COURSE AND OPTIONS SELCTION HANDBOOK

MECHANICAL ENGINEERING

Mechanical & Industrial Engineering
UNIVERSITY OF TORONTO

CONTENTS

WHAT IS COURSE AND OPTIONS SELECTION (COS)?

Each year the Office of the Registrar asks you to provide them with indicators as to which streams and technical elective courses you plan to take in the coming academic year. The information that you provide to us through Course and Options Selection (COS)/ Pre-registration process helps us identify the demand for courses. This information is used for the course scheduling process and for uploading your course selections to ACORN. When selecting your courses, be sure that your selections meet the program requirements for your program of study.

The Course and Options selection process is completed in Degree Explorer.

ALL INFORMATION IN THIS HANDBOOK WAS MOST RECENTLY UPDATED IN NOVEMBER 2024. COURSES, DEGREE REQUIREMENTS, AND DATES MAY CHANGE FROM YEAR TO YEAR. PLEASE REFER TO THE CURRENT YEAR'S ENGINEERING ACADEMIC CALENDAR.

IMPORTANT DATES

DATE	
EARLY FEBRUARY	**3RD YEAR MEC CURRICULUM TALK** **4TH YEAR MEC CURRICULUM AND CAPSTONE TALK**
MID FEBRUARY	**COURSE & OPTIONS SELECTION OPENS** https://www.acorn.utoronto.ca/degree-explorer/ Students may now log in and make their curriculum selections for the upcoming academic year
MID JULY	**COURSE SELECTION (ROUND 1) OPENS *ACORN*** Students may now make changes to their timetable. Electives offered by the Faculty of Engineering and Enhanced Enrollment Arts & Science electives are now open for enrollment
LATE JULY/EARLY AUGUST	**COURSE SELECTION (ROUND 2) OPENS *ACORN*** For courses offered by the Faculty of Arts & Science
MID AUGUST	**LAST DAY TO PAY OR DEFER TUITION FEES**
EARLY SEPTEMBER	**ENGINEERING FALL (F) LECTURES BEGIN**
MID SEPTEMBER	**FALL (F) & FULL-YEAR (Y) COURSE ADD DEADLINE** Deadline to submit technical elective substitution requests for 4F Deadline to submit thesis enrolment forms for fall (f) & full-year (y) projects Deadline to submit course request forms for fall (f) & full-year (y) courses
EARLY NOVEMBER	**FALL (F) COURSE DROP DEADLINE** Last day to drop Fall (F) Session courses without academic penalty, withdraw from the Fall (F) session without academic penalty, or transfer to part-time studies for the Fall (F) session
EARLY JANUARY	**ENGINEERING WINTER (S) LECTURES BEGIN**
MID JANUARY	**WINTER (S) COURSE ADD DEADLINE** Last day to add or substitute Winter (S) courses
EARLY MARCH	**WINTER (S) & FULL YEAR (Y) COURSE DROP DEADLINE**

For a complete list of the Sessional Dates click here
For Fee and Refund Schedule information click here

CURRICULUM OVERVIEW

FALL SESSION – YEAR 3

REQUIRED CORE COURSES	
MIE301H1	Kinematics and Dynamics of Machines
MIE312H1	Fluid Mechanics I
MIE342H1	Circuits with Applications to Mechanical Systems
MIE358H1	Engineering Economics
ENGINEERING NATURAL SCIENCE ELECTIVES (CHOOSE ONE):	
CHE353H1	Engineering Biology
CIV220H1	Urban Engineering Ecology
CIV300H1	Terrestrial Energy Systems

Students may select a Natural Science elective from the list above or from the list of approved Natural Science courses offered by the Faculty of Arts & Science. This list is available on the Faculty of Engineering website here.

WINTER SESSION – YEAR 3

REQUIRED CORE COURSES*	
MIE315H1	Design for the Environment
MIE313H1	Heat and Mass Transfer
STREAM OPTIONS (CHOOSE TWO):	
Manufacturing **MIE304H1**	Introduction to Quality Control
Mechatronics **MIE346H1**	Analog and Digital Electronics for Mechatronics
Solid Mechanics and Design **MIE320H1**	Mechanics of Solids II
Energy and Environment **MIE311H1**	Thermal Energy Conversion
Bioengineering ***(choose one)*** **BME331H1** **CHE354H1**	 Physiological Control Systems Cellular and Molecular Biology
COMPLEMENTARY STUDIES OR HUMANITIES AND SOCIAL SCIENCES ELECTIVE	
CS/HSS Elective	

*Please note that effective 2025-2026, MIE334H1 will be taken in second year.

