ADVANCED MATERIALS AND MANUFACTURING (AMM)

The following courses are offered by the Faculty of Engineering.

AMM 5101 Theory of Elasticity (3 units)
Analysis of stress and strain. Stress and strain tensors. Yield criteria laws of elasticity and general theorems. Stress functions. Two-dimensional problems in rectangular and polar co-ordinates. Applications in plates and shells. Strain energy techniques. Application of numerical analysis to elasticity problems.
Course Component: Lecture

AMM 5102 Advanced Stress Analysis (3 units)
Analysis of stress and strain. Stress and strain tensors. Yield criteria laws of elasticity and general theorems. Stress functions. Two-dimensional problems in rectangular and polar co-ordinates. Applications in plates and shells. Strain energy techniques. Application of numerical analysis to elasticity problems.
Course Component: Lecture

AMM 5103 Theory of Perfectly Plastic Solids (3 units)
Inelastic behaviour, model materials. Yield criteria and flow laws. Energy principles. Contained plastic deformation. Plane strain. Slipline fields. Applications to metal-forming processes.
Course Component: Lecture

AMM 5106 Advanced Topics in Elasticity (3 units)
Algebraic computation software. Curved solids. Governing equations of planar elastostatics in Cartesian coordinates. Linear elastostatics in curvilinear coordinates. Governing equations of plates. Linear shell theory in curvilinear coordinates. Introduction to non-linear elastostatics. Non-linear shell theory. Instability of cylindrical shells. Thick and thin shell elastodynamics.
Course Component: Lecture

AMM 5117 Introduction to Composite Materials (3 units)
Constituent materials fibres, resins, industrial reinforcements, prepregs. Manufacturing processes: preforming, fibre placement, liquid moulding, pultrusion, resin film infusion, in-autoclave and out-of-autoclave consolidation. Design for composites. Micromechanics, strength, classic theory of laminates. Practical case studies.
Course Component: Lecture
The courses AMM 5117, MCG 5117, MCG 4144, and MCG 4544 cannot be combined for units.

AMM 5118 Introduction to Plasticity (3 units)
The analysis of stress and strain in elastic and plastic continuum. Time independent plastic deformation. The microscopic basis of plastic behaviour. Rate dependent deformation. The effect of temperature. Materials testing. Applications.
Course Component: Lecture

AMM 5119 Fracture Mechanics (3 units)
Stress concentration in elastic and plastic media. The energy condition, crack resistance, compliance, the J. integral. Crack arrest. Plain strain and plain stress behaviour. The microscopic aspects of crack propagation. The effect of temperature. Fatigue, stress corrosion cracking, and creep fracture. Probabilistic fracture.
Course Component: Lecture

AMM 5121 Materials Selection in Engineering Design (3 units)
Design Concepts of materials selection, relationship between engineering design and materials selection, materials performance indices, effect of material shape on selection, process selection, materials selection and the environment.
Course Component: Lecture

AMM 5122 Failure analysis of high-temperature protective coatings for aerospace applications (3 units)
Investigation of failure mechanisms and mechanics of high-temperature protective coatings. Examples are given for thermal barrier coatings, oxidation resistance coatings. The detail mechanics involves coating adhesion, bond strength, interfacial fracture toughness, buckling, delamination, spallation and life prediction.
Course Component: Lecture

AMM 5123 Microstructure and Properties of Materials (3 units)
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 for observing microstructure in metals and other materials: TEM, SEM, electron diffraction, spectrometry.
Course Component: Lecture

AMM 5124 Fatigue and Damage Tolerance in Aircraft (3 units)
Fatigue and crack propagation problems applied to specific aircraft structures, airworthiness, Load Spectra and Stress Histories, Effects of Cracks and Notches, Fatigue, Linear Elastic Fracture Mechanics, Crack propagation Analysis.
Course Component: Lecture

AMM 5125 Materials characterization techniques (3 units)
Materials characterization techniques, methodologies of materials characterization: crystal structure, microstructural morphology, and Chemical microanalysis. The main methods of characterization include: (1) X-ray and electron diffractions; (2) optical, scanning and transmission electron microscopy, (3) X-ray and electron spectroscopy. The micro-analytical techniques include both qualitative and quantitative methods. Technical aspects of preparing samples and operating instruments are also introduced in order to help students acquire basic knowledge on practical aspects.
Course Component: Lecture

