

MECHATRONICS AND ROBOTICS ENGINEERING

Courses

MREN 103 Mechatronics Design I Units: 4.00

This course introduces students to basic engineering design methods and tools that are employed for developing mechatronic and robotic systems. The first part of the course consists of a series of laboratories and a hands-on project that introduce students to elements of mechatronic and robotic hardware and software. In the second part of the course, client-based team design projects will further develop skills that include communication, teamwork, project management and professionalism. The nature of the projects will be such that students will be required to reflect on the impact of their designs on society and the environment. The course encourages a sense of creativity and curiosity about robotics and mechatronics engineering. Students will use their knowledge of engineering graphics as acquired in APSC 162.

K4(Lec: Yes, Lab: Yes, Tut: No)

Requirements: Prerequisites: APSC 101, APSC 102

Corequisites: Exclusions:

Offering Term: W

CEAB Units:

Mathematics 0

Natural Sciences 0

Complementary Studies 26

Engineering Science 6

Engineering Design 16

Offering Faculty: Fac of Engineering Appl Sci

MREN 104 Mechatronics Design Project Units: 1.70

This course introduces students to basic engineering design methods and tools that are employed for developing mechatronic and robotic systems. The course consists of a series of laboratories and a hands-on project that introduce students to elements of mechatronic and robotic hardware and software. The course encourages a sense of creativity and curiosity about robotics and mechatronics engineering. This course covers the content and objectives of MREN 103, that are not covered by APSC 103 and is intended for transfer students into the second year of the MRE program. Students will use their knowledge of engineering graphics as acquired in APSC 162.

K1.7(Lec: Yes, Lab: Yes, Tut: Yes)

Requirements: Prerequisites: APSC 100, APSC 151 and permission of the instructor. Corequisites: Exclusions:

Offering Term: F

CEAB Units:

Mathematics 0

Natural Sciences 0

Complementary Studies 9

Engineering Science 3

Engineering Design 0

Offering Faculty: Fac of Engineering Appl Sci

MREN 178 Data Structures and Algorithms Units: 4.00

This course introduces fundamental structures and algorithms for storing, managing, manipulating and analyzing data. Topics covered include structures, such as multidimensional arrays, linked lists, stacks, queues, deques, asymptotic notation, hash and scatter tables, trees and search trees, heaps and priority queues, graphs, and algorithms such as recursion, branch-and-bound methods, searching, sorting, and probabilistic algorithms. Microcontroller-based laboratory exercises will explore applications of data structures and algorithms, using examples drawn from mechatronics and robotics engineering.

(Lec: 3, Lab: 0.5, Tut: 0.5)

Requirements: Prerequisites: APSC 143 or MNTC 313

Corequisites: Exclusions: ELEC 278 or CISC 235

Offering Term: W

CEAB Units:

Mathematics 12

Natural Sciences 0

Complementary Studies 0

Engineering Science 24

Engineering Design 12

Offering Faculty: Fac of Engineering Appl Sci



MREN 203 Mechatronics Design II Units: 4.00

This course introduces students to the engineering design process, while integrating knowledge of mechatronic and robotic equipment from MREN 103. The first part of the course will be a paper-based design project, with focus on mechatronics and robotics, that will introduce a formal engineering design process, incorporating elements of problem and scope definition, creativity and idea generation and decision making incorporating economic, societal, and environmental factors. The second part of the course will be prototype-based design project, which includes both hardware and software development, that will provide experience with the design-build-test-fail cycle in engineering design. Students will develop and apply intermediate engineering writing and speaking skills with the emphasis on professional correspondence, engineering reports, oral briefings, and formal oral presentations. Elements of professional practice such as engineering codes, standards and ethics are addressed. The connection between the environment and human activity is explored from a systems perspective.

