MECHANICAL ENGINEERING (MCG)

The following courses are offered by the Faculty of Engineering.

MCG 1100 Introduction to Mechanical Engineering (3 units)
Basics of graphical communication, conventional and computer-aided. Sketching, orthographic projections, assembly drawings, solid modelling. Dissection of simple mechanical systems, measurements, report writing.
Course Component: Laboratory, Lecture
Prerequisite: GNG 1105.

MCG 1500 Introduction au génie mécanique (3 crédits)
Notions de base de la communication graphique par les méthodes conventionnelles et assistées par ordinateur. Exécution des croquis, projections orthographiques, sections, dessins d'assemblages, modèles solides. Dissection des systèmes mécaniques, métrologie, rédaction des rapports.
Volet : Laboratoire, Cours magistral
Préalable : GNG 1505.

MCG 2101 Introduction to Design of Mechanical Systems (3 units)
The design process. Mechanical components-nomenclature and function. Project management. Technical report writing and oral presentations. Group design project.
Course Component: Laboratory, Lecture
Prerequisites: MCG 1100, (MCG 2360 or MCG 2141).

MCG 2108 Dynamics (3 units)
Newtonian mechanics. Particle kinematics and dynamics. Moving co-ordinates. Rigid body kinematics and dynamics.Impulse and momentum. Work and energy.
Course Component: Lecture, Tutorial
Prerequisite: GNG1105. MAT2322 is corequisite to MCG 2108.

MCG 2130 Thermodynamics I (3 units)
Fundamentals of engineering thermodynamics. Properties and state, properties tables, first law of thermodynamics for control mass and control volume systems, second law, entropy and its applications.
Course Component: Lecture, Tutorial

MCG 2131 Thermodynamics II (3 units)
Extension of thermodynamics principles to mixtures, psychrometrics, real gases and chemical reactions. Application of thermodynamics to standard power and refrigeration cycles. Laboratory experiments.
Course Component: Laboratory, Lecture, Tutorial
Prerequisite: MCG 2130.

MCG 2141 Biological and Engineering Materials I (3 units)
Introduction to structures of engineering metals and their mechanical properties. Defect structures; elastic and plastic deformation, strengthening processes. Introduction to equilibrium phase diagrams. Heat treatment of ferrous alloys. Introduction to fracture, corrosion, welding, and time dependent deformation in metals. Laboratories on biological materials.
Course Component: Laboratory, Lecture, Tutorial

MCG 2142 Biological and Engineering Materials II (3 units)
Processing, microstructures, mechanical properties and applications of structural ceramics, polymers and fibre composite materials. Microstructure-mechanical properties relationships in hard and soft biological tissues. Corrosion prevention and control in engineering structures and human implant devices. Laboratory experiments.
Course Component: Laboratory, Lecture
Prerequisites: ANP 1106, (MCG 2360 or MCG 2141).

MCG 2360 Engineering Materials I (3 units)
Introduction to structures of engineering metals and their mechanical properties. Defect structures; elastic and plastic deformation, strengthening processes. Introduction to equilibrium phase diagrams. Heat treatment of ferrous alloys. Introduction to fracture, corrosion, welding, and time dependent deformation in metals.
Course Component: Lecture, Tutorial

MCG 2361 Engineering Materials II (3 units)
Processing, strengthening mechanisms, properties and applications of structural ceramics, polymers and composite materials. Corrosion prevention and control. Laboratory experiments.
Course Component: Laboratory, Lecture
Prerequisite: MCG 2360.

MCG 2501 Introduction à la conception de systèmes mécaniques (3 crédits)
Processus de conception. Composantes mécaniques - terminologie et fonctionnement. Gestion de projet. Rédaction scientifique et communication orale. Projet de conception en groupe.
Volet : Laboratoire, Cours magistral
Préalables : MCG 1500, (MCG 2760 ou MCG 2541).

MCG 2508 Dynamique (3 crédits)
Mécanique Newtonienne. Cinématique et cinétique des particules. Système de coordonnées en mouvement. Cinématique et dynamique des corps rigides. Impulsion et quantité de mouvement. Travail et énergie.
Volet : Cours magistral, Tutoriel
Préalable : GNG 1505. Le cours MAT 2722 est concomitant à MCG 2508.

MCG 2530 Thermodynamique I (3 crédits)
Principes de la thermodynamique appliquée. Propriétés et états, tables des propriétés, premier principe de la thermodynamique pour un système fermé et un volume de contrôle, second principe, entropie et ses applications.
Volet : Cours magistral, Tutoriel

MCG 2531 Thermodynamique II (3 crédits)
Extension des principes de la thermodynamique aux mélanges, psychrométrique, gaz réels et réactions chimiques. Applications de la thermodynamique aux cycles de puissance et de réfrigération. Expériences au laboratoire.
Volet : Laboratoire, Cours magistral, Tutoriel
Préalable : MCG 2530.

MCG 2541 Matériaux biologiques et pour l'ingénieur I (3 crédits)
Introduction aux structures et propriétés mécaniques des matériaux. Imperfections structurales. Déformation élastique et plastique. Introduction aux diagrammes d'équilibres. Traitement thermique des alliages ferreux. Introduction à la fracture, corrosion, soudage et déformation liés à la durée des métaux. Travaux pratiques sur les matéraux biologiques.
Volet : Laboratoire, Cours magistral, Tutoriel

MCG 2542 Matériaux biologiques et pour l'ingénieur II (3 crédits)
Mise en oeuvre, microstructure, propriétés matérielles et applications des céramiques, polymères et matériaux composites à fibres. Relations entre les propriétés micro structurelles et mécaniques des tissus biologiques durs et mous. Prévention et contrôle de la corrosion en construction mécanique et dans les implants humains. Travaux pratiques.
Volet : Laboratoire, Cours magistral
Préalables : ANP 1506, (MCG 2760 ou MCG 2541).

MCG 2760 Matériaux de l'ingénieur I (3 crédits)
Introduction aux structures et propriétés mécaniques des matériaux. Imperfections structurales. Déformation élastique et plastique. Introduction aux diagrammes d'équilibres. Traitement thermique des alliages ferreux. Introduction à la fracture, corrosion, soudage et déformation liés à la durée des métaux.
Volet : Cours magistral, Tutoriel

MCG 2761 Matériaux de l'ingénieur II (3 crédits)
Processus de fabrication, mécanismes de durcissement, propriétés et applications des céramiques structurelles, des polymères et des matériaux composites, contrôle et prévention de la corrosion. Expériences de laboratoire.
Volet : Laboratoire, Cours magistral
Préalable : MCG 2760.

MCG 3110 Heat Transfer (3 units)
Fundamental principles of heat transmission by conduction, convection and radiation. Application of these principles to the solution of engineering problems.
Course Component: Lecture, Tutorial
Prerequisite: MCG 3340.

MCG 3130 Dynamics of Machinery (3 units)
Masses, motions and forces in machines. Engine force analysis. Flywheels and balancing. Vibrations of machinery and of shafting.
Course Component: Lecture, Tutorial
Prerequisite: MCG 2108.

MCG 3131 Machine Design (3 units)
The application of the theory of mechanics of materials to the design of machine elements.
Course Component: Lecture, Tutorial
Prerequisites: CVG 2140, MCG 2101, (MCG 2361 or MCG 2142), (MCG 3145 or MCG 3141).

MCG 3141 Advanced Strength of Materials and Applications to Biomechanical Systems (3 units)
Review of stress and strain, mechanical properties of materials, axial loading, torsion, bending, and transverse shear. Combined loadings, stress and strain transformations, theories of failure, deflection of beams and buckling of columns, energy methods. Applications to biomechanical systems.
Course Component: Lecture, Tutorial
Prerequisites: MCG 2142, CVG 2140, MCG 2108.

MCG 3142 Biocontrol Systems (3 units)
Feedback control theory. Samples of physiological control systems; body temperature regulation, heart rate regulation, etc. Time and frequency domain analysis of feedback control systems. Stability criteria. Control systems design and compensation techniques. Introduction to non-linear control systems. Simple models of physiological control systems; their analysis and simulation.
Course Component: Laboratory, Lecture
Prerequisites: MAT 3320, MCG 2142, MCG 3306, ELG 3336.

MCG 3143 Biofluid Mechanics (3 units)
Fundamentals of the human cardiovascular and respiratory systems. Differential treatment of fluid motion. Computational fluid dynamics. Non-Newtonian fluids. Haemodynamics and blood rheology. External flows. Additional topics may include measurements in the cardiovascular system, fluid machinery and biomedical applications.
Course Component: Laboratory, Lecture, Tutorial
Prerequisite: MCG 3340 for MCG students or CHG 2312 for CHG students.

MCG 3145 Advanced Strength of Materials (3 units)
Review of stress and strain at a point. Stress and strain transformations. Theories of failure and their application to design problems. Shear centre, bending of members in multiple plane. Energy methods, Castigliano's theorems, applications to straight and curved members. Torsion of these sections, non-circular sections. Impact stresses.
Course Component: Lecture, Tutorial
Prerequisites: CVG 2140, MCG 2108.

MCG 3305 Biomedical System Dynamics (3 units)
Modeling of mechanical, fluid, thermal and biomedical systems using a lumped parameter approach. Concepts of through and across variables in systems. Block diagrams for system representation. Linearization and solution of system equations. Transient and frequency response of biomedical systems.
Course Component: Laboratory, Lecture
Prerequisites: (ANP 1106 or MCG 2141), MAT 2384, MCG 2108.
Corequisite: ELG 3336.

MCG 3306 System Dynamics (3 units)
Modelling of mechanical, electrical, fluid and thermal systems using lumped parameter approach. Concepts of through and across variables in systems. Block diagram for system representation. Linearization and solution of system equations. Transient and frequency response of physical systems.
Course Component: Laboratory, Lecture
Prerequisites: MAT 2384, MCG 2108. Corequisite: ELG 3336.

MCG 3307 Control Systems (3 units)
Feedback theory. Time and frequency domain analysis of feedback control systems. Stability criteria. Design of simple feedback control systems and compensation techniques. Statespace analysis of systems. Laboratory experiments.
Course Component: Laboratory, Lecture
Prerequisites: MAT 3320, (MCG 3305 or MCG 3306).

