

# Engineering Practice

This section presents the requirements for programs in:

- **Master of Engineering - Engineering Practice**

## Master of Engineering - Engineering Practice (5.0 credits)

### Master of Engineering - Engineering Practice (Civil)

#### Requirements:

#### 1. 2.0 credits from: 2.0

EGEN 5100 [0.5]	Reinforced and Prestressed Concrete Design
EGEN 5101 [0.5]	Design of Steel Structures
EGEN 5102 [0.5]	Masonry Behaviour and Design
EGEN 5103 [0.5]	Pavements and Materials
EGEN 5104 [0.5]	Traffic Engineering
EGEN 5105 [0.5]	Foundation Engineering
EGEN 5106 [0.5]	Fundamentals of Fire Safety Engineering
EGEN 5107 [0.5]	Design for Fire Resistance
EGEN 5099 [0.5]	Directed Studies (with permission of program director only, and support of a full-time faculty member)

#### 2. 0.5 credit in: 0.5

ECMP 5000 [0.5]	Engineering Communications
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#### 3. 0.5 credit in: 0.5

ECMP 5001 [0.5]	Project Management
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#### 4. 0.5 credit in: 0.5

ECMP 5002 [0.5]	Research Methods and Professional and Ethical Practice
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#### 5. 1.5 credits from: 1.5

ECMP 5003 [0.5]	Entrepreneurship
ECMP 5004 [0.5]	Engineering Economics
ECMP 5005 [0.5]	Data Analytics
ECMP 5006 [0.5]	Governance, Policy Development and Decision-making
ECMP 5007 [0.5]	Climate Change and Sustainability
ECMP 5008 [0.5]	Risk Analysis

#### 6. 0.0 credit in: 0.0

ECMP 5009 [0.0]	Research Seminar
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#### Total Credits 5.0

### Master of Engineering - Engineering Practice (Software)

#### Requirements:

#### 1. 2.0 credits from: 2.0

EGEN 5200 [0.5]	Advanced Operating Systems
EGEN 5201 [0.5]	Embedded Systems Development
EGEN 5202 [0.5]	Secure Systems Engineering
EGEN 5203 [0.5]	Test-driven and Agile Software Development

EGEN 5204 [0.5]	In-memory and Stream Computing
EGEN 5205 [0.5]	Software Development for Parallel and Distributed Architectures

EGEN 5206 [0.5]	Web and Mobile Software Development
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EGEN 5207 [0.5]	Quantum Computing
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EGEN 5099 [0.5]	Directed Studies (with permission of program director only, and support of a full-time faculty member)
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#### 2. 0.5 credit in: 0.5

ECMP 5000 [0.5]	Engineering Communications
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#### 3. 0.5 credit in: 0.5

ECMP 5001 [0.5]	Project Management
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#### 4. 0.5 credit in: 0.5

ECMP 5002 [0.5]	Research Methods and Professional and Ethical Practice
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#### 5. 1.5 credits from: 1.5

ECMP 5003 [0.5]	Entrepreneurship
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ECMP 5004 [0.5]	Engineering Economics
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ECMP 5005 [0.5]	Data Analytics
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ECMP 5006 [0.5]	Governance, Policy Development and Decision-making
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ECMP 5007 [0.5]	Climate Change and Sustainability
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ECMP 5008 [0.5]	Risk Analysis
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#### 6. 0.0 credit in: 0.0

ECMP 5009 [0.0]	Research Seminar
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#### Total Credits 5.0

### Master of Engineering - Engineering Practice (Electrical)

#### Requirements:

#### 1. 2.0 credits from: 2.0

EGEN 5300 [0.5]	Signal Processing
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EGEN 5301 [0.5]	Integrated Circuits
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EGEN 5302 [0.5]	Modeling and Simulation of Electrical Circuits
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EGEN 5303 [0.5]	Sensor Systems
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EGEN 5304 [0.5]	Microprocessor Systems
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EGEN 5305 [0.5]	Power Systems
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EGEN 5306 [0.5]	Telecommunications Systems and Networks
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EGEN 5307 [0.5]	Control Systems and Robotics
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EGEN 5099 [0.5]	Directed Studies (with permission of program director only, and support of a full-time faculty member)
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#### 2. 0.5 credit in: 0.5

ECMP 5000 [0.5]	Engineering Communications
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#### 3. 0.5 credit in: 0.5

ECMP 5001 [0.5]	Project Management
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#### 4. 0.5 credit in: 0.5