FALL SESSION – YEAR 4

REQUIRED CORE COURSES	
MIE491Y1/APS490Y1	Capstone Design
STREAM OPTIONS (CHOOSE TWO):	
Manufacturing **MIE422H1**	Automated Manufacturing
Mechatronics **MIE404H1**	Control Systems I
Solid Mechanics and Design **MIE442H1**	Machine Design
Energy and Environment **MIE515H1**	Alternative Energy Systems
Bioengineering ***(choose one)*** **MIE439H1** **MIE458H1**	 Cellular and Tissue Biomechanics Biofluid Mechanics
TECHNICAL ELECTIVES (CHOOSE ONE):	
Refer to academic calendar for approved list	
COMPLEMENTARY STUDIES OR HUMANITIES AND SOCIAL SCIENCES ELECTIVE	
CS/HSS Elective	

WINTER SESSION – YEAR 4

REQUIRED CORE COURSES	
MIE491Y1	Capstone Design
TECHNICAL ELECTIVES (CHOOSE THREE):	
Refer to academic calendar for approved list	
COMPLEMENTARY STUDIES OR HUMANITIES AND SOCIAL SCIENCES ELECTIVE	
CS/HSS Elective	

For further information visit the Engineering Academic Calendar

NATURAL SCIENCE ELECTIVES

A natural science elective is a science course in physics, chemistry, life sciences, and/or earth sciences. You may choose from the engineering natural science electives (CHE353, CIV220 or CIV300) or from the extended list of approved electives here.

CAN I TAKE MY NATURAL SCIENCE ELECTIVE IN THE WINTER OR SUMMER TERM?

If the natural science elective you are interested in taking is only offered in the winter semester, you must first obtain formal approval from the MIE Undergraduate Office to overload. Many natural science electives on the extended list are also available in the summer.

WHAT IF I WANT TO CHANGE MY STREAM CHOICES FROM WHAT I SELECTED ON COS?

Please see the Important Dates for more details on opportunities to change your stream selections. Please try to make an informed decision for your COS selections to ensure you have a spot.

CAN I CHANGE MY STREAMS IN FOURTH YEAR?

No. In order to graduate, you must take a course following each of your stream selections in 3W. If you find another 4F stream course interesting, you may take it in place of a technical elective in addition to your two continued stream courses.

CAN I TAKE THREE STREAMS?

It is strongly advised that mechanical engineering students do not overload in third year. Only under exceptional circumstances are overloads granted in third year. If you are interested in taking three streams, you must first obtain formal approval from the MIE Undergraduate Office to overload.

WHAT IS A CS ELECTIVE?

Complementary Studies (CS) can be broadly defined as studies in humanities, social sciences, arts, management, engineering economics and communication that complement the technical curriculum. Engineering, math or science courses—including

astronomy and psychology—may not be used to fulfill your CS elective requirement. Additionally, the Rotman School of Management does not typically permit students outside of their faculty to take their courses (i.e. RSM courses).

WHAT IS AN HSS ELECTIVE?

Humanities and Social Science electives (HSS) are a subset of Complementary Studies (CS) Electives; therefore, they can be used to satisfy CS requirements. HSS courses may explore issues that involve the inter-relationship between the individual, society, the environment, aspects of human culture, including language, literature, history, philosophy, art, architecture, religion, and culture.

To graduate, a Mechanical Engineering student is required to complete 2.0 credits in complementary studies, of which at least 1.0 credits are HSS courses (0.5 credits = 1 half year course). These are typically taken in second, third and fourth year, or in the summer (additional tuition fees will be applied). For approved HSS electives click here.

TECHNICAL ELECTIVES

A technical elective is typically an engineering course focused on learning new practical/technical skills and/or applying core engineering principles and domain knowledge to solve realistic/tangible problems. Such courses may more heavily emphasize practical laboratory or project-based learning experiences, with a focus on application of existing domain knowledge.

Mechanical Engineering students are required to complete 2.0 technical elective credits from the list of approved electives (at least 0.5 must be a designated design elective credit). Fourth-year students may request to substitute 0.5 technical elective credit in each of the 4F and 4W terms.

DEGREE EXPLORER

Degree Explorer is a planning tool designed to help students and advisors evaluate academic progress towards completion of requirements for graduation. It is not a transcript. It allows you to map out your degree and can help you determine if you are on track. Just because you are able to enrol in a course on ACORN does not mean that it will fulfill your degree requirements.

PRACTICAL EXPERIENCE REQUIREMENT (PER)

Every student must complete a minimum of 600 hours of practical work before graduation. The nature of the work should form an integral part of a student's education and career development. It therefore must contain a good measure of responsibility (e.g., management of programs, systems, equipment, personnel, or finances), sound judgment and effective communication, and be supportive of the professional career of the student after graduation.

Students who receive credit for PEY Co-op will automatically complete the practical experience requirement. Student who do not receive credit for PEY Co-op or did not participate in the PEY Co-op program must submit a PER form to the MIE Undergraduate Office.

To view a complete list of the MIE UG Forms click here.

ENGINEERING MINORS & CERTIFICATES

Undergraduate Engineering students may pursue a number of minors and certificates that add breadth and depth to their academic careers. To obtain a minor, students generally take six (6) to eight (8) courses in a particular field. A certificate typically requires three (3) courses.

Minors and Certificates are managed by the Cross-Disciplinary Programs (CDP) Office and all inquiries associated with the minors should be addressed to engineering.minors@utoronto.ca. For further information on the types of minors available etc. click here.

HOW DO I ENROL IN A MINOR?

Each minor has a specific enrolment form for you to complete and submit to the Cross-Disciplinary Programs Office. Please note that enrolling in a minor does not guarantee you a spot in any of the engineering minor electives, as they are open to everyone. To avoid disappointment, plan ahead and select courses at 6AM on course selection days. You are responsible for making sure you fulfill the requirements.

