MECHANICAL AND MATERIALS ENGINEERING

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The second year curriculum is common to all sub-plans, but prior to or during the second year, students select from the following options (sub-plans) for their third year: General (ME1) allows students to select technical electives from a variety of specialized areas of study; Materials (ME2) includes courses in materials and metallurgical engineering; or Biomechanical (ME3) includes courses in the biomechanical field. Note that with the wide variety of courses offered, the Department cannot guarantee all courses are conflict free or offered each calendar year, particularly for students who choose to transfer or change options in their third or fourth year. Transferring programs could also result in extending the length of the program beyond the typical 4 years.

Students are invited to participate in one of the international design competition teams such as the Autonomous Sailboat Team (MAST), Baja SAE Team, Formula SAE Team, SAE Aero Design Team, ECO Vehicle Design Team, Fuel Cell Design Team or the Solar Design Team.

Options available:

- General Option (ME1)
- Materials Option (ME2)
- Biomechanical Option (ME3)

Programs

- Mechanical and Materials Engineering, B.A.Sc. (Class of 2024) (https://queensu-ca-public.courseleaf.com/engineering-applied-sciences/academic-plans/mechanical-engineering/mechanical-materials-engineering-basc-class-2023/)
- Mechanical and Materials Engineering, B.A.Sc. (Class of 2025) (https://queensu-ca-public.courseleaf.com/engineering-applied-sciences/academic-plans/mechanical-engineering/mechanical-materials-engineering-basc-class-2024/)
- Mechanical and Materials Engineering, B.A.Sc. (Class of 2026) (https://queensu-ca-public.courseleaf.com/engineering-applied-sciences/academic-plans/mechanical-engineering/mechanical-materials-engineering-basc-class-2026/)
- Mechanical and Materials Engineering: Technical Electives (https://queensu-ca-public.courseleaf.com/engineering-applied-sciences/academic-plans/mechanical-engineering/mechanical-materials-engineering-technical-electives/)

Courses

MECH 202 Mathematical and Computational Tools for Mechanical Engineers I Units: 3.50
This course will provide students with an introduction to vector calculus, analytical, and numerical solution methods for ordinary differential equations. The topics of the course will be presented through problems, models and applications relevant to the Mechanical Engineering Program. On completion of the course students will be able to: manipulate vectors; perform numerical integration; solve first- and higher-order ordinary differential equations analytically and numerically. Students will solve problems analytically and computationally in an active learning, tutorial environment.
K3.5(Lec: Yes, Lab: No, Tut: Yes)
Requirements: Prerequisites: APSC 111, APSC 142 or APSC 143 or MNTC 313, APSC 171, APSC 172 and APSC 174
Corequisites: Exclusions: MTHE 225, MATH 225 and MTHE 272
Offering Term: F
CEAB Units:
Mathematics 31
Natural Sciences 0
Complementary Studies 0
Engineering Science 11
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 203 Mathematical and Computational Tools for Mechanical Engineers II Units: 3.50
This course will introduce numerical and statistical methods for the solution of engineering problems, to complement those discussed in MECH 202. The topics of the course will be presented through problems, models and applications relevant to the Mechanical Engineering Program. On completion of the course students will be able to: solve linear systems of equations; analyze random processes; perform local optimization and hypothesis testing; interpolate and fit discrete data sequences. Students will solve problems analytically and computationally in an active learning, tutorial environment. The course will include a design project.
K3.5(Lec: Yes, Lab: No, Tut: Yes)
Requirements: Prerequisites: MECH 202 Corequisites: Exclusions: MTHE 225, MATH 225 and MTHE 272
Offering Term: W
CEAB Units:
Mathematics 31
Natural Sciences 0
Complementary Studies 0
Engineering Science 0
Engineering Design 11
Offering Faculty: Smith Engineering

MECH 210 Electronic Circuits and Motors for Mechatronics Units: 4.50
This introductory course for mechanical engineering students begins with a review of the concepts of resistance, capacitance, and inductance. Circuit analysis techniques are then applied to characterize the behaviour of commonly used mechatronic circuits including devices such as transformers, diodes, solenoids, DC motors and actuators. Transistors are introduced in switching applications. Selection and testing of electric motors and drivers/controllers for stationary and mobile mechanical applications. Lab activities will focus on design, construction, and testing of microcontroller based mechatronic systems for practical applications, building on skills typically developed in MECH 217. Students will solve mechatronics problems analytically and computationally in an active learning, tutorial environment.
K4.5(Lec: Yes, Lab: Yes, Tut: Yes)
Requirements: Prerequisites: APSC 111, APSC 112, APSC 171, APSC 172, and APSC 174 Corequisites: Exclusions: ELEC 210, ELEC 221
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 40
Engineering Design 14
Offering Faculty: Smith Engineering

MECH 211 Manufacturing Methods Units: 3.50
The objective of this course is to achieve a knowledge and understanding of a wide variety of manufacturing processes involving plastics and metals. This course forms the basis for improved product and machine design, and will assist the mechanical engineer to function in the areas of design, manufacturing and general engineering. Training in the use of machine and welding tools found in a modern job shop is a required activity practiced in the machine tool laboratory in MECH 212.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: Corequisites: Exclusions: MECH 213
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 28
Engineering Design 14
Offering Faculty: Smith Engineering

MECH 212 Machine Tool Laboratory Units: 1.00
Training in the use of machine and welding tools found in a modern job shop is a required activity practiced in the machine tool laboratory in this course.
(Lec: 0, Lab: 1, Tut: 0)
Requirements: Prerequisites: Corequisites: Exclusions: MECH 213
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 8
Engineering Design 4
Offering Faculty: Smith Engineering

MECH 213 Manufacturing Methods Units: 4.50
The objective of this course is to achieve a knowledge and understanding of
a wide variety of manufacturing processes involving plastics and metals.
This course forms the basis for improved product and machine design, and will assist the mechanical engineer to function in the areas of design, manufacturing and general engineering. Training in the use of machine and welding tools found in a modern job shop is a required activity practiced in the machine tool laboratory.
NOT OFFERED 2023-2024
(Lec: 3, Lab: 1, Tut: 0.5)
Requirements: Prerequisites: Corequisites: Exclusions: MECH 211, MECH 212
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 36
Engineering Design 18
Offering Faculty: Smith Engineering