ECMP 5002 [0.5]	Research Methods and Professional and Ethical Practice
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#### 5. 1.5 credits from: 1.5

ECMP 5003 [0.5]	Entrepreneurship
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ECMP 5004 [0.5]	Engineering Economics
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ECMP 5005 [0.5]	Data Analytics
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ECMP 5006 [0.5]	Governance, Policy Development and Decision-making
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ECMP 5007 [0.5]	Climate Change and Sustainability
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ECMP 5008 [0.5]	Risk Analysis
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#### 6. 0.0 credit in: 0.0

ECMP 5009 [0.0]	Research Seminar
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#### Total Credits 5.0

### Master of Engineering - Engineering Practice (Environmental)

#### Requirements:

<b>1. 2.0 credits from:</b>	<b>2.0</b>
EGEN 5400 [0.5]	Overview of Environmental Engineering Principles
EGEN 5401 [0.5]	Physical Processes in Water and Wastewater Treatment
EGEN 5402 [0.5]	Biological Processes in Water and Wastewater Treatment
EGEN 5403 [0.5]	Groundwater and Soil Remediation
EGEN 5404 [0.5]	Solid Wastes and Landfill
EGEN 5405 [0.5]	Air Pollution and Emission Control
EGEN 5406 [0.5]	Climate Change and Engineering
EGEN 5407 [0.5]	Environmental Impact Assessment
EGEN 5099 [0.5]	Directed Studies (with permission of program director only, and support of a full-time faculty member)
<b>2. 0.5 credit in:</b>	<b>0.5</b>
ECMP 5000 [0.5]	Engineering Communications
<b>3. 0.5 credit in:</b>	<b>0.5</b>
ECMP 5001 [0.5]	Project Management
<b>4. 0.5 credit in:</b>	<b>0.5</b>
ECMP 5002 [0.5]	Research Methods and Professional and Ethical Practice
<b>5. 1.5 credits from:</b>	<b>1.5</b>
ECMP 5003 [0.5]	Entrepreneurship
ECMP 5004 [0.5]	Engineering Economics
ECMP 5005 [0.5]	Data Analytics
ECMP 5006 [0.5]	Governance, Policy Development and Decision-making
ECMP 5007 [0.5]	Climate Change and Sustainability
ECMP 5008 [0.5]	Risk Analysis
<b>6. 0.0 credit in:</b>	<b>0.0</b>
ECMP 5009 [0.0]	Research Seminar
<b>Total Credits</b>	<b>5.0</b>

### Master of Engineering - Engineering Practice (Mechanical)

#### Requirements:

<b>1. 2.0 credits from:</b>	<b>2.0</b>
EGEN 5500 [0.5]	Applied Fluid Mechanics
EGEN 5501 [0.5]	Computational Fluid Mechanics
EGEN 5502 [0.5]	Thermodynamics and Energy Systems
EGEN 5503 [0.5]	Transport Phenomena (Heat and Mass)
EGEN 5504 [0.5]	Kinematics and Dynamics
EGEN 5505 [0.5]	Controls and Robotics
EGEN 5506 [0.5]	Mechanics and Fracture
EGEN 5507 [0.5]	Surfaces and Interfacial Phenomena
EGEN 5508 [0.5]	Introduction to Advanced Materials
EGEN 5099 [0.5]	Directed Studies (with permission of program director only, and support of a full-time faculty member)
<b>2. 0.5 credit in:</b>	<b>0.5</b>
ECMP 5000 [0.5]	Engineering Communications

<b>3. 0.5 credit in:</b>	<b>0.5</b>
ECMP 5001 [0.5]	Project Management
<b>4. 0.5 credit in:</b>	<b>0.5</b>
ECMP 5002 [0.5]	Research Methods and Professional and Ethical Practice
<b>5. 1.5 credits from:</b>	<b>1.5</b>
ECMP 5003 [0.5]	Entrepreneurship
ECMP 5004 [0.5]	Engineering Economics
ECMP 5005 [0.5]	Data Analytics
ECMP 5006 [0.5]	Governance, Policy Development and Decision-making
ECMP 5007 [0.5]	Climate Change and Sustainability
ECMP 5008 [0.5]	Risk Analysis
<b>6. 0.0 credit in:</b>	<b>0.0</b>
ECMP 5009 [0.0]	Research Seminar
<b>Total Credits</b>	<b>5.0</b>

### Admission

The requirement for admission to the M. Engineering - Engineering Practice is a four-year bachelor's degree in civil, computer, electrical, environmental, mechanical engineering, or software (students with other engineering degree disciplines should contact the Faculty for special consideration) from an institution recognized by Engineers Canada under the Washington Accord, with an average of at least B+. Applicants should note that simply meeting the minimum standards for admission will not guarantee admission to the program as there are only a limited number of positions available each year.

