Mechanical and Aerospace Engineering

- **M.A.Sc. Aerospace Engineering**
- **M.A.Sc. Materials Engineering**
- **M.A.Sc. Mechanical Engineering**
- **M.Eng. Aerospace Engineering**
- **M. Eng. Materials Engineering**
- **M.Eng. Mechanical Engineering**
- **Ph.D. Aerospace Engineering**
- **Ph.D. Mechanical Engineering**

M.A.Sc. (Aerospace, Materials, Mechanical Engineering), M.Eng. (Materials, Mechanical Engineering)

Academic Regulations

See the General Regulations section of this Calendar.

Admission Requirements

The normal requirement for admission to the master's program is a bachelor's degree with at least high honours standing in mechanical or aerospace engineering or a related discipline.

Program Requirements

M.A.Sc. - Master's by Thesis

The requirements for course work are specified in terms of credits: one credit is one hour/week for one term (thirteen weeks). The requirements for the master's are:

M.A.Sc. Aerospace Engineering - by thesis	
M.A.Sc. Materials Engineering - by thesis	
M.A.Sc. Mechanical Engineering - by thesis	
1. 2.5 credits in courses	2.5
2. Participation in the Mechanical and Aerospace Engineering seminar series	
3. 2.5 credits in:	2.5
MECH 5909 [2.0] M.A.Sc. Thesis	
Total Credits	5.0

Students are expected to complete the master's program within the maximum limits outlined in the Section 13.2 of the General Regulations section of this Calendar.

M.Eng. Aerospace Engineering - by coursework (5.0 credits)	
M.Eng. Materials Engineering - by coursework (5.0 credits)	
M.Eng. Mechanical Engineering - by coursework (5.0 credits)	
1. 5.0 credits in coursework	5.0
Total Credits	5.0

M.Eng. Aerospace Engineering - by Project (Independent Study) (5.0 credits)	
M.Eng. Materials Engineering - by Project (Independent Study) (5.0 credits)	
M.Eng. Mechanical Engineering - by Project (Independent Study) (5.0 credits)	
1. 1.5 credits in:	1.5
MECH 5908 [1.5] Independent Engineering Study	
2. 3.5 credits in courses	3.5
Total Credits	5.0

Students are expected to complete the master's program within the maximum limits outlined in the Section 13.2 of the General Regulations section of this Calendar.

Ph.D. Aerospace Engineering

Ph.D. Mechanical Engineering

Academic Regulations

See the General Regulations section of this Calendar.

Admission Requirements

The normal requirement for admission to the Ph.D. program is a master's degree in mechanical or aerospace engineering or a related discipline.

Students who are in the master's program may be admitted to the Ph.D. program if they show outstanding academic performance and demonstrate significant promise for advanced research, upon recommendation of the department.

In addition, graduate courses offered by departments in other disciplines may be taken for credit with approval by the department in which the student is registered.

Ph.D. Aerospace Engineering	
Ph.D. Mechanical Engineering	
(from the master's degree)	
1. 1.5 credits in courses	1.5
2. Participation in the Mechanical and Aerospace Engineering seminar series	
3. Successful completion of the comprehensive examination according to section 18.11 of the General Regulations section of this Calendar	
4. 8.5 credits in thesis.	8.5
MECH 6909 [8.5] Ph.D. Thesis	
Total Credits	10.0

Graduate Courses

In addition, graduate courses offered by departments in other disciplines may be taken for credit with approval by the department in which the student is registered.

Not all of the following courses are offered in a given year. Consult the Ottawa-Carleton Joint Institute for Mechanical and Aerospace Engineering (OCIMAE) website for course offerings.

