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

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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

Others

5 x major Canadian OEM's

- **Economic impact (Ref AIAC Aerospace Economic Impact, 2022)**
  - ~95k 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)

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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

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What is Our Makeup?

- Mechanical and Aerospace Engineering
  - Single, integrated department (not two separate parts)

- Approximately 1400 undergraduate students
  - 2022 first year admissions (~400)

- Mechanical
- Biomedical and Mechanical
- Aerospace
- SREE
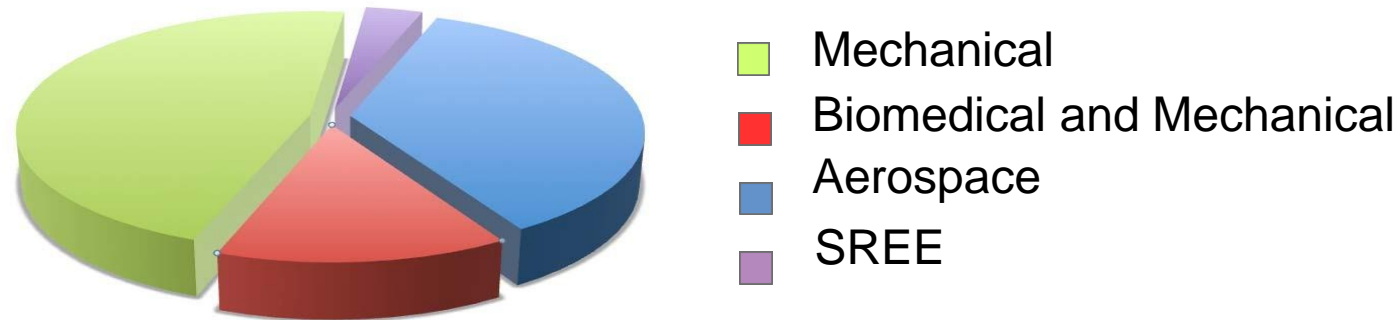
- Entrance averages ~85% Aerospace, ~80% Mechanical

- 50 full-time Professors/Instructors + 22 Adjunct Professors + 5 Emeritus Professors

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Engineering Education

4th year — 4th year project engineering electives

3rd year — engineering specialization

2nd year — math, engineering science (solids, fluids, thermo, materials)

1st year — common core: math, science, basic engineering, complementary studies
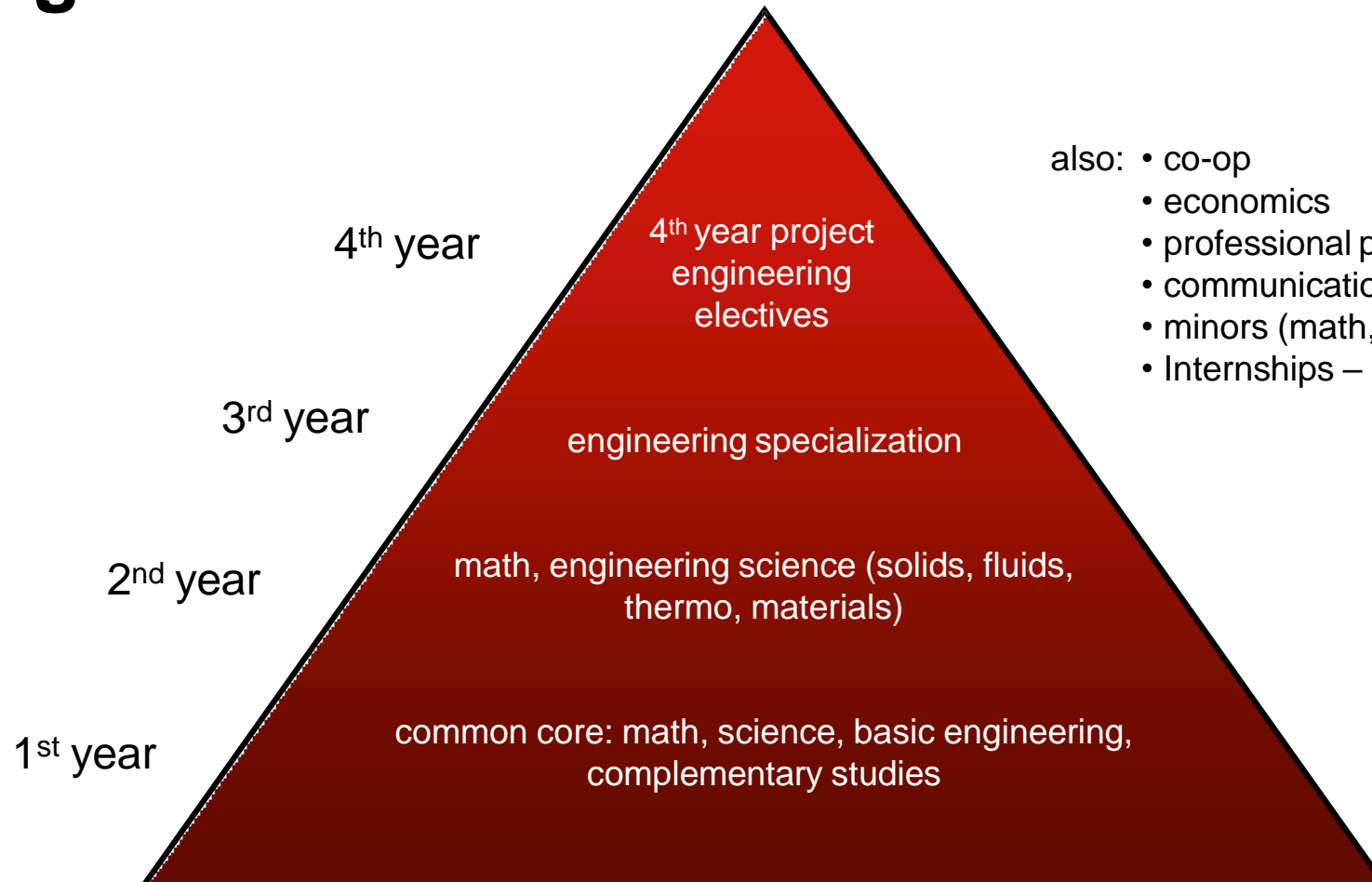
also:
- co-op
- economics
- professional practice
- communication skills
- minors (math, business, etc.)
- Internships – USRA, I-CUREUS, SaPP