MCG 3340 Fluid Mechanics I (3 units)
Fundamental concepts. Fluid statics. Fundamental laws of fluid motion. Dimensional analysis and similitude. Internal flows.
Course Component: Laboratory, Lecture, Tutorial
Prerequisites: MAT 2322, MCG 2108, MCG 2130. Corequisite: MAT 3320.

MCG 3341 Fluid Mechanics II (3 units)
External flows, aerodynamics. Differential treatment of fluid motion. Computational fluid dynamics. Fluid machinery. Compressible flow. Laboratory experiments.
Course Component: Laboratory, Lecture, Tutorial
Prerequisite: MCG 3340.

MCG 3510 Transfert de chaleur (3 crédits)
Principes fondamentaux en transfert de chaleur par conduction, convection et radiation. Application de ces principes pour la résolution de problèmes d'ingénierie.
Volet : Cours magistral, Tutoriel
Préalable : MCG 3740.

MCG 3530 Dynamique des machines (3 crédits)
Masses, mouvements et forces dans les machines. Analyse des forces dans un moteur. Volants d'inertie et équilibrage. Vibrations des machines et des arbres de transmission.
Volet : Cours magistral, Tutoriel
Préalable : MCG 2508.

MCG 3531 Conception des machines (3 crédits)
Application de la théorie de la mécanique des matériaux à la conception des composantes d'une machine.
Volet : Cours magistral, Tutoriel
Préalables : CVG 2540, MCG 2501, (MCG 2761 ou MCG 2542), (MCG 3545 ou MCG 3541).

MCG 3541 Résistance des matériaux et applications à des systèmes biomécaniques (3 crédits)
Révision des contraintes et déformations, propriétés mécaniques des matériaux, chargement axial, ainsi que de torsion, flexion, et cisaillement. Chargements combinés, transformation des contraintes et des déformations, théories de la rupture, déflexion des poutres et flambage des colonnes, méthodes énergétiques. Applications à des systèmes biomécaniques.
Volet : Cours magistral, Tutoriel
Préalable : MCG 2542.

MCG 3542 Biocontrôle (3 crédits)
Théorie du contrôle des systèmes en boucle fermée. Exemples de contrôle de systèmes physiologiques; régulation de la température du corps, régulation du rythme cardiaque, etc. Analyse temporelle et fréquentielle du contrôle de systèmes en boucle fermée. Critère de stabilité. Conception de contrôle de système et techniques de compensation. Introduction aux systèmes non linéaires. Modèles simples de contrôle de système physiologiques; analyse et simulation.
Volet : Laboratoire, Cours magistral
Préalables : MAT 3320, MCG 2542, MCG 3306, ELG 3336.

MCG 3543 Biomécanique des fluides (3 crédits)
Principes fondamentaux des systèmes cardiovasculaire et respiratoire humains. Équations différentielles du mouvement des fluides. Simulations numériques. Fluides non newtoniens. Hémodynamique et rhéologie sanguine. Ecoulements externes. D'autres sujets peuvent inclure les mesures dans le système cardiovasculaire, machines hydrolyques et les applications biomédicales.
Volet : Laboratoire, Cours magistral, Tutoriel
Préalables : MCG2542, MCG3740 pour les étudiants en génie mécanique (MCG) ou CHG 2712 pour les étudiants en génie chimique (CHG).

MCG 3545 Résistance des matériaux II (3 crédits)
Révision des contraintes et déformations en un point. Changements de repères. Théories de la rupture et leur utilisation en conception. Centre de cisaillement, fléchissement de membres en plusieurs plans. Méthodes énergétiques, théorèmes de Castigliano, application aux membres droits et courbes. Torsion de ces sections et de sections non circulaires. Contraintes de choc.
Volet : Cours magistral, Tutoriel
Préalables : CVG 2540, MCG 2508.

MCG 3705 Dynamique des systèmes biomédicaux (3 crédits)
Modélisation des systèmes mécaniques, thermiques, biomédicaux et des fluides avec l'approche des paramètres concentrés. Les concepts des variables d'efforts et d'écoulement. Les diagrammes bloc pour la représentation des systèmes. Linéarisation et solutions des équations des systèmes. La réponse transitoire et de fréquence des systèmes physiques
Volet : Laboratoire, Cours magistral
Préalables: (ANP 1506 ou MCG 2541), MAT 2784, MCG 2508.
Concomitant : ELG 3736.

MCG 3706 Dynamique des systèmes (3 crédits)
Modélisation des systèmes mécaniques, électriques, des fluides et thermiques avec l'approche des paramètres concentrés. Les concepts des variables d'efforts et d'écoulement. Les diagrammes bloc pour la représentation des systèmes. Linéarisation et solutions des équations des systèmes. La réponse transitoire et de fréquence des systèmes physiques.
Volet : Laboratoire, Cours magistral
Préalables : MAT 2784, MCG 2508. Concomitant : ELG 3736.

MCG 3707 Automatique (3 crédits)
La théorie de la rétroaction. L'analyse dans le domaine de temps et de fréquence des systèmes de réglage avec rétroaction. Critères de stabilité. La conception des systèmes simples de réglage avec rétroaction et des techniques de compensation. L'analyse des systèmes dans l'espace d'état. Expériences de laboratoire.
Volet : Laboratoire, Cours magistral
Préalables : MAT 3720, (MCG 3705 ou MCG 3706).

MCG 3740 Mécanique des fluides I (3 crédits)
Principes fondamentaux. Statique des fluides. Lois fondamentales des écoulements. Analyse non-dimensionnelle et principes de similarité. Ecoulements internes.
Volet : Laboratoire, Cours magistral, Tutoriel
Préalables : MAT 2722, MCG 2508, MCG 2530. Concomitant : MAT 3720.

MCG 3741 Mécanique des fluides II (3 crédits)
Écoulements externes, aérodynamique. Traitement différentiel de la mécanique des fluides. Simulation numérique. Pompes et turbines. Écoulements compressibles. Expériences de laboratoire.
Volet : Laboratoire, Cours magistral, Tutoriel
Préalable : MCG 3740.

MCG 4100 Thesis (6 units)
A student in the fourth year of Mechanical Engineering may elect to prepare a written thesis on an approved research topic, to be completed in one semester.
Course Component: Research
Prerequisite: Completion of 3rd year Mechanical Engineering or Biomedical Mechanical Engineering studies.

MCG 4102 Finite Element Analysis (3 units)
Review of matrix algebra and matrix structural analysis. Fundamentals of the finite element method. Simple one- and two-dimensional elements. Elementary programming in stress analysis, heat transfer and fluid flow. Preprocessing, post-processing. Use of commercial programs.
Course Component: Lecture, Tutorial
Prerequisites: GNG 1106, (MCG 3145 or MCG 3141) or equivalent.

MCG 4104 Building Energy Systems (3 units)
The theory and application of the principles of heating, ventilating and air conditioning are applied to engineering systems. The thermodynamic properties of air-water mixtures are discussed in relation to heating and cooling load calculations. Current engineering systems are studied.
Course Component: Lecture
Prerequisites: MCG 3110, (MCG 3341 or MCG 3143).

MCG 4107 Dynamics II (3 units)
Modelling, problem formulation and analysis of rigid body, multi-degree-of-freedom, mechanical, gyrodynamic, electro-mechanical, and vibrational systems using Newton, D'Alembert, Euler and Lagrange methods. Introduction to central force motion.
Course Component: Lecture
Prerequisite: MCG 3130.

MCG 4110 Fluid Machinery (3 units)
Review of fluid mechanics and thermodynamics of turbomachinery and positive displacement fluid machinery. Performance characteristics, selection and comparison of types.
Course Component: Lecture
Prerequisite: MCG 3341 or MCG 3143.

MCG 4111 Internal Combustion Engines (3 units)
The theory, thermodynamics, and mechanical principles of internal combustion engines. Basic engine types and their operation. Engine testing. Theories of combustion. Economy and selection of various engines for different purposes. Fuels.
Course Component: Lecture, Tutorial
Prerequisites: MCG 2131, (MCG 3341 or MCG 3143).

MCG 4112 Introduction to Microfluidics (3 units)
Physics of liquid transport in micro-fabricated systems including physics at the microscale, hydrodynamics of microfluidic systems, diffusion mixing, introduction to microfabrication, examples of microfluidics devices , hand-on project.
Course Component: Lecture
Prerequisite: MCG 3143 or MCG 3341.

MCG 4126 Energy Conversion (3 units)
Fuels, combustion fundamentals, pollutant formation and control, nuclear energy, solar energy, refrigeration, and other energy conversion systems.
Course Component: Lecture
Prerequisites: MCG 2131, MCG 3110, (MCG 3341 or MCG 3143).

MCG 4127 Computational Methods in Mechanical Engineering (3 units)
Solution of ordinary and partial differential equations in mechanical engineering by numerical techniques on computers. Matrix methods. Eigenvalue computation. Finite difference and finite element methods for solid mechanics, fluid mechanics and heat transfer problems.
Course Component: Lecture, Tutorial
Prerequisites: MAT 2384, (MAT 3320 or equivalent).

MCG 4128 Basic Nuclear Engineering (3 units)
Review of atomic structure and radioactive decay, nuclear reactions and the fission process; health physics and biological radiation protections. Radioisotope applications; engineering principles of nuclear reactors; energy production and distribution reactor, heat transfer; radiation damage and materials; reactor types.
Course Component: Lecture
Prerequisites: MCG 2131, MCG 3110, (MCG 3341 or MCG 3143).

MCG 4130 Industrial Planning (3 units)
A study of the methods and practices used in industrial planning, such as the organization of engineering activities and interfacing with the various branches of industrial units, cost estimation, operations and production design.
Course Component: Lecture
MCG 4328 is corequisite to MCG 4130.

MCG 4132 Robot Mechanics (3 units)
Robotics overview. Transformations. Basics of robot kinematics, statics and dynamics. Introduction to industrial robots and programming.
Course Component: Lecture, Tutorial
Prerequisite: MCG 3130.

MCG 4133 Automation Design and Control (3 units)
Concepts of batch and mass production. Sequencing and timing of the production cell operation. Cell balancing. Design and operational characteristics of hard and flexible manufacturing cells. Automated inspection. Programmable logic controllers. Computer-based cell controller. Cell design evaluation.
Course Component: Lecture
Prerequisites: MCG3131, MCG3307. MCG4322 is corequisite to MCG 4133.