The following codes identify the department offering the course:

- 'MECH' Department of Mechanical and Aerospace Engineering, Carleton University
- 'MAAJ' Department of Mechanical Engineering, University of Ottawa

Carleton University

MECH 5000 (MCG 5300)	Fundamentals of Fluid Dynamics
MECH 5001 (MCG 5301)	Theory of Viscous Flows
MECH 5003 (MCG 5303)	Incompressible Non-Viscous Flow
MECH 5004 (MCG 5304)	Compressible Non-Viscous Flow
MECH 5008 (MCG 5308)	Experimental Methods in Fluid Mechanics
MECH 5009 (MCG 5309)	Environmental Fluid Mechanics Relating to Energy Utilization
MECH 5100 (MCG 5310)	Performance and Economics of Aircraft
MECH 5101 (MCG 5311)	Dynamics and Aerodynamics of Flight
MECH 5104 (MCG 5314)	Ground Transportation Systems and Vehicles
MECH 5105 (MCG 5315)	Orbital Mechanics and Space Control
MECH 5106 (MCG 5121)	Space Mission Analysis and Design
MECH 5107 (MCG 5317)	Experimental Stress Analysis
MECH 5201 (MCG 5321)	Methods of Energy Conversion
MECH 5202 (MCG 5122)	Smart Structures
MECH 5203 (MCG 5322)	Nuclear Engineering
MECH 5300 (MCG 5330)	Engineering Acoustics
MECH 5301 (MCG 5331)	Aeroacoustics
MECH 5302 (MCG 5332)	Instrumentation Techniques
MECH 5304 (MCG 5334)	Computational Fluid Dynamics of Compressible Flows
MECH 5400 (MCG 5344)	Gas Turbine Combustion
MECH 5401 (MCG 5341)	Turbomachinery
MECH 5402 (MCG 5342)	Gas Turbines
MECH 5403 (MCG 5343)	Advanced Thermodynamics
MECH 5407 (MCG 5347)	Conductive and Radiative Heat Transfer
MECH 5408 (MCG 5348)	Convective Heat and Mass Transfer
MECH 5500 (MCG 5350)	Advanced Vibration Analysis
MECH 5501 (MCG 5125)	Advanced Dynamics
MECH 5502 (MCG 5352)	Optimal Control Systems
MECH 5503 (MCG 5353)	Robotics
MECH 5504 (MCG 5354)	Guidance, Navigation and Control
MECH 5505 (MCG 5355)	Stability Theory and Applications
MECH 5506 (MCG 5356)	Neuro and Fuzzy Control
MECH 5507 (MCG 5124)	Advanced Kinematics
MECH 5601 (MCG 5361)	Creative Problem Solving and Design
MECH 5602 (MCG 5362)	Failure Prevention (Fracture Mechanics and Fatigue)
MECH 5603 (MCG 5381)	Lightweight Structures
MECH 5604 (MCG 5364)	Computational Metallurgy
MECH 5605 (MCG 5365)	Finite Element Analysis I
MECH 5606 (MCG 5366)	Finite Element Analysis II
MECH 5607 (MCG 5367)	The Boundary Element Method (BEM)
MECH 5609 (MCG 5123)	Microstructure and Properties of Materials
MECH 5700 (MCG 5345)	Surfaces and Coatings
MECH 5701 (MCG 5369)	Metallic Phases & Transformations
MECH 5704 (MCG 5374)	Integrated Manufacturing Systems (CIMS)
MECH 5705 (MCG 5375)	CAD/CAM
MECH 5800 (MCG 5480)	Special Topics in Mechanical and Aerospace Engineering
MECH 5801 (MCG 5489)	Special Topics in Mechanical and Aerospace Engineering
MECH 5802 (MCG 5483)	Special Topics in Mechanical and Aerospace Engineering
MECH 5803 (MCG 5488)	Special Topics in Mechanical and Aerospace Engineering
MECH 5804 (MCG 5384)	Special Topics in Mechanical and Aerospace Engineering
MECH 5805 (MCG 5482)	Special Topics in Mechanical and Aerospace Engineering
MECH 5806 (MCG 5486)	Special Topics in Mechanical and Aerospace Engineering
MECH 5807 (MCG 5387)	Special Topics in Mechanical and Aerospace Engineering
MECH 5808 (MCG 5376)	Special Topics in Mechanical and Aerospace Engineering
MECH 5809 (MCG 5382)	Special Topics in Mechanical and Aerospace Engineering

