 engineering programs and Engineering Science with exposure to the numerous ways that engineering applies to EV design, batteries, manufacture, and logistics. This program will provide students with an introduction to EV studies that might spark an interest to explore careers or graduate programs in the area of EV.

2 Effective Date

September 1, 2024

3 Academic Rationale

Mechanical, industrial, electrical, computer, chemical, and materials science engineering principles are all relevant to future development of EV technology. Creating sustainable and thriving global communities through technologies that meet the climate crisis head-on, such as new ways of reducing demand for oil and gas, relates to the academic priorities of the Faculty of Applied Science & Engineering. This certificate introduces EV design principles to engineering students to better prepare them for professional practice, and also to highlight an opportunity for future graduate studies. Many engineering courses already include aspects of EV design, as evidenced by the existing engineering electives within the proposed program. The certificate provides an opportunity for students to learn about EVs within the context of engineering applications and expand their understanding of the technical and environmental implications of engineering in EV design.

4 Need and Demand

Although the certificate will be open to any engineering discipline, we anticipate that it will likely appeal most to students in mechanical, electrical, chemical, materials science, and industrial engineering, as well as engineering science.

We anticipate an initial enrolment in the core course of about 75-100 students. Completion of the certificate will depend on availability of, and student interest in, the courses connected to the certificate.

The certificate is motivated by strong demand both from industry and students. Initial consultation in 2021 with Honda of Canada, as well as Oakville Ford, led to proposals for the lab spaces that form the backbone of the proposed “Introduction to EV Design” course. Further consultation directly guided the course contents around manufacturing and design.

Students have also provided direct feedback on the certificate, including the proposed APS380H1 course. In 2021 and 2022, MIE tracked and categorized questions about the ME and IE programs from potential incoming students. For both years, over 60% and 65% of the questions for 2021 and 2022 respectively related to EVs in some manner, mostly (1) do we offer formal courses in EVs, and (2) how do our programs lead to jobs in this sector. In 2022, a draft of a proposed minor in EVs (a subset of which was used to

build this certificate) was shown to undergraduate student focus groups, composed of third- and fourth-year students in the MIE program in relevant streams (Energy, Mechatronics, Solid Mechanics). Of the 40 participants, all but two ranked the minor as “would likely complete” or “would definitely complete”; it is reasonable to assume a similar favorable opinion exists about a certificate in the same topic. Groups shared direct feedback: “EV courses are a must-have”, “I went into MIE specifically to work at Tesla”, “I wish we had these courses already available”. Within ECE, the area of electric vehicles has been identified as one of the priorities in the latest departmental strategic plan. ECE has invested in new lab infrastructure to satisfy the demand for EV related courses. ECE’s curriculum visualization tool, Iris, already highlights a number of ECE courses that touch on EV-specific content.

More recently, the final certificate proposal and APS380H1 draft syllabus were shown to 10 fourth-year MIE students for informal comments. One noted: “I wish we had something like this that we could put on our CVs now...” [Speaking about Tesla and US auto companies]: “It has been really hard to compete in the US. Their undergraduate programs have more focus on EVs and new labs. This would help us compete.” Another noted: “I really like the APS course. I didn’t know there was so much materials and chemistry involved... it’s really cool to see stuff from other departments, we don’t get much of that.” [Speaking about the MEng]: “I hope we could get some courses like this that I could take next year too.”

5 Admission Requirements

There are no admission requirements for engineering certificate programs. The certificate is open to all undergraduate students in any engineering discipline. Successful completion of the certificate by an eligible student will be recorded on the student’s academic transcript as part of their undergraduate program.

6 Program Requirements

The certificate consists of three half-course requirements, totaling 1.5 FCE. The courses can be completed as part of the elective credits in a student’s program or taken as Extra credits (not counting towards their degree requirements).