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Overview of Aerospace Bachelor Programs
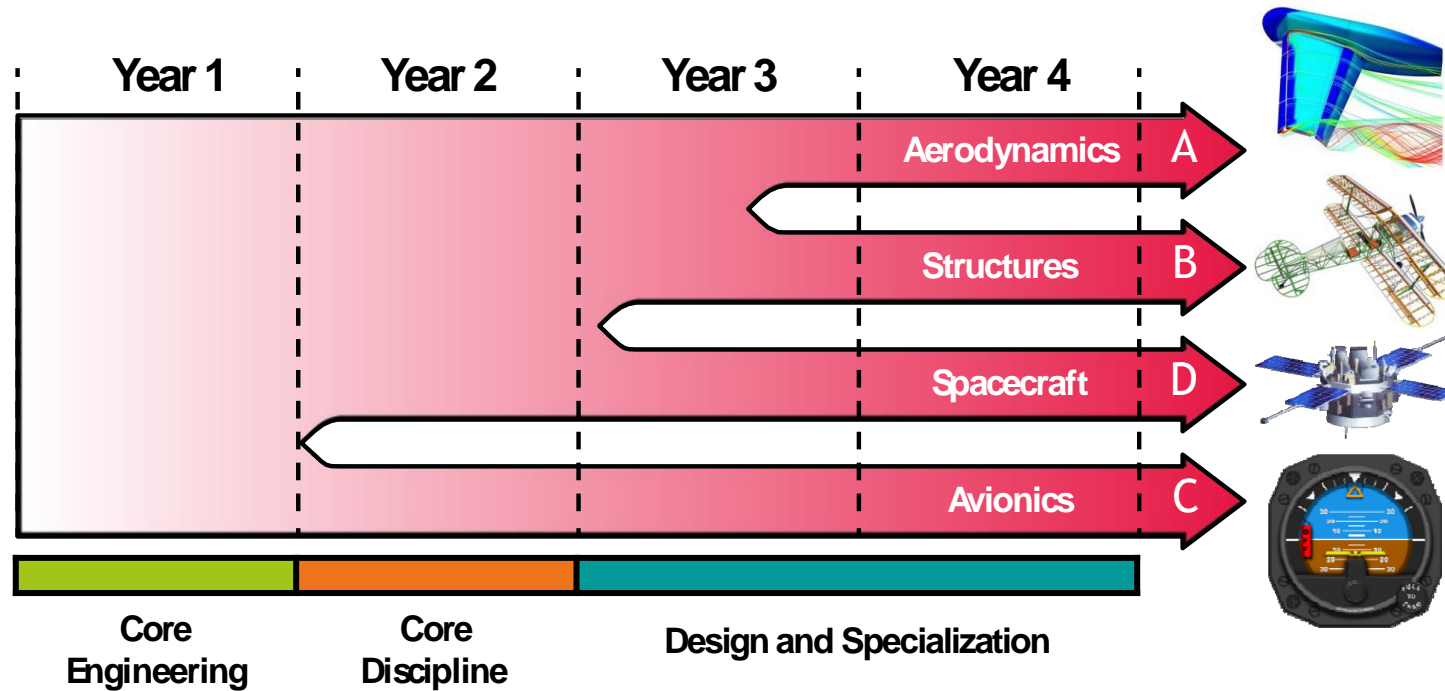
Stream C is offered in cooperation with Electronic Engineering

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

Year	Fall	Winter	Summer
1	Study 1	Study 2	Optional Work
2	Study 3	Study 4	Optional Work
3	Study 5	Study 6	Work
4	Work	Work	Work
5	Study 7	Study 8	

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)

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Jobs in Aerospace Engineering

Satellite & Space Robotic Design

Fixed Wing

Rotorcraft

Simulators

Gas Turbine Engines

Aerospace Systems
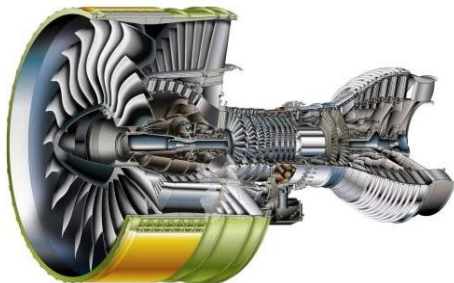
Maintenance, Repair, & Overhaul

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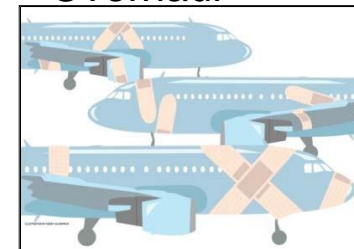
How to read the Engineering "Tree"

Basic Science Elective

Final Year Project "Capstone"

Engineering Electives

Beware of Pre-requisites!

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.