MCG 4134 Robot Design and Control (3 units)
Classification of robot manipulators. Forward and Inverse Kinematics. Design of joint actuating systems. Independent joint control. Point-to-point control. Path planning and trajectory control. Computed torque technique. Compliance and force control. Sensory components for robot control. End of arm tooling.
Course Component: Lecture, Tutorial
Prerequisites: MCG 3131, (MCG 3307 or MCG 3142).

MCG 4135 Deformation and Fracture of Engineering Materials (3 units)
This course will cover both macroscopic (continuum) and microscopic (discrete) aspects of deformation and fracture in engineering materials. Topics covered include elasticity, plasticity, dislocation theory, strengthening mechanisms, cracks and notches, crack tip stress fields and plastic zones, energy principles, ductile, brittle and fatigue fracture, and toughening mechanisms.
Course Component: Lecture
Prerequisites: MCG 2360, MCG 2361.

MCG 4136 Mechatronics (3 units)
Models for passive and active components for electro-mechanical systems. Network representation of signals and energy transmission and conversion. Selection of sensors and actuators for the control of mechanical systems. Modelling and simulation for the design of mixed dynamic systems.
Course Component: Lecture, Tutorial
Prerequisite: MCG 3307 or MCG 3142 or equivalent.

MCG 4137 Micro and Nano Systems (3 units)
Fundamental principles governing micro and nano systems, case study of selected applications, and overview of semiconductor micro and nano fabrication techniques. Topics include statics and dynamics at reduced dimensions, electrostatic actuation techniques, nanomechanical resonators, and fundamental performance limits imposed by the equipartition theorem and the fluctuation dissipation theorem.
Course Component: Lecture
Prerequisites: MAT 3320, MCG 2108, MCG 3307.

MCG 4139 Computational Methods in Fluid and Heat Transfer (3 units)
Models and simulation. Governing differential equations. Discretization concepts. Finite difference formulation. Control volume formulation. Examples of computer programs for the calculation of fluid flow and temperature fields.
Course Component: Lecture, Tutorial
Prerequisites: MCG 3110, (MCG 3341 or MCG 3143).

MCG 4142 Corrosion: Principles, Prevention and Control (3 units)
The effects and economic impact of corrosion. Basic concepts and principles of corrosion. Forms of corrosion. Corrosion recognition and prevention in engineering structures and devices. Corrosion characteristics of structural and engineering materials. Corrosion control. Corrosion testing and monitoring. Techniques for diagnosis of corrosion failures. Case studies.
Course Component: Lecture
Prerequisites: (MCG 2360 or MCG 2141), (MCG 2361 or MCG 2142), (MCG 3145 or MCG 3141).

MCG 4143 Product Design and Development (3 units)
A project-based course in which teams of students conceive, design and prototype a physical product. Topics include identifying customer needs, concept generation, product architecture, industrial design, and design-for-manufacturing.
Course Component: Laboratory, Lecture
Prerequisites: MCG 2101, MCG 3131, (MCG 3145 or MCG 3141), (MCG 3307 or MCG 3142).

MCG 4144 Introduction to Composite Materials (3 units)
Constituent materials. Industrial material forms. Manufacturing processes. Design for manufacture. Micromechanics of fibre-reinforced materials. Classic lamination theory. Introduction to failure. Design and analysis of laminated structures. Case studies.
Course Component: Lecture
Prerequisites: (MCG 2361 or MCG 2142), (MCG 3145 or MCG 3141).

MCG 4150 Bioinstrumentation (3 units)
Measurement systems. Basic sensors. Electrical safety. Measurements of respiratory system. Bioelectrical signals. Measurement of blood pressure, flow and volume. Laboratory experiments
Course Component: Lecture, Tutorial
Prerequisite: MCG 3307 or MCG 3142.

MCG 4151 Design of Artificial Joint Prostheses and Implants (3 units)
Function-mechanical properties relationships of biological tissues for the musculoskeletal system. Analysis of selected human joints. Biomaterials . Review of structural design and materials selection of existing joint prostheses. Project on the design of a joint prosthesis.
Course Component: Lecture, Tutorial
Prerequisites: MCG 3141, MCG 3130, MCG 3131.

MCG 4152 Design of Artificial Organs (3 units)
Human circulatory system. Design of artificial hearts. Design of artificial heart valves. Experimental evaluation of deformation of blood vessel. Design of artificial blood vessels. Design of artificial membrane-type organs (e.g. kidneys). Human respiratory system. Design of ventilators.
Course Component: Laboratory, Lecture, Tutorial
Prerequisite: MCG 3143.

MCG 4153 Biomechanics of Movement (3 units)
Human and animal movement examined through the lens of mechanics. Biological, mechanical, and neurological processes by which muscles produce movement. Experimental, mathematical, and computational tools. Clinical and sports applications. Recent advances in biomedical research. Assignments, computer simulations, and a small research project.
Course Component: Lecture
Prerequisites: MAT 3320, MCG 2108, (MCG 3305 or MCG 3306), (MCG 3141 or MCG 3145).

MCG 4154 Introduction to Biomaterials and Tissue Engineering (3 units)
This course provides an overview of the different classes of biomaterials and introduces the principles of materials science and cell biology that apply to biomaterials and tissue engineering (e.g., biomaterial surface modifications, molecular and cellular interactions with biomaterials, immune response). A portion of the course is dedicated to laboratory sessions to introduce cell culture principles and biocompatibility testing.
Course Component: Laboratory, Lecture
Prerequisite: MCG 2142.

MCG 4155 Advanced Engineering Materials (3 units)
Topics are covered in this course from a materials perspective. Materials selection and use. Materials forming. Fracture, failure analysis and fracture mechanics. Welding and materials joining.
Course Component: Lecture
Prerequisite: MCG 2361 or MCG 2142.

MCG 4190 Selected Topics I (3 units)
Discussion of recent progress in mechanical engineering.
Course Component: Lecture
Prerequisite: Completion of 3rd year Mechanical Engineering or Biomedical Mechanical Engineering studies.

MCG 4191 Selected Topics II (3 units)
Discussion of recent progress in mechanical engineering.
Course Component: Lecture, Tutorial
Prerequisite: Completion of 3rd year Mechanical Engineering or Biomedical Mechanical Engineering studies.

MCG 4192 Selected Topics III (3 units)
Discussion of recent progress in mechanical engineering.
Course Component: Laboratory, Lecture
Prerequisite: Completion of 3rd year Mechanical Engineering or Biomedical Mechanical Engineering studies.

MCG 4193 Selected Topics IV (3 units)
Discussion of recent progress in mechanical engineering.
Course Component: Laboratory, Lecture, Tutorial
Prerequisite: Completion of 3rd year Mechanical Engineering or Biomedical Mechanical Engineering studies.

MCG 4220 Thesis (6 units)
A student in the fourth year of Mechanical Engineering may elect to prepare a written thesis on an approved research topic, to be completed in two semesters.
Course Component: Research
Prerequisite: Completion of third year Mechanical Engineering or Biomedical Mechanical Engineering studies.

MCG 42201 Thesis (Part 1 of 2)
A student in the fourth year of Mechanical Engineering may elect to prepare a written thesis on an approved research topic, to be completed in two semesters. (Part 1 of 2)
Course Component: Research
Prerequisite: Completion of third year Mechanical Engineering or Biomedical Mechanical Engineering studies.

MCG 42202 Thesis (Part 2 of 2) (6 units)
A student in the fourth year of Mechanical Engineering may elect to prepare a written thesis on an approved research topic, to be completed in two semesters. (Part 2 of 2)
Course Component: Research
Prerequisite for MCG 42202

MCG 4308 Mechanical Vibration Analysis (3 units)
Analysis of natural frequencies of single degree and multi-degree-of-freedom discrete systems. Their response to excitation forces and amplitude. Analysis with complex variables. Analysis of natural frequencies of multi-degree-of-freedom and continuous systems such as beams and plates. Introduction to energy techniques for solving beam and plate problems.
Course Component: Lecture, Tutorial
Prerequisites: MAT 3320, MCG 3130.

MCG 4322 Mechanical Engineering Capstone Project (6 units)
Major group design project integrating concepts from all major areas of mechanical engineering. The design process; conceptual design, synthesis and analysis, design optimization, parametric design and design system integration.
Course Component: Laboratory, Lecture
Prerequisites: MCG 2131, MCG 3110, MCG 3130, MCG 3131, (MCG 3141 or MCG 3145), (MCG 3143 or MCG 3341).

MCG 43221 Mechanical Engineering Capstone Project: Part I
Major group design project integrating concepts from different areas of mechanical engineering. Multiple iterations of design solutions are generated, documented and presented through conceptual design, synthesis and analysis, and design optimization. Manufacturing, economic, and ethical considerations are included in the design process. (Part 1 of 2)
Course Component: Laboratory, Lecture
Prerequisites: MCG 2131, MCG 3110, MCG 3130, MCG 3131, (MCG 3141 or MCG 3145), (MCG 3143 or MCG 3341).

MCG 43222 Mechanical Engineering Capstone Project: Part II (6 units)
Major group design project integrating concepts from different areas of mechanical engineering. Multiple iterations of design solutions are generated, documented and presented through conceptual design, synthesis and analysis, and design optimization. Manufacturing, economic, and ethical considerations are included in the design process. (Part 2 of 2)
Course Component: Laboratory, Lecture
Prerequisite: MCG 43221.

MCG 4325 Gas Dynamics (3 units)
Compressible flow, wave propagation in compressible media; isentropic flow of a perfect gas; normal shock waves, oblique shock waves and their applications; Prandtl Meyer flow; flow with friction and flow heat addition or heat loss.
Course Component: Lecture, Tutorial
Prerequisite: MCG 3341 or MCG 3143.

MCG 4328 Manufacturing (3 units)
Metal casting processes. Bulk deformation processes, including rolling, forging, extrusion and drawing. Sheet forming processes. Powder metallurgy. Machining. Joining processes. Laboratory experiments.
Course Component: Laboratory, Lecture, Tutorial
Prerequisites: MCG 3110, MCG 3340, (MCG 2361 or MCG 2142).