While the certificate is technically open to any student who completes the courses, the program fits well (no overload courses required) for students in Chemical Engineering,

Electrical and Computer Engineering, and Materials Engineering. The program would currently require students in the following programs to take APS380H1 as an overload (or elective substitution) – Mechanical Engineering, Industrial Engineering and Engineering Science Majors in ECE, Robotics, and Energy Systems. Future curriculum adjustments in those programs may add APS380H1 as an elective option for their students, eliminating the need to overload.

Students in Civil and Mineral Engineering and the other Engineering Science Majors do not at this time have viable course paths to complete the program.

Mandatory Course:

- APS380H1 - Introduction to Electric Vehicle Design ((New course) This course is jointly run by MIE, ECE, CHE and CIV/MIN. The curriculum provides a broad overview of EV design and infrastructure issues and is designed to be accessible by students from all disciplines.

One of the following courses:

- MIE535H1: Electrification Through Electricity Markets (IND)
- MIE346H1: Analog and Digital Electronics for Mechatronics (MEC)
- MIE366H1: Electronics for Robotics (EngSci)
- ECE314H1: Fundamentals of Electrical Energy Systems (ECE)
- ECE349H1: Introduction to Energy Systems (EngSci)
- CHE469H1: Fuel Cells and Electro-chemical Conversion Devices (CHE)
- MSE458H1: Nanotech in Alternate Energy Systems (MSE)

One of the following courses:

- MIE363H1: Operations and Supply Chain Management (IND)
- MIE304H1: Introduction to Quality Control (MEC, IND)
- MIE404H1: Control Systems I (MEC)
- MIE515H1: Alternative Energy Systems (MEC)
- MIE443H1: Mechatronics Systems: Design and Integration (MEC)
- MIE444H1: Mechatronics Principle (MEC)
- ROB521H1: Mobile Robotics and Perception (EngSci)
- AER525H1: Robotics (EngSci)
- MIE519H1: Advanced Manufacturing Technologies (MEC)
- MSE443H1: Composites Materials Engineering (MSE)
- ECE311H1: Introduction to Control Systems (ECE)
- ECE342H1: Computer Hardware (ECE)

- ECE356H1: Introduction to Control Systems (ESC)
- ECE427H1: Photonic Devices (ECE)
- ECE463H1: Electric Drives (ECE)
- ECE470H1: Robotics (ECE)
- ECE520H1: Power Electronics (ECE)
- CHE507H1: Data-based Modelling for Prediction and Control (CHE)
- Relevant capstone or thesis project (H or Y)

7 Consultation

This certificate proposal was developed as a first phase of the creation of an EV minor, which has been under development since 2021.

The core course and curriculum of the certificate were developed through discussions with a subset of the FASE Electric Vehicle working group, including:

- Mathew Mackay – MIE
- Olivier Trescases - ECE
- Sanjeev Chandra – MIE
- Cristina Amon – MIE
- Sinisa Colic – MIE
- Ronald Venter – MIE
- Tomas Bernreiter – MIE
- Xinyu Liu – MIE

As part of the curriculum development process, the proposal has also been reviewed by and/or received input from:

- Chris Yip – Dean
- Dionne Aleman – Associate Dean, Cross-Disciplinary Programs
- Sharon Brown – Assistant Director, Cross-Disciplinary Programs Office
- Peter Lehn - ECE Energy Systems Group
- Daniela Galatro – Designate for CHE
- Sebastian Goodfellow – Designate for CIV/MIN
- Amy Bilton – Designate for ESC
- Scott Ramsay – Associate Chair, Undergrad, MSE
- Agnes Hsin – Undergraduate Liaison Officer, MSE
- Will Cluett – Associate Chair, Undergraduate Curriculum Development, CHE
- Mechanical Engineering fourth-year students

The course and proposal received endorsement by the FASE Undergraduate Curriculum Committee on November 1, 2023. Following consultations at the FASE Executive

Committee meeting on November 14, the proposal was recommended to have further consultation with the departments before proceeding. The updated proposal was returned to the Undergraduate Curriculum Committee who again endorsed it on January 16, 2024.