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FIRST YEAR		SECOND YEAR		THIRD YEAR		FOURTH YEAR	
FALL	WINTER	FALL	WINTER	FALL	WINTER	FALL	WINTER

MATH 1004 Calculus for Eng. Students

MATH 1104 Linear Algebra for Eng. Students

MATH 1005 Differential Equations & Infinite Series for Eng. Students

MATH 2004 Multivariable Calculus for Eng. Students

MATH 3705 Mathematical Methods I

AERO 3002 (3rd) Aerospace Design & Practice

MAAE 4907 / ECOR 4907 (4th) Engineering Design Project (note b) (1.0 credit)

Elective Basic Science Elective

CHEM 1101 Chemistry for Eng. Students

AERO 2001 (2nd) Aerospace Engineering Graphical Design

MAAE 2101 (2nd) Engineering Dynamics

MAAE 3004 Dynamics of Machinery

MAAE 3202 Mechanics of Solids II

AERO 4003 (4th) Aerospace Systems Design

AERO 4308 (4th) Aircraft Stability & Control

Elective Complementary Studies Elective

PHYS 1004 Introductory Electromagnetism & Wave Motion

MAAE 2202 (2nd) Mechanics of Solids I

MAAE 2400 (2nd) Thermodynamics & Heat Transfer

MAAE 3300 (2nd) Fluid Mechanics II

MAAE 3400 Applied Thermodynamics

AERO 4302 Aerodynamics & Heat Transfer

Elective Complementary Studies Elective

ECOR 1045 Statics (0.25 credit) · Weeks 1-6

ECOR 1041 Computation & Prog. (0.25 credit)

ECOR 1047 Visual Comm. (0.25 credit)

ECOR 1043 Circuits (0.25 credit)

AERO 4306 (4th) Aerospace Vehicle Performance

Elective Engineering Elective (note a)

ECOR 1046 Mechanics (0.25 credit) · Weeks 7-12

ECOR 1042 Data Management (0.25 credit)

MAAE 2300 (2nd) Fluid Mechanics I

MAAE 2700 (2nd) Engineering Materials

AERO 3700 Aerospace Materials

MAAE 3500 Feedback Control Systems

ECOR 1048 Dynamics (0.25 credit)

ECOR 1044 Mechatronics (0.25 credit)

Elective Engineering Elective (note a)

Elective Engineering Elective (note a)

ECOR 2050 Design & Analysis of Engineering Experiments

ELEC 3605 (2nd) Electrical Engineering

SYSC 3600 (2nd) Systems & Simulation

CCDP 2100 Communication Skills for Eng. Students

ECOR 1055 Introduction to Engineering Disciplines I (0.0 credit)

ECOR 1056 Introduction to Engineering Disciplines II (0.0 credit)

ECOR 4995 (4th) Professional Practice (note c)

ECOR 1057 Engineering Profession (0.0 credit)

ECOR 3800 (3rd) Engineering Economics

ECOR 2995 Engineering Portfolio (note d) (0.0 credit)

Notes

Course Prerequisites and Year Status Requirements

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Notes

(a) 0.5 credits from AERO 4402, AERO 4442 or AERO 4607 **AND** 1.0 credits in Mechanical and Aerospace Engineering (MAAE, 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 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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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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Program Map

FIRST YEAR		SECOND YEAR		THIRD YEAR		FOURTH YEAR	
FALL	**WINTER**	**FALL**	**WINTER**	**FALL**	**WINTER**	**FALL**	**WINTER**

First Year – Fall
- MATH 1004 – Calculus for Eng. Students
- Elective – Basic Science Elective
- Elective – Complementary Studies Elective
- ECOR 1045 – Statics (0.25 credit)
- ECOR 1047 – Visual Comm. (0.25 credit)
- ECOR 1046 – Mechanics (0.25 credit)
- ECOR 1048 – Dynamics (0.25 credit)
- ECOR 1055 – Introduction to Engineering Disciplines I (0.0 credit)
- ECOR 1057 – Engineering Profession (0.0 credit)

First Year – Winter
- MATH 1104 – Linear Algebra for Eng. Students
- CHEM 1101 – Chemistry for Eng. Students
- PHYS 1004 – Introductory Electromagnetism & Wave Motion
- ECOR 1041 – Computation & Prog. (0.25 credit)
- ECOR 1043 – Circuits (0.25 credit)
- ECOR 1042 – Data Management (0.25 credit)
- ECOR 1044 – Mechatronics (0.25 credit)
- ECOR 1056 – Introduction to Engineering Disciplines II (0.0 credit)

Second Year – Fall
- MATH 1005 – Differential Equations & Infinite Series for Eng. Students
- AERO 2001 – Aerospace Engineering Graphical Design (2nd)
- MAAE 2202 – Mechanics of Solids I (2nd)
- MAAE 2300 – Fluid Mechanics I (2nd)
- ECOR 2050 – Design & Analysis of Engineering Experiments (2nd)

Second Year – Winter
- MATH 2004 – Multivariable Calculus for Eng. Students
- MAAE 2101 – Engineering Dynamics (2nd)
- MAAE 2400 – Thermodynamics & Heat Transfer (2nd)
- MAAE 2700 – Engineering Materials (2nd)
- ELEC 3605 – Electrical Engineering

Third Year – Fall
- MATH 3705 – Mathematical Methods I
- MAAE 3004 – Dynamics of Machinery
- MAAE 3202 – Mechanics of Solids II
- AERO 3700 – Aerospace Materials
- SYSC 3600 – Systems & Simulation (2nd)
- ECOR 3800 – Engineering Economics (3rd)

Third Year – Winter
- AERO 3002 – Aerospace Design & Practice (3rd)
- MAAE 3300 – Fluid Mechanics II
- AERO 3101 – Lightweight Structures
- MAAE 3500 – Feedback Control Systems
- CCDP 2100 – Communication Skills for Eng. Students (2nd)