University of Ottawa

MAAJ 5001 (MCG 5101)	Theory of Elasticity
MAAJ 5002 (MCG 5102)	Advanced Stress Analysis
MAAJ 5003 (MCG 5103)	Theory Perfectly Plastic Solid
MAAJ 5004 (MCG 5104)	Theory of Plates & Shells

MAAJ 5005 (MCG 5105)	Continuum Mechanics
MAAJ 5006 (MCG 5106)	Advanced Topics in Elasticity
MAAJ 5007 (MCG 5107)	Adv. Dynamics w/Applications
MAAJ 5008 (MCG 5108)	Finite Element Analysis
MAAJ 5009 (MCG 5109)	Topics:Finite Element Analysis
MAAJ 5100 (MCG 5110)	Micromechanics of Solids
MAAJ 5101 (MCG 5111)	Gas Dynamics
MAAJ 5104 (MCG 5114)	Analy & Des: Pressure Vessels
MAAJ 5105 (MCG 5115)	Non-Linear Optimization
MAAJ 5107 (MCG 5117)	Intro to Composite Materials
MAAJ 5108 (MCG 5118)	Introduction to Plasticity
MAAJ 5109 (MCG 5119)	Fracture Mechanics
MAAJ 5206 (MSG 5126)	Deformation of Materials
MAAJ 5209 (MCG 5129)	Hot Working of Metals
MAAJ 5301 (MCG 5131)	Heat Transfer by Conduction
MAAJ 5302 (MCG 5132)	Heat Transfer by Convection
MAAJ 5303 (MCG 5133)	Heat Transfer by Radiation
MAAJ 5304 (MCG 5134)	Heat Transfer w/Phase Change
MAAJ 5306 (MCG 5136)	Fluid Mech & Heat Transfer
MAAJ 5307 (MCG 5137)	Solid Mechanics & Materials
MAAJ 5308 (MCG 5138)	Topics in Mech Engineering
MAAJ 5401 (MCG 5141)	Statistical Thermodynamics
MAAJ 5408 (MCG 5551)	Theorie d'Ecoulement Visqueux
MAAJ 5409 (MCG 5552)	Theorie de Turbulence
MAAJ 5500 (MCG 5557)	Mecanique de Fluides
MAAJ 5501 (MCG 5151)	Laminar Flow Theory
MAAJ 5502 (MCG 5152)	Theory of Turbulance
MAAJ 5505 (MCG 5155)	Inviscid Flow Theory
MAAJ 5506 (MCG 5156)	Measurement of Fluid Mech
MAAJ 5507 (MCG 5157)	Num Comp:Fluid Dyn & Heat Tran
MAAJ 5508 (MCG 5158)	Industrial Fluid Mechanics
MAAJ 5509 (MCG 5159)	Production Planning & Control
MAAJ 5601 (MCG 5161)	Environmental Engineering
MAAJ 5608 (MCG 5168)	Industrial Organization
MAAJ 5609 (MCG 5169)	Topics in Reliability Engineer
MAAJ 5700 (MCG 5170)	CAD/CAM
MAAJ 5701 (MCG 5171)	Applied Reliability Theory
MAAJ 5702 (MCG 5172)	Mgmt of Automation
MAAJ 5703 (MCG 5173)	Systems Engineer & Integration
MAAJ 5706 (MCG 5176)	Industrial Control Systems
MAAJ 5707 (MCG 5177)	Robot Mechanics
MAAJ 5708 (MCG 5178)	Advanced Topics in CAD/CAM
MAAJ 5709 (MCG 5179)	Manufacturing System Analysis
MAAJ 5800 (MCG 5180)	Fibre Composite Materials II
MAAJ 5801 (MCG 5181)	Advanced Vibrations
MAAJ 5802 (MCG 5182)	Theory of Elastic Instability
MAAJ 5804 (MCG 5184)	Mechatronics
MAAJ 5805 (MCG 5185)	Multivariate Digital Control
MAAJ 5806 (MCG 5186)	Non-Linear Disc Dyn & Control
MAAJ 5901 (MCG 5191)	Combustion in Premixed Systems
MAAJ 5902 (MCG 5192)	Combustion in Diffusion System