8 Resources

Administration of the certificate program will be managed through the Cross-Disciplinary Programs Office as part of its regular activities. No additional resources will be required for the administration of the certificate.

The new course, APS380, will require significant resources for laboratories and TA's. A MOU is under development between ECE and MIE to ensure the long-term viability of the new course and certificate. The MOU will include agreements on content development, hosting labs and course delivery.

9 Oversight & Accountability

Minors and certificates in the Faculty of Applied Science & Engineering are subject to periodic review in conjunction with the review of the Cross-Disciplinary Programs Office.

10 Summary of Process Steps & Approvals

Steps	Dates
<i>Development/consultation within CDPO</i>	<i>July-October 2023</i>
<i>Endorsement by Undergraduate Curriculum Committee</i>	<i>November 1, 2023</i>
<i>Consultation with Dean's Office and VPAP</i>	<i>November 2023</i>
<i>Consultation with FASE Executive Committee</i>	<i>November 14, 2023</i>
<i>Revised proposal endorsed by Undergraduate Curriculum Committee</i>	<i>January 16, 2024</i>
<i>Endorsed by FASE Executive Committee</i>	<i>February 5, 2024</i>
<i>Approval of FASE Council</i>	<i>February 27, 2024</i>
<i>Submission to VPAP upon approval</i>	<i>February 2024</i>
<i>Reported by VPAP to AP&P</i>	<i>June 2024</i>

Appendix A: Proposed Learning Outcomes and Undergraduate Degree-Level Expectations

The Faculty of Applied Science & Engineering aims to provide all of its undergraduate students with an education that will encourage them to be leaders in society in developing solutions to its most pressing problems. In order to achieve this, each graduate will have achieved the Undergraduate Degree-Level Expectations for the BASc described below.

Engineering minors and certificates are designed to recognize students for focusing their degree-program electives in a particular area of study. They are optional structures above and beyond a student's degree requirements and are therefore enhancements to existing rigorous degree-level expectations for engineering programs.

The certificate is structured around a broad, interdisciplinary introduction to the field of EV design and its constituent elements.

The foundational course, APS380H1: Introduction to Electric Vehicle Design, will provide an enhanced examination of EV concepts which goes beyond the content that is already found in our existing engineering curriculum. The course will cover major pillars of EV design and implementation, including EV design, manufacturing, powertrain, energy management, EV's and society and future directions.

In addition to the following Undergraduate Degree-Level Expectations, upon completion of the certificate program, students will be able to:

1. Understand the major components of electrified vehicles-principle, current status, technology outlook.
2. Explain the role of electric vehicles in the clean-energy transition and evaluate the challenges of integrating electrified vehicles into the electric grid.
3. Understand core EV sub-systems, battery technologies including lithium-ion batteries, battery management, battery capacity, power electronics, charging technologies and aging factors, thermal management of battery and power systems.
4. Augment domain-specific knowledge with cross-disciplinary courses and electives.

Degree Level Expectations for Graduates Receiving the Degree of Bachelor of Applied Science

Faculty of Applied Science and Engineering University of Toronto

1. Degree Learning Objectives and Requirements

Overall Learning Objectives

The Faculty of Applied Science and Engineering aims to provide all of its undergraduate students with an education that will allow them to be leaders in society in developing solutions to its most pressing problems. Our graduates will be able and inspired to:

- be leading practitioners of engineering and engineering design
- be known for their technical literacy as well as their knowledge of mathematics and the basic sciences and the role of technology in society
- be able to formulate and solve problems in complex systems independently and in teams
- pursue independent lifelong learning within their field of study and more broadly
- be prepared for careers, including graduate programs, that build upon their advanced technical knowledge
- participate meaningfully as leaders in society

In order to achieve this, each graduate will have achieved the following general learning objectives:

- a. Depth of knowledge that cultivates critical understanding and intellectual rigour in at least one engineering discipline.
- b. Competencies in learning and applying knowledge to solve problems facing society and that are fundamental to responsible and effective participation in the workplace, in the community, in scholarly activity, and in personal life:
 - i. Critical and Creative Thinking
 - ii. Oral and Written Communication
 - iii. Quantitative Reasoning
 - iv. Teamwork
 - v. Information Literacy
 - vi. Ethical Thinking and Decision-Making
- c. Breadth of knowledge across mathematics, basic sciences, engineering sciences, engineering economics and engineering design that cut across the engineering disciplines and across a range of nontechnical areas including the humanities and social sciences and an awareness of the impact of technology on society.
- d. Integration of skills and knowledge developed in a student's course of study through a capstone experience in the upper years.

2. Requirements to Graduate

In order to graduate with a BAsC degree, each student in the Faculty of Applied Science and Engineering will have completed a full undergraduate program as outlined in the Faculty Calendar within nine calendar years of first registration, exclusive of mandatory absences from his/her program. Current programs include: Chemical, Civil, Computer, Electrical, Industrial, Mineral, Materials and Mechanical Engineering as well as the BAsC in Engineering Science.

The practice of engineering is regulated, by statute, in all Canadian provinces and territories. To become a Professional Engineer (PEng), an individual must satisfy the requirements of the licensing bodies.

These requirements include a degree from an accredited program, successful completion of a professional practice examination in engineering law and ethics, and suitable experience. At present, all programs in the Faculty of Applied Science and Engineering are accredited and evaluated regularly by the Canadian Engineering Accreditation Board (CEAB) of the Canadian Council of Professional Engineers. Therefore, graduation from the Faculty may lead to registration in the provincial Associations of Professional Engineers, in accordance with individual policies. No student will be permitted to graduate who does not meet these requirements.

The criteria set out by the CEAB are designed to ensure that each graduate has a foundation in Mathematics and Basic Sciences, a broad preparation in Engineering Sciences and Engineering Design and an exposure to non-technical subjects (Complementary Studies) that complement the technical aspects of the curriculum. Basic Sciences must include physics and chemistry and also may include elements of life sciences and earth sciences; they impart an understanding of natural phenomena. Engineering Sciences normally involve Mathematics and Basic Sciences but carry knowledge further to creative applications. Complementary Studies include the humanities, social sciences, arts, management, engineering economics and communication skills.

Each program in the Faculty consists of a technical component and complementary studies component. The curriculum for students in their early years forms a basis in the fundamental subjects prior to subsequent specialization in the various engineering disciplines. Students are able to choose from a range of technical electives in their senior years. In the senior years, all programs contain a capstone experience through a design project, which integrates their skills and knowledge and provides students with the opportunity to carry out original work in their chosen fields of study.

There are a set of common requirements, described below, that cut across all programs in the following categories: Coursework, Promotion, English Proficiency, and Practical Experience. In this context, a course is defined as one half-course equivalent, which may consist of a half course ("S," "F" or "H") or half of a full-year "Y" course.

1. **Coursework:** Each program will have courses that provide the following:
 - a. Complementary Studies Electives
 - b. A basic knowledge of Engineering Economics
 - c. Technical Electives
 - d. Courses with substantial design content in Years 1, 2 and/or 3