Fourth Year – Fall
- MAAE 4907 / ECOR 4907 – Engineering Design Project (note b) (1.0 credit) (4th)
- AERO 4003 – Aerospace Systems Design (4th)
- MAAE 4102 – Materials: Strength and Fracture (4th)
- AERO 4608 – Composite Materials (4th)
- Elective – Engineering Elective (note a)
- ECOR 4995 – Professional Practice (note c) (4th)

Fourth Year – Winter
- AERO 4602 – Introductory Aeroelasticity (4th)
- Elective – Complementary Studies Elective
- Elective – Engineering Elective (note a)
- Elective – Engineering Elective (note a)

Additional
- ECOR 2995 Engineering Portfolio (note d) (0.0 credit)

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Notes

(a) 0.5 credits from AERO 4609, MECH 4103, MECH 4104, or MECH 4604 **AND** 1.0 credits in Mechanical and Aerospace Engineering (MAAE, 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 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.
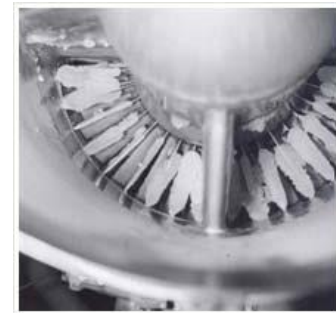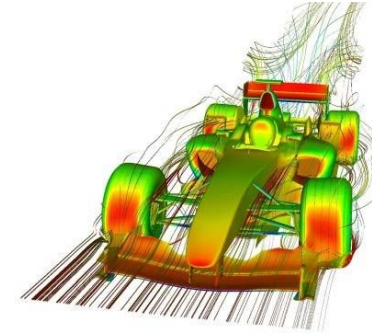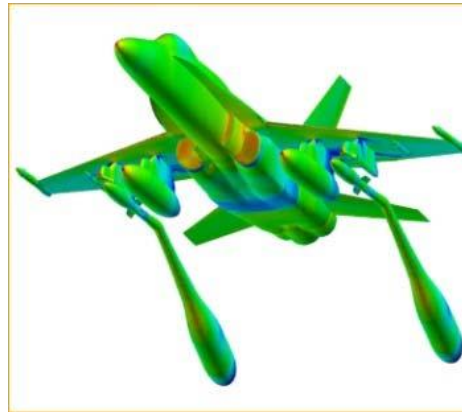
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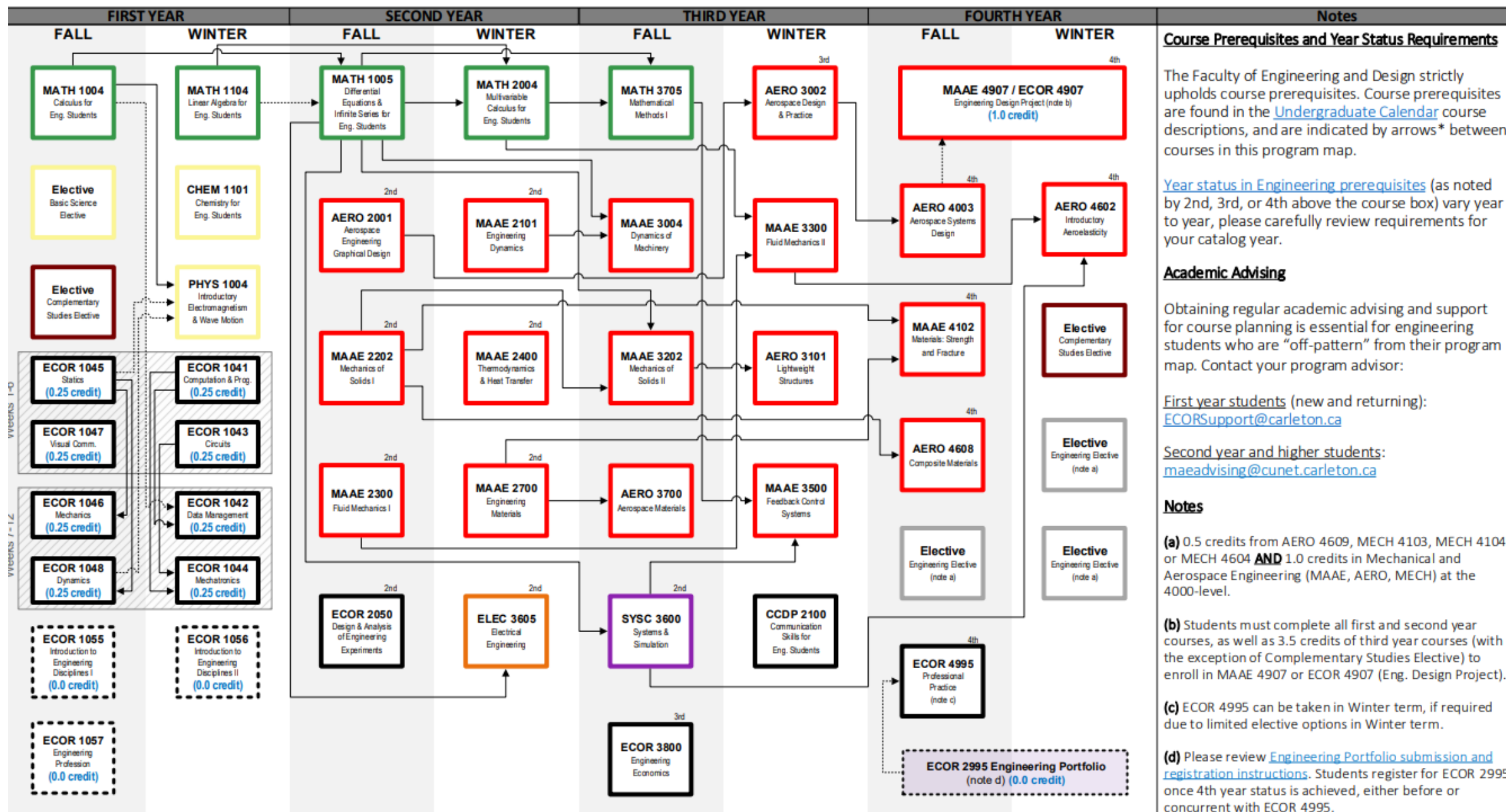
Key Industry and Research Opportunities

