Aerospace Engineering (AERO)

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**AERO 2001 [0.5 credit]**
Aerospace Engineering Graphical Design
Engineering drawing techniques; fits and tolerances; working drawings; fasteners. Elementary descriptive geometry; true length, true view, and intersection of geometric entities; developments. Assignments will make extensive use of Computer-Aided Design (CAD) and will include the production of detail and assembly drawings from actual physical models.
Includes: Experiential Learning Activity
Also listed as MAAE 2001.
Prerequisite(s): Second-year status in Engineering.
Lectures and tutorials two hours a week, laboratory four hours a week.

**AERO 3002 [0.5 credit]**
Aerospace Design and Practice
Includes: Experiential Learning Activity
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.
Includes: Experiential Learning Activity
Prerequisite(s): MAAE 3202.
Lectures three hours a week; problem analysis one hour a week.

**AERO 3240 [0.5 credit]**
Orbital Mechanics
Prerequisite(s): MAAE 2101.
Lectures three hours per week, tutorial one hour per week.

**AERO 3700 [0.5 credit]**
Aerospace Materials
Includes: Experiential Learning Activity
Prerequisite(s): MAAE 2700.
Lectures three hours a week; problem analysis one hour a week.

**AERO 3841 [0.5 credit]**
Spacecraft Design I
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.
Includes: Experiential Learning Activity
Prerequisite(s): 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.
Includes: Experiential Learning Activity
Prerequisite(s): AERO 3002 and fourth-year status in Engineering.
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.
Includes: Experiential Learning Activity
Prerequisite(s): MAAE 3004 and (MAAE 3300 or MECH 3310) 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 or MECH 3310.
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
Prerequisite(s): (MAAE 3300 or MECH 3310) and fourth-year status in Engineering.
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 or MECH 3310) and fourth-year status in Engineering.
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 3500 and fourth-year status in Engineering.
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, (MAAE 3300 or MECH 3310), and fourth-year status in Engineering.
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): MAAE 2400, (MAAE 3300 OR MECH 3310) and fourth-year status in Engineering.
Lectures three hours a week.

AERO 4446 [0.5 credit]
Heat Transfer for Aerospace Applications
Precludes additional credit for MECH 4406.
Prerequisite(s): MAAE 2400 and (MAAE 3300 or MECH 3310) and fourth-year status in Engineering.
Lectures three hours a week.

AERO 4540 [0.5 credit]
Spacecraft Attitude Dynamics and Control
Prerequisite(s): AERO 3240 and MAAE 3500 and fourth-year status in Engineering.
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; buffetig, limit cycle flutter.
Prerequisite(s): (MAAE 3300 or MECH 3310) and SYSC 3600 and fourth-year status in Engineering.
Lectures three hours a week.
AERO 4607 [0.5 credit]
Rotorcraft Aerodynamics and Performance
Prerequisite(s): MAAE 3004 and (MAAE 3300 or MECH 3310) and fourth-year status in Engineering.
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 2202 and fourth-year status in Engineering.
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): MAAE 2700 and fourth-year status in Engineering.
Lectures three hours per week.

AERO 4842 [0.5 credit]
Spacecraft Design II
System view of spacecraft. Requirements definition. Spacecraft payloads (remote sensing, imaging systems, astronomy instrumentation etc.). Exploration missions. Implications for systems and missions. Space system design case studies.
Includes: Experiential Learning Activity
Precludes additional credit for AERO 4802 (no longer offered).
Prerequisite(s): AERO 3841 and fourth-year status in Engineering.
Lectures three hours a week, tutorials or laboratories one hour per week.