- e. Capstone course(s) in Years 3 and/or 4 with strong integrative, design and independent work elements
 - f. Across all four years, programs will provide sufficient opportunities for the development of professional awareness and practice.
2. **Promotion:** All undergraduate programs will consist of eight Fall and Winter Sessions taken in order.
- a. To gain credit for a session a student must:
 - i. satisfy the academic regulations to proceed to the succeeding session as described in the calendar and
 - ii. not be subsequently required to repeat the session for which credit is to be gained, and
 - iii. achieve a course mark of 50% or greater in every course taken as part of the academic load in a session, and
 - iv. not have any outstanding designations of 'standing deferred,' 'incomplete' or 'No Grade Available' for any course in any session.
 - b. To be eligible to graduate, each student must attain a weighted Session Average of 60% or greater in the final session of their program. Any student who does not achieve a weighted Session Average of 60% in their final session (4W), but has attained a weighted Session Average that allows them to proceed to the next session on probation, shall repeat the final session and achieve a weighted Session Average of 60% or greater to graduate.
3. **English Proficiency:** Each student must show an ability to write English coherently and correctly. Every student will also take at least one course that includes a written communication component within their curriculum. Satisfactory completion of the course or courses is required for graduation.
4. **Practical Experience:** The Faculty requires that all students complete a minimum of 600 hours of practical work before graduation.

3. Degree Level Expectations for the Bachelor of Applied Science

1.1. Depth and Breadth of Knowledge

The Faculty ensures that a student has mastered a body of knowledge with appropriate depth by requiring that each student completes the requirements of one of the degree Programs of Study (POST) as described in the Faculty Calendar. The curriculum for students in First Year forms a common basis in the fundamental subjects, including the natural sciences and mathematics, prior to a subsequent specialization in the various engineering disciplines. Each program consists of a technical component and a complementary studies component.

Critical analysis and thinking and analytical skills are emphasized through the student's exposure to an increasingly sophisticated understanding of their program of study. Specialization within the discipline is developed through technical electives taken in the 3rd and 4th years of study. A detailed knowledge of and experience in design is ensured through the Design Course requirements, beginning with courses in the first three years as well as the

Capstone course(s) in each program. Opportunity to further develop these skills is provided through a research thesis that is available in most POSTs.

The Faculty assures that students have breadth of knowledge in a number of ways. Breadth across engineering is assured through a First Year of study that prepares a student for any of the programs of study. Breadth beyond engineering is developed through the Complementary Studies Electives as well as the Engineering Economics requirement.

1.2. Knowledge of Methodologies

Every POST has requirements which demonstrates a student's understanding of the methods of engineering design. Students in all engineering programs must successfully complete courses with substantial design in their first three years and a Capstone design course in their senior years. These courses require students to evaluate the appropriateness of various approaches to analyze and solve the design problem and also to devise and sustain arguments for their design. In most POSTs, students have the opportunity to participate in a research thesis course that familiarizes them with the specific methodologies currently in use in the development of knowledge in their discipline.

1.3. Application of Knowledge

The application of science and mathematics to solve problems is fundamental to all programs in Engineering and therefore is required in many of the courses within all POST. A minimum level of instruction in Engineering Science and Engineering Design is required, both of which directly involve the application of knowledge.

1.4. Communication Skills

The Faculty requires students to communicate information, arguments and analysis accurately and reliably, orally and in writing, to specialist and non-specialists audiences. The requirement for courses with substantial engineering design that are required across all programs require a series of technical reports and presentations with direct involvement with our Engineering Communication Program. In addition, our Capstone Design Courses and research theses all involve a written report and most involve oral presentations. The course requirements for instruction in Complementary Studies also adds to the education our students receive in communication skills. Also, the English Proficiency requirement insures a minimum level of writing ability for all graduates.

1.5. Awareness of Limits of Knowledge

Each POST develops, through a sequence of courses starting at the 100-series or 200-series and culminating at the 300-series or 400-series or 500-series of courses, an understanding of a discipline as it is currently appreciated by educators who are at the same time involved in original scholarship in the subject area. The course content at the upper series level is designed, in part, to provide students with an appreciation of the uncertainties, ambiguities and limitations of knowledge in the specific area.

1.6. Autonomy and Professional Capacity

The development of an awareness and understanding of professional practice is required for all POST. The required design courses require students to work in teams and also accept responsibility for their own contributions. Students are required to make their own decisions for their own learning through selection of their technical and nontechnical electives. Finally, in completing their course requirements, the Faculty expects strict adherence by students to

the Code of Behaviour on Academic Matters, which requires students to not tolerate or encourage the creation of an environment of cheating, misrepresentation or unfairness.