Mechanical Engineering (MECH) Courses

MECH 5000 [0.5 credit] (MCG 5300)
Fundamentals of Fluid Dynamics
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 modeling. Convective heat transfer: free versus forced convection; energy and energy integral equations; turbulent diffusion.
Also offered at the undergraduate level, with different requirements, as AERO 4302, for which additional credit is precluded.

MECH 5001 [0.5 credit] (MCG 5301)
Theory of Viscous Flows
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.

MECH 5003 [0.5 credit] (MCG 5303)
Incompressible Non-Viscous Flow
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.

MECH 5004 [0.5 credit] (MCG 5304)
Compressible Non-Viscous Flow
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.

MECH 5008 [0.5 credit] (MCG 5308)
Experimental Methods in Fluid Mechanics
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.

MECH 5009 [0.5 credit] (MCG 5309)
Environmental Fluid Mechanics Relating to Energy Utilization
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 modeling of environmental flows.

MECH 5100 [0.5 credit] (MCG 5310)
Performance and Economics of Aircraft
Aircraft performance analysis with emphasis on factors affecting take-off, landing and economic performance; high lift schemes; operating economics.

MECH 5101 [0.5 credit] (MCG 5311)
Dynamics and Aerodynamics of Flight
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. Also offered at the undergraduate level, with different requirements, as AERO 4308, for which additional credit is precluded.

MECH 5104 [0.5 credit] (MCG 5314)
Ground Transportation Systems and Vehicles
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.

MECH 5105 [0.5 credit] (MCG 5315)
Orbital Mechanics and Space Control
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.

MECH 5106 [0.5 credit] (MCG 5121)
Space Mission Analysis and Design
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.
Precludes additional credit for MAAE 4906 (Section B) if taken between 1994-1995 and 2003-2004 inclusive, MECH 5805 taken between 2002-2003 and 2003-2004 inclusive, MAAE 5700 (Section L) taken between 1994-1995 and 1996-1997 inclusive, and MAAE 5805 taken between 1999-2000 and 2001-2002 inclusive. Also offered at the undergraduate level, with different requirements, as Also offered at the undergraduate level, with different requirements, as AERO 4802., for which additional credit is precluded.

MECH 5107 [0.5 credit] (MCG 5317)
Experimental Stress Analysis
Introduction to theory of elasticity. Photo-elasticity: types of polariscopes, two- and three-dimensional stress fields, frozen patterns. Photoelastic coatings. Strain gauges; gauge factors, sensitivity, calibration, and temperature compensation. Moire fringes, brittle lacquers, mechanical strain gauges.

MECH 5201 [0.5 credit] (MCG 5321)
Methods of Energy Conversion
Technical, economic and environmental aspects of present and proposed large-scale systems of energy conversion.

MECH 5202 [0.5 credit] (MCG 5122)
Smart Structures
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.
Precludes additional credit for MECH 5807 (if taken 2001-2002 to 2003-2004).

MECH 5203 [0.5 credit] (MCG 5322)
Nuclear Engineering
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.

MECH 5300 [0.5 credit] (MCG 5330)
Engineering Acoustics
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.

MECH 5301 [0.5 credit] (MCG 5331)
Aeroacoustics
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.

MECH 5302 [0.5 credit] (MCG 5332)
Instrumentation Techniques
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.

MECH 5304 [0.5 credit] (MCG 5334)
Computational Fluid Dynamics of Compressible Flows
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.