MCG 4329 Reliability and Maintainability in Engineering Design (3 units)
Reliability and maintainability engineering history and current trend. The bathtub hazard rate concept. Equipment hazard rate models. Static and dynamic redundant configurations to improve product reliability during the design phase. Equipment reliability evaluation techniques. Mechanical component reliability evaluation methods. Failure modes and effect analysis: a useful engineering design tool. Design for product maintainability. Mechanical equipment replacement policies.
Course Component: Lecture
Prerequisites: MAT 2377, MAT 3320, MCG 3307.

MCG 4340 Mechanical Engineering Laboratory (3 units)
Professional engineering practice and ethics, societal and environmental obligations of the engineer, workplace health and safety. Laboratory experiments on mechanical engineering systems.
Course Component: Laboratory, Lecture, Seminar
Prerequisites: MCG 3131, (MCG 3341 or MCG 3143), (MCG 3145 or MCG 3141), (MCG 3307 or MCG 3142).

MCG 4345 Aerodynamics (3 units)
Potential flow analysis. Thin airfoil theory. Computation of flow about bodies. Laminar and turbulent boundary layer techniques.
Course Component: Lecture, Tutorial
Prerequisite: MCG 3341.

MCG 4366 Biomedical Mechanical Engineering Capstone Project (6 units)
Major group design project integrating concepts from different areas of mechanical biomedical engineering. Multiple iterations of design solutions are generated, documented and presented through conceptual design, synthesis and analysis, and design optimization. Manufacturing, economic, and ethical considerations are included in the design process.
Course Component: Laboratory, Lecture
Prerequisites: MCG 2131, MCG 3110, MCG 3130, MCG 3131, (MCG 3141 or MCG 3145), (MCG 3143 or MCG 3341).

MCG 43661 Biomedical Mechanical Engineering Capstone Project: Part I
Major group design project integrating concepts from different areas of mechanical biomedical engineering. Multiple iterations of design solutions are generated, documented and presented through conceptual design, synthesis and analysis, and design optimization. Manufacturing, economic, and ethical considerations are included in the design process. (Part 1 of 2)
Course Component: Laboratory, Lecture
Prerequisites: MCG 2131, MCG 3110, MCG 3130, MCG 3131, (MCG 3141 or MCG 3145), (MCG 3143 or MCG 3341).

MCG 43662 Biomedical Mechanical Engineering Capstone Project: Part II (6 units)
Major group design project integrating concepts from different areas of mechanical biomedical engineering. Multiple iterations of design solutions are generated, documented and presented through conceptual design, synthesis and analysis, and design optimization. Manufacturing, economic, and ethical considerations are included in the design process. (Part 2 of 2)
Course Component: Laboratory, Lecture
Prerequisite: MCG 43661.

MCG 4512 Introduction à la microfluidique (3 crédits)
Physique des transports dans les systèmes micro-fabriqués. Physique à l'échelle microscopique, hydrodynamique des systèmes microfluidiques, mélange et diffusion, introduction à la microfabrication, exemples de dispositifs microfluidiques, projet pratique.
Volet : Cours magistral
Préalable : MCG 3543 ou MCG 3741.

MCG 4535 Déformation et rupture des matériaux d'ingénierie (3 crédits)
Ce cours couvrira à la fois les aspects macroscopique (continus) et microscopique (discrets) de la déformation et de la rupture dans les matériaux d'ingénierie. Les sujets abordés incluent l'élasticité, la plasticité, la théorie des dislocations, les mécanismes de renforcement, fissures et entailles, champs de contraintes en front de fissure et zones plastiques, principes énergétiques, rupture ductile, fragile et par fatigue, et mécanismes de durcissement.
Volet : Cours magistral
Préalables : MCG 2760, MCG 2761.

MCG 4537 Micro et Nano Systèmes (3 crédits)
Principes fondamentaux régissant les micro et nano systèmes, étude de cas d'applications sélectionnées et aperçu des techniques de micro et nano fabrication de semi-conducteurs. Les sujets incluent la mécanique statique et dynamique à dimensions réduites, les actionneurs électrostatiques, les résonateurs nanomécaniques, ainsi que les limites de performance imposées par le principe d'équipartition de l'énergie et le théorème de fluctuation-dissipation.
Volet : Cours magistral
Préalables : MAT 3720, MCG 2508, MCG 3707.

MCG 4542 Corrosion : Principes, prévention et contrôle (3 crédits)
Les effets et l'impact de la corrosion. Les concepts fondamentaux et les principes de la corrosion. Les formes de corrosion. Reconnaitre et prévenir la corrosion dans les éléments structuraux et les composants mécaniques. La résistance à la corrosion des matériaux structuraux. Le contrôle de la corrosion. L'évaluation et le monitorage de la corrosion. Les techniques pour l'étude de défaillances causées par la corrosion. L'étude de cas.
Volet : Cours magistral
Préalables : (MCG 2760 ou MCG 2541), (MCG 2761 ou MCG 2542), (MCG 3545 ou MCG 3541).

MCG 4543 Conception et développement de produits (3 crédits)
Un cours par projet dans lequel des équipes d'étudiants doivent concevoir, créer et développer le prototype d'un produit physique. Les thèmes du cours incluent l'identification des besoins des clients, la génération de concepts appropriés, l'architecture du produit, la conception industrielle et la préparation de la fabrication.
Volet : Laboratoire, Cours magistral
Préalables : MCG 2501, MCG 3531, (MCG 3545 ou MCG 3541), (MCG 3707 ou MCG 3542).

MCG 4544 Introduction aux matériaux composites (3 crédits)
Matériaux constituants. Matériaux, semi-produits et auxiliaires industriels. Design pour fabrication. Micromécanique des matériaux renforcés de fibres. Théorie classique des laminés. Introduction à la rupture des matériaux composites. Design et analyse des structures laminées. Études de cas.
Volet : Cours magistral
Préalables : (MCG 2761 ou MCG 2542), (MCG 3545 ou MCG 3541).

MCG 4550 Bio-instrumentation et biocontrôles (3 crédits)
Systèmes de mesures. Capteurs usuels. Sécurité électrique. Mesures sur le système respiratoire. Signaux bioélectriques. Mesure de la pression sanguine, du débit et du volume sanguins. Travaux pratiques.
Volet : Cours magistral, Tutoriel
Préalable : MCG 3707 ou MCG 3542.

MCG 4551 Biomécanique et biomatériaux des articulations prothétiques (3 crédits)
Relations entre la fonction et les propriétés matérielles des tissus biologiques du système locomoteur. Analyse d'articulations humaines choisies. Revue de la conception structurelle et du choix des matériaux pour les implants prosthétiques. Projet sur la conception d'une prosthèse articulaire.
Volet : Cours magistral, Tutoriel
Préalables : MCG 3541, MCG 3130, MCG 3131.

MCG 4552 Organes artificiels (3 crédits)
Système circulatoire humain. Conception des coeurs artificiels. Conception des valves cardiaques artificielles. Evaluation expérimentale des déformations d'un vaisseau sanguin. Conception des vaisseaux artificiels. Conception d'organes du type membrane (par exemple, reins). Système respiratoire humain. Conception de respirateurs.
Volet : Laboratoire, Cours magistral, Tutoriel
Préalable : MCG 3543.

MCG 4553 Biomécanique du mouvement (3 crédits)
Le mouvement des humains et animaux examiné à travers le prisme de la mécanique. Processus biologiques, mécaniques et neurologiques par lesquels les muscles produisent un mouvement. Outils expérimentaux, mathématiques et informatiques. Applications cliniques et sportives. Progrès récents de la recherche biomédicale. Devoirs, simulations informatiques et un projet de recherche. Course Component: Lecture
Volet : Cours magistral
(Préalables : MAT 3720, MCG 2508, (MCG 3541 ou MCG 3545), (MCG 3705 ou MCG 3706).

MCG 4554 Introduction aux biomatériaux et au génie tissulaire (3 crédits)
Ce cours donne un aperçu des différentes classes de biomatériaux et présente les principes de la science des matériaux et de la biologie cellulaire qui s'appliquent aux biomatériaux et au génie tissulaire (par exemple, les modifications de surface des biomatériaux, les interactions moléculaires et cellulaires avec les biomatériaux, la réponse immunitaire). Une partie du cours est consacrée à des séances de laboratoire pour introduire les principes de la culture cellulaire et les tests de biocompatibilité.
Volet : Laboratoire, Cours magistral
Préalable : MCG 2542.

MCG 4592 Thèmes choisis III (3 crédits)
Discussion de thèmes choisis en génie mécanique.
Volet : Laboratoire, Cours magistral
Préalable: Avoir complété la troisième année d'études en génie mécanique ou génie mécanique biomédical.

MCG 4593 Thèmes choisis IV (3 crédits)
Discussion de thèmes choisis en génie mécanique.
Volet : Laboratoire, Cours magistral, Tutoriel
Préalable: Avoir complété la troisième année d'études en génie mécanique ou génie mécanique biomédical.

MCG 4708 Analyse des vibrations mécaniques (3 crédits)
Analyse des fréquences propres des systèmes discrets linéaires à un, deux et à plusieurs degrés de liberté. Leurs réponses à des forces et amplitudes d'excitation. Analyse avec des variables complexes. Analyse des fréquences propres des systèmes à plusieurs degrés de liberté, et des systèmes continus tels que les poutres et les plaques. Introduction aux techniques de l'énergie pour la résolution de problèmes de plaque.
Volet : Cours magistral, Tutoriel
Préalables : MAT 3720, MCG 3530.

MCG 4722 Projet de fin d'études en génie mécanique (6 crédits)
Projet de conception majeur fait en groupe qui intègre des concepts de tous les aspects principaux du génie mécanique. Plusieurs itérations de solutions de conception sont générées, documentées et présentées par l'entremise de la conceptualisation, la synthèse et l'analyse, et l'optimisation de la conception. Les considérations de fabrication, économiques et éthiques sont incluses dans le processus de conception.
Volet : Laboratoire, Cours magistral
Préalables : MCG 2531, MCG 3510, MCG 3530, MCG 3531, (MCG 3541 ou MCG 3545), (MCG 3543 ou MCG 3741).

