

MECH. ENGINEERING GRADUATE (MECG)

MECG 7150 Conduction Heat Transfer 3 cr

Steady and unsteady state heat transfer by conduction, single and multidimensional systems. Conduction with moving boundaries and computer uses of finite difference techniques.

MECG 7160 Convective Heat Transfer 3 cr

Conservation principles and flux laws. Differential and integral equations of the boundary layer. Momentum and heat transfer for laminar and turbulent flow inside tubes and over external surfaces.

MECG 7170 Radiation 3 cr

Thermal radiation properties, blackbody radiation, heat exchange by radiation among surfaces in the presence or absence of participating media. Theory and measurement techniques, network methods, solar energy utilization.

MECG 7190 Classical Fluid Mechanics 1 3 cr

Bernoulli's equation, equations of motion, two-dimensional motion, streaming motions, aerofoils, sources and sinks, moving cylinders, theorem of Schwartz and Christoffel, jets and currents.

MECG 7200 Classical Fluid Mechanics 2 3 cr

Helmholtz motions, right linear vortices, waves. Stokes stream function, spheres and ellipsoids, solid moving through a fluid, vortex motion, viscosity.

MECG 7220 Boundary Layer Theory 3 cr

Basic concepts of boundary layer and separation. Navier-Stokes equations, exact solutions. Momentum and energy equations, approximate solutions; boundary layer control, and thermal boundary layers.

MECG 7240 Turbomachinery 3 cr

Generalized flow relations in rotating machinery, velocity triangles, limitation on work done per stage and Mach number effects, vortex flow, flow in cascades, blade temperatures and stresses, performance of turbomachines.

MECG 7260 Theory of Vibrations 3 cr

The formulation of vibration problems using variational principles; matrix formulation of the free and forced vibrations of discrete and continuous systems; the effect of damping; approximate methods for solving the equations of motion; numerical techniques.

MECG 7290 Diffusion in Solids 3 cr

Diffusion equations, atomic theory of diffusion, diffusion in dilute alloys, diffusion in a concentration gradient, diffusion in non-metals, high diffusivity paths, thermal diffusion, and electrolysis in solids.

MECG 7330 Phase Transformation in Solids 3 cr

Advanced treatment of phase transformations in solids such as precipitation, eutectoid decomposition, and martensitic reactions.

MECG 7340 Corrosion and Oxidation of Metallic Materials 3 cr

Topics include the electromechanical basis of corrosion, corrosion prevention by inhibitors, alloying and heat treatment passivity, stress corrosion crackling and fatigue, crack initiation and propagation, solid state chemistry including ionic and electronic conduction, and oxidation of metals and alloys.

MECG 7350 Research Topics in Physical Metallurgy and Metal Physics 3 cr

Topics selected from recent researches in physical metallurgy and metal physics.

MECG 7370 Modern Research Techniques 3 cr

Laboratory course designed to introduce the research student to a wide variety of equipment and techniques useful in metallurgical research, discussion, and laboratory.

MECG 7380 Electron Microscopy of Materials 3 cr

Theory and practice of electron microscopy, with emphasis on the application of transmission technique to materials research.

MECG 7390 Dislocation Theory 3 cr

Description of a dislocation; the stress field around a dislocation; forces on a dislocation; dislocation reactions in crystals, dislocation multiplication, pole mechanisms, twinning, stacking fault tetrahedron. Peierls force and related topics; image forces, interactions with point defects and other topics.

MECG 7400 Solidification of Metals and Alloys 3 cr

The theory of solidification with respect to microstructure and solute distribution. Practical applications such as casting semiconductors and zone refining.

MECG 7410 Theory of Turbulence 3 cr

Development and application of statistical theories to isotropic, nonisotropic, and homogeneous turbulent fluid motion.

MECG 7420 Selected Topics in Turbulence 3 cr

An extension of MECG 7410 to investigate the specialized problems of turbulence such as space-time correlation functions and spectral transfer in constrained and unconstrained fluid flows.