MECH 5400 [0.5 credit] (MCG 5344)
Gas Turbine Combustion
Combustion fundamentals and gas turbine combustor design. Combustion fundamentals include fuel evaporation, chemistry of combustion, chemical kinetics and emissions formation and introduction to computational combustion modelling. Combustor design addresses the interrelationship between operational requirements and combustion fundamentals.
Precludes additional credit for MECH 5800 (MCG 5480) when MECH 5800 was offered with this topic.

MECH 5401 [0.5 credit] (MCG 5341)
Turbomachinery
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.

MECH 5402 [0.5 credit] (MCG 5342)
Gas Turbines
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.

MECH 5403 [0.5 credit] (MCG 5343)
Advanced Thermodynamics
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.

MECH 5407 [0.5 credit] (MCG 5347)
Conductive and Radiative Heat Transfer
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.

MECH 5408 [0.5 credit] (MCG 5348)
Convective Heat and Mass Transfer
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.

MECH 5500 [0.5 credit] (MCG 5350)
Advanced Vibration Analysis
General theory of continuous and discrete multi-degree-of-freedom vibrating systems. Emphasis on numerical techniques of solving complex vibrating systems, with selected applications from aerospace, civil, and mechanical engineering.

MECH 5501 [0.5 credit] (MCG 5125)
Advanced Dynamics
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.
Precludes additional credit for MECH 5500 (if taken 2001-2002, 2002-2003).

MECH 5502 [0.5 credit] (MCG 5352)
Optimal Control Systems
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 programming. Practical applications are emphasized throughout the course.

MECH 5503 [0.5 credit] (MCG 5353)
Robotics
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.

MECH 5504 [0.5 credit] (MCG 5354)
Guidance, Navigation and Control
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.

MECH 5505 [0.5 credit] (MCG 5355)
Stability Theory and Applications
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.

MECH 5506 [0.5 credit] (MCG 5356)
Neuro and Fuzzy Control
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.
Precludes additional credit for EACJ 5709 (ELG 5196).

MECH 5507 [0.5 credit]
Advanced Kinematics
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.

MECH 5601 [0.5 credit] (MCG 5361)
Creative Problem Solving and Design
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 specialty.
Also listed as IDES 5301.

MECH 5602 [0.5 credit] (MCG 5362)
Failure Prevention (Fracture Mechanics and Fatigue)
Design of engineering structures to ensure against failure due to fatigue or brittle fracture. Nature of fatigue and brittle fracture; selection of suitable material, geometry, and inspection procedures for the load and environmental conditions.

MECH 5603 [0.5 credit] (MCG 5381)
Lightweight Structures
Structural behaviour. Fundamentals of basic elasticity. Energy methods of structural analysis. Bending, shear, and torsion of open and closed multicell structures. Bending of plates. Structural idealization and its effects on open and closed sections. Structural stability.

MECH 5604 [0.5 credit] (MCG 5364)
Computational Metallurgy
Development of microstructure in alloys in solidification processes and post-solidification processing. Nucleation and growth of solid phase. Formation of a dendrite structure, macro and micro segregations. Pore formation in castings. Thermodynamic and kinetics of phase transformations and structure evolution in solid alloys.

MECH 5605 [0.5 credit] (MCG 5365)
Finite Element Analysis I
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.

MECH 5606 [0.5 credit] (MCG 5366)
Finite Element Analysis II
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.

MECH 5607 [0.5 credit] (MCG 5367)
The Boundary Element Method (BEM)
Integral equations. The BIE for potential theory and for elastostatics in two-dimensions. Boundary elements and numerical integration schemes. Practical applications.

MECH 5609 [0.5 credit] (MCG 5123)
Microstructure and Properties of Materials
Essential microstructural features of metals and alloys: crystal structure, dislocations, grain boundaries. The importance of these features in controlling mechanical properties is emphasized. Analytical techniques observing microstructure in metals and other materials: TEM, SEM, electron diffraction, spectrometry.
Precludes additional credit for MECH 5804 (if taken 2002-2003, 2003-2004).