MCG 47221 Projet de fin d'études en génie mécanique : Partie I
Projet de conception majeur fait en groupe qui intègre des concepts de tous les aspects principaux du génie mécanique. Plusieurs itérations de solutions de conception sont générées, documentées et présentées par l'entremise de la conceptualisation, la synthèse et l'analyse, et l'optimisation de la conception. Les considérations de fabrication, économiques et éthiques sont incluses dans le processus de conception. (Partie 1 de 2)
Volet : Laboratoire, Cours magistral
Préalables : MCG 2531, MCG 3510, MCG 3530, MCG 3531, (MCG 3541 ou MCG 3545), (MCG 3543 ou MCG 3741).

MCG 47222 Projet de fin d'études en génie mécanique : Partie II (6 crédits)
Projet de conception majeur fait en groupe qui intègre des concepts de tous les aspects principaux du génie mécanique. Plusieurs itérations de solutions de conception sont générées, documentées et présentées par l'entremise de la conceptualisation, la synthèse et l'analyse, et l'optimisation de la conception. Les considérations de fabrication, économiques et éthiques sont incluses dans le processus de conception. (Partie 2 de 2)
Volet : Laboratoire, Cours magistral
Préalable : MCG 47221

MCG 4728 Procédés de fabrication (3 crédits)
Procédés de moulage des métaux. Procédés de déformation plastique incluant le laminage, le forgeage, l'extrusion et le tréfilage. Formage de feuilles métalliques. Métallurgie des poudres. Usinage. Procédés d'assemblage. Travaux de laboratoire.
Volet : Laboratoire, Cours magistral
Préalables : MCG 3510, MCG 3740, (MCG 2761 ou MCG 2542).

MCG 4740 Pratique du génie mécanique (3 crédits)
Pratique et éthique de l'ingénierie. Obligations de l'ingénieur envers la société et l'environnement. Santé au travail et sécurité. Expériences de laboratoire sur des systèmes de génie mécanique.
Volet : Laboratoire, Cours magistral
Préalables : MCG 3531, MCG 3707, (MCG 3741 ou MCG 3543), (MCG 3545 ou MCG 3541).

MCG 4766 Projet de fin d'études en génie mécanique biomédicale (6 crédits)
Projet de conception majeur fait en groupe qui intègre des concepts de tous les aspects principaux du génie mécanique biomédical. Plusieurs itérations de solutions de conception sont générées, documentées et présentées par l'entremise de la conceptualisation, la synthèse et l'analyse, et l'optimisation de la conception. Les considérations de fabrication, économiques et éthiques sont incluses dans le processus de conception.
Volet : Laboratoire, Cours magistral
Préalables : MCG 2531, MCG 3510, MCG 3530, MCG 3531, (MCG 3541 ou MCG 3545), (MCG 3543 ou MCG 3741).

MCG 47661 Projet de fin d'études en génie mécanique biomédicale : Partie I
Projet de conception majeur fait en groupe qui intègre des concepts de tous les aspects principaux du génie mécanique biomédical. Plusieurs itérations de solutions de conception sont générées, documentées et présentées par l'entremise de la conceptualisation, la synthèse et l'analyse, et l'optimisation de la conception. Les considérations de fabrication, économiques et éthiques sont incluses dans le processus de conception. (Partie 1 de 2)
Volet : Laboratoire, Cours magistral
Préalables : MCG 2531, MCG 3510, MCG 3530, MCG 3531, (MCG 3541 ou MCG 3545), (MCG 3543 ou MCG 3741).

MCG 47662 Projet de fin d'études en génie mécanique biomédicale : Partie 2 (6 crédits)
Projet de conception majeur fait en groupe qui intègre des concepts de tous les aspects principaux du génie mécanique biomédical. Plusieurs itérations de solutions de conception sont générées, documentées et présentées par l'entremise de la conceptualisation, la synthèse et l'analyse, et l'optimisation de la conception. Les considérations de fabrication, économiques et éthiques sont incluses dans le processus de conception. (Partie 2 de 2)
Volet : Laboratoire, Cours magistral
Préalable : MCG 47661.

MCG 5104 Theory of Plates and Shells (3 units)
A general coverage of various approaches to plate problems and the application of these methods to practical cases. A study of the theory of shells including deformation of shells without bending, stresses under various loading conditions, general theory of shells, shells forming surfaces of revolution. This course is equivalent to MAAJ 5004 at Carleton University.
Course Component: Lecture

MCG 5105 Continuum Mechanics (3 units)
Fundamental equations of continuum mechanics. Thermodynamics of continua. Rheological equations. Hamilton's principle for continua. Analytical solution of some elasticity and incompressible fluid dynamic problems. Extension to viscoelasticity and plasticity. Sound waves. Shock waves. Numerical methods of solution. This course is equivalent to MAAJ 5005 at Carleton University.
Course Component: Lecture

MCG 5107 Advanced Dynamics With Applications (3 units)
Review of Euler/Newton and D'Alembert formulation, Euler Angles, gyrodynamics, rotating machinery. Lagrangian dynamics, generalized co-ordinates, virtual work, generalized forces and the power function. Systems constraint forces and equilibrium. Modelling and formulation of multi-degree of freedom vibrational, electro-mechanical, dissipative systems, and other engineering applications. This course is equivalent to MAAJ 5007 at Carleton University.
Course Component: Lecture

MCG 5108 Finite Element Analysis (3 units)
Review of matrix algebra and structural mechanics. Fundamentals of the finite element method. Analysis of two-dimensional trusses and the elastic continuum. Finite element program development, commercial programs, pre and post processers. Isoparametric concept, modelling issues. Steady-state field problems, axisymmetric analysis. Applications in mechanical engineering. This course is equivalent to MAAJ 5008 at Carleton University.
Course Component: Lecture

MCG 5109 Advanced Topics in Finite Element Analysis (3 units)
Finite elements and their solution techniques. Multilayered plate, shell and continua. Eigenvalue and transient analysis, material and geometric non-linearities. Applications to fracture mechanics. Steady and transient state heat conduction. Potential flow. Creeping flow and incompressible viscous flow with inertia. This course is equivalent to MAAJ 5009 at Carleton University.
Course Component: Lecture

MCG 5110 Micromechanics of Solids (3 units)
Introduction. Classes of materials in Micromechanics. Continuum Mechanics vs Probabilistic Micromechanics. Cartesian Tensor Notation. Analysis of stress, strain and motion. The stochastic deformation process and theory. Structured materials and intelligent systems. Experimental approaches. This course is equivalent to MAAJ 5100 at Carleton University.
Course Component: Lecture

MCG 5111 Gas Dynamics (3 units)
Review of thermodynamics. Conservation equations. Wave propagation in compressible media. Isentropic flow. Normal and oblique shock waves. Prandtl-Meyer expansion fans. Applications. Ideal gas flow in ducts of variable section, friction, heat transfer. Method of characteristics. Imperfect gas effects, dissociation, ionization. Methods of measurement. This course is equivalent to MAAJ 5101 at Carleton University.
Course Component: Lecture

MCG 5115 Nonlinear Optimization (3 units)
Formulation of optimization problems. Unconstrained optimization: direct search techniques, gradient techniques. Constrained optimization: by unconstrained minimization, by direct methods. Mathematical programming. Geometric programming. Dynamic programming. Examples and applications in Mechanical Engineering topics. This course is equivalent to MAAJ 5105 at Carleton University.
Course Component: Lecture

MCG 5120 Micro and Nano Systems (3 units)
Fundamental principles governing micro and nano systems, case study of selected applications, and overview of semiconductor micro and nano fabrication techniques. Topics include statics and dynamics at reduced dimensions, electrostatic actuation techniques, nanomechanical resonators, and fundamental performance limits imposed by the equipartition theorem and the fluctuation dissipation theorem.
Course Component: Lecture
The courses MCG 5120, MCG 4137, and MCG 4537 cannot be combined for units.

MCG 5121 Space Mission Analysis and Design (3 units)
Review of solar system and space exploration. Space mission design and geometry. Analysis of orbit design, transfers, interplanetary trajectories. Effect of environment on spacecraft design. Space propulsion and launch vehicle design. Launch sequence, windows, cost. Reusable launch systems. This course is equivalent to MECH 5106 at Carleton University.
Course Component: Lecture

MCG 5122 Smart Structures (3 units)
Structural dynamics principles: modal analysis and wave propagation. Linear time invariant systems: feedback, feedforward, SISO, MIMO, digital and adaptive filters. "Smart" Structures: multifunctional materials, collocation principles, geometric filtering and control authority. Applications in aero-acoustics and aeroelasticity. Courses MCG 5122, MCG 5387 (MECH 5807) cannot be combined for units. This course is equivalent to MECH 5202 at Carleton University.
Course Component: Lecture

MCG 5124 Advanced Kinematics (3 units)
Algebraic-geometry applications: kinematic calibration of serial and in-parallel robots; kinematic synthesis of planar, spherical, spatial mechanisms. Various DH-parametrisations, Jacobian formulations. Topics in projective geometry; Cayley-Klein geometries; Plücker line coordinates; Gröbner bases; Grassmannians; kinematic mapping; Burmester theory. Emphasis on practical applications. This course is equivalent to MECH 5507 at Carleton University.
Course Component: Lecture

MCG 5125 Advanced Dynamics (3 units)
Developing and applying the governing equations of motion for discrete and continuous mechanical systems. Includes Newton-Euler and Lagrangian formulations; classical and finite element approaches for continuous systems; and linear stability, frequency response, and propagation solution methods. This course is equivalent to MECH 5501 at Carleton University.
Course Component: Lecture
Precludes additional credit for MCG 5350 (MECH 5500).