MECG 7450 Biomechanics 3 cr

Topics in kinematics related to normal gait and prosthetic devices; properties of materials used for prostheses; arterial, bone, and composite materials, including design and manufacturing methods.

PR/CR: A minimum grade of C is required unless otherwise indicated.

Prerequisite: ECE 2090 or consent of instructor.

MECG 7460 Topics in Heat Transfer 1 3 cr

Selected topics in heat transfer based on MECG 7150, MECG 7160, and MECH 7170. Topics will be chosen from the following: conduction with and without internal heat generation, combined mode heat transfer problems, boiling and condensation heat transfer, heat exchanger design, propulsion systems heat transfer problems, special problems in forced, free and mixed convection, and two-phase flow.

MECG 7470 Topics in Heat Transfer 2 3 cr

A continuation of certain topics of MECG 7460 to include the most recent advances in these areas.

MECG 7500 Topics in Aerodynamics 3 cr

Topics in Aerodynamics.

MECG 7600 Selected Topics in Engineering Design 3 cr

Lectures and seminars on selected advanced topics in the field of mechanical engineering design.

Mutually Exclusive: ENG 7510

MECG 7610 Engineering Properties of Polymers 3 cr

A survey of the physics of crystalline and amorphous polymers, including molecular weight distribution measurements, physics of rubber elasticity, theories of the glass transition, crystallinity measurements, crystallization kinetics, mechanical properties of crystalline and amorphous polymers.

MECG 7620 Fracture of Materials and Structures 3 cr

Griffith criterion for crack propagation, stress intensity factors, plasticity effects, experimental methods for evaluation of criteria, J-integral, crack opening displacement. Microscopic aspects, dislocations at the crack tip, cleavage fracture, nil ductility temperature. Fatigue, creep, stress corrosion cracking.

MECG 7680 Advanced Operations Research 3 cr

Formulations and algorithms for the following problems, set partitioning, set covering, clustering, location, layout, order picking, vehicle routing, vehicle scheduling. Applications of these problems to planning of manufacturing systems, scheduling of production, systems, materials handling systems and planning for warehouse and storage systems.

PR/CR: A minimum grade of C is required unless otherwise indicated.

Prerequisite: MECH 4760 or consent of instructor.

MECG 7690 Computer Integrated Manufacturing 3 cr

Basic concepts of microcomputer hardware and software with special emphasis on different manufacturing applications. These include data acquisition and analysis, machine monitoring and diagnostics, process control, robotics, machine tool control, automatic testing and quality control.

MECG 7740 Selected Topics in Robot Technology 3 cr

The role of digital computers and digital interface equipment in the control and operation of robots. Fundamentals of robot kinematics and coordinate systems. Various robotic sensing systems such as vision, tactile, proximity, ultrasonic. The selection of topics may change from time to time depending on student interest and advances in the field of robotic technology.

PR/CR: A minimum grade of C is required unless otherwise indicated.

Prerequisite: MECH 4840 or consent of instructor.

MECG 7760 Advanced Solid Mechanics 3 cr

Selected advanced topics in solid mechanics; e.g., relationship between solid physics and solid mechanics, mechanical properties for static, low- and high-cycle fatigue, failure theories and mechanisms, theory of shell structures, numerical methods, applications.

MECG 7770 Computer-Aided Engineering 3 cr

Principles and mathematical formulation of computer-aided design, manufacturing and database management systems; related topics pertinent to computer integrated design and manufacturing systems.

MECG 7780 Selected Topics in Engineering Mechanics 3 cr

Lectures and seminars on selected advanced topics in engineering mechanics such as space dynamics, orbital mechanics and kineto-elastodynamics, current problems, implications in current research.

MECG 7790 Transport Phenomena in Porous Media 3 cr

Single and multiphase flow in porous media. Porosity, permeability, capillary pressure, relative permeability, electrical properties.

MECG 7800 Topics in Porous Media 3 cr

An extension of MECG 7790 to allow investigation of special topics; e.g., computational methods, experimental techniques, mixed transport phenomena (diffusion/dispersion, conductive/convective heat transfer), advanced concepts, etc.

