McGill

Department of Mechanical Engineering

Master's Degree Program in Aerospace Engineering

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1 Introduction

The Aerospace Engineering Masters Degree Program is offered to any graduate engineer who wishes to specialize in this Area. Within this Program, it is possible to further specialize in:

- Aeronautics and Space Engineering
- Avionics and Control
- Structures and Materials
- Product Development and System Integration

The program is offered in collaboration with Concordia University, École Polytechnique, École de Technologie Supérieure (ETS), Université Laval, Université de Sherbrooke and thirteen Aerospace Industries in the vicinity of Montréal. It is being coordinated by the Comité Industrie/universités sur la Maîtrise en Génie Aéronautique et Spatial (CIMGAS) that has representatives from all participating universities and aerospace companies. McGill's representative in CIMGAS is Professor Mathias Legrand. All enquiries regarding this program should be directed to the Graduate Students Affairs Coordinator of the Department of Mechanical Engineering. Students must explicitly choose their specialization and are responsible for registering for the appropriate courses. Combining core courses from different specializations is not permitted. Questions regarding programs of study and specializations should be directed to Mathias Legrand (mathias.legrand@mcgill.ca).

Students with a Bachelor Degree from McGill University Students with a Bachelor Degree from McGill University considering the Master's Degree Program in Aerospace Engineering should be aware of the following:

Technical Complementary Courses These undergraduate courses *cannot* be counted toward the completion of the Master's degree in Aerospace Engineering and must be replaced by other courses approved by the specialization convenor.

Extra courses Undergraduate courses taken outside the degree program requirements are classified as extra. They can be credited toward the Master's degree in Aerospace Engineering if successfully passed with the minimum grade B−. They must be clearly marked as 'Extra' in the undergraduate transcript. Upon entry to the Master's program, the student must submit a request to have the credits transferred.

2 Degree Requirements

The Aeronautics and Space Engineering, Structures and Materials, and Avionics and Controls specializations require a minimum of 45 credits which must include:

- Core courses ..... [between 19 and 22 credits]
  The number of credits depends on the specialization and the selected courses.
- Aerospace Case Study (MECH 687) ..... [3 credits]
  A Case Study may be taken at other participating universities but is considered as a McGill course.
- Industrial Stage (MECH 688) ..... [6 credits]
  In special circumstances, the Industrial Stage might be replaced by a suitable combination of Aeronautics Projects (MECH 681 and MECH 682).
- Advanced courses ..... [selection of courses to reach a minimum of 45 credits]
  A minimum of two (2) advanced courses are to be taken outside of McGill, at least at two (2) other participating universities. This does not include the MECH 687 Aerospace Case Study that may also be taken at other participating universities but is considered as a McGill course.

The Product Development and System Integration specialization requires a minimum of 45 credits which must include:

- Core courses ..... [12 credits]
- Courses specific to Product Development and System Integration ..... [12 credits]
- Aerospace Case Study (MECH 687) ..... [3 credits]
  A Case Study may be taken at other participating universities but is considered as a McGill course.
- Industrial Stage (MECH 688) ..... [6 credits]
  In special circumstances, the Industrial Stage might be replaced by a suitable combination of Aeronautics Projects (MECH 681 and MECH 682).
- Advanced courses ..... [selection of courses to reach a minimum of 45 credits]
  A minimum of two (2) advanced courses are to be taken outside of McGill, at least at two (2) other participating universities. This does not include the MECH 687 Aerospace Case

Study that may also be taken at other participating universities but is considered as a McGill course.

Note that *at most* thirteen (13) units[1] may be taken at other participating universities. Students may register for a course at one of the other participating universities through CREPUQ's IUT system at:

http://www.crepuq.qc.ca

Please also note that there are processing delays in these requests, and they should be submitted more than three weeks in advance of the internal McGill add/drop deadline. In addition, it is not advisable to take a course outside McGill in your last term of studies, as it can take one to two months after the end of term for the grade to be received at McGill and hence delay graduation.

3 Core Courses

3.1 Candidates with a Degree in Mechanical Engineering

All candidates with an undergraduate degree in Mechanical Engineering who wish to undertake the Aeronautics and Space Engineering, or Structures and Materials specializations are required to take twelve (12) credits from the following courses:

MECH 605	Applied Maths 1	[4 credits]
MECH 610	Fundamentals of Fluid Mechanics	[4 credits]
MECH 632	Advanced Mechanics of Materials	[4 credits]
MECH 642	Advanced Dynamics	[4 credits]

Students are strongly urged to complete these courses early in their program, as problems may arise if they are taken later.