MCG 5131 Heat Transfer by Conduction (3 units)
Steady one-dimensional systems. Equations of Bessel and Legendre. Extended surface. Fourier series and partial differential equations. Steady two-dimensional systems. Steady-state numerical methods. Steady heat source systems. Steady porous systems. Transient systems; stationary and moving sources. Transient numerical method. This course is equivalent to MAAJ 5301 at Carleton University.
Course Component: Lecture

MCG 5132 Heat Transfer by Convection (3 units)
General problems of convection. Fundamental equations. Boundary layer equations. Forced convection in laminar flow. Forced convection in turbulent flow. Free convection. Condensing and boiling. Heat transfer to liquid metals. Heat transfer in high-speed flow. Special topics. This course is equivalent to MAAJ 5302 at Carleton University.
Course Component: Lecture

MCG 5133 Heat Transfer by Radiation (3 units)
Thermal radiation and radiation properties. Radiant interchange among surfaces separated by radiatively non-participating media. Radiant energy transfer through absorbing, emitting and scattering media. Combined conduction and radiation. This course is equivalent to MAAJ 5303 at Carleton University.
Course Component: Lecture

MCG 5134 Heat Transfer With Phase Change (3 units)
Pool boiling. Hydrodynamics of two-phase flow. Flow boiling and flow boiling crisis. Instability of two-phase flow. Condensation. This course is equivalent to MAAJ 5304 at Carleton University.
Course Component: Lecture

MCG 5136 Special Studies in Fluid Mechanics and Heat Transfer (3 units)
This course is equivalent to MAAJ 5306 at Carleton University.
Course Component: Lecture

MCG 5138 Advanced Topics in Mechanical Engineering (3 units)
This course is equivalent to MAAJ 5308 at Carleton University.
Course Component: Lecture

MCG 5141 Statistical Thermodynamics (3 units)
Kinetic theory of an ideal gas. The distribution of molecular velocities. Transport phenomena. Maxwell-Boltzmann statistics. Quantum mechanics. Quantum statistics. Partition functions. Partition functions and thermodynamic properties. Derivations of specific heats of gases. Gas mixtures. Law of mass action. This course is equivalent to MAAJ 5401 at Carleton University.
Course Component: Lecture

MCG 5147 Finite-Volume Methods for Compressible Gas Flows (3 units)
Review of hyperbolic conservation laws and the compressible Euler equations. Godunov-type finite volume schemes. Approximate Riemann solvers. Time-marching methods. Polynomial solution reconstruction. Godunov's theorem. Solution monotonicity. Viscous operators.
Course Component: Lecture

MCG 5148 High-Performance Parallel Scientific Computing (3 units)
Shared- and distributed-memory computer architectures. Parallel speedup, efficiency and Amdahl's law. Classical relaxation methods for linear systems. Domain decomposition methods. Shur-compliment method. Multigrid methods. Krylov subspace methods. Fast Fourier transforms and the Cooley-Tukey algorithm.
Course Component: Lecture

MCG 5149 Non-Equilibrium Gas Dynamics (3 units)
Foundations and applications of compressible fluid flow with non–-# equilibrium processes. Includes mechanical, chemical, and thermal non–-#equilibrium with application to detonation waves in gases and solids, shock waves with chemical and vibrational relaxation and impulsive motion in arbitrary media.
Course Component: Lecture

MCG 5151 Laminar Flow Theory (3 units)
Derivation and exact solutions of the Navier-Stokes equations. Low Reynolds number flows, Stokes flow. Oseen flow, lubrication theory. Laminar boundary layers. Introduction to hydrodynamic stability. This course is equivalent to MAAJ 5501 at Carleton University.
Course Component: Lecture

MCG 5152 Theory of Turbulence (3 units)
Review of the basic theories and experimental results of turbulent flow. Universal equilibrium theory, locally isotropic theories, isotropic turbulence, homogeneous shear flow, turbulent pipe and channel flow, jets, wakes, boundary layers. Turbulent diffusion of passive contaminants. Modelling of turbulence. This course is equivalent to MAAJ 5502 at Carleton University.
Course Component: Lecture

MCG 5155 Inviscid Flow Theory (3 units)
Langrangian and Eulerian description of fluid motion. Euler equations, velocity potential, irrotational flow, stream function, singular flows. Conformal mapping, Schwarz-Christoffel theorems. Airfoil theory, circulation and lift. This course is equivalent to MAAJ 5505 at Carleton University.
Course Component: Lecture

MCG 5156 Measurement in Fluid Mechanics (3 units)
Review of the common experimental techniques used in fluid mechanical research and applications. Flow visualization techniques. Hot-wire anemometry. Laser-Doppler anemometry. Measurement of concentration, temperature, force, pressure. This course is equivalent to MAAJ 5506 at Carleton University.
Course Component: Lecture

MCG 5157 Numerical Computation of Fluid Dynamics and Heat Transfer (3 units)
Governing equations. Explicit, implicit, finite difference and control volume procedures for approximating the parabolic and elliptic sets of partial differential equations and boundary conditions. Numerical solution by direct and iterative Gauss-Seidel relaxation methods. Considerations of stability, convergence, and numerical diffusion. Computational problems. This course is equivalent to MAAJ 5507 at Carleton University.
Course Component: Lecture

MCG 5167 Nuclear Reactor Engineering (3 units)
Course Component: Lecture

MCG 5169 Advanced Topics in Reliability Engineering (3 units)
Overview of classical reliability concepts. Fault tree construction and evaluation. Common-cause failure analysis of engineering systems. Human reliability modelling in engineering systems. Human unreliability data banks. Reliability of information and communication systems. This course is equivalent to MAAJ 5609 at Carleton University.
Course Component: Lecture

MCG 5170 Computer-Aided Design (3 units)
The design process. Structure of computer-aided drafting software. Analysis and optimization software. Software integration. Parametric design. Major group design project which integrates concepts from all major areas of mechanical engineering. Courses MCG 5170, MCG 4322 cannot be combined for units. This course is equivalent to MAAJ 5700 at Carleton University.
Course Component: Lecture
Exclusion: May not be taken for credit with MCG 4322.

MCG 5171 Applied Reliability Theory (3 units)
Failure rate. Repair time. System reliability estimation: binomial model. Strength stress model. Failure detection and isolation. Statistical quality control. This course is equivalent to MAAJ 5701 at Carleton University.
Course Component: Lecture

MCG 5173 Systems Engineering and Integration (3 units)
Introduction to modelling methods employed for the planning and design of sub-systems and complex systems. Discrete and continuous time, lumped and distributed parameters models. State estimation. Parameters identification. Discretization and stochastic effects. Technological systems modelling and simulation examples. This course is equivalent to MAAJ 5703 at Carleton University.
Course Component: Lecture

MCG 5177 Robot Mechanics (3 units)
Robotics overview. Transformations. Basics of robot kinematics, statics and dynamics. Introduction to practical robots, control and programming. Project in analysis, design or application of manipulators. Courses MCG 5177, MCG 4132 cannot be combined for units. This course is equivalent to MAAJ 5707 at Carleton University.
Course Component: Lecture

MCG 5184 Mechatronics (3 units)
Models for passive and active components for electro-mechanical systems. Network representation of signals and energy transmission and conversion. Selection of sensors and actuators for the control of mechanical systems. Modelling and simulation for the design of mixed dynamic systems. Courses MCG 5184, MCG 4136 cannot be combined for units. This course is equivalent to MAAJ 5804 at Carleton University.
Course Component: Tutorial, Lecture

MCG 5185 Multivariable Digital Control (3 units)
Quantization. Z-Transform. State equations. Jordan canonical form. Multirate and nonsynchronous samplings. Controllability and observability of digital systems. Digital controllers design using bilinear transformation. Digital PID controller. Stability. Optimal control of digital systems. Examples of controlling mechanical system actuators. This course is equivalent to MAAJ 5805 at Carleton University.
Course Component: Lecture

MCG 5186 Non-Linear Discontinuous Dynamics and Control (3 units)
Hamiltonian dynamics. Hamiltonian control systems. Lyapunov dynamics. Decoupling. Phase space analysis. Switching and sliding mode control. Boundary layer continuous approximation. Actuator, sensors and controller requirements. Manipulation control examples. This course is equivalent to MAAJ 5806 at Carleton University.
Course Component: Lecture

MCG 5191 Combustion in Premixed Systems (3 units)
Stoichiometry, thermo-chemistry, ignition, flame propagation, flame stabilization, diffusion flames, turbulent combustion, modelling. This course is equivalent to MAAJ 5901 at Carleton University.
Course Component: Lecture

MCG 5192 Combustion in Diffusion Systems (3 units)
Gaseous jet flames, combustion of liquid droplets, atomization, spray flames, coal combustion, fluidized bed combustion. This course is equivalent to MAAJ 5902 at Carleton University.
Course Component: Lecture

MCG 5300 Fundamentals of Fluid Dynamics (3 units)
Differential equations of motion. Viscous and inviscid regions. Potential flow: superposition; thin airfoils; finite wings; compressibility corrections. Viscous flow: thin shear layer approximation; laminar layers; transition; turbulence modelling. Convective heat transfer: free versus forced convection; energy and energy integral equations; turbulent diffusion. This course is equivalent to MECH 5000 at Carleton University.
Course Component: Lecture

MCG 5301 Theory of Viscous Flows (3 units)
Navier-Stokes and boundary layer equations; mean flow equations for turbulent kinetic energy; integral formulations. Stability, transition, turbulence, Reynolds stresses; separation. Calculation methods, closure schemes. Compressibility, heat transfer, and three-dimensional effects. This course is equivalent to MECH 5001 at Carleton University.
Course Component: Lecture

MCG 5303 Incompressible Non-Viscous Flows (3 units)
The fundamental equations and theorems for non-viscous fluid flow; solution of two-dimensional and axisymmetric potential flows; low-speed airfoil and cascade theory; wing lifting-line theory; panel methods. This course is equivalent to MECH 5003 at Carleton University.
Course Component: Lecture

MCG 5304 Compressible Non-Viscous Flows (3 units)
Steady isentropic, frictional, and diabatic flow; shock waves; irrotational compressible flow, small perturbation theory and similarity rules; second-order theory and unsteady, one-dimensional flow. This course is equivalent to MECH 5004 at Carleton University.
Course Component: Lecture

MCG 5305 Uninhabited Aircraft Systems Design (3 units)
Theory of flight and air vehicle performance; propulsion systems; launch and recovery. Regulatory development; privacy policies. Mission design; sensor performance. Guidance, navigation, control and communications theory. System-level reliability; life cycle cost assessment. Includes: Experiential Learning Activity. This course is equivalent to MECH 5005 at Carleton University.
Course Component: Lecture