AMM 5126 Deformation of Materials (3 units)
The deformation and fracture properties of metals, ceramics and polymers. Introduction to dislocation theory. Rheological models. Analysis and interpretation of constant strain rate, constant stress and stress relaxation tests in terms of the material structure.
Course Component: Lecture

AMM 5129 Hot Working Metals (3 units)
High temperature mechanical properties in metals. Types of recovery, recrystallization and precipitation in metals and their effects on hot strength and structure. Hot rolling of metals. Selection of rolling schedules. Influence of as-rolled structures on room temperature tensile and fracture stresses, impact strength.
Course Component: Lecture

AMM 5130 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
The courses AMM 5130, MCG 5130, MCG 4135, and MCG 4535 cannot be combined for units.

AMM 5137 Special Studies in Solid Mechanics and Materials (3 units)
Course Component: Lecture

AMM 5138 Advanced Topics in Advanced Materials and Manufacturing (3 units)
Course Component: Lecture

AMM 5144 Superalloys and Ceramix-Metal Matrix Composites (3 units)
Manufacture and properties of superalloys and ceramic-metal matrix composites used in aerospace, turbine, mining and energy applications. Powder metallurgy, phase diagrams, mechanical alloying, deformation, creep, fatigue, fracture mechanics, wear and corrosion. Physics-based modelling of materials' strength including the contribution of solid solution, precipitation and ceramic particle strengthening as a function of application temperature.
Course Component: Lecture

AMM 5159 Advanced Production Planning and Control (3 units)
The principles of production management. Methods engineering, manufacturing control. Recording and evaluation of operations. Financial and production planning. Inventory control. Automation. Factory planning. This course is equivalent to MAAJ 5509 at Carleton University.
Course Component: Lecture

AMM 5168 Industrial Organization (3 units)
Principles of organization. Production processes. Organization and planning production. Evaluation of production activities. The economics of production. Planning for economy. Information engineering. Standardization. This course is equivalent to MAAJ 5608 at Carleton University.
Course Component: Lecture

AMM 5179 Manufacturing System Analysis (3 units)
Manufacturing systems, system selection, cost justification. Flexible and agile, group technology cellular manufacturing operations. Transfer and assembly line systems. Material transport and storage systems. Process planning, tolerance analysis, Taguchi methods. Manufacturing and assembly. Just-in-time production. Quality function deployment.
Course Component: Lecture

AMM 5182 Theory of Elastic Instability (3 units)
Considerations of instability with respect to small deformation. Differential equations for linear elements. Conservative and non-conservative force systems. Energy methods. Instability in beams. Instability of elements curved in a plane. Applications of trigonometric series. Stability of linear members in the inelastic zone.
Course Component: Lecture

AMM 5317 Experimental Stress Analysis (3 units)
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.
Course Component: Lecture

AMM 5345 Surfaces and Coatings (3 units)
Surface Engineering: Coatings & Thin Films Technologies- SURFACE ENGINEERING is a multidisciplinary activity intended to tailor the properties of the surfaces of engineering components so that their function and serviceability can be improved. Different surface modification, thin films and thick coating manufacturing methods such as surface hardening, chemical conversion coating, electro deposition, electroless plating, thermal spraying, physical vapour deposition, and chemical vapour deposition, are introduced.
Course Component: Lecture

AMM 5362 Failure Prevention (3 units)
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. This course is equivalent to MECH 5602 at Carleton University.
Course Component: Lecture

AMM 5364 Computational Metallurgy (3 units)
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. This course is equivalent to MECH 5604 at Carleton University.
Course Component: Lecture

AMM 5369 Metallic Phases and Transformations (3 units)
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.
Course Component: Lecture

AMM 5374 Integrated Manufacturing – CIMS (3 units)
Topics essential to CIMS including computer graphics, geometric modelling, numerically controlled machining, and flexible manufacturing. The fundamental data structures and procedures for computerization of engineering design, analysis and production. This course is equivalent to MECH 5704 at Carleton University.
Course Component: Lecture

AMM 5381 Lightweight Structures (3 units)
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. This course is equivalent to MECH 5603 at Carleton University.
Course Component: Lecture

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

AMM 6998 Projet / Project (6 crédits / 6 units)
Projet en génie 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 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

AMM 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 consultation. / 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

AMM 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