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

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Program Map

	FIRST YEAR		SECOND YEAR		THIRD YEAR		FOURTH YEAR	
	FALL	WINTER	FALL	WINTER	FALL	WINTER	FALL	WINTER

FIRST YEAR

- FALL: MATH 1004 — Calculus for Eng. Students
- WINTER: MATH 1104 — Linear Algebra for Eng. Students
- FALL: Elective — Basic Science Elective
- WINTER: CHEM 1101 — Chemistry for Eng. Students
- FALL: Elective — Complementary Studies Elective
- WINTER: PHYS 1004 — Introductory Electromagnetism & Wave Motion
- ECOR 1045 — Statics (0.25 credit)
- ECOR 1041 — Computation & Prog. (0.25 credit)
- ECOR 1047 — Visual Comm. (0.25 credit)
- ECOR 1043 — Circuits (0.25 credit)
- ECOR 1046 — Mechanics (0.25 credit)
- ECOR 1042 — Data Management (0.25 credit)
- ECOR 1048 — Dynamics (0.25 credit)
- ECOR 1044 — Mechatronics (0.25 credit)
- ECOR 1055 — Introduction to Engineering Disciplines I (0.0 credit)
- ECOR 1056 — Introduction to Engineering Disciplines II (0.0 credit)
- ECOR 1057 — Engineering Profession (0.0 credit)

SECOND YEAR

- FALL: MATH 1005 — Differential Equations & Infinite Series for Eng. Students
- WINTER: MATH 2004 — Multivariable Calculus for Eng. Students
- ELEC 2501 — Circuits & Signals (2nd)
- ELEC 2507 — Electronics I (2nd)
- MAAE 2101 — Engineering Dynamics (2nd)
- ELEC 2607 — Switching Circuits (2nd)
- MAAE 2202 — Mechanics of Solids I (2nd)
- AERO 2001 — Aerospace Engineering Graphical Design (2nd)
- ECOR 2050 — Design & Analysis of Engineering Experiments (2nd)
- MAAE 2700 — Engineering Materials (2nd)

THIRD YEAR

- FALL: MATH 3705 — Mathematical Methods I
- WINTER: ELEC 3909 — Electromagnetic Waves (3rd)
- ELEC 3105 — Electromagnetic Fields (2nd)
- AERO 3002 — Aerospace Design & Practice (3rd)
- ELEC 3500 — Digital Electronics (2nd)
- MAAE 2300 — Fluid Mechanics I (2nd)
- ELEC 3509 — Electronics II (2nd)
- MAAE 3500 — Feedback Control Systems (2nd)
- SYSC 3600 — Systems & Simulation (2nd)
- CCDP 2100 — Communication Skills for Eng. Students
- ECOR 3800 — Engineering Economics (3rd)

FOURTH YEAR

- FALL: MAAE 4907 / ECOR 4907 — Engineering Design Project (note b) (1.0 credit) (4th)
- WINTER: AERO 4504 — Avionics Systems (4th)
- AERO 4003 — Aerospace Systems Design (4th)
- MAAE 2400 — Thermodynamics & Heat Transfer (2nd)
- SYSC 3501 — Communication Theory
- Elective — Engineering Elective (note a)
- Elective — Complementary Studies Elective
- Elective — Engineering Elective (note a)
- Elective — Engineering Elective (note a)
- ECOR 4995 — Professional Practice (note c) (4th)
- ECOR 2995 Engineering Portfolio (note d) (0.0 credit)

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Notes

(a) 1.5 credits in Mechanical and Aerospace Engineering (MAAE, AERO or MECH) at the 4000-level or AERO 3240, AERO 3841, ELEC 4502, ELEC 4503, ELEC 4505, ELEC 4506, ELEC 4509, ELEC 4600, ELEC 4602, ELEC 4609, ELEC 4703, ELEC 4706, ELEC 4707, ELEC 4708, ELEC 4709, SYSC 4205, SYSC 4600 or SYSC 4607.