### Transfer and Transfer Credit

Graduate students currently registered in other graduate programs in Engineering at Carleton University, and who hold a four-year bachelor's degree in engineering from an institution recognized by Engineers Canada under the Washington Accord can transfer into this program. Transfer credit will be awarded for courses where a grade of B or higher was earned in other graduate programs in Engineering at Carleton University towards the fulfilment of discipline specific Engineering course requirements.

### Regulations

See the General Regulations section of this Calendar.

### Regularly Scheduled Break

For immigration purposes, the summer term (May to August) for the Master of Engineering - Engineering Practice is considered a regularly scheduled break approved by the University. Students should resume full-time studies in September.

**Note:** a Regularly Scheduled Break as described for immigration purposes does not supersede the requirement for continuous registration in Thesis, Research Essay, or Independent Research Project as described in Section 8.2 of the Graduate General Regulations.

## **Engineering Complementary Courses (ECMP) Courses**

### **ECMP 5000 [0.5 credit]**

#### **Engineering Communications**

Designed to advance the student's ability to communicate technical ideas and conclusions effectively to peers and stakeholders. The course is divided into three sections involving the principles and practice of written, verbal, and graphical communication modes.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program.

### **ECMP 5001 [0.5 credit]**

#### **Project Management**

Introduction to project management tools, techniques, templates, and methodologies. This course examines the eight knowledge areas of the Project Management Institute (PMI) which provide an integrated approach to managing engineering projects.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program.

### **ECMP 5002 [0.5 credit]**

#### **Research Methods and Professional and Ethical Practice**

The technical and professional duties / responsibilities of engineers; the ethics of the engineering profession; technical and professional organizations. Engineers role in society, including elements of equity, sustainable development, environmental stewardship, public and worker safety and health considerations. Introduction to methods of engineering research.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program.

### **ECMP 5003 [0.5 credit]**

#### **Entrepreneurship**

Introduction to the conceptual and practical considerations in developing new products. The theory and practice of project management, innovation and entrepreneurship, business planning, marketing, and mobilizing human and financial resources applied to the creation of new business activities and ventures will be discussed.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program.

### **ECMP 5004 [0.5 credit]**

#### **Engineering Economics**

The application of engineering economics, financial analysis and market assessment to engineering alternatives in the planning, development and ongoing management of industrial enterprises.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program.

### **ECMP 5005 [0.5 credit]**

#### **Data Analytics**

Introduction to data analytics, including visualization and knowledge discovery in massive datasets; unsupervised learning: clustering algorithms; dimension reduction; supervised learning: pattern recognition, smoothing techniques, classification. Computer software will be used.

Prerequisite(s): enrolment in the M.Eng. - Engineering Practice program.

### **ECMP 5006 [0.5 credit]**

#### **Governance, Policy Development and Decision-making**

Provide a foundational knowledge level of key governance structures and political institutions at the Canadian federal, provincial, and municipal levels, as well as Indigenous structures. Scholarship on policy development, strategic thinking and decision making is introduced, along with the role of information.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program.

### **ECMP 5007 [0.5 credit]**

#### **Climate Change and Sustainability**

The complex and multifaceted elements of climate change and sustainable living are introduced in terms of the humanities, sciences, engineering, business and public policy perspectives, as well as root causes and potential adaptive responses.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program.

### **ECMP 5008 [0.5 credit]**

#### **Risk Analysis**

The challenge of living and operating responsibly within a finite level of risk is a ubiquitous aspect of engineered systems. A framework for the identification and evaluation of risk is provided through examples, and discussions include means to manage ongoing risk.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program.

### **ECMP 5009 [0.0 credit]**

#### **Research Seminar**

A series of invited lectures to present the motivation, methodologies, results, and societal implications of ongoing engineering research projects occurring within the Faculty. Graded SAT/UNS.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program.

## **Engineering General (EGEN) Courses**

### **EGEN 5099 [0.5 credit]**

#### **Directed Studies**

Independent research project supervised by a full time faculty member who will provide mentorship for the project.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program.

### **EGEN 5100 [0.5 credit]**

#### **Reinforced and Prestressed Concrete Design**

Design of prestressed concrete structures; masonry and reinforced masonry elements.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program.

