MATH 4907 [0.5 credit] (formerly 70.497*)
Directed Studies
Prerequisite: B.Math.(Honours) students only.

The following courses have not been offered in recent years, but may be offered sometime in the future:

MATH 3405 Classical Mechanics
MATH 3706 Mathematical Methods II
MATH 3900 Mathematical Problem Solving
MATH 4001 Vector Calculus
MATH 4405 Analytical Dynamics
MATH 4406 Hydrodynamics and Elasticity

Mechanical Engineering (MECH)

Department of Mechanical and Aerospace Engineering
Faculty of Engineering

MECH 3002 [0.5 credit] (formerly 88.302*)
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.
Prerequisites: MAAE 2001, MAAE 3202.
Lectures three hours a week, problem analysis three hours a week.

MECH 3700 [0.5 credit] (formerly 88.370*)
Principles of Manufacturing
Manufacturing processes, materials. Casting: solidification and heat ow theory, defect formation, casting design. Metal forming: elementary plasticity theory, plastic failure criteria, force and work calculations. Bulk and sheet forming. Joining: heat ow and defect formation theory, residual stresses. Machining theory and practice. Hardening: diffusion, wear resistance.
Prerequisite: MAAE 2700.
Lectures and tutorials three hours a week; problem analysis and laboratories one hour a week.

MECH 4003 [0.5 credit] (formerly 88.403*)
Mechanical Systems Design
Design of mechanical systems: establishing design criteria, conceptual design, design economics, value analysis, synthesis and optimization. Mechanical elements/systems: gear and exible drive systems, uid power systems. These elements are utilized in group design projects.
Prerequisite: MECH 3002.
Lectures three hours a week, problem analysis three hours a week.

MECH 4006 [0.5 credit] (formerly 88.406*)
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.
Prerequisites: MAAE 2101, MAAE 3004 (Dynamics of Machinery) and third- or fourth-year registration.
Lectures three hours a week.

MECH 4007 [0.5 credit] (formerly 88.407*)
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.
Prerequisites: MAAE 2101, MAAE 3004 (Dynamics of Machinery) and third-or fourth-year registration.
Lectures three hours a week.

MECH 4101 [0.5 credit] (formerly 88.411*)
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: MAAE 3202.
Lectures three hours a week.

MECH 4103 [0.5 credit] (formerly 88.413*)
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: MAAE 3202 (Mechanics of Solids II)
Lectures three hours a week.

MECH 4104 [0.5 credit] (formerly 88.414*)
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: MAAE 3004.
Lectures three hours per week.

MECH 4305 [0.5 credit] (formerly 88.435*)
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. Also offered at the graduate level, with additional or different requirements, as MECH 5401, for which additional credit is precluded.
Prerequisite: MAAE 3300.
Lectures three hours a week.

MECH 4401 [0.5 credit] (formerly 88.441*)
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.
Precludes additional credit for Engineering AERO 4402.
Prerequisite: MAAE 2400.
Lectures three hours a week.

MECH 4403 [0.5 credit] (formerly 88.443*)
Power Generation Systems
Energy sources and resources. Basic elements of power generation. Hydro-electric, fossil-fuel and fissile-fuel power plants. Other methods of conversion. Future methods of conversion. Economic and environmental considerations. Power generation systems. Future power needs.
Prerequisite: MAAE 2400.
Lectures three hours a week.

MECH 4406 [0.5 credit] (formerly 88.446*)
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.
Prerequisite: MAAE 3300.
Lectures three hours a week.

MECH 4407 [0.5 credit] (formerly 88.447*)
Heating & 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.
Prerequisites: MAAE 2400 and third- or fourth- year registration.
Lectures three hours a week.

MECH 4501 [0.5 credit] (formerly 88.451*)
State Space Modeling & 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 SYSC 5502.
Prerequisite: MAAE 4500 or MAAE 3502 (taken before 1999-2000).
Lectures three hours a week.

MECH 4503 [0.5 credit] (formerly 88.453*)
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.
Prerequisites: MATH 3705 and SYSC 3600.
Lectures three hours a week.

MECH 4604 [0.5 credit] (formerly 88.464*)
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.
Prerequisites: MAAE 3202 and MAAE 3300.
Lectures three hours a week.