(Lec: 2, Lab: 2, Tut: 0)

Requirements: Prerequisites: MREN 103 Corequisites:
Exclusions:

Offering Term: W

CEAB Units:

Mathematics 0

Natural Sciences 0

Complementary Studies 24

Engineering Science 0

Engineering Design 33

Offering Faculty: Fac of Engineering Appl Sci

MREN 223 Signals and Systems Units: 5.00

This course covers the basic concepts and techniques for the modeling and analysis of signals and systems. Topics include signals, system properties, linear time-invariant systems, convolution, impulse response and step response in continuous-time and discrete-time domains; Fourier series; Fourier transforms, spectral analysis; fundamental concepts of filtering in continuous-time and discrete-time domains; AM modulation/demodulation; Laplace transforms, and frequency response; sampling, reconstruction, and digitization; z transform and frequency response. Computational realizations of the analysis tools and their applications are explored in the laboratory using MATLAB. (Lec: 4, Lab: 0.5, Tut: 0.5)

Requirements: Prerequisites: ELEC 221, and MTHE 235 or MTHE 237 Corequisites: Exclusions:

Offering Term: W

CEAB Units:

Mathematics 15

Natural Sciences 0

Complementary Studies 0

Engineering Science 45

Engineering Design 0

Offering Faculty: Fac of Engineering Appl Sci

MREN 230 Thermodynamics and Heat Transfer Units: 3.75

This course introduces fundamental thermodynamics and heat transfer concepts needed to analyze thermal systems including: ideal gas laws; work and heat; conservation of energy; thermodynamic properties of pure substances; equations of state; applications to open and closed systems; heat transfer by conduction, convection and radiation. Theory will be complemented with a series of labs that introduce temperature measurement devices and thermal circuit analysis.

(Lec: 3, Lab: 0.25, Tut: 0.5)

Requirements: Prerequisites: MREN 241 Corequisites:
Exclusions:

Offering Term: W

CEAB Units:

Mathematics 0

Natural Sciences 30

Complementary Studies 0

Engineering Science 15

Engineering Design 0

Offering Faculty: Fac of Engineering Appl Sci

MREN 241 Fluid Mechanics and Fluid Power Units: 3.75

An introductory course in fluid mechanics with application to fluid power systems. Topics include properties of fluids, fluids at rest, dimensional analysis, the laws of conservation of mass and momentum, Bernoulli's equation for incompressible flow and the energy equation, flow measurements, elementary pipe flow problems including losses due to pumps, valves etc. Laboratories will introduce students to pressure and flow measuring devices, pneumatic and hydraulic components and actuators, and circuit analysis of fluid power systems.

(Lec: 3, Lab: 0.25, Tut: 0.5)

Requirements: Prerequisites: APSC 111 Corequisites:

Exclusions:

Offering Term: F

CEAB Units:

Mathematics 0

Natural Sciences 30

Complementary Studies 0

Engineering Science 15

Engineering Design 0

Offering Faculty: Fac of Engineering Appl Sci

MREN 303 Mechatronics Design III Units: 4.00

In this course, students will apply their growing technical knowledge of mechatronics and robotics, and the formal engineering design process, to solve a multi-parameter design problem. Working in teams, students will work as a small start-up company that needs to come up with a market-specific technology product, while considering the impact of that product on the society and the environment. Each team must prepare a design proposal that describes their product's market need and high-level specifications, and schedule its milestones for the 12-week term. In addition, teams are required to create a working hardware/software prototype that is demonstrated before an audience at the end of the 12 weeks. Agile project management methodologies are encouraged to iteratively execute, evaluate and correct designs in an efficient way. Teams will demonstrate advanced communication skills by documenting their design process and their product's functional specifications through an online blog and a final report. The teams must have students from both the Mechanical and Electrical streams.