MECH 215 Instrumentation & Measurement Units: 3.50
This course presents techniques and devices for measurements in mechanical systems of solids and fluids. On completion of the course, students will be able to: Identify and Quantify measurement objectives in practical engineering applications; Apply statistical analysis, including uncertainty for interpreting test results; Specify and Select transducers, acquisition systems, and procedures to measure temperature, pressure, stress, strain and force; position, velocity and acceleration; Apply physical principles to predict static and dynamic system performance for pressure, strain, temperature and position measurements.
COURSE DELETED 2018-2019
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisite of APSC112 and registered in a BSCE or BASC Academic Program.
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 42
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 216 Instrumentation and Measurement Labs Units: 2.00
This course is composed of active lab modules that provide hands-on practical experience to complement the theory presented in MECH 215. On completion of the course, students will be able to: Install and test a micro controller system for data acquisition and control; Acquire and process digital and analog data; Apply transducers for temperature, pressure, stress, strain and force; position, velocity and acceleration; Formulate conclusions supported by data and comparison of results to appropriate models; Discuss the limitations of data employed, key findings, trends evident, uncertainty and error; Create graphs, tables and charts to clearly present data and support conclusions; Compose technical writing to concisely report measurement results and draw valid conclusions. Students will use experimental and numerical skills typically acquired in MTHE 272 and MECH 215.
COURSE DELETED 2018-2019
K2(Lec: Yes, Lab: Yes, Tut: No)
Requirements: Prerequisite: APSC112 and regi
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 16
Engineering Design 8
Offering Faculty: Smith Engineering

MECH 217 Measurement in Mechatronics Units: 4.25
This course focusses on measurement theory and Arduino programming to put that theory into practice. Active lab modules provide hands-on practical experience making measurements, doing analysis, and drawing conclusions from them. On completion of the course, students will be able to: Install and test a micro controller system for data acquisition and control; Program in C to acquire and process digital and analog data; Apply transducers, acquisition systems, and procedures to measure pressure, strain, temperature and position; Apply statistical analysis, including uncertainty, for interpreting test results; Apply physical principles to describe static and dynamic system performance for pressure, strain, temperature and position measurements; Students will be expected to use mathematical and computational skills typically acquired in first year. Previous experience with C will be an asset, but is not required.
(Lec: 3, Lab: 1.25, Tut: 0)
Requirements: Prerequisites: APSC 112 Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 36
Engineering Design 15
Offering Faculty: Smith Engineering

MECH 221 Solid Mechanics I Units: 3.50
Review of statics, forces and equilibrium, internal forces in simple structures and other material from first year. Further development of axial, torsion, shear and bending moment diagrams, and concepts of stress and strain. Introduction to mechanical properties of materials, centroids and moments of areas, axial stress, flexural stress, transverse shear stress, calculation of displacement by integration, combined loading, and stress transformation. This course is designed primarily for mechanical engineering students.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: APSC 111, APSC 171, and APSC 182 or permission of instructor Corequisites: Exclusions: CIVL 220, CIVL 230
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 42
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 228 Kinematics And Dynamics Units: 3.50
This course will cover the following topics in the field of dynamics. Kinematics of particles: planar and three-dimensional motion (rectilinear, curvilinear), choosing a coordinate system, conversions between systems, space curvilinear motion using vector derivatives, free and constrained paths, relative motion between particles. Kinetics of systems of particles: generalized Newton's Second Law, work and energy, impulse and momentum, conservation of energy and momentum, impact. Students will solve dynamics problems analytically and computationally in an active learning environment.
K3.5(Lec: No, Lab: Yes, Tut: No)
Requirements: Prerequisites: APSC 111, APSC 171 Corequisites: Exclusions: MECH 229
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 11
Complementary Studies 0
Engineering Science 31
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 229 Kinematics and Dynamics Units: 3.50
This course will cover the following topics in the field of dynamics. Kinematics of particles: planar and three-dimensional motion (rectilinear, curvilinear), choosing a coordinate system, conversions between systems, space curvilinear motion using vector derivatives, free and constrained paths, relative motion between particles. Kinetics of systems of particles: generalized Newton's Second Law, work and energy, impulse and momentum, conservation of energy and momentum, impact. Students will solve dynamics problems analytically and computationally in an active learning environment.
*This course is an exact duplicate of MECH 228 but for MREN and MINE students only.
K3.5(Lec: No, Lab: Yes, Tut: No)
Requirements: Prerequisites: APSC 111, APSC 171 Corequisites: Exclusions: MECH 228
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 11
Complementary Studies 0
Engineering Science 31
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 230 Applied Thermodynamics I Units: 3.50
An introductory course in thermodynamics. Topics include: properties and behaviour of pure substances, concepts of heat, work and energy, the First and Second Laws of Thermodynamics, and the analysis of a variety of power and refrigeration cycles.
(Lec: 3, Lab: 0, Tut: 0.5)
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 30
Complementary Studies 0
Engineering Science 12
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 241 Fluid Mechanics I Units: 3.50
An introductory course in fluid mechanics. Topics include properties of fluids, fluids at rest, manometers and other pressure measuring devices, 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, pumps, etc. On completion of the course students will be able to: Explain Bernoulli based energy equations with reference to energy and hydraulic grade lines, static and dynamic pressure; Explain control volume and control mass analysis with reference to Eulerian and Lagrangian frames, applied forces and flows; Solve simple flow systems for velocity distributions using continuity and Navier Stokes equations with appropriate boundary conditions; Solve flow and force problems in an integral framework using Bernoulli, conservation of mass and momentum; Solve piping system performance problems using Bernoulli with friction, minor losses, pump and turbine performance curves; Calculate pressures and forces on submerged surfaces in a static fluid; Solve scaling problems using dimensionless groups.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: APSC 111 Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 24
Complementary Studies 0
Engineering Science 18
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 270 Materials Science and Engineering Units: 3.50
This course provides the student with a background in the basic structural concepts of materials and the relationships between processing, structure, properties and performance. The topics will range from atomic bonding and arrangements, through micro-and macro-structures and their influence on properties, to the processing techniques required to produce the desired structures. All current types of engineering materials, including metals, ceramics, polymers, composites and semiconductors are covered.
(Lec: 3, Lab: 0, Tut: 0.5)
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 11
Complementary Studies 0
Engineering Science 31
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 273 Materials Science and Engineering Lab Units: 1.00
This course provides a hands-on exploration of some of the concepts introduced in MECH 270. This will include mechanical testing at room and elevated temperature as well as subsequent examination of microstructure. Results obtained will be related to the mechanisms discussed in MECH 270.
K1.0(Lec: 0, Lab: 1, Tut: 0)
Requirements: Prerequisites: Corequisites: MECH 270 Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 3
Complementary Studies 0
Engineering Science 9
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 302 Mathematical and Computational Tools for Mechanical Engineers III Units: 3.50