(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.
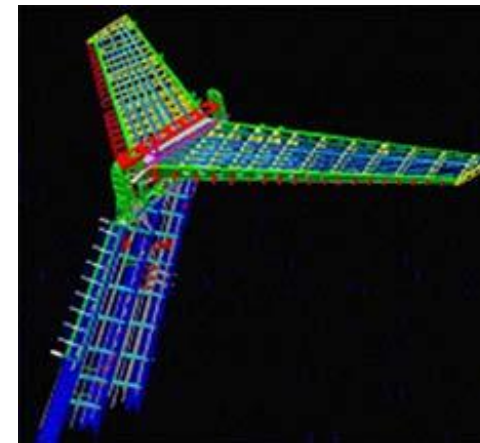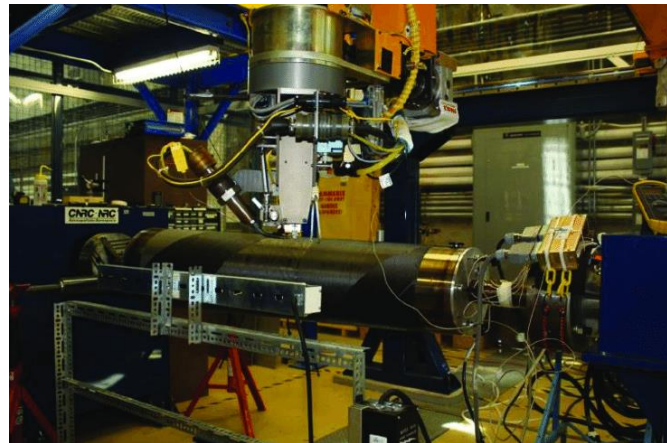
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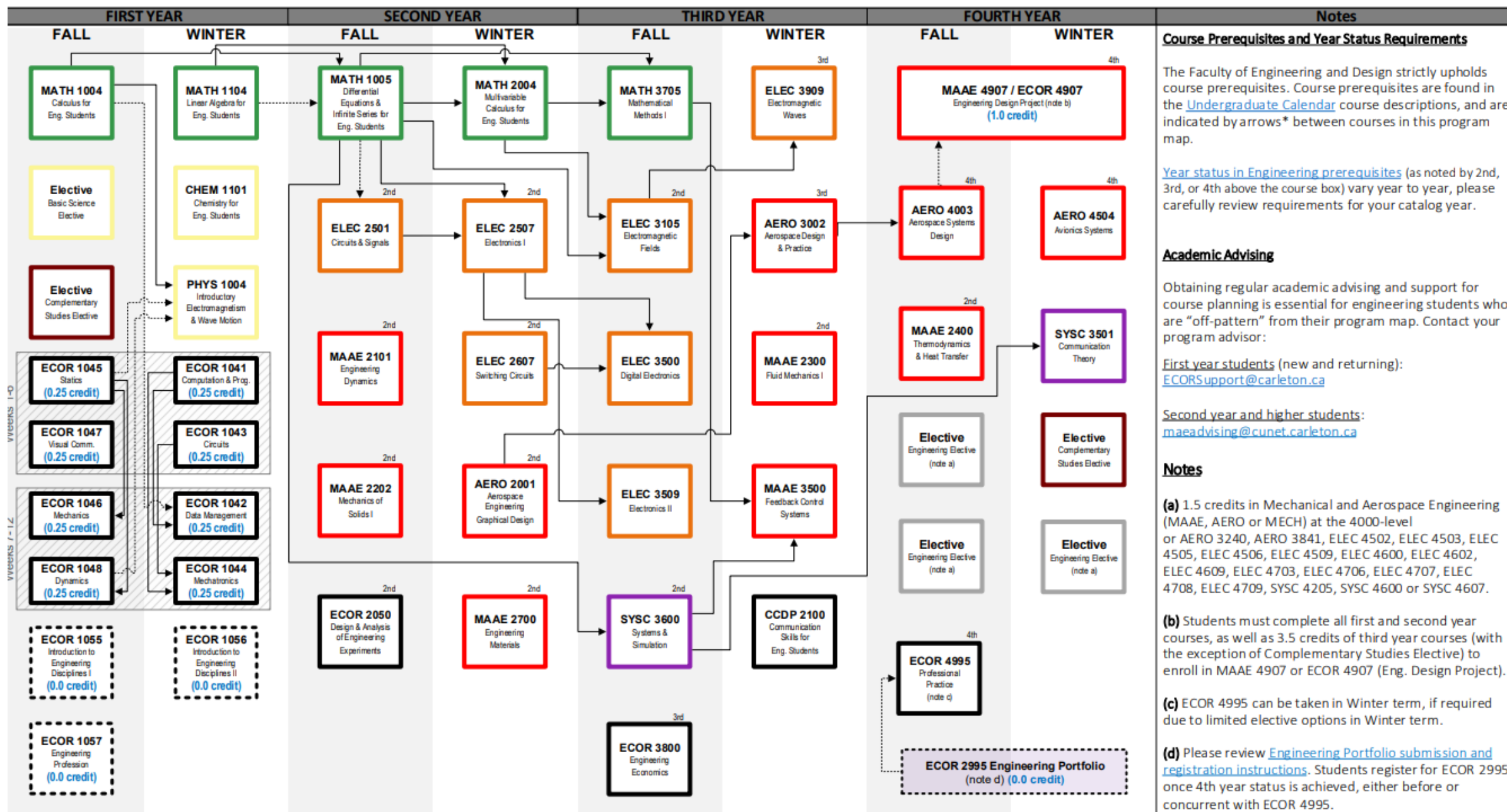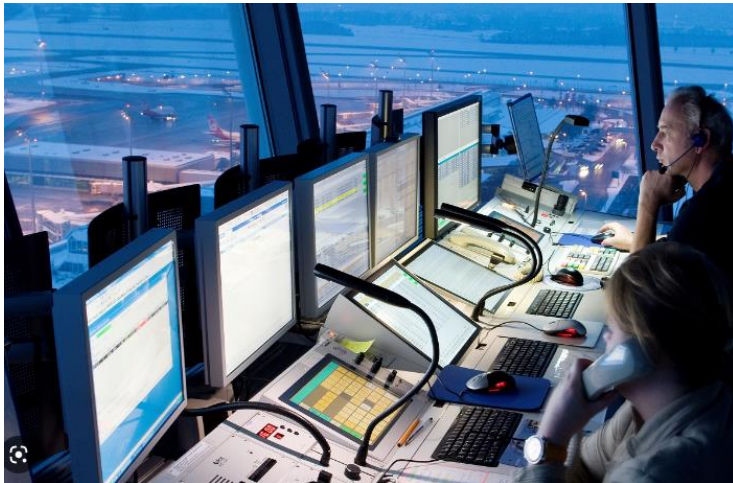# Key Industry and Research Opportunities

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

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FIRST YEAR		SECOND YEAR		THIRD YEAR		FOURTH YEAR		Notes
FALL	**WINTER**	**FALL**	**WINTER**	**FALL**	**WINTER**	**FALL**	**WINTER**	