### **EGEN 5101 [0.5 credit]**

#### **Design of Steel Structures**

Brittle fracture and fatigue problems. Behavior and design of composite beams and plate girders. Discussion of frame behavior; overall buckling and instability concepts as related to the design of columns and bracing systems.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Civil Engineering or permission of the Director.

### **EGEN 5102 [0.5 credit]**

#### **Masonry Behaviour and Design**

Historical developments. Masonry units, mortars and grouts. Behavior, strength and stability of masonry under axial compression. Reinforced masonry in bending and combined axial load and bending. Ductility and joint control. Design application including discussion of code requirements.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Civil Engineering or permission of the Director.

### **EGEN 5103 [0.5 credit]**

#### **Pavements and Materials**

Advanced pavement management, network and project level management, data collection and management, pavement evaluation, pavement design, rehabilitation and maintenance, pavement performance models, life cycle analysis, implementation of pavement management systems, future directions and research needs.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Civil Engineering or permission of the Director.

### **EGEN 5104 [0.5 credit]**

#### **Traffic Engineering**

Human factors, traffic control devices, signal warrants, principles of signalized intersections, signal timing, signal optimization and coordination, capacity, traffic delay, left turn, diamond interchange, unsignalized intersection, roundabouts, actuated control, incident management, freeway control.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Civil Engineering or permission of the Director.

### **EGEN 5105 [0.5 credit]**

#### **Foundation Engineering**

Review of methods of estimating compression and shear strength of soils. Bearing capacity and performance of shallow and deep foundations, pile groups, and use of in-situ testing for design purposes.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Civil Engineering or permission of the Director.

### **EGEN 5106 [0.5 credit]**

#### **Fundamentals of Fire Safety Engineering**

The fire safety system, including social, economic and environmental issues; description of the fire safety regulatory system and the governing building codes and standards. This includes the global fire safety system in a facility and active fire protection systems; detection, suppression, smoke management.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Civil Engineering or permission of the Director.

### **EGEN 5107 [0.5 credit]**

#### **Design for Fire Resistance**

Behaviour of materials and structures at elevated temperatures; fire-resistance tests; fire-resistance ratings; building code requirements; real-world fires; assessing the fire resistance of steel, concrete and wood building assemblies.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Civil Engineering or permission of the Director.

**EGEN 5200 [0.5 credit]****Advanced Operating Systems**

Advanced process of state transitions, operations, interrupts, and parallel processes. Multiprocessor considerations of resource allocation, critical events, deadlock avoidance, detection, and recovery. Memory management strategies (paging page management, scheduling algorithms; file system functions, file organization, space allocation and elements of operating systems security.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Computer or Software Engineering or permission of the Director.

**EGEN 5201 [0.5 credit]****Embedded Systems Development**

Applications of embedded systems and challenges of embedded systems design; embedded processors, embedded reconfigurable hardware, embedded software; specification, modeling, design and verification of embedded systems; real time systems; construction of event-driven systems; performance issues; practical examples.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Computer or Software Engineering or permission of the Director.

**EGEN 5202 [0.5 credit]****Secure Systems Engineering**

Causes and consequences of computer system failure. Structure of fault-tolerant computer systems. Methods for protecting software and data against computer failure. Quantification of system reliability. Introduction to formal methods for safety-critical systems. Computer and computer network security.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Computer or Software Engineering or permission of the Director.

**EGEN 5203 [0.5 credit]****Test-driven and Agile Software Development**

Software requirements specification and testing. Risk analysis and metrics for software testing. Software testing process; test planning, design, implementation, execution, and evaluation. Test design via white and black box approaches; coverage-based testing techniques. Unit, integration, and system testing. Acceptance tests. Software maintenance and regression testing.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Computer or Software Engineering or permission of the Director.

**EGEN 5204 [0.5 credit]****In-memory and Stream Computing**

Review of data storage and scalability of systems with respect to random-access memory (RAM) and parallelization technologies. In-memory processes that provide real time insights by combining logic, analytics, and data. Potential applications include e-commerce, transportation.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Computer or Software Engineering or permission of the Director.

**EGEN 5205 [0.5 credit]****Software Development for Parallel and Distributed Architectures**

Advanced parallel programming and distributed systems, and high-performance computing in engineering. Both shared-memory parallel computers and distributed-memory multicomputers are considered. Aspects of the practice of parallelism will be covered. Emphasis is on thread programming, data-parallel programming, and performance evaluation.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Computer or Software Engineering or permission of the Director.

