Aerospace Engineering (AERO)

Department of Mechanical and Aerospace Engineering

Faculty of Engineering and Design

AERO 3002 [0.5 credit]
Aerospace Design and Practice
Design approach and phases. Design integration. Influence of mission and other requirements on vehicle configuration. Trade-off studies, sizing and configuration layout. Flight vehicle loads, velocity-load factor diagram. Structural design: overall philosophy, role in design process, methods.
Prerequisite(s): MAAE 2001 and third-year status in Engineering.
Lectures three hours a week, problem analysis three hours a week.

AERO 3101 [0.5 credit]
Lightweight Structures
Structural concepts; theory of elasticity; bending, torsion and shear in thin-walled beams having single or multi-cell sections; work and energy principles; deformation and force analysis of advanced structures, including stiffened thin-wall panels; finite element methods. Stability and buckling of thin-walled structures.
Prerequisite(s): MAAE 3202.
Lectures three hours a week; problem analysis and laboratories one hour a week.

AERO 3240 [0.5 credit]
Orbital Mechanics
Review of rigid body dynamics, orbital elements, Keplerian two-body problem, orbit transfers, rendezvous, time of flight, interplanetary trajectories, manoeuvres (flyby, capture). Orbit determination and perturbations. Advanced topics: restricted three body problem, Lagrange's planetary equations.
Prerequisite(s): MAAE 2101.
Lectures three hours per week, tutorial one hour per week.

AERO 3700 [0.5 credit]
Aerospace Materials
Properties, behaviour and manufacturing methods for metals, polymers and ceramics used in aerospace applications. Specialty alloys for gas turbines. Properties and manufacture of aerospace composites. Behaviour of materials in space.
Prerequisite(s): MAAE 2700.
Lectures three hours a week; problem analysis and laboratories one hour a week.

AERO 3841 [0.5 credit]
Spacecraft Design
Design of spacecraft and spacecraft subsystems with emphasis on mission requirements and current design methods: spacecraft configuration, payload, structural, attitude control, thermal, power, and other related subsystems. Spacecraft integration and testing. Precludes additional credit for AERO 4801.
Prerequisite(s): MAAE 2001 and and AERO 3240.
Lectures three hours a week, tutorials or laboratories three hours per week.

AERO 4003 [0.5 credit]
Aerospace Systems Design
Stress and deflection analysis; fatigue, safe life, damage tolerant design. Propulsion systems integration; landing gear; control and other subsystems. Mechanical component design. Airworthiness regulations and certification procedures. Weight and cost estimation and control. System reliability. Design studies of aircraft or spacecraft components.
Prerequisite(s): MAAE 2202 and AERO 3002.
Lectures three hours a week, problem analysis three hours a week.

AERO 4009 [0.5 credit]
Aviation Management and Certification
Product development, quality control. Strategic organizational analysis and design. Airworthiness, type certification and planning, delegation of authority, airplane flight manual. Aerospace system design and safety.
Prerequisite(s): fourth-year status in Engineering.
Lectures three hours per week.

AERO 4300 [0.5 credit]
Acoustics and Noise Control
Behaviour of compressible fluids, sound waves and properties of sound sources; measurement of sound; human perception of sound; prediction methods based on energy considerations; sound propagation in realistic environments: outdoors, rooms, ducts; absorption and transmission loss, noise control; case studies.
Prerequisite(s): MATH 3705 and fourth-year status in Engineering.
Lectures three hours a week.

AERO 4302 [0.5 credit]
Aerodynamics and Heat Transfer
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.
Prerequisite(s): MAAE 3300.
Also offered at the graduate level, with different requirements, as MECH 5000., for which additional credit is precluded.
Lectures three hours a week.

AERO 4304 [0.5 credit]
Computational Fluid Dynamics
Differential equations of motion. Numerical integration of ordinary differential equations. Potential flows: panel methods; direct solution; vortex-lattice methods. Finite-difference formulations: explicit versus implicit methods; stability. Parabolized and full Navier-Stokes equations; conservation form. Transonic and supersonic flows: upwind differencing. Grid transformations. Computer-based assignments.
Prerequisite(s): MAAE 3300 or MECH 3310.
Lectures three hours a week.

AERO 4306 [0.5 credit]
Aerospace Vehicle Performance
Morphology of aircraft and spacecraft. Performance analysis of fixed wing aircraft: drag estimation, propulsion, take-off, climb and landing, endurance, payload/range, manoeuvres; operational economics. Performance analysis of rotor craft: rotor-blade motion, hovering and vertical ascent, forward flight, and autorotation. Rocket propulsion; escape velocity; orbital dynamics.
Prerequisite(s): MAAE 3300.
Lectures three hours a week.

AERO 4308 [0.5 credit]
Aircraft Stability and Control
Static stability and control: equilibrium requirements; longitudinal stability requirements; neutral points; manoeuvring flight; control forces and control requirements; lateral static stability certification requirements. Dynamic stability: axis systems; governing equations; phugoid and short period modes; lateral dynamic modes. Closed-loop control.
Prerequisite(s): MAAE 3300. Additional recommended background: MAAE 4500.
Also offered at the graduate level, with different requirements, as MECH 5101., for which additional credit is precluded.
Lectures three hours a week.

