Mechanical Engineering (MECH)

Mechanical Engineering (MECH) Courses

MECH 2600 [0.5 credit]
Introduction to Biomedical Engineering
Foundations in cellular biology, physiology, and human anatomy, with quantitative concepts and examples that relate to the subspecialties of biomedical engineering. Introduction to specialties in biomedical engineering including bioinstrumentation, bioimaging, biomechanics, biomaterials, and bio-molecular engineering including applied examples.
Lecture three hours a week.

MECH 3002 [0.5 credit]
Machine Design and Practice
The design of mechanical machine elements is studied from theoretical and practical points of view. Topics covered include: design factors, fatigue, and discrete machine elements. Problem analysis emphasizes the application to practical mechanical engineering problems.
Prerequisite(s): MAAE 2001 and MAAE 3202.
Lectures three hours a week, problem analysis three hours a week.

MECH 3310 [0.5 credit]
Biofluid Mechanics
Applications of fundamental fluid mechanics to human circulatory and respiratory systems. Basic viscous flow theory including: blood flow in the heart and large arteries, air flow in extra-thoracic (nose-mouth throat) airways and lungs.
Prerequisite(s): MATH 2004 and MAAE 2300.
Lectures three hours per week, laboratories or tutorials three hours per week.

MECH 3700 [0.5 credit]
Principles of Manufacturing
Manufacturing processes, materials. Casting: solidification and heat flow theory, defect formation, casting design. Metal forming: elementary plasticity theory, plastic failure criteria, force and work calculations. Bulk and sheet forming. Joining: heat flow and defect formation, residual stresses. Machining theory and methods. Hardening: diffusion, wear resistance.
Prerequisite(s): MAAE 2700.
Lectures three hours a week, problem analysis and laboratories three hours a week on alternate weeks.

MECH 3710 [0.5 credit]
Biomaterials
Materials used in biomedical applications: metals, polymers, ceramics and composites. Material response and degradation. Properties of biologic materials; bone, cartilage, soft tissue. Materials selection for biocompatibility.
Prerequisite(s): MAAE 2700 and MECH 2600.
Lectures three hours per week, laboratories and problem analysis three hours per week.

MECH 4003 [0.5 credit]
Mechanical Systems Design
Design of mechanical systems: establishing design criteria, conceptual design, design economics, value analysis, synthesis and optimization. Mechanical elements/systems: gear and flexible drive systems, fluid power systems. These elements are utilized in group design projects.
Prerequisite(s): MATH 3705 and MECH 3002.
Lectures three hours a week, problem analysis three hours a week.

MECH 4006 [0.5 credit]
Vehicle Engineering I
The course emphasizes the engineering and design principles of road transport vehicles. Topics to be covered include: performance characteristics, handling behaviour and ride quality of road vehicles.
Prerequisite(s): MAAE 3004 and MATH 3705.
Lectures three hours a week.

MECH 4007 [0.5 credit]
Vehicle Engineering II
Engineering and design principles of off-road vehicles and air cushion technology. Topics include: mechanics of vehicle-terrain interaction - terramechanics, performance characteristics of off-road vehicles, steering of tracked vehicles, air cushion systems and their performance, applications of air cushion technology to transportation.
Prerequisite(s): MAAE 3004 and MATH 3705.
Lectures three hours a week.

MECH 4013 [0.5 credit]
Biomedical Device Design
Medical Devices: the industry and its regulation. Design methodologies. Examination of specific medical devices: surgical equipment, orthopedic devices, rehabilitation engineering, life support, artificial organs. Case studies.
Prerequisite(s): MAAE 3202, MATH 3705, MECH 3710 and MECH 4210.
Lectures three hours per week, laboratories or tutorial three hours per week.

MECH 4101 [0.5 credit]
Mechanics of Deformable Solids
Course extends the student's ability in design and stress analysis. Topics include: introductory continuum mechanics, theory of elasticity, stress function approach, Lamé and Mitchell problems, stress concentrations, thermoelasticity and plasticity.
Prerequisite(s): MAAE 3202 and MATH 3705.
Lectures three hours a week.

MECH 4102 [0.5 credit]
Corrosion and Corrosion Control
Introduction to corrosion. Corrosion mechanisms. Thermodynamics of corrosion. Electro-chemical kinetics of corrosion. Corrosion: types, prevention, control, testing, monitoring and inspection techniques. Corrosion in specific metals (eg. Fe, Ni, Ti and Al). Corrosion issues in specific industries: power generation and chemical processing industries.
Prerequisite(s): MATH 3705.
Lectures three hours a week.