MECG 7810 Computational Thermofluids 3 cr

An introduction to the solution of thermofluids problems. Computational techniques (finite difference, finite element, boundary element). Modelling of turbulent flow. Spectral methods.

MECG 7840 Systems Modelling and Simulation 3 cr

Topics may include: Models and Model Building. Mathematical Models: analytical solutions, numerical solutions, steady-state solutions.

Modeling techniques: state models, linear graphs, bond graphs, transfer functions, large-scale models, linear vs nonlinear models. Simulation of Systems (discrete/continuous) on digital computers; numerical operations and algorithms. Simulation Languages (discrete/continuous) applied to analysis and design of dynamic and control systems, or, services and manufacturing systems.

PR/CR: A minimum grade of C is required unless otherwise indicated.

Prerequisite: consent of instructor.

MECG 7850 Applied Finite Element Method 3 cr

Weighted Residuals, Boundary versus Finite Element Method, Conventional and Special elements, Equality and Inequality Constraints, Error Estimates, Self-adaptive Techniques and Mixed Formulations.

PR/CR: A minimum grade of C is required unless otherwise indicated.

Prerequisites: CIVL 4240 or instructor approval.

MECG 7860 Selected Topics in Control Engineering 3 cr

Lectures and seminars on selected advanced topics in the field of systems and control that include mechanical systems, dynamics, control theory and mechatronics.

MECG 7890 M.Sc. Graduate Research Seminar 1 cr

Seminar presentation and discussion of current research topics in mechanical, industrial and materials engineering research.

MECG 7900 Ph.D. Graduate Research Seminar 1 cr

Seminar presentation and discussion of current research topics in mechanical, industrial and materials engineering research.

MECG 7910 System Design for Robots and Teleoperators 3 cr

Definitions and classification. Kinematics: transformations, forward and inverse kinematic solution methods, differential kinematic equations, motion trajectories. Dynamics: energy method vs. Newton-Euler formulation. Actuators; electric, hydraulics and pneumatics. Control: requirement and methods for control of robots and teleoperators.

PR/CR: A minimum grade of C is required unless otherwise indicated.

Prerequisites: MECH 3430, MECH 3480 or equivalent.

MECG 7920 Engineering Mechanics of Composite Materials 3 cr

Brief overview of composites; constituents; properties; processing and application; micro-mechanics of reinforcement; elastic behaviour of unidirectional lamina; strength of unidirectional lamina; elastic behaviour of multi-directional laminates; stress and failure analysis of multidirectional laminates; hydrothermal effects and durability; introduction to textile composites.

MECG 7930 Advanced Non-Linear Systems Analysis 3 cr

Topics may include (i) Modelling of Constrained Dynamic Systems, including derivation of dynamic equations for constrained systems using Lagrangian equations and/or Newton-Euler equations; (ii) Advanced Stability Theories, including construction of Lyapunov functions and Lyapunov's stability control; and (iii) Introduction to Analysis of Non-smooth Systems, including Filippov's solution analysis and extended Lyapunov's stability theory to non-smooth systems. Applications to computer modelling of bipedal locomotion, analysis of robotic contact tasks and stability analysis of power systems will be addressed.

MECG 7940 Experimental Methods in Fluid Mechanics 3 cr

Topics will be chosen from: Review of fluid mechanics, combustion and turbulence theory; role of experiments; conventional measurement methods for temperature, pressure and velocity; laser-based techniques for local and global velocity measurements (Laser Doppler Anemometry (LDA), Phase-Doppler Anemometry (PDA), Particle Image Velocimetry (PIV)); other laser-based techniques for imaging and concentration measurements in reacting and non-reacting single and two-phase flows.

MECG 7950 Selected Topics for Productivity Improvement in Manufacturing 3 cr

Will address techniques that can assist North American manufacturing and improve productivity in the global market place in the 21st century. Topics include: productivity techniques, quality, cost, manufacturing control and other pertinent issues.