MATH 1004 — Calculus for Eng. Students

MATH 1104 — Linear Algebra for Eng. Students

MATH 1005 — Differential Equations & Infinite Series for Eng. Students

MATH 2004 — Multivariable Calculus for Eng. Students

MATH 3705 — Mathematical Methods I

AERO 3002 (3rd) — Aerospace Design & Practice

MAAE 4907 / ECOR 4907 — Engineering Design Project (note b) (4th) **(1.0 credit)**

Elective — Basic Science Elective

CHEM 1101 — Chemistry for Eng. Students

MAAE 2202 (2nd) — Mechanics of Solids I

AERO 2001 (2nd) — Aerospace Engineering Graphical Design

AERO 3240 — Orbital Mechanics

AERO 3841 — Spacecraft Design I

AERO 4842 (4th) — Spacecraft Design II

ELEC 4509 (4th) — Communications Links

Elective — Complementary Studies Elective

PHYS 1004 — Introductory Electromagnetism & Wave Motion

ECOR 1045 — Statics (0.25 credit)

ECOR 1041 — Computation & Prog. (0.25 credit)

ECOR 1047 — Visual Comm. (0.25 credit)

ECOR 1043 — Circuits (0.25 credit)

MAAE 2300 (2nd) — Fluid Mechanics I

MAAE 2101 (2nd) — Engineering Dynamics

MAAE 3004 — Dynamics of Machinery

MAAE 3300 — Fluid Mechanics II

AERO 4446 (4th) — Heat Transfer for Aerospace Applications

AERO 4442 (4th) — Transatmospheric Spacecraft Propulsion

ECOR 1046 — Mechanics (0.25 credit)

ECOR 1042 — Data Management (0.25 credit)

ECOR 1048 — Dynamics (0.25 credit)

ECOR 1044 — Mechatronics (0.25 credit)

ECOR 2050 (2nd) — Design & Analysis of Engineering Experiments

MAAE 2400 (2nd) — Thermodynamics & Heat Transfer

ELEC 3909 (3rd) — Electromagnetic Waves

MAAE 3500 — Feedback Control Systems

AERO 4540 (4th) — Spacecraft Attitude Dynamics & Control

Elective — Engineering Elective (note a)

ECOR 1055 — Introduction to Engineering Disciplines I (0.0 credit)

ECOR 1056 — Introduction to Engineering Disciplines II (0.0 credit)

Elective — Complementary Studies Elective

MAAE 2700 (2nd) — Engineering Materials

SYSC 3600 (2nd) — Systems & Simulation

CCDP 2100 — Communication Skills for Eng. Students

Elective — Engineering Elective (note a)

Elective — Engineering Elective (note a)

ECOR 1057 — Engineering Profession (0.0 credit)

ECOR 4995 — Professional Practice (note c) (4th)

ECOR 3800 (3rd) — Engineering Economics

ECOR 2995 Engineering Portfolio (note d) **(0.0 credit)**

Weeks 1-6, *Weeks 7-12*

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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@cunet.carleton.ca

Notes

(a) 1.5 credits in Mechanical and Aerospace Engineering (MAAE, AERO or MECH) at the 4000-level or AERO 3101, AERO 3700, 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 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.

*Arrow Legend

→ Required prerequisite

⋯⋯→ Concurrent prerequisite

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 EngAcadSupport@carleton.ca for inquiries regarding this program map.