MECH 4103 [0.5 credit]
Fatigue and Fracture Analysis
Elastic and elasto-plastic fracture mechanics. Fatigue design methods, fatigue crack initiation and growth Paris law and strain-life methods. Fatigue testing, scatter, mean stress effects and notches. Welded and built up structures, real load histories and corrosion fatigue. Damage tolerant design and fracture control plans.
Prerequisite(s): MAAE 3202 and MATH 3705.
Lectures three hours a week.

MECH 4104 [0.5 credit]
Vibration Analysis
Free and forced vibrations of one and two degree-of-freedom systems. Vibration measurement and isolation. Numerical methods for multi-degree-of-freedom systems. Modal analysis techniques. Dynamic vibration absorbers. Shaft whirling. Vibration of continuous systems: bars, plates, beams and shafts. Energy methods. Holzer method.
Prerequisite(s): MAAE 3004 and MATH 3705.
Lectures three hours per week.

MECH 4105 [0.5 credit]
Introduction to Nuclear Engineering
Atomic theory, nuclear physics, radioactivity, photoelectric effect, mass defect, binding energy, nuclides, neutron diffusion and moderation. Reactor theory, kinetics, control. Reactor types, reactor poisoning, xenon oscillations. Reactor materials, corrosion, fuel and fuel cycle. Nuclear medicine. Radiation protection, reactor safety fundamentals.
Prerequisite(s): MATH 3705.
Lectures three hours a week.

MECH 4106 [0.5 credit]
Nuclear Power Plant Design
Elements of design, basic design, and new generation of nuclear reactors. Major systems of CANDU reactor and its safety principles. Balance of Plant Systems. Licensing requirements for design (IAEA, CNSC and USNRC regulations). Analytical/computer codes in safety assessments and design.
Prerequisite(s): MATH 3705.
Lectures three hours per week.

MECH 4107 [0.5 credit]
Internal Combustion Engines
This course explores the design process of an internal combustion engine including: Internal Aerodynamics, Combustion, Rotating and Reciprocating Components, Structures, Control Systems, Manufacturing and Testing Methods. Students will design/optimize an engine component utilizing industry standard Ricardo Wave simulation software.
Prerequisite(s): MATH 3705.
Lecture three hours per week.

MECH 4210 [0.5 credit]
Biomechanics
The biomechanics of biological systems; muscles and movement, nerves and motor control. Measurements of motion, strain and neural signals. The hand and manipulation; locomotion and the leg.
Prerequisite(s): MAAE 2101 and MATH 3705.
Lectures three hours per week, laboratories or tutorials three hours per week.

MECH 4305 [0.5 credit]
Fluid Machinery
Types of machines. Similarity: performance parameters; characteristics; cavitation. Velocity triangles. Euler equation: impulse and reaction. Radial pumps and compressors: analysis, design and operation. Axial pumps and compressors: cascade and blade-element methods; staging; off-design performance; stall and surge. Axial turbines. Current design practice.
Prerequisite(s): (MAAE 3300 or MECH 3310) and MATH 3705.
Lectures three hours a week.

MECH 4401 [0.5 credit]
Power Plant Analysis
Criteria of merit; selection of power plant for transportation and power generation applications; interrelation among mechanical, thermodynamic and aerodynamic design processes; jet propulsion, turbojets and turbofans; alternative proposals for vehicular power plant; combined cycle applications.
Prerequisite(s): MAAE 2400 and MATH 3705.
Lectures three hours a week.

MECH 4403 [0.5 credit]
Power Generation Systems
Energy sources and resources. Basic elements of power generation. Hydro-electric, fossil-fuel, fissile-fuel power plants. Geothermal, solar and wind power plants. Economic and environmental considerations. Energy storage. Future power needs.
Precludes additional credit for Precludes additional credit for SREE 4001.
Prerequisite(s): MAAE 2300, MAAE 2400 and MATH 3705.
Lectures three hours a week.

MECH 4406 [0.5 credit]
Heat Transfer
Mechanisms of heat transfer: fundamentals and solutions. Steady and transient conduction: solution and numerical and electrical analog techniques. Convective heat transfer: free and forced convection for laminar and turbulent flows; heat exchangers. Heat transfer between black and grey surfaces, radiation shields, gas radiation, radiation interchange.
Precludes additional credit for Precludes additional credit for AERO 4446.
Prerequisite(s): (ENVE 2001 or MAAE 2400) and (MAAE 3300, MECH 3310, or ENVE 3001) and MATH 3705.
Lectures three hours a week. Problem analysis and laboratories three hours a week.