1.7. Other Degree Level Expectations

The Faculty requires all students to have developed competency in several areas of learning and applying knowledge not identified explicitly in the previous sections. In particular, the Faculty requires students to have developed competencies in quantitative reasoning and in information literacy.

Quantitative reasoning is considered the ability to identify, assemble and interpret quantitative information and make and test hypotheses based on such data. Development of this competency is an explicit part of all POSTs offered by the Faculty.

The Faculty requires all students to develop an advanced understanding of how to obtain information, manipulate and evaluate it and bring diverse sources together to develop a comprehensive understanding of specific issues, solve problems or apply the scientific method to create further knowledge in the discipline. These advanced information literacy skills are developed through the studies in their concentration(s) and are demonstrated in the advanced courses required in each POST.

Appendix B: Proposed Calendar Copy

Course Requirements for the Certificate in Electric Vehicle Design

Electrifying the transportation sector is one of the major priorities to reach Net Zero emissions. The transition to electric vehicles (EVs) in the automotive sector is the largest technology shift in over 100 years. A new generation of skilled engineers is needed to address the cross-disciplinary challenges in the growing EV sector.

This certificate provides an opportunity for students to learn about EVs within the context of engineering applications and expand their understanding of the technical and environmental implications of engineering in EV design.

All undergraduate Engineering students are eligible to participate in this certificate program. Students who complete the requirements of the certificate will receive a notation on their transcript upon graduation.

The requirements for the certificate are the successful completion of the following courses:

Courses	Term	Lec	Lab	Tut	Wgt
Mandatory Course:					
APS380H1 - Introduction to Electric Vehicle Design	F	3	3a	0	0.5
One of the following courses:					
MIE535H1: Electrification Through Electricity Markets	S	3	1	1	0.5
MIE346H1: Analog and Digital Electronics for Mechatronics	S	3	1.5	1	0.5
MIE366H1: Electronics for Robotics	F	3	1.5	2	0.5
ECE314H1: Fundamentals of Electrical Energy Systems	F	3	1.5	1	0.5
ECE349H1: Introduction to Energy Systems	F	3	1.5	1	0.5
CHE469H1: Fuel Cells and Electro-chemical Conversion Devices	S	3	0	1	0.5
MSE458H1: Nanotech in Alternate Energy Systems	S	3	0	2	0.5

One of the following courses:	Term	Lec	Lab	Tut	Wgt
MIE363H1: Operations and Supply Chain Management	S	3	0	2	0.5
MIE304H1: Introduction to Quality Control	S	3	1	2	0.5
MIE404H1: Control Systems I					
MIE515H1: Alternative Energy Systems	F	3	0	1	0.5
MIE443H1: Mechatronics Systems: Design and Integration	S	2	5	0	0.5
MIE444H1: Mechatronics Principle	F	2	3	0	0.5
ROB521H1: Mobile Robotics and Perception	S	3	1.5	1	0.5
AER525H1: Robotics	F	3	1.5	2	0.5
MIE519H1: Advanced Manufacturing Technologies	S	3	0	0	0.5
MSE443H1: Composites Materials Engineering	F	3	0	0	0.5
ECE311H1: Introduction to Control Systems	F/S	3	1.5	1	0.5
ECE342H1: Computer Hardware	S	3	3	0	0.5
ECE463H1: Electric Drives	S	3	1.5	1	0.5
ECE520H1: Power Electronics	F	3	1.5	1	0.5
CHE507H1: Data-based Modelling for Prediction and Control	S	3	0	1	0.5
Relevant capstone or thesis project (H or Y)	F/S/Y				0.5/ 1.0

Note: Availability of the courses for timetabling purposes is not guaranteed; the onus is on the student to ensure compatibility with their timetable.