AERO 4402 [0.5 credit]
Aerospace Propulsion
Propulsion requirements, effects of Mach Number, altitude, and application; basic propeller theory; propeller, turboshaft, turbojet, turbofan and rocket; cycle analysis and optimization for gas turbine power plant; inter-relations between thermodynamic, aerodynamic and mechanical designs; rocket propulsion; selection of aeroengines.
Precludes additional credit for MECH 4401.
Prerequisite(s): MAAE 2400 and MAAE 3300.
Lectures three hours a week.

AERO 4442 [0.5 credit]
Transatmospheric and Spacecraft Propulsion
Planetary/interplanetary environments and effects. Launch and spacecraft propulsion: liquid/solid/hybrid rockets, ram/scramjets, combined cycle engines, electrothermal, electromagnetic, electrostatic, nuclear, and propellantless propulsion. Trajectory analysis, multi-staging, separation dynamics. Advanced engine concepts.
Prerequisite(s): AERO 4302 or AERO 4446 or MECH 4406.
Lectures three hours a week.

AERO 4446 [0.5 credit]
Heat Transfer for Aerospace Applications
Fundamentals of heat transfer with emphasis on aerospace systems design. Conduction, convection and radiation modes of heat transfer. Radiation exchange between surfaces and view factors. Radiation in spacecraft thermal control. High speed flight and reentry heating.
Precludes additional credit for MECH 4406.
Prerequisite(s): MAAE 2400, MAAE 3300.
Lectures three hours a week.

AERO 4540 [0.5 credit]
Spacecraft Dynamics and Control
Rigid body dynamics. The dynamic behavior of spacecraft. Environmental torques. The design of attitude control systems. Gravity gradient, spin, and dual spin stabilization. Attitude manoeuvres. The design of automatic control systems. Impacts of attitude stabilization techniques on mission performance.
Prerequisite(s): MATH 3705, AERO 3240 and SYSC 3600.
Lectures three hours a week.

AERO 4602 [0.5 credit]
Introductory Aeroelasticity
Review of structural behaviour of lifting surface elements; structural dynamics, Laplace Transforms, dynamic stability; modal analysis; flutter, Theodorsen's theory; flutter of a typical section; wing flutter, T-tail flutter, propeller whirl flutter; gust response; buffeting, limit cycle flutter.
Prerequisite(s): MAAE 3300 and SYSC 3600.
Lectures three hours a week.

AERO 4607 [0.5 credit]
Rotorcraft Aerodynamics and Performance
Rotorcraft history and fundamentals. Momentum theory: hover, axial climb and descent, autorotation, forward flight, momentum theory for coaxial and tandem rotors. Blade element analysis. Rotor airfoil aerodynamics. Rotor blade dynamics and trim. Helicopter performance, height-velocity curves, conceptual design. High-speed rotorcraft.
Prerequisite(s): MAAE 3300 and MAAE 3004.
Lectures three hours per week.

AERO 4608 [0.5 credit]
Composite Materials
Reinforcing mechanisms in composite materials; material properties. Strength and elastic constants of unidirectional composites; failure criteria. Analysis of laminated plates; bending and eigenvalue problems. Environmental effects and durability. Damage tolerance. Design of composite structures.
Prerequisite(s): MAAE 3202.
Lectures three hours a week.

AERO 4609 [0.5 credit]
Joining of Materials
Design for joining: base material and component geometry. Selection of joining method and filler material; Adhesive bonding; Soldering; Brazing; Diffusion bonding; Resistance welding; Fusion welding (GTAW, EB, laser and plasma arc); Friction welding; NDE. Emphasis on Aerospace materials and applications.
Prerequisite(s): AERO 3700 or MECH 3700.
Lectures three hours per week.

AERO 4801 [0.5 credit]
Spacecraft Design
Types of spacecraft. Fundamentals of orbital mechanics. The design of spacecraft and spacecraft subsystems with emphasis on mission requirements and current design methods: spacecraft configuration, payload, structural, propulsion, attitude control, thermal, power, communication and other related subsystems. Spacecraft integration and testing.
Precludes additional credit for AERO 3841.
Prerequisite(s): AERO 3002 or MECH 3002.
Lectures three hours a week.

AERO 4802 [0.5 credit]
Space Mission Analysis and Design
History of space exploration. Review of solar system. Space mission design. Space mission geometry. Space mission analysis:orbit design, orbit transfers and interplanetary trajectories. Space environment and its effect on spacecraft design. Space propulsion and launch vehicle design. Launch sequence, launch windows and launch cost.
Precludes additional credit for AERO 4842, MAAE 4906B (1994-2004 inclusive), MECH 5802 (2002-2004 inclusive), MECH 5700 Section "L" (1994-1997 inclusive), MECH 5805 (1999-2002 inclusive).
Prerequisite(s): AERO 3002 or MECH 3002.
Also offered at the graduate level, with different requirements, as MECH 5106, for which additional credit is precluded.

AERO 4842 [0.5 credit]
Space Mission Design
Space mission elements. System view of spacecraft. Requirements definition. Space mission geometry. Orbit selection. Space environment and its effect on spacecraft design. Launch vehicle design and selection. Mission operations. Space systems design examples.
Precludes additional credit for AERO 4802.
Prerequisite(s): AERO 3841.
Lectures three hours a week, tutorials or laboratories one hour per week.

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