MCG 5306 Theory of Subsonic Flows (3 units)
Course Component: Lecture

MCG 5307 Theory of Supersonic Flows (3 units)
Course Component: Lecture

MCG 5308 Experimental Methods in Fluid Mechanics (3 units)
Fundamentals of techniques of simulation of fluid dynamic phenomena. Theoretical basis, principles of design, performance and instrumentation of ground test facilities. Applications to aerodynamic testing. This course is equivalent to MECH 5008 at Carleton University.
Course Component: Lecture

MCG 5309 Environmental Fluid Mechanics Relating to Energy Utilization (3 units)
Characteristics of energy sources and emissions into the environment. The atmosphere; stratification and stability, equations of motion, simple winds, mean flow, turbulence structure and dispersion near the ground. Flow and dispersion in groundwater, rivers, lakes and oceans. Physical and analytical modelling of environmental flows. This course is equivalent to MECH 5009 at Carleton University.
Course Component: Lecture

MCG 5310 Performance and Economics of V/Stol Aircraft (3 units)
Aircraft performance analysis with emphasis on factors affecting take-off, landing and economic performance; high lift schemes; operating economics. This course is equivalent to MECH 5100 at Carleton University.
Course Component: Lecture

MCG 5311 Dynamics and Aerodynamics of Low Speed Flight (3 units)
Static stability theory. Euler's equations for rigid body motion; the linearized equations of motion; stability derivatives and their estimation. Longitudinal and lateral dynamic response of an aircraft to control and disturbance. This course is equivalent to MECH 5101 at Carleton University.
Course Component: Lecture

MCG 5314 Ground Transportation Systems and Vehicles (3 units)
Performance characteristics, handling and directional stability, ride comfort and safety of various types of ground vehicle systems including road vehicles, terrain-vehicle systems, guided transport systems, and advanced ground transport technology. This course is equivalent to MECH 5104 at Carleton University.
Course Component: Lecture

MCG 5315 Orbital Mechanics and Space Craft Control (3 units)
Orbital dynamics and perturbations due to the Earth's figure, the sun, and the moon with emphasis on mission planning and analysis. Rigid body dynamics applied to transfer orbit and on-orbit momentum management and control of spacecraft. Effects of flexible structures on a spacecraft control system. This course is equivalent to MECH 5105 at Carleton University.
Course Component: Lecture

MCG 5321 Methods of Energy Conversion (3 units)
Technical, economic and environmental aspects of present and proposed large-scale systems of energy conversion. This course is equivalent to MECH 5106/MECH 5201 at Carleton University.
Course Component: Lecture

MCG 5322 Nuclear Engineering (3 units)
Reactor design and safety requirement overview; reactor physics, chemistry and engineering, CANDU reactor design and operation; CANDU reactor fuel channels, thermalhydraulics and fuel; reactor safety design and analysis; IAEA and Canadian safety analysis requirements; reactor accidents; nuclear energy policy.
Course Component: Lecture

MCG 5324 Building Performance Simulation (3 units)
During this course students will develop an understanding of the methodologies and theory employed historically and contemporarily in the Building Performance Simulation (BPS) field, develop capabilities for extending the functionality of BPS tools, and establish skills in applying BPS tools in research, analysis, and design. Includes: Experiential Learning Activity
Course Component: Lecture

MCG 5325 Wind Engineering (3 units)
Theoretical and practical areas pertinent to the operation of wind turbines. World energy needs, wind farms versus traditional power plants, global wind characteristics, efficient turbine design, electrical components, modes of turbine operation and control, mechanical design, economic and environmental concerns. This is equivalent to MECH5206 at Carleton.
Course Component: Lecture

MCG 5326 System Modelling, Dynamics and Control (3 units)
The course provides an understanding of system modelling and the connection between energy domains. Within the temporal and/or frequency domains, system identification techniques and control aspects are explored for discrete and continuous systems along with lumped and distributed parameter models. This is equivalent to MECH5508 at Carleton
Course Component: Lecture

MCG 5327 Nonlinear Systems Analysis & Controls (3 units)
Introduction to nonlinear systems, stability of periodic solutions and limit cycles. Second-order nonlinear systems. Mathematical foundations for stability analysis, Lyapunov and LaSalle's methods. Autonomous and non-autonomous systems. Input-Output stability formalisms. Basics of nonlinear control techniques based on Lyapunov methods. This is equivalent to MECH5509 at Carleton.
Course Component: Lecture

MCG 5328 3D Machine Vision: From Robots to the Space Station (3 units)
Through lectures and project work, this course introduces fundamental 3D machine vision methods (triangulation and time-of-flight), presents cutting-edge neural network approaches, and explores major engineering applications (e.g. robotics, autonomous vehicles, space navigation) where perception of the 3D environment is essential. This is equivalent to MECH5103 at Carleton.
Course Component: Lecture

MCG 5329 Space Robotics (3 units)
This graduate course in space robotics is designed to teach the full spectrum of manipulator robotics applied to in-orbit servicing and repair of spacecraft and the removal of orbital debris as the first step towards developing a space infrastructure. The course covers space manipulator missions, kinematics, dynamics, trajectory generation, control systems and some special topics. This course is equivalent to MECH 5108 at Carleton University.
Course Component: Lecture

MCG 5330 Engineering Acoustics (3 units)
Review of acoustic waves in compressible fluids; acoustic pressure, intensity and impedance; physical interpretation and measurement; transmission through media; layers, in-homogeneous media, solids; acoustic systems; rooms, ducts, resonators, mufflers, properties of transducers; microphones, loudspeakers, computational acoustics. This course is equivalent to MECH 5300 at Carleton University.
Course Component: Lecture

MCG 5331 Aero-Acoustics (3 units)
The convected wave equation; theory of subsonic and supersonic jet noise; propeller and helicopter noise; fan and compressor noise; boundary layer noise, interior noise; propagation in the atmosphere; sonic boom; impact on environment. This course is equivalent to MECH 5301 at Carleton University.
Course Component: Lecture

MCG 5332 Instrumentation Techniques (3 units)
An introduction for the non-specialists to the concepts of digital and analog electronics with emphasis on data acquisition, processing and analysis. Topics covered include operational amplifiers, signal processing, digital logic systems, computer interfacing, noise in electronic systems. Hands-on sessions illustrate theory and practice. This course is equivalent to MECH 5302 at Carleton University.
Course Component: Lecture

MCG 5334 Computational Fluid Dynamics of Compressible Flows (3 units)
Solution techniques for parabolic, elliptic and hyperbolic equations developed for problems of interest to fluid dynamics with appropriate stability considerations. A staged approach to solution of full Euler and Navier-Stokes equations is used. Grid generation techniques appropriate for compressible flows are introduced. This course is equivalent to MECH 5304 at Carleton University.
Course Component: Lecture

MCG 5341 Turbomachinery (3 units)
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. Courses MCG 5341, MCG 4110 (MECH 4305) cannot be combined for units. This course is equivalent to MECH 5401 at Carleton University.
Course Component: Lecture

MCG 5342 Gas Turbines (3 units)
Interrelationship among thermodynamic, aerodynamic, and mechanical design. Ideal and real cycle calculations. Cycle optimization; turbo-shaft, turbojet, turbofan. Component performance. Off-design performance; matching of compressor, turbine, nozzle. Twin-spool matching. This course is equivalent to MECH 5402 at Carleton University.
Course Component: Lecture

MCG 5343 Advanced Thermodynamics (3 units)
The course covers three major topics: review of fundamentals from a consistent viewpoint, properties and equations of state, and applications and special topics. The third topic includes an introduction to statistical thermodynamics. This course is equivalent to MECH 5403 at Carleton University.
Course Component: Lecture

MCG 5344 Gas Turbine Combustion (3 units)
This course covers two major topics: combustion fundamentals and gas turbine combustor design. Combustion fundamentals include fuel evaporation, chemistry of combustion, chemical kinetics and emission formation and introduction to computational combustion modeling. Combustor design addresses the interrelationship between operational requirements and combustion fundamentals. Courses MCG 5344, MCG 5480 (MECH 5800) cannot be combined for units if MCG 5344 is taken as the topic. This course is equivalent to MECH 5400 at Carleton University.
Course Component: Lecture

MCG 5347 Conductive and Radioactive Heat Transfer (3 units)
Analytical, numerical and analog solutions to steady-state and transient conduction heat transfer in multi-dimensional systems. Radiative heat exchange between black, grey, non-grey diffusive and specular surfaces, including effects of athermanous media. This course is equivalent to MECH 5407 at Carleton University.
Course Component: Lecture

MCG 5348 Convective Heat and Mass Transfer (3 units)
Analogies between heat, mass and momentum transfer. Forced and free convection relations for laminar and turbulent flows analytically developed where possible and otherwise deduced from experimental results, for simple shapes and in heat exchangers. Mass transfer theory and applications. This course is equivalent to MECH 5408 at Carleton University.
Course Component: Lecture

MCG 5349 Two-Phase Flow and Heat Transfer (3 units)
Course Component: Lecture

MCG 5350 Advanced Vibration Analysis (3 units)
General theory of discrete multi-degree-of-freedom vibrating systems. Emphasis on numerical techniques of solving complex vibrating systems, with selected applications from aeronautical, civil, and mechanical engineering. This course is equivalent to MECH 5500 at Carleton University.
Course Component: Lecture

MCG 5352 Optimal Control Systems (3 units)
Review of transfer function and state-space system descriptions. Elements of the optimal control problem. Variational calculus. Optimal state feedback control. Riccati equations. Optimal observers and Kalman-Bucy Filters. Extension to discrete time systems including an introduction to dynamic programing. Practical applications are emphasized throughout the course. This course is equivalent to MECH 5502 at Carleton University.
Course Component: Lecture

MCG 5353 Robotics (3 units)
The history of and introduction to robotics methodology. Robots and manipulators; homogeneous transformation, kinematic equations, solving kinematic equations, differential relationships, motion trajectories, dynamics. Control; feedback control, compliance, servomotors, actuators, external and internal sensors, grippers and vision systems. Microprocessors and their application to robot control. Programming. This course is equivalent to MECH 5503 at Carleton University.
Course Component: Lecture

MCG 5354 Guidance, Navigation and Control (3 units)
Guidance system classification, flight control systems, targeting, target tracking, sensing. Modern multivariable control analysis; design requirements, sensitivity, robustness, perturbations, performance analysis. Modern filtering and estimation techniques. Terrestrial navigation; tactical air navigation (TACAN), star trackers Guidance mission and performance. Aircraft, missile and spacecraft guidance and control. This course is equivalent to MECH 5504 at Carleton University.
Course Component: Lecture

