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

- Key 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
  - Canada is home to the UN International Civil Aviation Organization (Montreal)

- Aerospace is a national industry with regional clusters
  - 2/3rd of economic activity in Quebec (45%) and Ontario (25%)
  - Significant activities in all provinces and territories
  - Canada is a leader in civil helicopters, gas turbines, small sats, flight simulators, MRO, space robotics, communication satellites, fixed wing utility aircraft, regional jet aircraft, landing gear systems, space-based air traffic control among others
Canadian Aerospace Important Facts and Figures

- **Canada is a Global leader in:**
  - Civil helicopters
  - Small gas turbines
  - Simulators
  - Regional aircraft, turboprops
  - Business jets
  - Avionics
  - Landing gear systems
  - Small and microsatellites
  - Space robotics
  - Maintenance
  - Research
  - Regulatory

- **Economic impact (Ref AIAC Aerospace Economic Impact, 2022)**
  - ~95k employees, $32B in revenue (~80% from exports)
  - Employment normalized to population – 2\textsuperscript{nd} versus all other nations (France is 1\textsuperscript{st})
  - Revenue normalized to GDP - 2\textsuperscript{nd} versus all other nations (U.S. is 1\textsuperscript{st})
Aerospace at Carleton

• First BEng program in Canada (1988) and largest by enrolment
  • (~500 in 2022 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
What is Our Makeup?

- Mechanical and Aerospace Engineering
  - Single, integrated department (not two separate parts)
- Approximately 1400 undergraduate students
  - 2022 first year admissions (~400)
- Entrance averages ~85% Aerospace, ~80% Mechanical
- 50 full-time Professors/Instructors + 22 Adjunct Professors + 5 Emeritus Professors
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
• minors (math, business, etc.)
• Internships – USRA, I-CUREUS, SaPP

Carleton University
Overview of Aerospace Bachelor Programs

Stream C is offered in cooperation with Electronic Engineering
Engineering Co-op Program

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

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Core Aerospace Courses

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

Satellite & Space Robotic Design

Fixed Wing

Rotorcraft

Simulators

Gas Turbine Engines

Aerospace Systems

Maintenance, Repair, & Overhaul
How to read the Engineering “Tree”

Beware of Pre-requisites!

Basic Science Elective

Final Year Project “Capstone”

Engineering Electives

Two Complementary Studies Electives
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
  - Aeroelasticity
  - 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.
AEROSPACE ENGINEERING - STREAM A

Course Prerequisites and Year Status Requirements

The Faculty of Engineering and Design strictly upholds course prerequisites. Course prerequisites are found in the Undergraduate Calendar course descriptions, and are indicated by arrows* between courses in this program map.

Year status in Engineering prerequisites (as noted by 2nd, 3rd, or 4th above the course box) vary year to year, please carefully review requirements for your catalog year.

Academic Advising

Obtaining regular academic advising and support for course planning is essential for engineering students who are "off-pattern" from their program map. Contact your program advisor:

First year students (new and returning):
ECORsupport@carleton.ca

Second year and higher students:
maeadvising@econet.carleton.ca

Notes

(a) 0.5 credits from AERO 4402, AERO 4442 or AERO 4507 AND 1.0 credits in Mechanical and Aerospace Engineering (MAE, AERO, MECH) at the 4000-level.

(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 4507 or EOR 4507 (Eng Design Project).

(c) EOR 495S can be taken in Winter term, if required due to limited elective options in Winter term

(d) Please review Engineering Portfolio submission and registration instructions. Students register for EOR 299S once 4th year status is achieved, either before or concurrent with EOR 499S.

Kindly note: this program map has been designed to ease course planning and registration for engineering students. Information is accurate at the time this document is produced. Prerequisites, course titles, course offerings, and course schedule patterns are based on the academic year in which this map was prepared and are subject to change. Please contact EngineeringStudentServices@carleton.ca for inquiries regarding this program map.