(Lec: 2, Lab: 2, Tut: 0)

Requirements: Prerequisites: MREN 203 Corequisites:

Exclusions:

Offering Term: W

CEAB Units:

Mathematics 0

Natural Sciences 0

Complementary Studies 15

Engineering Science 0

Engineering Design 33

Offering Faculty: Fac of Engineering Appl Sci

**MREN 318 Sensors and Electric Actuators Units: 5.50**

This course introduces the basic technologies, structures and operation principles of sensors and electric actuators used in mechatronic systems. The topics include physical principles for the measurement of motion, force, torque, pressure, flow, humidity, radiation (visible and IR) and temperature using analog and digital transducers; methods for signal collection, conditioning and analysis; actuating principles and steady-state characteristics of dc, induction, synchronous, stepper and servo motors, and power transmission systems. Various components will be experimentally tested and analyzed. (Lec: 4, Lab: 1, Tut: 0.5)

Requirements: Prerequisites: ELEC 271, ELEC 252, and MREN 223 Corequisites: Exclusions:

Offering Term: F

CEAB Units:

Mathematics 0
Natural Sciences 17
Complementary Studies 0
Engineering Science 31
Engineering Design 18

Offering Faculty: Fac of Engineering Appl Sci

MREN 320 Automation: Machine Design and Control Units: 3.50

This courses introduces fundamental concepts for designing automation machines: designing and specifying machine elements such as cams, gears and drives; designing mechanisms that generate different types of motion for part feeding, orienting, transferring and indexing; controlling motion through pneumatic and electric actuators and PLCs; machine vision systems for inspection; and condition monitoring machines for fault detection and safety. Students will get hands-on experience programming and controlling an automation machine through a series of labs with a tabletop mechatronic workcell. (Lec: 3, Lab: 0.5, Tut: 0)

Requirements: Prerequisites: MREN 223, ELEC 443 or MECH 350, or permission of the instructor. Corequisites: Exclusions:

Offering Term: W

CEAB Units:

Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 16
Engineering Design 26

Offering Faculty: Fac of Engineering Appl Sci

MREN 348 Intro to Robotics Units: 3.50

Robotics is an interdisciplinary subject concerning areas of mechanics, electronics, information theory, control systems and automation. This course provides an introduction to robotics and covers fundamental aspects of modeling and control of robot manipulators. Topics include history and application of robotics in industry, rigid body kinematics, manipulator forward, inverse and differential kinematics, workspace, singularity, redundancy, manipulator dynamics, trajectory generation, actuators, sensors, and manipulator position and contact force control strategies. Applications studied using MATLAB/Simulink software simulation and laboratory experiments. (Lec: 3, Lab: 0.5, Tut: 0)

Requirements: Prerequisites: MREN 223, ELEC 443 or MECH 350, or permission of the instructor. Corequisites: Exclusions:

Offering Term: W

CEAB Units:

Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 16
Engineering Design 26

Offering Faculty: Fac of Engineering Appl Sci

MREN 403 Mechatronics Design IV Units: 8.00

In this course, students culminate their learning of mechatronics and robotics, and engineering design, through a team-based capstone design project focused on solving a real-world, industry-level technical challenge, which includes a detailed design phase, as well as robust building and iterative design testing, leading to participation in and external design competition. The course is conducted over two terms. In addition to the design, build and testing of a mechatronics or robotics system, each team is required to demonstrate communication, teamwork, and management skills at a professional level by preparing a formal design proposal, which includes a management plan, providing regular progress reports, and submitting a final design report, together with a formal presentation on the project and its results. Top-placed teams in a preliminary internal design competition will be sponsored to represent Queen's University at an external design competition.

(Lec: 2, Lab: 6, Tut: 0)

Requirements: Prerequisites: Successful completion of the 3rd year of the MRE program
Corequisites: Exclusions:

Offering Term: FW

CEAB Units:

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 0

Engineering Design 0

Offering Faculty: Fac of Engineering Appl Sci

MREN 410 Intelligent Machines and Autonomous Systems Units: 3.50

This course provides students with a working knowledge of methods for design and analysis of robotic and intelligent machines that can think, learn and act in uncertain conditions. Topics include basic principles and methods of machine vision, machine learning and identification, decision-making, and their applications in the design of an autonomous system.

(Lec: 3, Lab: 0, Tut: 0.5)

Requirements: Prerequisites: MREN 178, MREN 223 and ELEC 371, or permission of the instructor
Corequisites: Exclusions:

Exclusions:

Offering Term: F

CEAB Units:

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 24

Engineering Design 18

Offering Faculty: Fac of Engineering Appl Sci