I DIDN'T GET INTO THE COURSES I WANTED TO, AND I'M WORRIED I WONT FINISH MY MINOR BEFORE GRADUATION. WHAT DO I DO?

Due to popularity, many engineering minor courses are offered in the summer. You are also welcome to complete those courses following graduation, it just may not

appear on your transcript until later. You can also visit the Cross-Disciplinary Programs Office to cancel your enrolment you in a minor.

WILL MY HSS/CS ELECTIVES BE ADDED TO MY TIMETABLE AUTOMATICALLY? WHAT IF I AM ENROLLED IN A MINOR THAT REQUIRES THAT COURSE?

No, you must add them yourself on course selection days. Enrolling in a minor does not guarantee you a spot in its required courses.

ENROLLMENT & REGISTRATION

OVERLOADS

- To enrol in more than 2.5 credits in a semester, you must receive approval from the Undergrad Office
- Minimum CGPA required: 2.7

"EXT" OR EXTRA COURSES

- All courses that are above and beyond a student's degree requirements must be marked as "Extra."
- The grade for an extra/EXT course will be displayed on the transcript, but it will not be factored into the GPA or sessional average.
- Extra courses can be used to fulfill the requirements of a minor or certificate.

FAILED COURSES

If you have failed a core course, you must re-take it at the next available opportunity. Many first year engineering courses are offered during the summer. If you were unsuccessful in a second or third year course that is a pre-requisite for an upper level course, you must retake the pre-requisite course first. To add a core course, please submit the Course Request Form (https://www.mie.utoronto.ca/programs/ undergraduate/forms-policies/) to the Undergraduate Office by one week before the add course deadline. To add a failed elective, you may do so yourself on the course selection dates.

STREAMS & MINORS

MANUFACTURING STREAM

Manufacturing, the transformation of materials and information (technology) into useful products for human beings, is the cornerstone to many economic activities. It is a versatile skill, with employment opportunities existing over a wide range of Canadian industry, including automotive, microelectronics, aeronautics, pharmaceutical, etc. It is an exciting, creative field, where engineers get to design from cradle-to-grave. You must understand how an idea can be produced, and at what cost. This design may also include the manner the product should be disposed of or recycled. It is a truly international field, with demand around the world. Within Canada, average earnings of all employees in manufacturing are 22% higher than average earnings across all economic occupations in Canada.

STREAM COURSES

3W - MIE304H1S - INTRODUCTION TO QUALITY CONTROL

In manufacturing and service industries alike, quality is viewed as an important strategic tool for increasing competitiveness. Continuous quality improvement is a key factor leading to a company's success. With more emphasis on quality, the cost and the product cycle time are reduced and the communication between producer and customer is improved.

TOPICS: Introduction to quality engineering. Quality standards and certification. TQM. Modeling processes with simulation. Making inferences about product quality from real or simulation output data. Introduction to statistical process control. Control charts for variables and attributes. Process capability analysis. Lot Acceptance Sampling.

4F - MIE422H1S - AUTOMATED MANUFACTURING

Introduction to Computer Integrated Manufacturing. Definitions, terminology.

Organization of manufacturing systems. Introduction to NC machines. Introduction to robotics. Types of robot motion. Robot kinematics. Jacobians, singularities. Robot motion trajectories. Interpolation, spline fits. Robot joint control. Flexible manufacturing systems, justification. Robot cell design. Group technology. Design of group technology cell. Programmable logic controllers.

TOPICS: Introduction to Computer Integrated Manufacturing, Introduction to robotics and kinematics, CNC Basics, CNC Programming, Programmable Logic Controllers (PLCs) FMS, Table-top manufacturing, Group technology

SUGGESTED TECHNICAL ELECTIVES (4TH YEAR ONLY)

COURSE CODE	*COURSE TITLE*
MIE360H1	Systems Modelling and Simulation
MIE435H1	Early-Stage Design Methods
MIE440H1	Design of Effective Products
MSE401H1	Materials Selection for Sustainable Product Design
FOR424H1	Innovation and Manufacturing of Sustainable Materials
MIE469H1	Reliability and Maintainability Engineering
MIE506H1	MEMS Design and Microfabrication
MIE519H1	Advanced Manufacturing Technologies
MSE543H1	Composite Materials Engineering

FIELDS OF APPLICATION

Automation, Manufacturing Management, Fundamental Technology, Process Design, Machine Programming

LINKS

Canadian Society of Manufacturing Engineers www.sme.org/smecanada

ADVANCED MANUFACTURING MINOR

SAMPLE COURSE SELECTION FOR MINOR (3RD YEAR)

REQUIRED CORE COURSES

MIE342H1	Circuits with Applications to Mechanical Engineering Systems

STREAM OPTIONS	
Manufacturing **MIE304H1**	Introduction to Quality Control

SAMPLE COURSE SELECTION FOR MINOR (4TH YEAR)

STREAM OPTIONS	
MIE422H1 (see note below)	Automated Manufacturing
TECHNICAL ELECTIVES	
AER525H1 (see note below)	Robotics
MIE410H1	Finite Element Analysis
MIE440H1	Design of Effective Products
CHE475H1	Biocomposites: Mechanics & Bioinspiration
FOR424H1	Innovation and Manufacturing of Sustainable Materials
MIE441H1	Design Optimization
MIE443H1	Mechatronics Systems: Design and Integration
MIE469H1	Reliability & Maintainability Engineering
MIE519H1	Advanced Manufacturing Technologies
MIE540H1	Product Design
COMPLEMENTARY STUDIES ELECTIVE	
TEP343H1	Engineering Leadership
TEP442H1	Cognitive & Psychological Foundations of Effective Leadership
CHE488H1	Entrepreneurship & Business for Engineers
JRE420H1	People Management & Organizational Behaviour

Note: Students may take only one of MIE422H1 or AER525H1.