MECH 4704 [0.5 credit] (formerly 88.474*)
Integrated Manufacturing - CIMS
Overview of the topics essential to CIMS including computer graphics, geometric modeling, numerically controlled machining, and flexible manufacturing with the objective of understanding the fundamental data structures and procedures for computerization of engineering design, analysis and production. Also offered at the graduate level, with additional or different requirements, as MECH 5704, for which additional credit is precluded.
Prerequisite: Engineering AERO 3700 or MECH 3700.
Lectures three hours a week.

MECH 4705 [0.5 credit] (formerly 88.475*)
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: MAAE 2001 (Engineering Graphics and Design) and Fourth-year registration. Lectures three hours a week.

MECH 4805 [0.5 credit] (formerly 88.485*)
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 Engineering ELEC 4805.
Prerequisites: STAT 3502, SYSC 3600 and ELEC 3605 or ELEC 2501.
Lectures three hours a week.

MECH 4907 [1.0 credit] (formerly 88.497)
Engineering Project
Students are required to complete a major project in

engineering analysis, design, development or research. Opportunities to develop initiative, self-reliance, creative ability and engineering judgment. The results must be submitted in a comprehensive report with appropriate drawings, charts, bibliography, etc.
Prerequisite: Completion of or concurrent registration in MECH 4003, and fourth-year registration in the Mechanical program.

Mechanical and Aerospace Engineering (MAAE)

Department of Mechanical and Aerospace Engineering
Faculty of Engineering

MAAE 2001 [0.5 credit] (formerly 86.201*)
Engineering Graphical Design
Engineering drawing techniques; fits and tolerances; working drawings; fasteners. Elementary descriptive geometry; true length, true view, and intersection of geometric entities; developments. Assignments will make extensive use of Computer-Aided Design (CAD) and will include the production of detail and assembly drawings from actual physical models.
Precludes additional credit for ECOR 1001.
Prerequisite: ECOR 1010.
Lectures and tutorials two hours a week, laboratory four hours a week.

MAAE 2101 [0.5 credit] (formerly 86.211*)
Engineering Dynamics
Review of kinematics and kinetics of particles: rectilinear and curvilinear motions; Newton's second law; energy and momentum methods. Kinematics and kinetics of rigid bodies: plane motion of rigid bodies; forces and accelerations; energy and momentum methods.
Precludes additional credit for CIVE 2101 or ECOR 2101.
Prerequisites: ECOR 1101 and MATH 1005 and MATH 1104.
Lectures three hours a week, problem analysis three hours a week.

MAAE 2202 [0.5 credit] (formerly 86.222*)
Mechanics of Solids I
Review of Principles of Statics; friction problems; Concepts of stress and strain at a point; statically determinate and indeterminate stress systems; torsion of circular sections; bending moment and shear force diagrams; stresses and deflections in bending; stress and strain transformations; buckling instability.
Precludes additional credit for CIVE 2200.
Prerequisites: ECOR 1101, MATH 1005 and MATH 1104.
Lectures three hours a week, problem analysis and laboratory three hours a week.

MAAE 2300 [0.5 credit] (formerly 86.230*)
Fluid Mechanics I
Fluid properties. Units. Kinematics, dynamics of fluid motion: concepts of streamline, control volume, steady and one-dimensional flows; continuity, Euler, Bernouilli, steady flow energy, momentum, moment of momentum equations; applications. Fluid statics; pressure distribution in fluid at rest; hydrostatic forces on plane and curved surfaces; buoyancy.
Prerequisites: MATH 1005, MATH 1104 and ECOR 1101.
Lectures three hours a week, laboratory and problem analysis three hours a week.

MAAE 2400 [0.5 credit] (formerly 86.240*)
Thermodynamics & Heat Transfer
Basic concepts of thermodynamics: temperature, work, heat, internal energy and enthalpy. First law of thermodynamics for closed and steady-flow open systems. Thermodynamic properties of pure substances; changes of phase; equation of state. Second law of thermodynamics: concept of entropy. Simple power and refrigeration cycles. Introduction to heat transfer: conduction, convection and radiation.
Precludes additional credit for ECOR 2401.
Prerequisites: CHEM 1101 or CHEM 1000, MATH 1005 and MATH 1104.
Lectures three hours a week, laboratory and problem analysis three hours a week.