MCG 5355 Stability Theory and Applications (3 units)
Fundamental concepts and characteristics of modern stability definitions. Sensitivity and variational equations; linear variational equations; phase space analysis; Lyapunov's direct method. Autonomous and nonautonomous systems; stability in first approximation; the effect of force type on stability; frequency method. This course is equivalent to MECH 5505 at Carleton University.
Course Component: Lecture

MCG 5356 Neuro and Fuzzy Control (3 units)
Knowledge-based controllers. Fuzzy control: mathematics, relations, operations, approximate reasoning. Fuzzy knowledge base control and structure. Fuzzification, inference engine; defuzzification. Nonlinear, adaptive fuzzy control systems. Stability, Neuro-Control: processing, learning. Adaptation of artificial neural systems: associative memories, algorithms, applications, and network implementation. Neurofuzzy systems: industrial applications. Courses MCG 5356, ELG 5386 (EACJ 5386), ELG 5196 (EACJ 5709) cannot be combined for units. This course is equivalent to MECH 5506 at Carleton University.
Course Component: Lecture
Exclusion: ELG 5386

MCG 5361 Creative Problem Solving and Design (3 units)
Problem-solving processes and how they can be applied in engineering design. Emphasis on learning methodologies rather than accumulating information. Techniques can be successfully applied in any engineering speciality. This course is equivalent to MECH 5601/IDES 5301 at Carleton University.
Course Component: Lecture

MCG 5365 Finite Element Analysis I (3 units)
An introduction to the finite element methodology, with emphasis on applications to heat transfer, fluid flow and stress analysis. The basic concepts of Galerkin's method, interpolation, numerical integration, and isoparametric elements are taught using simple examples. This course is equivalent to MECH 5605 at Carleton University.
Course Component: Lecture

MCG 5366 Finite Element Analysis II (3 units)
Time marching heat flow problems with linear and nonlinear analysis. Static plasticity. Time-dependent deformation problems; viscoplasticity, viscoelasticity, and dynamic analysis. Isoparametric elements and numerical integration are used throughout. This course is equivalent to MECH 5606 at Carleton University.
Course Component: Lecture

MCG 5367 The Boundary Element Method (Bem) (3 units)
Integral equations. The BEM for potential theory and for elastostatics in two-dimensions. Boundary elements and numerical integration schemes. Practical applications. This course is equivalent to MECH 5607 at Carleton University.
Course Component: Lecture

MCG 5370 Special Topics in Mechanical and Aeronautical Engineering (3 units)
Course Component: Lecture

MCG 5375 CAD/CAM (3 units)
Computer-aided design process, computer graphics including hardware and software standards. Wire frames, boundary representations, constructive solids geometry, sculptured surfaces. Data bases. Graphics and product interchange files. Computer-aided manufacturing; numerical control, CNC, DNC, adaptive control. CAM programming, popular commercial CAD programs. Management issues. This course is equivalent to MECH 5705 at Carleton University.
Course Component: Lecture

MCG 5376 Special Topics in Mechanical and Aerospace Engineering (3 units)
Topic will vary from year to year.
Course Component: Lecture

MCG 5380 Safety and Risk Assessment of Nuclear Power (3 units)
Course Component: Lecture

MCG 5384 Special Topics in Mechanical and Aerospace Engineering (3 units)
Topic will vary from year to year.
Course Component: Lecture

MCG 5396 Directed Studies (3 units)
Course Component: Research
Permission of the Department is required.

MCG 5398 Independent Engineering Study (3 units)
Students pursuing a master's degree by course work carry out an independent study, analysis, and solution of an engineering problem or design project. The results are given in the form of a written report and presented at a departmental seminar. Carried out under the general direction of a faculty member. This course is equivalent to MECH 5908 at Carleton University.
Course Component: Lecture

MCG 5470 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5471 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5472 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5473 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5474 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5475 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5476 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5477 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5478 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5479 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5480 Special Topics in Mechanical and Aerospace Engineering (3 units)
In-depth study of a topic in Mechanical and Aerospace Engineering. This course is equivalent to MECH 5800 at Carleton University.
Course Component: Lecture

MCG 5481 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5482 Special Topics in Mechanical and Aerospace Engineering (3 units)
This course is equivalent to MECH 5805 at Carleton University.
Course Component: Lecture

MCG 5483 Fundamentals of Combustion (3 units)
Emphasis on gas phase reacting flows. Background of combustion thermodynamics, diffusion mass transfer, and chemical kinetics. Detonations and deflagrations. Chemical and dynamic structure of flames. Gaseous flame propagation under laminar and turbulent conditions. Flame stabilization and extinction. Introduction to burning rate theory.
Course Component: Lecture

MCG 5484 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5485 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5486 Special Topics an Mechanical and Aerospace Engineering (3 units)
This course is equivalent to MECH 5806 at Carleton University.
Course Component: Lecture

MCG 5487 Special Topics in Mechanical and Aerospace Engineering (3 units)
This course is equivalent to MECH 5807 at Carleton University.
Course Component: Lecture

MCG 5488 Special Topics in Mechanical and Aerospace Engineering (3 units)
This course is equivalent to MECH 5803 at Carleton University.
Course Component: Lecture

MCG 5489 Special Topics in Mechanical and Aerospace Engineering (3 units)
Topics will vary from year to year. This course is equivalent to MECH 5801 at Carleton University.
Course Component: Lecture

MCG 5490 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5491 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5492 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5493 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5494 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5495 Special Topics in Mechanical and Aerospace Engineering (3 units)
Course Component: Lecture

MCG 5551 Théorie d'écoulement visqueux (3 crédits)
Dérivation des solutions exactes des équations de Navier-Stokes. Écoulement à petit nombre de Reynolds. Écoulement de Stokes. Écoulement d'Oseen. Théorie de lubrification. Couches limites laminaires. Introduction à la stabilité hydrodynamique. Ce cours est équivalent à MAAJ 5408 à la Carleton University.
Volet : Cours magistral

MCG 5552 Théorie de turbulence (3 crédits)
Révision des théories fondamentales et des résultats expérimentaux des écoulements turbulents. Théorie universelle de l'équilibre, théorie isotropique locale. Turbulence isotropique, contrainte homogène des écoulements, écoulements turbulents dans les tuyaux et les canaux, jets, sillages, couches limites. Diffusion turbulente. Modèles de turbulence. Ce cours est équivalent à MAAJ 5409 à la Carleton University.
Volet : Cours magistral

MCG 5557 Méthodes numériques en mécanique (3 crédits)
Équations primitives. Méthodes de différences finies. Méthodes intégrales. Critère de stabilité. Calcul des écoulements transitoires laminaires tri-dimensionnels. Méthodes MAC de Los Alamos. Calcul des écoulements multidimensionnels turbulents. Modèles de turbulence. Méthode numérique de Gosman. Ce cours est équivalent à MAAJ 5500 à la Carleton University.
Volet : Cours magistral

MCG 5900 Séminaire de M.A.Sc. / MASc Seminar
Une série de séminaires présentés par des étudiants aux cycles supérieurs et des chercheurs invités. En plus d'avoir à présenter un séminaire, les étudiants doivent assister et participer à au moins dix séminaires. Noté S (satisfaisant) ou NS (non satisfaisant). / A series of seminars presented by graduate students and invited researchers. Students are required to attend and participate in at least 10 seminars and to make one presentation. Graded S (Satisfactory) / NS (Not satisfactory).
Volet / Course Component: Séminaire / Seminar

MCG 5947 Séminaire de maîtrise en ingénierie / Master of Engineering Seminar
Une série de séminaires présentés par des étudiants aux cycles supérieurs et des chercheurs invités. Les étudiants doivent assister et participer à au moins dix séminaires. Noté S (satisfaisant) ou NS (non satisfaisant). / A series of seminars presented by graduate students and invited researchers. Students are required to attend and participate in at least 10 seminars. Graded S (Satisfactory) / NS (Not satisfactory).
Volet / Course Component: Séminaire / Seminar

MCG 6998 Projet / Project (6 crédits / 6 units)
Projet en génie mécanique ou en matériaux avancés et fabrication dirigé par un professeur approuvé par le directeur des études supérieures et donnant lieu à la rédaction d'un rapport approfondi (30-40 pages approx). Noté S (satisfaisant) ou NS (non satisfaisant) par le directeur du projet et un autre professeur nommé par le directeur des études supérieures en génie mécanique. Le projet est normalement complété en une session d'études à temps plein. / Project in mechanical engineering or in advanced materials and manufacturing supervised by a professor approved by the director of graduate studies and leading to the writing of an in-depth report (approx. 30-40 pages). Graded S (Satisfactory) or NS (Not satisfactory) by the supervisor and by another professor appointed by the director of graduate studies in Mechanical Engineering. The project can normally be completed in one session of full-time study.
Volet / Course Component: Recherche / Research
Permission of the Department is required.

MCG 9900 Séminaire de doctorat / PhD Seminar
Une série de séminaires présentés par des étudiants aux cycles supérieurs et des chercheurs invités. En plus d'avoir à présenter un séminaire, les étudiants doivent assister et participer à au moins 15 séminaires. Noté S (satisfaisant) ou NS (non satisfaisant) / A series of seminars presented by graduate students and invited researchers. Students are required to attend and participate in at least 15 seminars and make one presentation. Graded S (Satisfactory) / NS (Not satisfactory).
Volet / Course Component: Séminaire / Seminar

MCG 9997 Préparation du rapport de candidature au doctorat / Preparation of Ph.D. Candidacy Paper
À la suite de la réussite à l'examen de synthèse, inscription requise de tous les candidats au doctorat jusqu'à ce que le projet de thèse soit accepté par le Comité consultatif. / Following completion of the comprehensive examination, registration required for all PhD candidates until the thesis proposal is accepted by the Advisory Committee.
Volet / Course Component: Recherche / Research

MCG 9998 Examen général du doctorat / PhD Comprehensive
Inscription requise de tous les candidats au doctorat jusqu'à la réussite à l'examen de synthèse. / Registration required for all PhD candidates until the comprehensive examination is passed.
Volet / Course Component: Recherche / Research