If you are pursuing any minor please refer to the Academic Calendar for more information on taking the required courses to achieve that minor. This may require overloading. Taking a stream does not mean you will complete the minor in that area.

For more information, please refer to Advanced Manufacturing Minor.

MECHATRONICS STREAM

Ten years ago it was comparably easy to explain the functions of a camera to a young engineer, even though the mechanisms were complex. Today, it is nearly impossible since the design of a camera not only involves mechanics and optics, but also electronics and software. The design of such products and processes requires a synergetic combination of mechanical and electrical engineering and computer science.

As with our mechanical engineering program, mechatronics at U of T emphasizes design. You will learn the skills needed to design and build mechatronic systems and that includes mechanical design (mechanical, hydraulic, pneumatic, thermal), electronic design, programming skills and their integration into functional systems.

As Canada's largest and oldest mechatronics program, you will have access to well-established labs where you put theory into action as well as cutting edge technology provided by our outstanding professors, support engineers and graduate students. Remember, U of T is Canada's best research university! You benefit from our established mechatronics graduate studies.

STREAM COURSES

3W - MIE346H1S - ANALOG AND DIGITAL ELECTRONICS FOR MECHATRONICS

A study of the fundamental behaviour of the major semiconductor devices (diodes, bipolar junction transistors and field effect transistors). Development of analysis and design methods for basic analog and digital electronic circuits and devices using analytical, computer and laboratory tools. Application of electronic circuits to instrumentation and mechatronic systems.

TOPICS: Laplace Transform for Circuit Analysis, Operational Amplifiers, Filters and Tuned Amplifiers, Diodes, Signal Generators and Waveform-Shaping Circuits, MOSFETs, BJTs, OpAmps and Data Converters, Digital Logic Circuits. Lab topics

include Voltage Controlled Oscillator, Diode Circuits, Transistors and Relays, Analog Pulse Width Modulations Motor Driver, Digital Logic and Stepper Motor Driver.

4F - MIE404H1F - CONTROL SYSTEMS I
Analysis of stability, transient and steady state characteristics of dynamic systems. Characteristics of linear feedback systems. Design of control laws using the root locus method, frequency response methods and state space methods. Digital control systems. Application examples.

TOPICS: MATLAB & Simulink, Feedback control and PID, Root Locus Design, Frequency Response Analysis, Magnetic Levitation

SUGGESTED TECHNICAL ELECTIVES (4TH YEAR ONLY)

COURSE CODE	COURSE TITLE
AER307H1	Aerodynamics
AER525H1	Robotics
MIE444H1	Mechatronics Principles
MIE438H1	Microprocessors and Embedded Microcontrollers
MIE443H1	Mechatronics Systems: Design and Integration
MIE505H1	Micro/Nano Robotics

FIELDS OF APPLICATION
Robotics, Sensing and Control Systems, Medical imaging, Computer aided and integrated manufacturing systems, Microcontrollers/PLCs, Mobile Apps

LINKS
Institute for Robotics and Mechatronics- https://robotics.utoronto.ca/

ROBOTICS AND MECHATRONICS MINOR

SAMPLE COURSE SELECTION FOR MINOR (3RD YEAR)

REQUIRED CORE COURSES	
MIE301H1	Kinematics and Dynamics of Machines

STREAM OPTIONS

MIE346H1	Analog and Digital Electronics for Mechatronics

SAMPLE COURSE SELECTION FOR MINOR (4TH YEAR)