This course will introduce advanced numerical and statistical methods for the solution of engineering problems, to complement those discussed in MECH 202 and 203. The topics of the course will be presented through problems, models and applications relevant to the Mechanical Engineering Program.
On completion of the course the students will be able to: perform spectral analysis, use Laplace transforms, perform multi-variate statistical analysis and apply machine learning methods.
K3.5 (Lec: Yes, Lab: No, Tut: Yes)
Requirements: Prerequisites: MECH 202 MECH 203 Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 31
Natural Sciences 0
Complementary Studies 0
Engineering Science 11
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 310 Digital Systems for Mechatronics Units: 4.50

Microcontroller based operation of programmable digital sensors, servo motors, stepper motors, and activation of pneumatic and hydraulic drivers. PLC control of sequential logic operations in mechanical systems. Introduction to frequency response of systems with FFT application for machine health monitoring. Industrial communication standards for local and internet-based information transfer; Internet of Things (IOT) concepts. Off grid systems, photovoltaics, and inverters. Lab activities will focus on design, construction, and testing of microcontroller based mechatronic systems for practical applications, building on skills developed in MECH 217 and MECH 210.
K4.5(Lec: Yes, Lab: Yes, Tut: Yes)
Requirements: Prerequisites: MECH 210 Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 40
Engineering Design 14
Offering Faculty: Smith Engineering

MECH 321 Solid Mechanics II Units: 3.50

This course continues the study of solid mechanics. On completion of the course students will be able to: Calculate the total normal and shear stress at a point and sketch the stress distributions on a cross-section of a structural component (such as a crank) experiencing 3D combined (axial, transverse and/or moment causing) loads and non-symmetric loads; Calculate the residual normal or shear stress at a point and sketch the stress distribution on a cross-section of a structural component that is experiencing axial, torsional and/or bending loads followed by unloading; Calculate the normal or shear stress at a point on a cross-section of a structural component that is under load (axial, torsional and/or bending) and is supported in a statically indeterminate configuration (using force balance equations together with compatibility equations derived from known boundary conditions); Calculate the normal or shear stress at a point on a cross-section of a structural component that is under load (axial, torsional and/or bending) and contains one or more locations of stress concentration; Calculate, using general equations and/or graphically using a Mohr's circle, the normal and shear stress and/or strain transformations at a point within a structural component under load as a function of the orientation relative to a fixed coordinate system and find the maximum in-plane normal and shear stress and/or strain; Calculate the deflections and angles of deflection at any point on a transversely loaded beam of uniform cross-section using the principle of superposition and the standard equations for single loads acting on simply supported beams; Solve for critical loads in terms of buckling for concentrically and eccentrically loaded columns; Calculate the optimum dimensions (design) for shafts and beams under combined 3D loading based on specified material failure criteria; Design mechanism or structural components to withstand all forces for given loads, maximum deflection tolerances, factor of safety and material properties.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MECH 221 Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 30
Engineering Design 12
Offering Faculty: Smith Engineering

MECH 323 Machine Design I Units: 4.50
This course emphasizes the application of theoretical and engineering background taught in other courses, but also relies heavily on empirical approaches and simplifications of theory. Core material includes static and fatigue failure theories and the design/specification of selected machine elements. The course is centered around a major design project which is undertaken in groups.
(Lec: 3, Lab: 1, Tut: 0.5)
Requirements: Prerequisites: APSC 200 or APSC 202, MECH 321 Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 27
Engineering Design 27
Offering Faculty: Smith Engineering

MECH 328 Dynamics And Vibration Units: 3.50
This course covers the kinematics and dynamics of rigid bodies in two and three dimensions, as well as an introduction to vibrations. Topics in dynamics include: mathematically rigorous kinematic analysis, Newton's laws, energy methods, impulse and momentum methods, mass moments of inertia, and gyroscopic motion. Topics in vibrations include: free and forced vibration of single-degree-of-freedom systems, undamped and damped systems, equivalent single degree of freedom system of continuous elements/systems using energy equivalence and equation of motion.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MECH 228 or ENPH 225 Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 11
Complementary Studies 0
Engineering Science 17
Engineering Design 14
Offering Faculty: Smith Engineering

