Aerospace Stream Selection: Streams A, B, C, D
Canadian Aerospace
Important Facts and Figures

• Key early milestones
  • First powered flight in the Commonwealth – Baddeck, 23 Feb 1909, AES Silver Dart
  • Canada was third nation to have its own satellite built and launched – 1962, Alouette

• Aerospace is a national industry with regional clusters
  • 2/3rd of economic activity in Quebec (45%) and Ontario (25%)
  • Montreal region has third largest concentration of aircraft manufacturing activity in World [1st: Seattle (Boeing). 2nd: Toulouse (Airbus)]
Canadian Aerospace
Important Facts and Figures

• Canada is a Global leader in:
  • Civil helicopters
  • Small gas turbines
  • Simulators
  • Regional aircraft, business jets
  • Avionics
  • Landing gear systems,
  • Small and microsatellites
  • Maintenance

• Economic impact (Ref AIAC Aerospace Economic Impact, 2018)
  • ~90k employees, $32B in revenue (~80% from exports)
  • Employment normalized to population – 2nd versus all other nations (France is 1st)
  • Revenue normalized to GDP - 2nd versus all other nations (U.S. is 1st)
Aerospace at Carleton

- First BEng program in Canada (1988) and largest by enrolment
  (457 in 2020 vs. 30 in 1992)
- Four streams
  A - Aerodynamics, Propulsion and Vehicle Performance
  B - Aerospace Structures, Systems and Vehicle Design
  C - Aerospace Electronics and Systems
  D - Space Systems Design
- Originally only Stream A and B
  • Stream C added in the early 1990's
  • Stream D added in 2007-08
Engineering Education

1st year

common core: math, science, basic engineering, complementary studies

2nd year

math, engineering science (solids, fluids, thermo, materials)

3rd year

engineering specialization

4th year

4th year project engineering electives

also:
• co-op
• economics
• professional practice
• communication skills
• minor (math, business, etc.)
Aerospace Streams
Overview of Bachelor Programs

Stream C is offered in cooperation with Electronic Engineering
Core Aerospace Courses

Most or all AERO students take

- AERO 2001 Engineering Graphical Design
- MAAE 2101 Engineering Dynamics
- MAAE 2202 Mechanics of Solids I
- MAAE 2300 Fluid Mechanics I
- MAAE 2400 Thermodynamics and Heat Transfer
- MAAE 2700 Engineering Materials
- MATH 1005 Differential Equations
- MATH 2004 Multivariable Calculus
- ECOR 2050 Design and Analysis of Engineering Experiments

- AERO 3002 Aero Design and Practice
- AERO 3700 Aerospace Materials
- AERO 4003 Systems Design
- MAAE 3004 Dynamics of Machinery
- MAAE 3300 Fluid Mechanics II
- MAAE 3500 Feedback Control Systems
- MATH 3705 Mathematical Methods I
- ECOR 3800 Engineering Economics

- MAAE 4907 (Capstone Design Project)
- many stream-specific courses that can be taken as electives (space permitting)
Jobs in Aerospace Engineering

Overview of Bachelor Programs

- Aircraft Design
- Rotorcraft Design
- Satellite & Space Robotic Design
- Simulators
- Gas Turbine Engines
- Aerospace Systems
- Maintenance, Repair, & Overhaul

Department of Mechanical & Aerospace Engineering
How to read the Engineering “Tree”

Beware of Pre-requisites!

Basic Science Elective

Elective

Final Year Project

Engineering Electives

Two Complementary Studies Electives

Department of Mechanical & Aerospace Engineering
Stream A
Aerodynamics, Propulsion & Vehicle Performance

- Sample stream-specific courses
  - Aerodynamics and Heat Transfer
  - Aerospace Vehicle Performance
  - Aircraft Stability and Control
- Typical electives
  - Computational Fluid Dynamics (CFD)
  - Rotorcraft Aerodynamics and Performance
  - Aerelasticity
  - Aeroacoustics

- Example Careers
  - Aerodynamicist
  - Computational fluid dynamics engineer
  - Aircraft conceptual design
  - Aeroelastic analysis engineer
  - Aeroacoustics engineer
  - Flight test engineer
  - Stability and handling prediction
  - Performance prediction engineer
  - Jet engine aerodynamic designer
  - Launch vehicle aerodynamicist
  - Other:
    - wind energy
    - ground vehicle aerodynamics
    - building aerodynamics, etc.
Key Industry and Research Opportunities
Stream B
Aerospace Structures, Systems and Vehicle Design