**Please run your audit after making any registration changes to verify they have been applied successfully
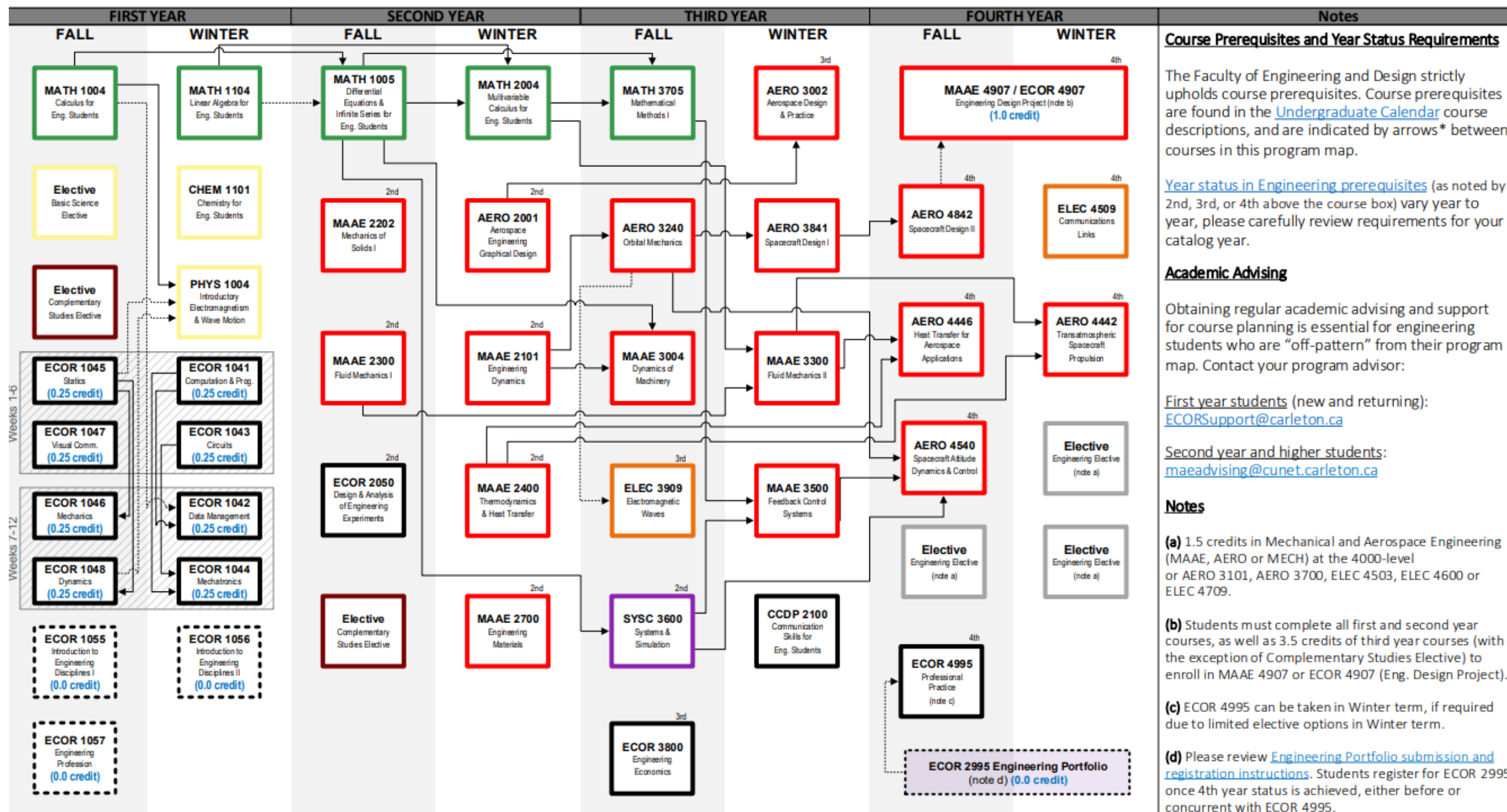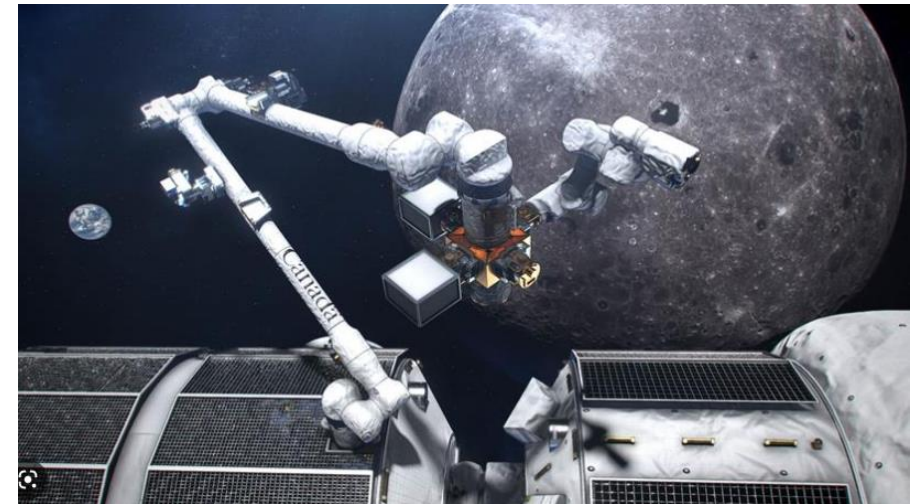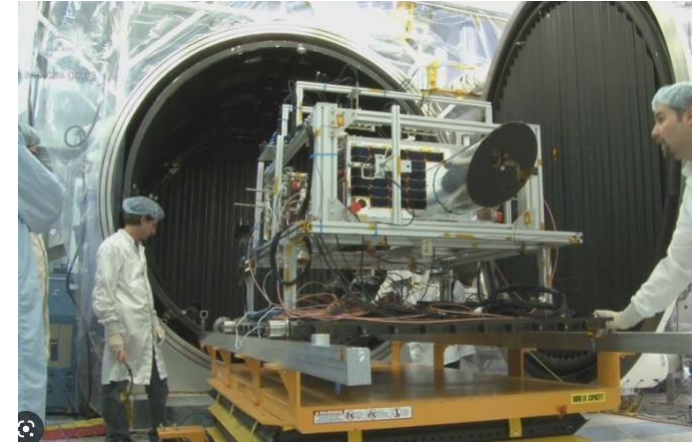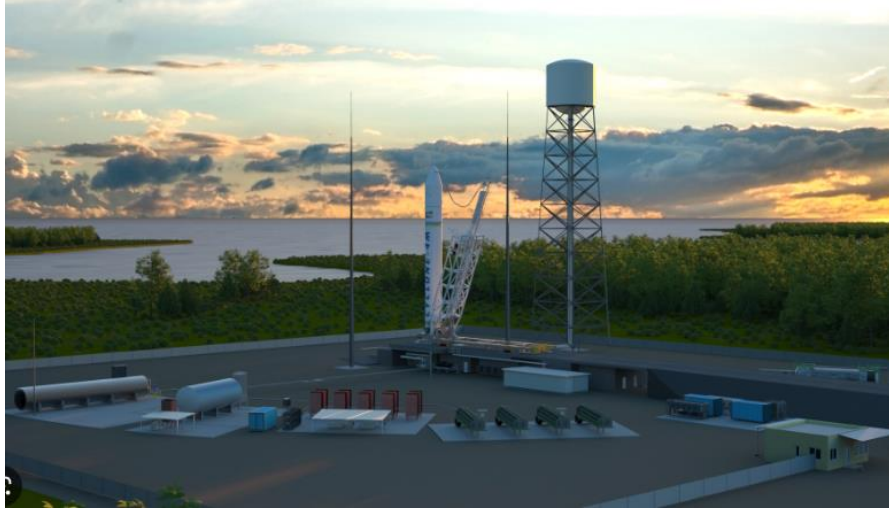
Key Industry and Research Opportunities

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/

Carleton University

Contacts for questions

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