MECH 330 Applied Thermo II Units: 3.50
A continuation of MECH 230 with selected topics such as gas and vapour power cycles, refrigeration, mixtures of gases and vapours, combustion and available energy.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MECH 230 or ENPH 274 (PHYS 274) or MREN 230 Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 42
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 333 Gender, Engineering and Technology Units: 3.00
This course examines relations between gender and technology. The main topics covered are: the role of technology on the shaping of society particularly in terms of gendering of jobs and exclusion of women, gender issues in the workplace, the impact of technology on women's lives, and women's impacts on technology. Historical perspectives are presented and contemporary examples from western and developing countries are discussed.
(Lec: 3, Lab: 0, Tut: 0)
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 36
Engineering Science 0
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 341 Fluid Mechanics II Units: 3.50
A second course in fluid mechanics covering the differential form of conservation laws, boundary layer and external flows, compressible flows and the operation of rotational fluid machinery. On completion of the course students will be able to: Apply control volume analysis to mass, momentum and energy conservation; Apply differential form of mass and momentum conservation to the concept of flow field and its properties, including Navier Stokes equations; Apply stream function and velocity potential to the analysis of two-dimensional inviscid flows, and use the superposition principle to build complex flow fields from building block ingredients; Calculate drag and lift on solid bodies such as airfoils; Explain boundary layer flows, including the concept of various boundary layer thicknesses, shape factor, flow separation and the difference between laminar and turbulent boundary layers; Explain compressible flow features based on one-dimensional compressible subsonic and supersonic flows, with and without normal shock waves; Calculate design parameters of rotational fluid machinery, including centrifugal pumps and wind turbines.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MECH 241 or MREN 241 Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 11
Natural Sciences 0
Complementary Studies 0
Engineering Science 31
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 346 Heat Transfer Units: 3.50
An introductory course which covers conduction, convection and radiation modes of heat transfer. Both analytical and numerical analysis will be discussed, and concepts will be reinforced through tutorial and laboratory sessions. Latter topics will include combined modes of heat transfer and the design of heat exchangers.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MECH 230 or MREN 230 or ENPH 274 (PHYS 274) and MECH 241 or MREN 241 or MECH 341 Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 42
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 350 Automatic Control Units: 3.50
An introduction to the basic principles of modelling, analysis and control of dynamic systems. Topics include: modes of control, principles of feedback, Laplace and transfer functions, transient response of first and second order systems, stability criteria, root locus, Bode and frequency response. After completion of this course a student will be able to design a control system by classical techniques and will have an awareness of modern techniques.
(Lec: 2.75, Lab: 0.25, Tut: 0.5)
Requirements: Prerequisites: MECH 203 or MTHE 225 or MTHE 235 or MTHE 237, and MECH 228 or MECH 229 or ENPH 225, and registered in a BSCE or BASC Academic Program Corequisites: Exclusions:
Offering Term: FW
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 23
Engineering Design 19
Offering Faculty: Smith Engineering

MECH 361 Project Based Engineering: Conceive, Design, Implement & Operate Units: 3.50
This course provides academic credit for 3rd year students who take a lead role in design and implementation of an engineering device of substantial complexity that is part of a student project. The student has to demonstrate significant involvement with the project during the Fall term and be recommended by an academic advisor in order to qualify and be approved by the course coordinator. Students who are permitted to take this course will be required to conceive, design, implement and operate a sub-system or complete competition entry using the knowledge and skills acquired in earlier courses. Successful course completion will consist of specification of function, analysis, selection of materials and/or components, preparation of working drawings, manufactured prototype, completed with a major report and poster presentation. The evaluation will be based on joint assessment by the project academic advisor and the course coordinator.
NOT OFFERED 2023-2024
K3.5(Lec: No, Lab: Yes, Tut: No)
Requirements: Prerequisites: Completion of 2nd Year and permission of the course coordinator upon the recommendation by the academic advisor. Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 0
Engineering Design 42
Offering Faculty: Smith Engineering

MECH 370 Prin Of Materials Processing Units: 3.50
The basic mechanisms of mass transport and phase transformations in materials are developed from thermodynamic and kinetic principles. Topics include phase equilibria, diffusion, solidification and solid-state transformations. The application of these phenomena to materials processing methods, such as casting, forming, heat treatment and sintering is described.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MECH 270 Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 18
Complementary Studies 0
Engineering Science 24
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 371 Fracture Mech & Dislocation Units: 3.50
Fracture Mechanics are developed to explain crack propagation in materials and structures. This includes development of the strain energy release rate (GIC) and the critical stress intensity factor (KIC). Emphasis will be placed on developing the correlation between microstructure control and the resistance to crack propagation which this variable produces. Dislocation theory will be evoked to analyze the stress fields of point, line and plane defects. Plasticity and fracture will be detailed, which includes the time dependent aspects of such processes as static fatigue and creep fracture.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MECH 270 Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 11
Complementary Studies 0
Engineering Science 20
Engineering Design 11
Offering Faculty: Smith Engineering

MECH 393 Biomechanical Product Development Units: 3.50
This course focuses on design, manufacturing and product management of various assistive technology devices to be used by community members, such as gaming or communication devices for children with motor control impairments, or ileostomy guides or pill dispensers for older persons, as well as various other external devices for persons with disabilities. Some aspects, such as the determination of the geometry and different sizes are product specific, while safety criteria, regulations, rational choice of alternatives, design procedures and product management are applicable when designing a much larger variety of products. Much of the theory will be based on examples of assistive devices for persons
with disabilities.
(Lec: 3, Lab: 0, Tut: 0.5)
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 18
Engineering Design 24
Offering Faculty: Smith Engineering

MECH 394 Frontiers in Biomechanical Engineering Units: 3.50
This course addresses the fundamental principles of biomechanical engineering through four introductory modules, each dedicated to one topic: biology, biomechanics, biotransport, and mechatronics. Each module introduces the background and technical principles required to understand topics in biomechanical engineering. This course content emphasizes the multidisciplinary approaches needed to understand a problem from both biology and mechanical engineering perspectives and includes guest lectures given by biomechanical engineering experts with a goal of providing students with exposure to the current biomechanical engineering research landscape.
Students are presumed to have sound background in mechanical measurement, solid mechanics, kinematics and dynamics typically acquired from MECH 217, 221, 228, 321 and 328.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MECH 217, MECH 221, MECH 228, or permission of instructor Corequisites: Exclusions: CHEE 340
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 12
Complementary Studies 0
Engineering Science 30
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 396 Mechanical and Materials Engineering Laboratory I Units: 2.00
This is the first of two laboratory courses in the third year of the Materials Option of the Mechanical Engineering program. Lecture topics and course assignments are selected to provide the background required to undertake the laboratory work.
K2(Lec: Yes, Lab: Yes, Tut: Yes)
Requirements: Prerequisites: Completion of 2nd year or permission of the instructor. Corequisites: MECH 370 Exclusions: MECH 398
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 24
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 397 Mech And Material Eng Lab II Units: 2.00
This is the second of two laboratory courses in the third year of the Materials Option of the Mechanical Engineering program. Lecture topics and course assignments are selected to provide the background required to undertake the laboratory work. Approximately half of the material is common with MECH 399.
K2(Lec: Yes, Lab: Yes, Tut: Yes)
Requirements: Prerequisites: Completion of 2nd year or permission of the instructor Corequisites: MECH 371 Exclusions: MECH 399
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 24
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 398 Mechanical Engineering Laboratory I Units: 2.00
This is the first of two laboratory courses in the third year of the General Option of the Mechanical Engineering program. Lecture topics and course assignments are selected to provide the background required to undertake the laboratory work. Lab modules from MECH 396/MECH 397/MECH 399 completed but not counted for credit may be included for credit in this course.
K2(Lec: Yes, Lab: Yes, Tut: Yes)
Requirements: Prerequisites: Completion of 2nd year or permission of the instructor. Corequisites: Exclusions: MECH 396
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 24
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 399 Mechanical Eng Lab II Units: 2.00
This is the second of two laboratory courses in the third year of the General Option of the Mechanical Engineering program. Lecture topics and course assignments are selected to provide the background required to undertake the laboratory work. Lab modules from MECH 396/MECH 397/ MECH 398 completed but not counted for credit may be included for credit in this course.
K2(Lec: Yes, Lab: Yes, Tut: Yes)
Requirements: Prerequisites: Completion of 2nd year or permission of the instructor. Corequisites: Exclusions: MECH 397
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 24
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 420 Vibrations Units: 3.50
Considers mechanical vibration, the problems it presents and the means
of dealing with it. Completes the treatment of systems with two
degrees-of-freedom (introduced in MECH 328) and proceeds to systems with higher number of degrees-of-freedom. Co-ordinate systems, types of coupling, matrix formulation, vibration absorbers and dampers, specific and hysteretic damping, Rayleigh's method, torsional vibration, Holzer method, introduction
to the finite element method, beam vibration.
NOT OFFERED 2023-2024
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MECH 328 or ENPH 211 (PHYS 211) and ENPH 225 (PHYS 225) Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 29
Engineering Design 13
Offering Faculty: Smith Engineering