**EGEN 5206 [0.5 credit]****Web and Mobile Software Development**

Developing web and mobile applications. Topics include: client-side/mobile programming language, development tools, graphical user interface patterns (e.g., event-driven programming, separation of content and presentation, layout policies) and framework, interactions with the server-side.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Computer or Software Engineering or permission of the Director.

**EGEN 5207 [0.5 credit]****Quantum Computing**

Introduction to the theory and practice of quantum computation. Topics covered include quantum mechanics. Quantum algorithms including Simon's algorithm, prime factorization algorithm, and Grover's search algorithm. Mathematical models of quantum computation, as well as Quantum error correcting codes, cryptography, and fault tolerance.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Computer or Software Engineering or permission of the Director.



**EGEN 5300 [0.5 credit]****Signal Processing**

Practical application of processing techniques to the measurement, filtering and analysis of mechanical system signals; topics include: signal classification, A/D conversion, spectral analysis, digital filtering and real-time signal processing.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Electrical Engineering or permission of the Director.

**EGEN 5301 [0.5 credit]****Integrated Circuits**

Very Large-Scale Integration (VLSI) design techniques and their application. Electrical characteristics of MOSFET devices and CMOS circuits. Use of CAD tools for simulation and integrated circuit layout. Modeling delays, advanced digital logic circuit techniques, memory.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Electrical Engineering or permission of the Director.

**EGEN 5302 [0.5 credit]****Modeling and Simulation of Electrical Circuits**

Frequency response: active device high-frequency behaviour and circuit models; amplifier circuits and design. Feedback: concepts and structure; feedback topologies and amplifiers; open- and closed-loop response. Operational amplifiers: behaviour, circuit analysis and design.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Electrical Engineering or permission of the Director.

**EGEN 5303 [0.5 credit]****Sensor Systems**

Advanced topics dealing with technologies, transduction mechanisms, and fabricated sensors and actuators. Sensors for acceleration, rotation rate, pressure, and different micro actuators with application microfluidics, chemical, gas, and biosensors.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Electrical Engineering or permission of the Director.

**EGEN 5304 [0.5 credit]****Microprocessor Systems**

Advanced microcomputer architecture, assembly language programming, sub-routine handling, memory and input/output system and interrupt concepts.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Electrical Engineering or permission of the Director.

**EGEN 5305 [0.5 credit]****Power Systems**

Introduction to power system and their transient states. Power system voltage stability; PV and QV curve methods. Power system angular stability; transient stability and equal area criterion; steady-state stability and power system stabilizer. Electromagnetic transients in power systems, insulation coordination and equipment protection.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Electrical Engineering or permission of the Director.

**EGEN 5306 [0.5 credit]****Telecommunications Systems and Networks**

Provides a fundamental understanding of the design, development, implementation, operation, and management of telecommunications systems and networks, including theoretical knowledge and practical considerations for reliable systems across a range of sizes of operation.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Electrical Engineering or permission of the Director.

**EGEN 5307 [0.5 credit]****Control Systems and Robotics**

Fundamental aspects of modeling and control of robot manipulators as devices that involve mechanics (kinematics and dynamics), electronic actuators, information theory, and automation, as well issues workspace, over and under actuated systems, and strategies for force management.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Electrical Engineering or permission of the Director.

**EGEN 5400 [0.5 credit]****Overview of Environmental Engineering Principles**

Basic mechanisms of chemistry, biology, and physics relevant to environmental engineering. Principles of equilibrium, mass transfer, material balances, microbial growth, water, energy, and nutrient cycles. Applications to environmental systems as biological degradation, mass and energy movement, and design of water and wastewater treatment systems.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Environmental Engineering or permission of the Director.

**EGEN 5401 [0.5 credit]****Physical Processes in Water and Wastewater Treatment**

Theory and design of chemical and physical unit processes utilized in the treatment of water and wastewater, sedimentation, flotation, coagulation, precipitation, filtration, disinfection, ion exchange, reverse osmosis, adsorption, and gas transfer.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Environmental Engineering or permission of the Director.

**EGEN 5402 [0.5 credit]****Biological Processes in Water and Wastewater Treatment**

Study of the theoretical and applied aspects of wastewater treatment by activated sludge, fixed and moving biological films, conventional and aerated lagoons, sludge digestion, septic tanks, land treatment, and nutrient removal. Guidelines, regulations and economics. System analysis and design of facilities.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Environmental Engineering or permission of the Director.