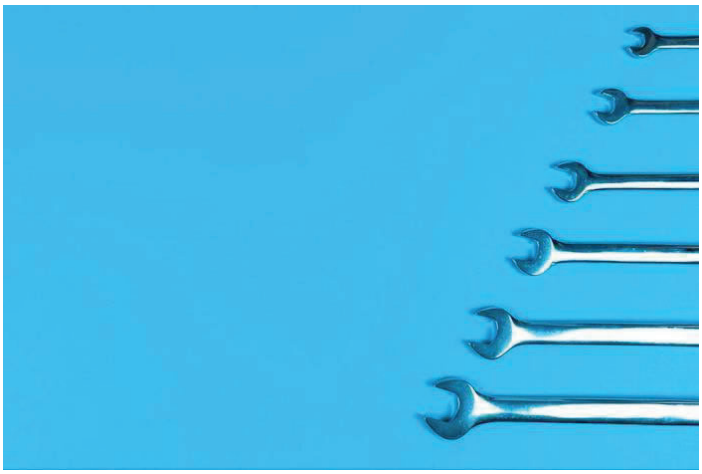
FALL SESSION

STREAM OPTIONS	
Manufacturing **MIE422H1**	Automated Manufacturing
Mechatronics **MIE404H1**	Control Systems I
Bioengineering **BME331H1**	Physiological Control Systems
Solid Mechanics & Design **MIE442H1**	Machine Design
TECHNICAL ELECTIVES (CHOOSE ONE):	
MIE438H1	Microprocessors and Embedded Microcontrollers
AER525H1	Robotics
MIE443H1	Mechatronics Systems: Design and Integration
MIE444H1	Mechatronics Principles
MIE505H1	Micro/Nano Robotics
MIE506H1	MEMS Design and Microfabrication

Note: If you are pursuing any minor please refer to the Academic Calendar for more information on taking the required courses to achieve that minor. This may require overloading. Enrolling in a stream does not mean that you will complete a minor in that area.

For more information, please refer to Robotics and Mechatronics Minor.

SOLID MECHANICS & DESIGN STREAM



Solid mechanics is the analysis of stress, strain and deflection. It is one of the core technical areas of mechanical engineering. Applications of solid mechanics are common in: the design of virtually every product; creating manufacturing processes and equipment; biomechanics as related to medicine and dentistry; many fields of graduate research.

STREAM COURSES

3W - MIE320H1S - MECHANICS OF SOLIDS II

Three-dimensional stress transformation, strain energy, energy methods, finite element method, asymmetric and curved beams, superposition of beam solutions, beams on elastic foundations, buckling, fracture mechanics, yield criteria, stress concentration, plane stress and strain.

4F - MIE442H1F - MACHINE DESIGN

Introduction to the fundamental elements of mechanical design including the selection of engineering materials, load determination and failure analysis under static, impact, vibration and cyclic loads. Surface failure and fatigue under contact loads, lubrication and wear. Consideration is given to the characteristics and selection of machine elements such as bearings, shafts, power screws and couplings.

SUGGESTED TECHNICAL ELECTIVES (4TH YEAR ONLY)

COURSE CODE	*COURSE TITLE*
MIE435H1	Early-Stage Design Methods
MIE440H1	Design of Effective Products
MSE401H1	Materials Selection for Sustainable Product Design
MIE402H1	Vibrations

MIE408H1	Thermal and Machine Design of Nuclear Power Reactors
MIE550H1	Advanced Momentum, Heat and Mass Transfer
CHE475H1	Biocomposites: Mechanics and Bioinspiration
MIE439H1	Cellular and Tissue Biomechanics
MIE437H1	Fundamentals of Injury Biomechanics and Prevention
MIE441H1	Design Optimization
MIE469H1	Reliability and Maintainability Engineering
MIE506H1	MEMS Design and Microfabrication
MIE540H1	Product Design

FIELDS OF APPLICATION

Geomechanics (Modeling the shape of planets, tectonics, and earthquake prediction), Infrastruction (Designing foundations or structures), Mechanical Design (Designing load bearing components for vehicles, powertrain design), Manufacturing (Metal and polymer forming processes, machining), Biomedical (Implant design, bone mechanics, modeling stress phenomena controlling cellular and molecular processes), Materials Science (Composite design, allow microstructions, material processing design), Microelectronics (Failure resistant packaging)

LINKS

The Canadian Society for Mechanical Engineering www.csme-scgm.ca

The Society of Automotive Engineers www.sae.org

ENERGY AND ENVIRONMENT STREAM

The energy industry is one of the biggest in Canada, dominated by oil and gas, nuclear power and electricity. Environmental engineers play a pivotal role in improving polluted environments, designing facilities that directly affect our modern economy, public health and safety, and designing environmentally-responsible products and processes. Their knowledge of physics, chemistry, and biological processes allows them to address problems such as protecting air, water and land quality; providing safe drinking water; treating and disposing of industrial wastes;

preventing environmental problems by designing “cleaner” manufacturing processes; and developing alternative energy sources. Mechanical engineers in this field have a strong foundation in thermal dynamics and fluid mechanics. Engineers with a firm knowledge of environmental processes and solutions are widely sought after by employers in both industry and government.

STREAM COURSES

3W – MIE311H1S - THERMAL ENERGY CONVERSION

Engineering applications of thermodynamics in the analysis and design of heat engines and other thermal energy conversion processes within an environmental framework. Steam power plants, gas cycles in internal combustion engines, gas turbines and jet engines. Refrigeration, psychrometry and air conditioning. Fossil fuel combustion and advanced systems includes fuel cells.

TOPICS: Vapor Power Cycles, Gas Power Cycles, Refrigeration and Heat pumps, Psychrometry and ideal Gas Mixture, Efficient Energy Utilization

4F - MIE515H1F - SUSTAINABLE ENERGY SYSTEMS

This course provides students with the knowledge and skills to evaluate different sustainable energy systems. The course overviews the basic operating principles of different current sustainable energy technologies, the social and economic considerations for implementing these systems, and overviews examples of implementations. Specific topics include solar thermal systems, solar photovoltaic systems, wind, wave, and tidal energy, energy storage, and considerations when connecting to the grid.