MECH 423 Introduction To Microsystems Units: 3.50
This course will deal with the practical engineering aspects of micro-machining technologies and microsystems. The contents will include: scaling issues, microfabrication technologies and production methods, classification and analysis of Microsystems (including microsensors, microactuators, RF switches, micromirrors, and other micromechanisms), the integration of devices into Microsystems (both assembly and interfacing). Micro-machining will be compared and contrasted to both micro-electronics and traditional macro-machining. The development and use of Microsystems simulation and design tools will be covered as well.
(Lec: 3, Lab: 0, Tut: 0.5)
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 25
Engineering Design 17
Offering Faculty: Smith Engineering

MECH 424 Sustainable Product Design Units: 3.50
This course deals with sustainable product design and manufacture. Topics include: product Life Cycle Analysis issues; Streamlined Life Cycle Analysis
and international Life Cycle Analysis standards; Energy, Global Warming
Potential, Green House Gas and carbon emission issues (including energy
needs in product design and manufacturing); Carbon footprint, basic chemistry
of carbon emissions, international standards for carbon emissions signatures. Design topics include: product design for manufacture and assembly, design for disassembly and design for environment. Product end-of-life considerations include: recycling, remanufacture and reuse. Students will complete several open ended projects. Guest speakers will be included where possible.
NOT OFFERED 2023-2024
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MECH 323 or permission of the instructor Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 0
Engineering Design 42
Offering Faculty: Smith Engineering

MECH 430 Thermal Systems Design Units: 4.00
This course is concerned with the technical, economic and environmental
aspects of conventional and novel methods of energy supply and use.
Emphasis will be placed on the analysis and design of thermal systems.
Topics include: electric utility demand and supply; the analysis of thermal
power generation systems including combined cycle and cogeneration plants; emission control; alternative energy systems. A group project related to
the design of a thermal system will form a significant portion of this course.
NOT OFFERED 2023-2024
(Lec: 3, Lab: 0, Tut: 1)
Requirements: Prerequisites: MECH 330, 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 24
Offering Faculty: Smith Engineering

MECH 435 Internal Combustion Engines Units: 3.50
This course covers all aspects of the design and operation of internal combustion engines. Principles of thermodynamics and fluid mechanics are used in the analysis of internal combustion engines. Course content includes discussions on both spark ignition and compression ignition (diesel) engines with special emphasis placed on new engine technologies. Intake, in-cylinder and exhaust flows are considered along with various aspects of combustion phenomenon relevant to engines. This course includes a laboratory involving engine performance measurements made using a dynamometer.
(Lec: 3, Lab: 0.08, Tut: 0.42)
Requirements: Prerequisites: MECH 230 or CHEE 210 Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 30
Engineering Design 12
Offering Faculty: Smith Engineering

MECH 437 Fuel Cell Technology Units: 3.50
Introduction to and history of various fuel cell systems. Fuel cell fundamentals including thermodynamics, electrode kinetics, fuel cell performance and
transport issues. Systems covered include Polymer Electrolyte Membrane (PEMFC), Direct Methanol (DMFC), Alkaline (AFC), Solid Oxide (SOFC), and Molten Carbonate (MCFC). Fueling processing issues and combined heat and power systems. Overview of the current fuel cell industry.
NOT OFFERED 2023-2024
(Lec: 3.0, Lab: 0, Tut: 0.5)
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 21
Engineering Design 21
Offering Faculty: Smith Engineering

MECH 439 Turbomachinery Units: 3.50
Fluid mechanics and thermodynamics applied to turbomachines; dimensionless performance characteristics; momentum and energy equations; thermodynamics and efficiencies; cascade aerodynamics; compressors and turbines, reaction and stage loading; radial equilibrium; radial flow machines; application of generalized performance to choice of compressors; mechanical details and auxiliary systems.
NOT OFFERED 2023-2024
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MECH 330, MECH 341, or permission of the instructor Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 42
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 441 Fluid Mechanics III Units: 3.50
Topics will include: Derivation of equations of motion for incompressible fluids; exact solutions for laminar flows; stability and transition; introduction to turbulence, including turbulent boundary layers, jets, wakes and mixing layers; drag reduction; introduction to the modelling of turbulence. NOT OFFERED 2023-2024
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MECH 341 Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 42
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 444 Computational Fluid Dynamics Units: 3.50
This course provides an overview of, and hands-on experience in, the numerical modelling of fluid flows. Finite volume, finite difference and finite elements methods are introduced. Students are expected to gain critical insight into the capabilities and limitations of fluid flow models by numerically simulating various engineering flows and by doing a term project. Topics include: comparison of numerical, experimental and analytical methods in fluid mechanics, numerical grids and their generation, flow equations and their discretization, solution techniques, turbulence modelling and data presentation. Features of commercial codes are critically reviewed.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MTHE 272 (MATH 272) or ENPH 213 (PHYS 213) or MECH 203, MECH 341 Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 30
Engineering Design 12
Offering Faculty: Smith Engineering

