MECHATRONICS AND ROBOTICS ENGINEERING

Courses

MREN 103  Mechatronics and Robotics Design 1  Units: 4.00
This course introduces students to basic engineering design methods and tools that are employed for developing mechatronic and robotic systems. In the first part of the course, a client-based team design project will further develop skills that include communication, teamwork, project management, professionalism and ethics. The nature of the projects will be such that students will be required to reflect on the impact of their work on society and the environment. The second part of the course consists of a series of laboratories followed by a hands-on project that will introduce students to elements of mechatronic and robotic hardware and software. The course encourages a sense of creativity and curiosity about mechatronics and robotics engineering.

K4(Lec: Yes, Lab: Yes, Tut: No)
Requirements: Prerequisites: APSC 101 Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 26
Engineering Science 6
Engineering Design 16
Offering Faculty: Smith Engineering
Course Learning Outcomes:

1. CLOs coming soon; please refer to your course syllabus in the meantime.

MREN 104  Mechatronics and Robotics Design Project  Units: 2.00
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.
Note: this course is only open to students transferring into year 2 of the MRE program.

K2(Lec: Yes, Lab: Yes, Tut: No)
Requirements: Prerequisites: APSC 101, APSC 151 and permission of the instructor. Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 8
Engineering Science 4
Engineering Design 12
Offering Faculty: Smith Engineering
Course Learning Outcomes:

1. CLOs coming soon; please refer to your course syllabus in the meantime.
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 142 or 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: Smith Engineering
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MREN 203 Mechatronics and Robotics Design II  Units: 4.00
In this course, students will apply their growing technical knowledge of mechatronics and robotics, and the engineering design process, to solve an open-ended design problem. Working in teams, students will be provided with a kit of components from which they are required to design, build and test a mechatronics or robotics device that performs a certain task. The problem will be posed as an internal design competition. Prototyping and alternate design methodologies are presented to iteratively execute, evaluate and correct designs in an efficient way. Working prototypes are to be demonstrated before an audience at the end of the term. Teams will demonstrate advanced communication skills by documenting the design process and their project management. Elements of professionalism and ethics are addressed.
K4(Lec: Yes, Lab: Yes, Tut: No)
Requirements: Prerequisites: MREN 103, APSC 199 or have passed the English Proficiency Test Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 24
Engineering Science 0
Engineering Design 33
Offering Faculty: Smith Engineering
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.
MREN 223 Signals and Systems Units: 4.00
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 in continuous-time and discrete-time domains; Fundamentals of Fourier series; Fourier transforms, spectral analysis; Laplace transforms, and frequency response; sampling, reconstruction, and digitization; z transform and frequency response; fundamental concepts of filtering in continuous-time and discrete-time domains; Computational realizations of the analysis tools and their applications are explored in the laboratory.
(Lec: 3, Lab: 0.5, Tut: 0.5)
Requirements: Prerequisites: ELEC 221, and MTHE 235 or MTHE 237 Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 12
Natural Sciences 0
Complementary Studies 0
Engineering Science 36
Engineering Design 0
Offering Faculty: Smith Engineering
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

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: Smith Engineering
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.
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: Smith Engineering
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MREN 303 Mechatronics and Robotics Design III  Units: 4.00
In this course, students will apply their growing technical knowledge of mechatronics and robotics, and the engineering design process, to solve an open-ended design problem. Working in teams, students will be provided with a kit of components from which they are required to design, build and test a mechatronics or robotics device that performs a certain task. The problem will be posed as an internal design competition. Prototyping and alternate design methodologies are presented to iteratively execute, evaluate and correct designs in an efficient way. Working prototypes are to be demonstrated before an audience at the end of the term. Teams will demonstrate advanced communication skills by documenting the design process and their project management. Elements of professionalism and ethics are addressed.
K4(Lec:Yes, Lab: Yes, Tut: No)
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: Smith Engineering
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.
MREN 318 Sensors and Electric Actuators Units: 4.50
This course introduces the basic technologies, structures and operation principles of sensors and electric actuators used in mechatronic systems. The topics include methods for signal collection, conditioning and analysis; physical principles for the measurement of motion, force, torque, pressure, flow and temperature using analog and digital transducers; actuating principles and steady-state characteristics of dc, induction, synchronous, and special motors. Various components will be experimentally tested and analyzed.
(Lec: 3, Lab: 1, Tut: 0.5)
Requirements: Prerequisites: ELEC 271, ELEC 252, MREN 223
Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 14
Complementary Studies 0
Engineering Science 26
Engineering Design 14
Offering Faculty: Smith Engineering
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MREN 320 Industrial Automation Units: 3.50
Industrial automation is about the design of machines used in autonomous systems for the production of goods and services. It is an interdisciplinary subject concerning areas of machine design, sensors, actuators and control systems. This course covers central concepts of automation including hardware components for automation, mechanical actuation systems, automation design synthesis, logic design for automation processes, electro-pneumatic actuation, PLC programming and PLC-based applications of PID. Students will get hands-on experience with a PLC controlled automation machine through a series of labs.
(Lec: 2, Lab: 1, Tut: 0.5)
Requirements: Prerequisites: MREN 318, 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: Smith Engineering
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.
MREN 348 Introduction to Robotics  Units: 4.00
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: 0.5)
Requirements: Prerequisites: 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 22
Engineering Design 26
Offering Faculty: Smith Engineering
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.

MREN 403 Mechatronics and Robotics 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 project management plan, providing regular progress reports, and submitting a final design report, together with a formal presentation on the project and its results. Elements of professionalism and ethics are addressed.
K8(Lec: Yes, Lab: Yes, Tut: No)
Requirements: Prerequisites: MREN 303, MREN 318, MREN 348, MECH 350, ELEC 353, ELEC 371 or permission of the program. Corequisites: Exclusions: 
Offering Term: FW
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 28
Engineering Science 0
Engineering Design 68
Offering Faculty: Smith Engineering
Course Learning Outcomes:
1. CLOs coming soon; please refer to your course syllabus in the meantime.
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: 0.5, Tut: 0)
*Requirements:* Prerequisites: MREN 178, MREN 223 and ELEC 371, or permission of the instructor Corequisites:
Exclusions:
*Offering Term:* W
*CEAB Units:*
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 24
Engineering Design 18
*Offering Faculty:* Smith Engineering
*Course Learning Outcomes:*

1. CLOs coming soon; please refer to your course syllabus in the meantime.