SUGGESTED TECHNICAL ELECTIVES (4TH YEAR ONLY)

COURSE CODE	COURSE TITLE
MIE414H1	Applied Fluid Mechanics
MIE407H1	Nuclear Reactor Theory and Design
MIE516H1	Combustion and Fuels
CIV440H1	Environmental Impact and Risk Assessment
FOR424H1	Innovation and Manufacturing of Sustainable Materials
MIE408H1	Thermal and Machine Design of Nuclear Power Reactors
MIE504H1	Applied Computational Fluid Dynamics
MIE507H1	Heating, Ventilating, Air Conditioning (HVAC) Fundamentals

MIE517H1	Fuel Cell Systems
MIE563H1	Analytic and Numerical Solution of Engineering PDEs

FIELDS OF APPLICATION

Power generation, Automotive (engine design, intake, exhaust, and cooling system design), Aerodynamics (Wind power systems, car body design), Fluid pumping systems (Oil and gas pipelines), Manufacturing (Die-casting, metal processing), Electronics (electronics cooling, ink-jet printing), MEMS systems (microfluidics), Environmental assessment (pollution control).

LINKS

Association of Energy Engineers www.aeecenter.org
Institute for Sustainable Energy energy.utoronto.ca

BIOENGINEERING STREAM

Biomedical engineers design and develop products for the most complex system on earth – the human body. Artificial organs, medical imaging devices, drug delivery systems are innovative and lifesaving solutions that arise from applying engineering principles to medical problems. Biomedical engineering jobs are expected to increase by 31.4% over the next seven years, more than double the average predicted rate in other fields.

STREAM COURSES

Students may choose to take either BME331 OR CHE354 for their 3W stream course.

3W - BME331H1S - PHYSIOLOGICAL CONTROL SYSTEMS

Introduces physiological concepts and selected physiological control systems present in the human body, and proposes quantitative modeling approaches for these systems. Topics covered will include (1) the endocrine system and its subsystems, including glucose regulation and the stress response, (2) the cardiovascular system and related aspects such as cardiac output, venous return, control of blood flow by the tissues, and nervous regulation of circulation, and (3) the nervous and musculoskeletal systems, including the control of voluntary motion. Linear control theory will be used to develop skills in system modeling and examine concepts of system response and system control in the context of a healthy human body.

TOPICS: Homeostasis, modeling physical systems (Laplace transform), transfer functions & block diagrams, endocrine system, cardiovascular system, system response in time and frequency domains, stability analysis, nervous system, design of PID controllers, controllability and observability, system identification.

3W - CHE354H1S- CELL & MOLECULAR BIOLOGY

Prerequisite: CHE353H1F. This course will cover the principles of molecular and cellular biology as they apply to both prokaryotic and eukaryotic cells. Topics will include: metabolic conversion of carbohydrates, proteins, and lipids; nucleic acids; enzymology; structure and function relationships within cells; and motility and growth. Genetic analysis, immunohistochemistry, hybridomis, cloning, recombinant DNA and biotechnology will also be covered. This course will appeal to students interested in environmental microbiology, biomaterials and tissue engineering, and bioprocesses.

Students may choose to take either MIE439 OR MIE458 for their 4F stream course.

4F – MIE439H1F - CELLULAR AND TISSUE BIOMECHANICS

Introduction to the application of the principles of mechanical engineering - principally solid mechanics and rheology - to living systems. Topics include cellular mechanics and hard and soft tissue mechanics, with consideration of both experimental approaches and analytical modelling. Applications of these topics to biomimetic and biomechanical design are emphasized through a major, integrative group project.

4F – MIE458H1F - BIOFLUID MECHANICS

This course will teach students how to apply fundamental fluid mechanics to the

study of biological systems. The course is divided into three modules, with the focus of the first two modules on the human circulatory and respiratory systems, respectively. Topics covered will include blood rheology, blood flow in the heart, arteries, veins and microcirculation, the mechanical properties of the heart as a pump; air flow in the lungs and airways, mass transfer across the walls of these systems, the fluid mechanics of the liquid-air interface of the alveoli, and artificial mechanical systems and devices for clinical aid. The third and final module will cover a range of other fluid problems in modern biology.

SUGGESTED TECHNICAL ELECTIVES (4TH YEAR ONLY)

COURSE CODE	*COURSE TITLE*
MIE437H1	Fundamentals of Injury Biomechanics and Prevention
BME466H1	Drug Delivery at Biological Barriers and Interfaces
BME488H1	Intro to Immunoengineering
BME520H1	Imaging Case Studies in Clinical Engineering
BME595H1	Medical Imaging
CHE475H1	Biocomposites: Mechanics and Bioinspiration
MIE504H1	Applied Computational Fluid Dynamics
MIE550H1	Advanced Momentum, Heat and Mass Transfer
MIE533H1	Waves and Their Applications in Non-Destructive Testing and Imaging

FIELDS OF APPLICATION

Bioinformatics (software for bio modelling), Biotechnology (products related to agriculture & environment), Instrumentation and Diagnostics (tools for research, hospital diagnostic equipment), Medical Devices (prosthetics, pace makers), Therapeutics (Pharmaceuticals), Biomedical Suppliers (development of lab and medical equipment)