MECH 448 Compressible Fluid Flow Units: 3.50
Introduction and review of work done in earlier courses; basic equations for one-dimensional compressible flow; isentropic one-dimensional flow; steady and unsteady normal shock waves; oblique shock waves; steady and unsteady expansion waves; two-dimensional isentropic flow; nozzle flows; effects of friction and heat transfer; boundary layer flow; design of aircraft engine intake systems; design of supersonic wind-tunnels and shock tubes. Students are expected to have knowledge of fluid mechanics typically acquired in MECH 241/ MECH 341. Those who have not taken these or similar courses will need to prepare through self study.
(Lec: 3, Lab: 0, Tut: 0.5)
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 31
Engineering Design 11
Offering Faculty: Smith Engineering

MECH 452 Mechatronics Engineering Units: 5.00
This is a course in mechatronic systems design. Mechatronics Engineering, an integration of computer, electrical and mechanical engineering, is studied in a series of workshops that focus on electronics, microcontrollers, programmable logic controllers and mobile robots. The lectures provide the theoretical background to the workshops, and include discussion of related industrial and commercial applications. The knowledge and experience gained in the lectures and workshops is applied to a team design project. Students will use their knowledge of electric circuits, microcontrollers and control systems typically acquired in MECH 210, MECH 217 and MECH 350.
(Lec: 2, Lab: 2.5, Tut: 0.5)
Requirements: Prerequisites: Permission of the instructor Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 30
Engineering Design 30
Offering Faculty: Smith Engineering

MECH 455 Computer Integrated Manufacturing Units: 3.50
The course focuses on the following subjects within the field of Computer Integrated Manufacturing (CIM): robot kinematics and applications in CIM, machine-vision-based inspection, virtual modelling of CIM workcells, and workcell control and scheduling. Laboratory work allows students to learn robot programming and workcell control. Students complete a course project
where they design a PLC-based control strategy for a manufacturing workcell.
(Lec: 2, Lab: 1.5, Tut: 0)
Requirements: Prerequisites: Must be registered in BSCE or BASC program. Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 21
Engineering Design 21
Offering Faculty: Smith Engineering

MECH 456 Introduction To Robotics Units: 3.50
This course will cover the following topics in the field of robotics: historical development; robot components (sensors, actuators, and end effectors, and their selection criteria); basic categories of robots (serial and parallel manipulators, mobile robots); mobility/constraint analysis; workspace analysis; rigid body kinematics (homogeneous transformation, angle and axis of rotation, Euler angles); manipulator kinematics and motion trajectories (displacement and velocity analyses, differential relations, Jacobian matrix); non-redundant and redundant sensing/ actuation of manipulators; manipulator statics (force and stiffness); singularities; and manipulator dynamics.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MECH 350 or MTHE 332 (MATH 332) or MTHE 335 or ELEC 443 or permission of the instructor Corequisites: Exclusions: ELEC 448
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 21
Engineering Design 21
Offering Faculty: Smith Engineering

MECH 457 Additive Manufacturing Units: 4.00
This elective course provides a comprehensive introduction to additive manufacturing (AM), with an emphasis on a scientific/technical approach to process/product design, as well as troubleshooting, for various industrial applications. The course includes an overview of AM techniques (including process configurations, processing conditions and the common machinery/instruments), followed by part design, process design & optimization in the context of AM and AM process modelling and control. Both polymer 3D printing and metal powder-based techniques will be covered. The theoretical course material will be complemented by a group-based practical/hands-on project using the existing AM facility within the department.
(Lec: 3, Lab: 1, Tut: 0)
Requirements: Prerequisites: MECH 213 or (MECH 211 and MECH 212), MECH 270, MECH 203 Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 48
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 460 Team Project-Conceive & Design Units: 4.00
Students working in teams will be required to conceive and design a product, system or process using the knowledge and skills acquired in earlier courses. Elements of the design will include: specification of function, analysis, selection of materials and/or components, preparation of working drawings, cost analysis and tenders, and preparation of preliminary design report. A research project may be accepted as an engineering design project provided it can be clearly shown that the elements of conceive and design are fulfilled in the completion of the project. Lectures and Guest Speakers will focus on related professional skills and topics including engineering ethics, professional organizations and legislation, intellectual property and information systems in support of the project.
K4(Lec: Yes, Lab: Yes, Tut: Yes)
Requirements: Prerequisites: MECH 321, MECH 323, MECH 328, MECH 346 and MECH 350, or in final year of MECH program. Corequisites: MECH 464 Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 0
Engineering Design 48
Offering Faculty: Smith Engineering

MECH 461 Research Project Units: 4.00
This course provides an opportunity for students to work individually on an engineering research project with staff members of the Department. The topic is selected by the student in consultation with a Department supervising faculty member by the end of the Fall term. The projects are laboratory-based to be completed by the end of the Winter term with a major report and presentation of the work.
K4(Lec: No, Lab: Yes, Tut: No)
Requirements: Prerequisites: Completion of 3rd year and permission of the instructor. Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 48
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 462 Team Project - Implement and Operate Units: 3.50
This course is intended to enable team projects that started in MECH 460, to continue to the implement and operate phases of the design cycle. However, new projects can be the subject of MECH 462 as long as they meet the implement and operate objectives of the course. An engineering report is prepared and defended. The presentation is normally supported by a working prototype or physical mock-up of the design. Testing a process or system can replace the building of a prototype. Choices of available projects are limited and should be discussed with the instructor.
K3.5(Lec: Yes, Lab: Yes, Tut: Yes)
Requirements: Prerequisites: MECH 460 Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 0
Engineering Design 42
Offering Faculty: Smith Engineering