**EGEN 5403 [0.5 credit]****Groundwater and Soil Remediation**

Principles of groundwater chemistry, the chemical evolution of natural groundwater flow systems, sources of contamination, and mass transport processes. Hydrogeologic aspects of waste disposal and groundwater remediation.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Environmental Engineering or permission of the Director.

**EGEN 5404 [0.5 credit]****Solid Wastes and Landfill**

Principles of solid waste management to protect public health. Study of solid waste components, refuse collection, storage, and handling. Design and operation of solid waste transfer and disposal facilities including transfer stations, resource recovery and composting facilities, incinerators, and landfills.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Environmental Engineering or permission of the Director.

**EGEN 5405 [0.5 credit]****Air Pollution and Emission Control**

Types of gaseous and particulate pollutants and their sources, effects of air pollution on man, vegetation, and materials, indoor air pollution, sampling and analysis of air pollutants, air pollution meteorology and dispersion, control techniques for gaseous and particulate pollutants, and air quality management aspects.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Environmental Engineering or permission of the Director.

**EGEN 5406 [0.5 credit]****Climate Change and Engineering**

Current and projected impacts of climate change on the circumpolar north, including the land, its biota, northern communities, drivers that shape these interactions, as well as how these impact engineered structures.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Environmental Engineering or permission of the Director.

**EGEN 5407 [0.5 credit]****Environmental Impact Assessment**

Principles and elements of environmental assessment with an interdisciplinary focus. Topics include types of environmental assessments, when to use them, data required, sampling strategies, how data should be collected and analyzed and ultimately communicated to pass legal and scientific scrutiny.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Environmental Engineering or permission of the Director.

**EGEN 5500 [0.5 credit]****Applied Fluid Mechanics**

Kinematics of fluid motion, fundamental fluid equations and concepts, laminar boundary layers, potential flow, stability and transition, introduction to turbulence, practical examples in mechanical engineering.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Mechanical Engineering or permission of the Director.

**EGEN 5501 [0.5 credit]****Computational Fluid Mechanics**

Solutions of the transport equations of momentum, mass, and energy. Transport processes are reviewed but emphasis is placed on the numerical solution of the governing differential equations. Different solution methodologies and software.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Mechanical Engineering or permission of the Director.

**EGEN 5502 [0.5 credit]****Thermodynamics and Energy Systems**

Principles of thermodynamics; properties of homogeneous fluid phases; phase and chemical equilibria; application to industrial and energy problems.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Mechanical Engineering or permission of the Director.

**EGEN 5503 [0.5 credit]****Transport Phenomena (Heat and Mass)**

Transport expressions for physical properties are combined with conservation laws to yield generalized equations used to solve a variety of engineering problems in fluid mechanics, and heat and mass transfer; steady-state and transient cases; special topics in non-Newtonian flow and forced diffusion.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Mechanical Engineering or permission of the Director.

**EGEN 5504 [0.5 credit]****Kinematics and Dynamics**

Kinematics and dynamics of rigid bodies moving in three dimensions. Spatial kinematics of rigid bodies, Euler angles, tensor of inertia and the Newton-Euler equations of motion for rigid bodies.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Mechanical Engineering or permission of the Director.

**EGEN 5505 [0.5 credit]****Controls and Robotics**

Introduction to advanced robotics including mobile robots, redundant manipulators, walking robots, aerial and marine autonomous vehicles. Kinematic and dynamic models for advanced robots. Linear and nonlinear control theory overview with applications to advanced robots.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Mechanical Engineering or permission of the Director.

**EGEN 5506 [0.5 credit]****Mechanics and Fracture**

Basic concepts of linear and nonlinear fracture mechanics: linear and nonlinear stationary crack-tip stress, strain and displacement fields; energy balance and energy release rates; fracture resistance concepts-static and dynamic fracture toughness; criteria for crack growth; fracture control methodology and applications.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Mechanical Engineering or permission of the Director.

**EGEN 5507 [0.5 credit]****Surfaces and Interfacial Phenomena**

Basics of colloid and interfacial phenomena with application to the energy sector, materials, processing, and biomedical industry.

Prerequisite(s): enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Mechanical Engineering or permission of the Director.

**EGEN 5508 [0.5 credit]****Introduction to Advanced Materials**

Introduction to advanced materials focusing on emerging materials like fibre-reinforced composite materials. Manufacturing methods of lightweight, safe and environment-friendly structures and their use in the industry. Standard analytical techniques (Micro and Macro approach) for materials' mechanical characterization and strength theories. Failure analysis of composites.

Includes: Experiential Learning Activity