MECH 4407 [0.5 credit]
Heating and Air Conditioning
Environmental demands for residential, commercial and industrial systems. Methods of altering and controlling environment. Air distribution. Refrigeration methods, equipment and controls. Integrated year-round air-conditioning and heating systems; heat pumps. Cooling load and air-conditioning calculations. Thermal radiation control. Component matching. System analysis and design.
Prerequisite(s): (ACSE 3209 or MAAE 2400) and MATH 3705.
Lectures three hours a week.

MECH 4408 [0.5 credit]
Thermofluids and Energy Systems Design
Integration of fluid mechanics, thermodynamics, and heat transfer for design of energy conversion systems. Chemical kinetics and mass transfer. Efficient combustion, fuel cells and batteries. Efficient operation and design of engines, power generators, boilers, furnaces, incinerators, and co-generation systems. Emerging energy systems.
Prerequisite(s): MAAE 3400 and MATH 3705.
Lectures three hours per week.

MECH 4501 [0.5 credit]
State Space Modeling and Control
Review of matrices. Geometric structure and dynamics of linear systems. Controllability and observability. Pole placement design of controllers and observers. Design of regulator and servo systems. Transmission zeros. Eigenstructure assignment. Relationship to frequency or classical control techniques. Computer solutions using MATLAB. Applications.
Precludes additional credit for Precludes additional credit for SYSC 5502.
Prerequisite(s): (MAAE 3500 or SYSC 4505) and MATH 3705.
Lectures three hours a week.

MECH 4503 [0.5 credit]
An Introduction to Robotics
History of robotics and typical applications. Robotic actuators and sensors. Kinematics of manipulators, inverse kinematics, differential relationships and the Jacobian. Manipulator dynamics. Trajectory generation and path planning. Robot control and performance evaluation. Force control and compliance. Applications in manufacturing and other industries.
Prerequisite(s): (MAAE 3500 or SYSC 4505) and MATH 3705.
Lectures three hours a week.

MECH 4604 [0.5 credit]
Finite Element Methods
Finite element methodology with emphasis on applications to stress analysis, heat transfer and fluid flow using the simplest one- and two-dimensional elements. Direct equilibrium, variational and Galerkin formulations. Computer programs and practical applications. Higher order elements.
Prerequisite(s): MAAE 3202 and MATH 3705.
Lectures three hours a week.

MECH 4704 [0.5 credit]
Integrated Manufacturing - CIMS
Overview of the topics essential to CIMS including integration of design and assembly techniques, numerical analysis, statistical process control and related production technologies within the manufacturing enterprise.
Prerequisite(s): MATH 3705.
Also offered at the graduate level, with different requirements, as MECH 5704, for which additional credit is precluded.
Lectures three hours a week.

MECH 4705 [0.5 credit]
CAD/CAM
Introduction to contemporary computer aided design and manufacturing (CAD/CAM) Topics covered include mathematical representation, solid modeling, drafting, mechanical assembly mechanism design, (CNC) machining. Current issues such as CAD data exchange standards, rapid prototyping, concurrent engineering, and design for X (DFX) are also discussed.
Prerequisite(s): (AERO 2001 or MAAE 2001) and MATH 3705.
Lectures three hours a week.

MECH 4805 [0.5 credit]
Measurement and Data Systems
Experimental data, accuracy and uncertainty analysis. Analog systems. Sensors. Signal conditioning. Op-Amps, instrumentation amplifiers, charge amplifiers, filters. Digital techniques. Encoders, A/D D/A converters. Data acquisition using microcomputers. Hardware and software considerations. Interfacing. Applications to measurement of motion, strain, force/torque, pressure, fluid flow, temperature.
Precludes additional credit for Precludes additional credit for ELEC 4805.
Prerequisite(s): ECOR 2050 and MATH 3705.
Lectures three hours a week.

MECH 4806 [0.5 credit]
Mechatronics
Introduction to the integration of mechanical, electronic and software components to build mechatronic devices. Mechanical and electrical systems modeling, simulation and implementation. Basic automation and computer requirements. Design tools and examples of mechatronic applications.
Prerequisite(s): (MAAE 3500 or SYSC 4505) and MATH 3705.
Lectures three hours per week.