LINKS

Institute of Biomaterials and Biomedical Engineering (IBBME)
https://bme.utoronto.ca/

Club for Undergraduate Biomedical Engineering (CUBE)

https://cube.skule.ca/

BIOENGINEERING MINOR

SAMPLE COURSE SELECTION FOR MINOR (3RD YEAR)

NATURAL SCIENCE ELECTIVE	
CHE353H1	Engineering Biology
STREAM OPTIONS	
Bioengineering **CHE354H1**	Cellular and Molecular Biology
Bioengineering **BME331**	Physiological Control Systems

SAMPLE COURSE SELECTION FOR MINOR (4TH YEAR)

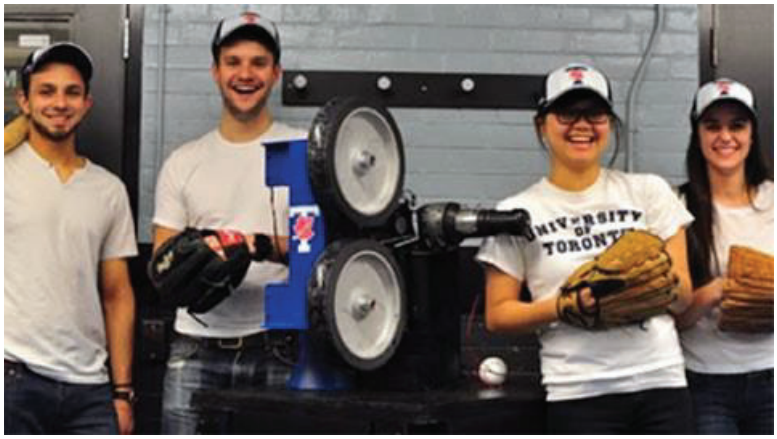
STREAM OPTIONS	
Bioengineering **MIE439H1**	Cellular and Tissue Biomechanics
Bioengineering **MIE458H1**	Biofluid Mechanics
TECHNICAL ELECTIVES	
MIE523H1	Engineering Psychology and Human Performance
BME595H1	Medical Imaging
CHE475H1	Biocomposites: Mechanics and Bioinspiration
FOR424H1	Innovation and Manufacturing of Sustainable Material
COMPLEMENTARY STUDIES ELECTIVE	
HPS318H1	History of Medicine I
HPS319H1	History of Medicine II
FOR308H1	Discovering Wood and its Role in Societal Development

Note: If you are pursuing any minor please refer to the Academic Calendar for more information on taking the required courses to achieve that minor. This may require overloading. Enrolling in a stream does not mean that you will complete a minor in that area.

For more information, please refer to Bioengineering Minor.

MIE491/APS490: CAPSTONE DESIGN

The capstone design course provides an experience in engineering practice through a significant design project. Student teams meet specific client needs through a creative, interactive, and open-ended design process.



Throughout the fourth year of your program, you will work with a faculty supervisor and an industry client on a Capstone Design Project. The Capstone Design Project provides you with an opportunity to work on a problem of real value to your client. You will work with them and your supervisor to define your project goals (within the scope of the problem identified), to decide how you will go about achieving these goals and to organize yourself to achieve them.

All capstone projects fall into one of the following categories:

STANDARD CAPSTONE PROJECT: These projects are sourced by MIE Capstone Coordinators/MIE faculty members and each project is supervised by a single MIE faculty member.

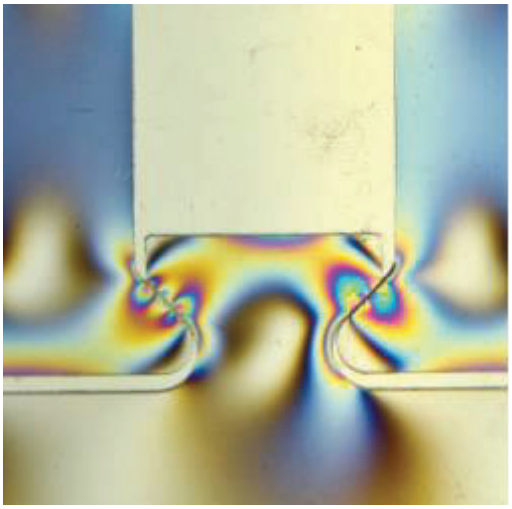
STUDENT-SOURCED CAPSTONE PROJECT: These projects are sourced by students through PEY Co-op or other industry contacts. Students must form a team and find a single MIE faculty member to supervise their project. Students interested in this type of project must submit their proposed project for approval by **mid-June**.

MULTIDISCIPLINARY PROJECTS (APS490Y): These projects are sourced by capstone coordinators across the Faculty of Applied Science and the Multidisciplinary Capstone course coordinator. They require team members from at least two disciplines and are supervised by a single engineering faculty member. These projects have an accelerated self-selection and matching process, and may require a competitive interview.