MECH 5700 [0.5 credit] (MCG 5345)
Surfaces and Coatings
Surface characteristics of solid materials and surface degradation/failure mechanisms including wear, fretting, oxidation, corrosion, and erosion are introduced. Coating methods including PVD, CVD, laser, thermal spray and electrochemical deposition are discussed in the context of failure prevention measures.

MECH 5701 [0.5 credit] (MCG 5369)
Metallic Phases & Transformations
Thermodynamics of crystals, phase diagrams, principles of alloy phases, thermal analysis. Transformation rate and mechanisms. Short and long range diffusional transformations, diffusionless transformations. Phase transformations in engineering systems.
Precludes additional credit for MECH 5608 if taken during 2001-2002 or during 2005-2006.
Prerequisite(s): MECH 2700 or the equivalent.

MECH 5704 [0.5 credit] (MCG 5374)
Integrated Manufacturing Systems (CIMS)
Topics essential to CIMS including computer graphics, geometric modeling, numerically controlled machining, and flexible manufacturing. The fundamental data structures and procedures for computerization of engineering design, analysis and production.
Also offered at the undergraduate level, with different requirements, as MECH 4704, for which additional credit is precluded.

MECH 5705 [0.5 credit] (MCG 5375)
CAD/CAM
Computer aided design and manufacturing methodology through hands-on experience and state-of-the-art software. Topics include mathematical representation, solid modeling, drafting, mechanical assembly, mechanism design and CNC machining. CAD data exchange standards, rapid prototyping, concurrent engineering and design for X are also discussed.

MECH 5800 [0.5 credit] (MCG 5480)
Special Topics in Mechanical and Aerospace Engineering
Topic will vary from year to year.

MECH 5801 [0.5 credit] (MCG 5489)
Special Topics in Mechanical and Aerospace Engineering
Topic will vary from year to year.

MECH 5802 [0.5 credit] (MCG 5483)
Special Topics in Mechanical and Aerospace Engineering
Topic will vary from year to year.

MECH 5803 [0.5 credit] (MCG 5488)
Special Topics in Mechanical and Aerospace Engineering
Topic will vary from year to year.

MECH 5804 [0.5 credit] (MCG 5384)
Special Topics in Mechanical and Aerospace Engineering
Topic will vary from year to year.

MECH 5805 [0.5 credit] (MCG 5482)
Special Topics in Mechanical and Aerospace Engineering
Topic will vary from year to year.

MECH 5806 [0.5 credit] (MCG 5486)
Special Topics in Mechanical and Aerospace Engineering
Topic will vary from year to year.

MECH 5807 [0.5 credit] (MCG 5387I)
Special Topics in Mechanical and Aerospace Engineering
Topic will vary from year to year.

MECH 5808 [0.5 credit] (MCG 5376)
Special Topics in Mechanical and Aerospace Engineering
Topic will vary from year to year.

MECH 5809 [0.5 credit] (MCG 5382)
Special Topics in Mechanical and Aerospace Engineering
Topic will vary from year to year.

MECH 5906 [0.5 credit] (MCG 5395)
Directed Studies

MECH 5908 [1.5 credit] (MCG 5398)
Independent Engineering Study
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.

MECH 5909 [2.0 credits] (MCG 5398)
M.A.Sc. Thesis

MECH 6909 [8.5 credits] (MCG 5398)
Ph.D. Thesis

Summer session: some of the courses listed in this Calendar are offered during the summer. Hours and scheduling for summer session courses will differ significantly from those reported in the fall/winter Calendar. To determine the scheduling and hours for summer session classes, consult the class schedule at central.carleton.ca

Not all courses listed are offered in a given year. For an up-to-date statement of course offerings for the current session and to determine the term of offering, consult the class schedule at central.carleton.ca