***Please run your audit after making any registration changes to verify they have been applied successfully.
Key Industry and Research Opportunities
Stream B
Aerospace Structures, Systems and Vehicle 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

- 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
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Academic Advising

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- First year students (new and returning): ECORSsupport@carleton.ca
- Second year and higher students: maeadvising@carleton.ca

Notes

(a) 0.5 credits from AERO 4605, MECH 4103, MECH 4104, or MECH 4804 and 1.0 credits in Mechanical and Aerospace Engineering (MAE, AERO, MECH) at the 4000 level.

(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 MAE 4907 or ECOR 4907 (Eng. Design Project).

(c) ECOR 4995 can be taken in Winter term, if required due to limited elective options in Winter term.

(d) Please review engineering portfolio submission and registration instructions. Students register for ECOR 2999 once 4th year status is achieved, either before or concurrent with ECOR 4995.

**Please run your audit after making any registration changes to verify they have been applied successfully.**
Key Industry and Research Opportunities
Stream C
Aerospace Electronics and Systems
• Sample stream-specific courses
  • Avionics
  • Communication Theory
  • Electromagnetic waves
  • Digital Electronics
  • Power Engineering
  • Robotic systems

• Typical Electives:
  • Any from Electronics or MAE that you have the pre-requisites for

• Example careers
  • Aircraft Systems engineering
  • Fly-by-wire flight controls
  • Uninhabited aircraft systems
  • Airborne remote sensing
  • Engine controls
  • Spacecraft communications and payloads
  • Terrestrial telecommunications
  • Sustainable power generation including solar, wind and nuclear
AEROSPACE ENGINEERING - STREAM C

Course Prerequisites and Year Status Requirements

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First year students (new and returning):
ECOSupport@ualberta.ca

Second year and higher students:
maeadvising@unet.carleton.ca

Notes

(a) 1.5 credits in Mechanical and Aerospace Engineering (MAE, AERO or MECH) at the 4000-level or AERO 3841, ELEC 4502, ELEC 4505, ELEC 4506, ELEC 4507, ELEC 4508, ELEC 4509, ELEC 4600, ELEC 4602, ELEC 4603, ELEC 4703, ELEC 4706, ELEC 4707, ELEC 4708, ELEC 4709, ELEC 4709, ELEC 4602, ELEC 4603.

(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 MAE 4907 or ECOR 4907 (Eng. Design Project).

(c) ECOR 4995 can be taken in Winter term, if required due to limited elective options in Winter term.

(d) Please review Engineering Portfolio submission and registration instructions. Students register for ECOR 2995 once 4th year status is achieved, either before or concurrent with ECOR 4995.

*Arrow Legend

- Required prerequisite
- Concurrent prerequisite

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**Please run your audit after making any registration changes to verify they have been applied successfully.
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
Course Prerequisites and Year Status Requirements

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Second year and higher students: maeadvising@unet.carleton.ca

Notes

(a) 1.5 credits in Mechanical and Aerospace Engineering (MAAE, AERO or MECH) at the 4000-level or AERO 3301, AERO 3700, ELEC 4508, ELEC 4630 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 elective) to enroll in MAAE 4907 or ECOR 4907 (Eng. Design Project).

(c) ECOR 4995 can be taken in Winter term, if required due to limited elective options in Winter term.

(d) Please review Engineering Portfolio submission and registration instructions. Students register for ECOR 2995 once 4th year status is achieved, either before or concurrent with ECOR 4995.
Key Industry and Research Opportunities
Current Capstone Design Projects

- Advanced Aircraft Design
- Satellite Design Project
- FSAE Formula Car
- Carleton University Simulator Project
- Crash Test Dummy
- Intelligent Telepresence and Assistive Devices
- Sustainable Energy Systems Portfolio
- Assisted Autonomous Vehicle
- Autonomous Space Robotics
- Biologically Inspired Environmentally Friendly Aerial Vehicle (BEFAV)
- Metal Powder Power Plants (MP3)
- Rocket Design Project
- Mechatronic Dosimetry Systems (MEDS)

https://carleton.ca/mae/fourth-year-projects-2023-2024/
Contacts for questions

- Aerospace streams
  - jeremy.laliberte@carleton.ca
- Registration, course/stream selection, academic advising
  - maeadvising@cunet.carleton.ca