PROJECT SELECTION

For those interested in the **Multidisciplinary** and/or **Standard Capstone Projects,** you can apply as soon as the projects are posted (typically in May). Matching will be finalized by mid-August. ***Competitive selection**

MIE498H1/Y1: RESEARCH THESIS



The purpose of MIE498 is two-fold: to enable students to pursue a technical project of interest, and to improve their communication skills. **It is particularly useful for students thinking about graduate school and who want to learn more about engineering research.** Preparing a Progress Report and a Thesis gives students experience in technical writing, and making oral presentations about their projects helps students improve their oral communication skills. MIE498 is an important course in the curriculum because an engineering graduate should be able to present to prospective employers proficiently.

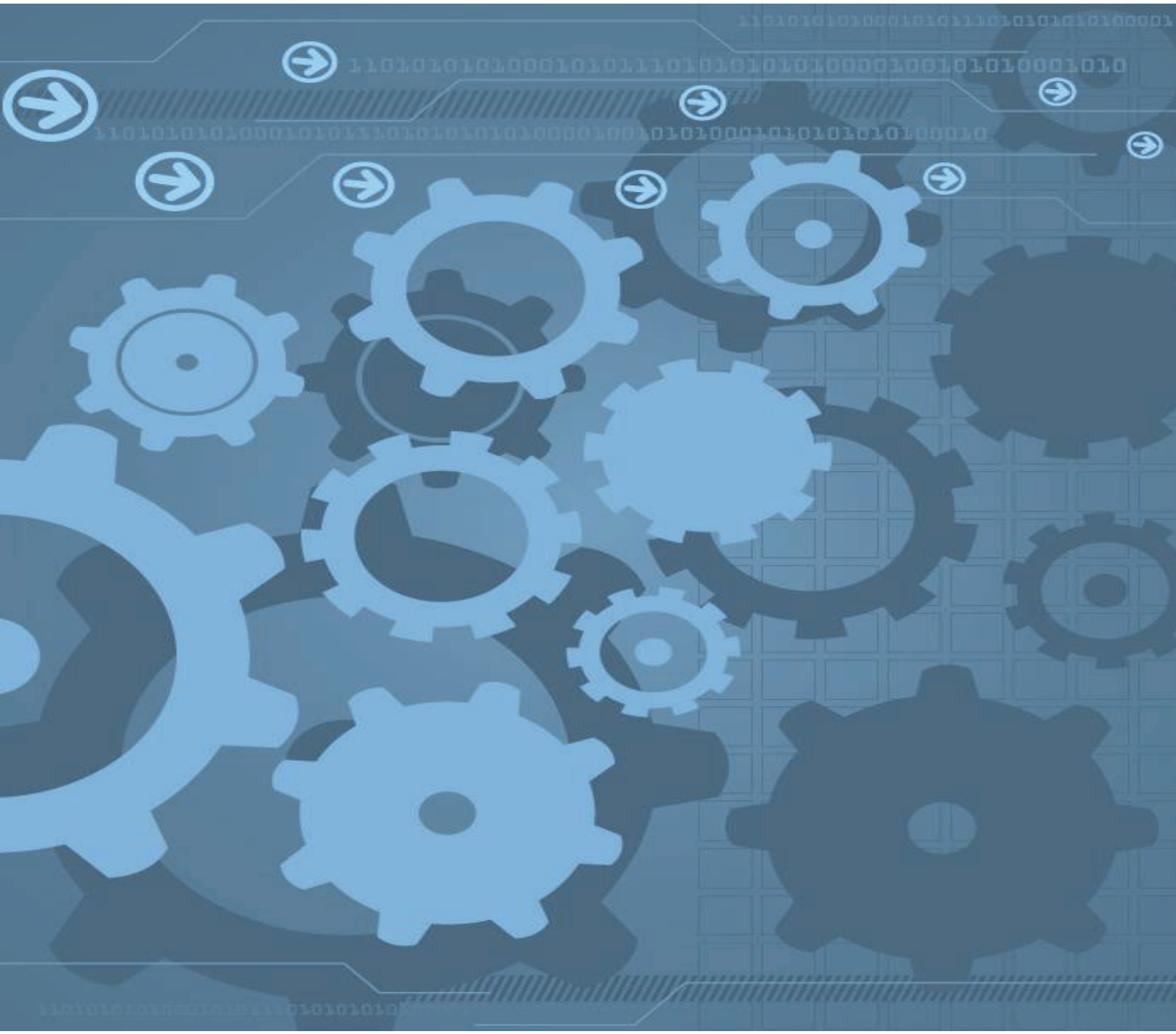
Formal approval to register for the fourth-year thesis must be obtained from the Undergraduate Office. **Enrolment in our thesis course is restricted to students**

with an overall CGPA of at least 2.7 This criterion can be relaxed under exceptional circumstances with the written approval of the supervisor.

At the beginning of the term, students will establish with the supervisor, in writing, which reports are to be submitted, the content of these reports, their due dates, and the grading scheme. **The Thesis Enrolment Form and research proposal, however, must be submitted to the Undergraduate Office by one week before the course add date and is not negotiable.**

In the event your thesis project is not approved, as part of COS and on course selection day, please select a back-up approved curriculum technical elective. By submitting your thesis form on time, you will receive a decision before the course add deadline.

Enrolment Procedure: Please review the guidelines here.



MIE UG OFFICE CONTACT INFORMATION

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