- Sample stream-specific courses
  - Aerospace Materials
  - Lightweight Structures
  - Composite Materials
  - Aeroelasticity
  - Strength and Fracture
- Typical electives
  - Finite Element Methods
  - Rotorcraft Aerodynamics and Performance
  - Rocket Design

- Example careers
  - Airframe structural engineer
  - Computational structural dynamicist
  - Conceptual design
  - Aeroelastics engineer
  - Aircraft mechanical systems
  - Landing gear
  - Engine structural design
  - Manufacturing engineer
  - Spacecraft structural design
  - Other:
    - Wind turbine structural design
    - transportation structures
Key Industry and Research Opportunities
Stream C
Aerospace Electronics and Systems

- **Sample stream-specific courses**
  - Communication Theory
  - Electromagnetic waves
  - Digital Electronics
  - Power Engineering

  Typical Electives:
  - Any from Electronics or MAE

- **Example careers**
  - Avionics engineer
  - Systems engineering
  - Fly-by-wire flight controls
  - Unmanned aerial systems
  - Airborne remote sensing
  - Engine controls
  - Spacecraft communications
  - Terrestrial telecommunications
  - Power generation
Students wanting to register in 2nd year status requirement courses must complete all first year Science, Mathematics and Engineering courses [including a C- (C minus) grade or better in all ECOR 104x courses]

Notes:
(a) 1.5 credits in Mechanical and Aerospace Engineering (MAAE, AERO or MECH) at the 4000-level of AERO 4400, AERO 4504, ELEC 4302, ELEC 4305, ELEC 4306, ELEC 4309, ELEC 4500, ELEC 4602, ELEC 4604, ELEC 4703, ELEC 4706, ELEC 4707, ELEC 4708, ELEC 4709, SYSC 4305, SYSC 4306 or SYSC 4600

(b) Students must complete all first and second year courses, as well as 3.5 credits of third year courses (with the exception of Complementary Studies Elective to enroll in MAAE 4907 (Str Design Project).
Key Industry and Research Opportunities
Stream D
Space Systems Design

Sample stream-specific courses
• Orbital Mechanics
• Spacecraft Design I and II
• Spacecraft Attitude Dynamics and Control
• Transatmospheric and Spacecraft Propulsion

Typical Electives:
- Any from MAE

Example careers
• Satellite Operations – Telesat, Kepler, CSA/SED, Planet
• Systems Engineering – UTIAS/SFL (employees, not students), Telesat, Kepler, MDA, Comdev/Honeywell
• Satellite Design, build and test – MDA, Magellan
• Launch Vehicle Engineering and Management – SpaceX, Rocketlab
• Government research – CSA/DFL, NRC
Students wanting to register in 2nd year status requirement courses must complete all first year Science, Mathematics and Engineering courses [including a C- (C minus) grade or better in all ECOR 104x courses]

Notes:
(a) 1.5 credits in Mechanical and Aerospace Engineering (MAAE, AERO or MCE) at the 1000 level of AERO 3101, AERO 3705, ELEC 4503, ELEC 4600 or ELEC 4709.
(b) Students must complete all first and second year courses, as well as 3.5 credits of third year courses (with the exception of Complementary Studies Electives) to enroll in MAAE 4907 (Eng. Design Project).
Key Industry and Research Opportunities
What is Our Makeup?
Department of Mechanical & Aerospace Engineering

- Single, integrated department (not two separate parts)
- Approximately 1300 undergraduate students
  - 2019 first year admissions (total 365)
- Entering minimum averages: 83% Aerospace, 76% Mechanical
- 41 full-time Professors + 22 Adjunct Professors + 5 Emeritus Professors
**Engineering Co-op Program**

Department of Mechanical & Aerospace Engineering

- Co-op option available for all programs
- 30% of students in co-op
- 4, 8, 12, and 16 month placement options
- Placement options after 2\textsuperscript{nd} year
- 12 or 16 month placement after 3\textsuperscript{rd} year most popular

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Currently 12 Capstone Design Projects

- Fixed-Wing Unmanned Air Vehicle
- Satellite Design Project
- UAV - Blended-Wing
- FSAE Formula Car
- Carleton University Simulator Project
- Gas Turbine
- Building Integrated Thermal Energy Systems
- Crash Test Dummy
- Intelligent Telepresence and Assistive Devices
- Biomass Reactor
- Sustainable Energy Systems Portfolio
- Integrated Autonomous Car