MECH 463 Engineering Project for International Students Units: 2.00
This course is for students registered at a university outside Canada who wish to do a research project at Queen's to satisfy the requirements of their home university. Projects must be initiated by a faculty supervisor at the student's home university in consultation with a Queen's professor who has agreed to act as a supervisor. The time frame and requirements for course completion will be agreed upon by the two project supervisors prior to the student arriving at Queen's. This course is NOT available or intended for typical exchange agreement students.
K2(Lec: No, Lab: Yes, Tut: No)
Requirements: Prerequisites: Permission of instructor. Corequisites: Exclusions:
Offering Term: FW
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 0
Engineering Design 24
Offering Faculty: Smith Engineering

MECH 464 Communications & Project Management Units: 1.50
This course provides advanced instruction and practice in technical communication and project management for multidisciplinary engineering projects. Content includes request for proposals, project planning and proposal writing, quality function deployment, oral presentation skills, client communications and concise report writing. Course deliverables are closely tied to deliverables in Capstone design courses. Open to Mechanical and Materials Engineering students only.
(Lec: 0.75, Lab: 0, Tut: 0.75)
Requirements: Prerequisites: Corequisites: MECH 460 or permission of the instructor Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 18
Engineering Science 0
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 465 Computer Aided Design Units: 3.50
Concept of computational design including the choice of the objective function, equality and inequality constraints, and analysis methods; one-dimensional search methods, sensitivity analysis, and the steepest descent method. The principles of the finite element method and its application to stress analysis of mechanical components. The prerequisite may be waived for students with a strong background in solid mechanics from other courses.
(Lec: 3, Lab: 0.5, Tut: 0)
Requirements: Prerequisites: Must be registered in BSCE or BASC program. Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 11
Engineering Design 31
Offering Faculty: Smith Engineering

MECH 470 Deformation Processing Units: 3.50
This course focuses on the elastic-plastic deformation of metals as it relates
to the fabrication of stock materials, the manufacture of components
and in-service material performance. Methods for describing and analyzing
elastic-plastic behaviour, at both macroscopic and microscopic length-scales,
are presented. Additional topics include the measurement and prediction
of forming limits, the effects of deformation rate and temperature on
plastic flow, and mechanisms of ductile failure. In the final portion of
the course, the concept of microstructural design is introduced and
then reinforced through a series of case studies. Material from
MECH 370/371 will be reviewed and students who have not completed those courses may require some additional reading to keep up.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MECH 270 Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 30
Engineering Design 12
Offering Faculty: Smith Engineering

MECH 476 Eng Of Polymers And Composite Units: 3.50
This course introduces the microstructure-property-processing relationships needed to understand the applicability of polymers and composites to engineering design. The courses start with an introduction to the structure and properties of different polymers. The mechanics of polymers are covered including elasticity, rubber elasticity, pressure dependent yield and viscoelasticity. The mechanics of composites depend not only on the matrix, but also on the reinforcing phase.
While focusing on polymer composites, metal and ceramic-based composites will also be introduced. Topics covered will include the influence of the interface, mechanical and transport properties and design of composites. The final goal is to correlate constitutive relations describing the time-temperature dependence of mechanical properties of polymers and composites to microstructure and linking these relations to practical design. Material from MECH 370/371 will be reviewed and students who have not completed those courses may require some additional reading to keep up.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MECH 270 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

MECH 478 Biomaterials Units: 3.50
An introduction to the structure, properties and performance of biomaterials used for the construction of medical devices. Examples of biomaterials are bioactive ceramics, biodegradable polymers and advanced titanium-based alloys used for the construction of orthopedic implants. Topics covered will include surface and bulk properties of biomaterials and their impact on the clinical performance of implants. Discussion will focus on tissue-biomaterials interactions, biocompatibility and biodegradation. The course will also cover the current in-vitro and in-vivo testing methods for evaluating the long-term performance of biomaterials.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: Must be registered in BSCE or BASC program. Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 11
Engineering Design 31
Offering Faculty: Smith Engineering

MECH 479 Nano-Structured Materials Units: 3.50
The majority of conventional materials have grain or crystallite sizes ranging from micrometers to several millimeters. Capabilities now exist to synthesize materials with grains where one or more dimension is on the nanoscale (less than 100 nm). As the grain size decreases, there is a significant increase in the volume fraction of grain boundaries or interfaces. This characteristic strongly influences the chemical and physical properties of the materials. For example, nanostructured ceramics are tougher and stronger than coarser grained ceramics, while nanostructured metals exhibit increases in yield strength and elastic modulus. It has also been shown that other properties (e.g. electrical, optical and magnetic) are influenced by a fine grain structure. The goal of this course is to introduce the student to the impact of length scale, from millimeter to nanometer, on material properties, with a primary but not exclusive focus on mechanical properties. It will include discussions on synthesis approaches as well as examples of applications. Material from MECH 370/371 will be reviewed and students who have not completed those courses may require some additional reading to keep up.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MECH 270 Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 11
Complementary Studies 0
Engineering Science 20
Engineering Design 11
Offering Faculty: Smith Engineering

MECH 480 Airplane Aerodynamics and Performance Units: 3.50
A technical course on the principles of flight. Techniques for the quantitative prediction of the aerodynamic characteristics of the wing will be described. Extensions to account for real-world effects will be discussed. These results will be used to predict the airplane performance (range, climb rate, maximum speed, etc.) The concept aerodynamic stability will be introduced and discussed. Students are expected to know MATLAB proficiently and have fluids knowledge typically acquired in MECH 241 and MECH 341. Those who have not taken these or similar courses will need to prepare through self study.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: Must be registered in BSCE or BASC program. Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 42
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 481 Wind Energy Units: 3.50
An introductory course on wind-turbine operation and aerodynamics.
Topics include: the Betz limit; the Blade Element Momentum method; characteristics of the atmospheric boundary layer; unsteady aerodynamic
theory; gusts and blade aeroelasticity; blade noise and health effects; and
wind-park siting and planning. Extension of some of these topics to small wind turbines, run-of-the-river water turbines and off-grid systems will also be
presented. Students are expected to have sufficient experience with fluid
dynamics equivalent to MECH 341. Those who have not taken such a
course will need to prepare through self-study.
NOT OFFERED 2023-2024
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: Must be registered in BSCE or BASC program. Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 42
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 482 Noise Control Units: 3.50
An introduction to the principles of noise control. Topics include: basic
properties of sound and noise, the measurement of noise, effects of noise on people, description of sound fields, acoustics of rooms and enclosures,
acoustical materials and structures, and noise source identification.
A coherent approach to the solution of noise control problems is stressed throughout the course.
NOT OFFERED 2023-2024
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: Must be registered in BSCE or BASC program. Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 25
Engineering Design 17
Offering Faculty: Smith Engineering

