ADVANCED MATERIALS AND MANUFACTURING (AMM)

The following courses are offered by the Faculty of Engineering.

**AMM 5101 Theory of Elasticity (3 units)**

Course Component: Lecture

**AMM 5102 Advanced Stress Analysis (3 units)**

Course Component: Lecture

**AMM 5103 Theory of Perfectly Plastic Solids (3 units)**

Course Component: Lecture

**AMM 5104 Advanced Topics in Elasticity (3 units)**

Course Component: Lecture

**AMM 5107 Introduction to Composite Materials (3 units)**

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)**

Course Component: Lecture

**AMM 5119 Fracture Mechanics (3 units)**

Course Component: Lecture

**AMM 5120 Materials Selection in Engineering Design (3 units)**

Course Component: Lecture

**AMM 5121 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 5122 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 5123 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 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 microanalytical 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 5127 Advanced Materials and Manufacturing Processes (3 units)**

Course Component: Lecture

**AMM 5128 Test Methods and Failure Analysis (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 Ceramic-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)
Course Component: Lecture

AMM 5179 Manufacturing System Analysis (3 units)
Course Component: Lecture

AMM 5182 Theory of Elastic Instability (3 units)
Course Component: Lecture

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

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

---

This is a copy of the 2023-2024 catalog.
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