MECH 483 Nuclear Materials Units: 3.50
A nuclear reactor presents a unique environment in which materials must perform. In addition to the high temperatures and stresses to which materials are subjected in conventional applications, nuclear materials are subjected to various kinds of radiation which affect their performance, and often this dictates a requirement for a unique property (for example, a low cross section for thermal neutron absorption) that is not relevant in conventional applications. The effects of the radiation may be direct (e.g., the displacement of atoms form their normal positions by fast neutrons or fission fragments), or indirect (e.g., a more aggressive chemical environment caused by radiolytic decomposition). This course describes materials and structures typically used in nuclear environments, their manufacture, the unique conditions to which they are subjected, the basic physical phenomena that affect their performance and the resulting design and operational requirements for reactor components. The course includes a field trips to components manufacturers and to Canada's national nuclear research laboratory. Material from MECH 370/371 will be reviewed and students who have not completed those courses may require some additional reading to keep up.
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: MECH 270 Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 11
Complementary Studies 0
Engineering Science 20
Engineering Design 11
Offering Faculty: Smith Engineering

MECH 484 Introduction To Ceramics Units: 3.50
An introduction to the processing, structure and properties of advanced ceramics used for the design of components in electronic, automotive, aerospace, energy, mining and chemical and petrochemical industries. The emphasis is placed on understanding the relationship between microstructure and mechanical, electrical and thermal properties of ceramics. Ceramic systems and related devices which are discussed include electronic and ionic conductors, capacitors, transducers, varistors, and dielectric substartes. The effect of porosity, grain size and residual stresses on strength, elastic and fracture properties of isotropic and anisotropic ceramics is also discussed. Material transport mechanism and sintering of powder ceramics materials is covered with recent examples of forming and sintering of oxides, carbides and nitrides.
COURSE DELETED 2019-2020
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: MECH 370 and MECH 371
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 30
Engineering Design 12
Offering Faculty: Smith Engineering

MECH 492 Biological Fluid Dynamics Units: 3.50
An introductory course on biological flows across a broad range of scales from flagellar motility to the beating heart. Topics range from the dynamics of classical biomedical flows such as the circulatory and respiratory systems. (e.g. wall compliance, pulsatility, and transition to turbulence) through to cellular-level motility and biopropulsion in general over a range of Reynolds numbers. Topics relating to comparative biology (e.g. allometry and evolutionary convergence) and common imaging techniques used for biological flows (e.g. acoustic, nuclear magnetic resonance, optical and x-ray techniques) will be covered as well. Students are expected to have sufficient experience with measurement science and fluid dynamics theory equivalent to MECH 217 and MECH 241. Those who have not taken such courses will need to prepare through self-study.
NOT OFFERED 2023-2024
(Lec: 3, Lab: 0, Tut: 0.5)
Requirements: Prerequisites: Must be registered in BSCE or BASC program. Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 42
Engineering Design 0
Offering Faculty: Smith Engineering

MECH 494 Kinematics Of Human Motion Units: 3.50
In this course students will explore the application of classical mechanics to the analysis of human motion related to athletics, orthopaedics, and rehabilitation. The course covers the structure of human joints, including experimental and analytical techniques in the study of human joint kinematics; applications to the design of artificial joints and to clinical diagnosis and treatments. Students are introduced to the motion capabilities of the human body and how to develop and study kinematic models of the individual joints of the human body. Experimental methods used to collect kinematic data will be studied through interactive labs. Topics include defining body position and displacement, three dimensional representation of human motion, basic functional anatomy of individual joints, rigid body kinematics (homogeneous transformations, Euler angles, helical axis), intrajoint kinematics, joint modelling, articular surface motion. Three-dimensional kinematics of individual joints is emphasized from the perspective of total joint replacement design.
(Lec: 2, Lab: 1, Tut: 0.5)
Requirements: Prerequisites: MECH 393 and MECH 394, or permission of instructor Corequisites: Exclusions:
Offering Term: W
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 12
Engineering Design 30
Offering Faculty: Smith Engineering

MECH 495 Ergonomics And Design Units: 3.50
This course provides an overview of ergonomic problems that are addressed in engineering design; including biomechanical, physical and physiological issues. Case studies will range from the design of vehicle cockpits to process control rooms, from industrial manual materials handling tasks to human directed robots, and from domestic tools to biomechanical devices.
(Lec: 3, Lab: 0.5, Tut: 0)
Requirements: Prerequisites: MECH 323 or permission of the instructor Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 0
Engineering Design 42
Offering Faculty: Smith Engineering

MECH 496 Musculoskeletal Biomechanics Units: 3.50
Develops approaches to musculoskeletal biomechanics, including
experimental and analytical approaches to movement analysis, experimental instrumentation and devices, and biomechanical devices for musculoskeletal disorder rehabilitations. Analysis of the contribution of external loading, forces generated by muscles and constraints provided by other musculoskeletal
structures to predict forces and stresses in musculoskeletal joints and tissues. Numerical and modelling approaches, including inverse dynamics, and optimization, and determination of segmental inertial properties. Biomechanical devices including upper limb and lower limb orthotics and prosthetics. Applications in orthopedic engineering, movement assessment, ergonomics, joint injury and replacements, and biomechanical system design. Application of machine learning in biomechanics and human movement
analysis. Students are presumed to have had a sound introduction to biomechanics, typically acquired from MECH 394.
NOT OFFERED: 2023-2024
(Lec: 2, Lab: 1, Tut: 0.5)
Requirements: Prerequisites: MECH 328 Corequisites: Exclusions:
Offering Term: F
CEAB Units:
Mathematics 0
Natural Sciences 0
Complementary Studies 0
Engineering Science 20
Engineering Design 22
Offering Faculty: Smith Engineering