3.1.1 Aeronautics and Space Engineering Specialization

In addition to the twelve (12) credits of core courses listed at the beginning of Section 3.1, students specializing in Aeronautics and Space Engineering are *required* to take:

MECH 532	Aircraft Performance, Stability and Control	[3 credits]
MECH 533	Subsonic Aerodynamics	[3 credits]
MECH 542	Spacecraft Dynamics	[3 credits]

In addition to the core courses, students are required to take Advanced Courses [Section 7] that have been approved by the Aeronautics and Space Engineering convenor.

3.1.2 Structures and Materials Specialization

In addition to the twelve (12) credits of core listed at the beginning of Section 3.1, students specializing in Structures and Materials are *required* to take:

MECH 536	Aircraft Structures	[3 credits]

[1] This is a McGill rule which represents a third (1/3) of coursework credit.

MECH 530	Mechanics of Composite Materials	[3 credits]
either MECH 546	Finite Element Methods in Solid Mechanics	[3 credits]
or CIVE 602	Finite Element Analysis	[4 credits]

In addition to the core courses, students are required to take Advanced Courses [Section 7] that have been approved by the Structures and Materials convenor.

3.2 Candidates with Degrees other than Mechanical Engineering

3.2.1 Structures and Materials Specialization

Students with an undergraduate degree different from Mechanical Engineering and specializing in Structures and Materials are *required* to take:

MIME 565	Aerospace Metallic Materials and Manufacturing Processes	[3 credits]
MECH 530	Mechanics of Composite Materials	[3 credits]
MECH 536	Aircraft Structures	[3 credits]
either MECH 546	Finite Element Methods in Solid Mechanics	[3 credits]
or CIVE 602	Finite Element Analysis	[4 credits]
MECH 605	Applied Maths 1	[4 credits]
MECH 632	Advanced Mechanics of Materials	[4 credits]

In addition to the core courses, students are required to take Advanced Courses [Section 7] that have been approved by the Structures and Materials convenor.

3.2.2 Avionics and Control Specialization

Students specializing in the Avionics and Control are expected to have an undergraduate degree in Electrical Engineering and are *required* to take:

ECSE 501	Linear Systems	[3 credits]
MECH 513	Control Systems	[3 credits]
ECSE 509	Probability and Random Signals 2	[3 credits]
ECSE 511	Introduction to Digital Communication	[3 credits]
MECH 532	Aircraft Performance, Stability and Control	[3 credits]
MECH 605	Applied Maths 1	[4 credits]

In addition to the core courses, students are required to take Advanced Courses [Section 7] that have been approved by the Avionics and Control convenor.

Candidates with a non-Electrical Engineering background who wish to specialize in Avionics and Control will be required to take certain preparatory undergraduate courses, not for credit toward their degree, to bring their background to a level which will allow them to take the required graduate courses. Selection of these courses will be done by the Avionics and Control convenor, based on the student's prior record.

3.3 Specialization in Product Development and System Integration

For this program, students are selected in collaboration with industry. The program is managed by CAMAQ and the courses are offered at École Polytechnique de Montréal.

In addition to the twelve (12) credits of core courses listed at the beginning of Section 3.1, students specializing in Product Development and System Integration are *required* to take the following twelve (12) credits at École Polytechnique de Montréal:

MEC8310	Projet en environnement virtuel	[4 credits]
MEC8508	Développement de produits en environnement virtuel	[4 credits]
MEC8910A	Gestion de projet en génie aéronautique	[4 credits]

In addition to the core courses, students are required to take Advanced Courses [Section 7] that have been selected in collaboration with, and approved by, the Product Development and System Integration convenor.

4 Aerospace Case Studies

Case Study courses are organized by CIMGAS, and are shared while being offered at one of the participating universities and are conducted by industrial experts. The member of the Aerospace Engineering Committee in charge of coordinating McGill's involvement in these Case Study courses is Professor Mathias Legrand. As it is not possible to repeat the material given in a particular Case Study, it is the responsibility of the student to choose an appropriate Case Study *when it is offered*. While only one Case Study course is required by the Program, a second may be taken with the permission of the appropriate convenor. Please also note that enrolment in some Case Study courses may be limited and that the course is given in the language chosen by the industrial expert(s) in charge of a particular case, either French or English. The following courses at the other participating universities are equivalent to McGill's MECH 687:

Concordia	MECH 6961 or MECH 6971
École Polytechnique	MEC 6612 or MEC 6613 or ELE 6911 or ELE 6912
ETS	MGA 900
Université Laval	GMC 6902
Université de Sherbrooke	GMC 791

Students must register for the case study at the university where it is being given, and can do so through CREPUQ's IUT system at:

http://www.crepuq.qc.ca

MECH 687 – Aerospace Case Studies This course covers topical case studies drawn from aerospace industrial experience. It is conducted in a modular form by experienced engineers from industry. It is given in collaboration with the other institutions participating in this joint program, and may be conducted in the language of convenience to the instructors. Even though this course might be taken at another participating university, it is considered as a McGill course. Students registering for this course at another participating university through CREPUQ should *also* register for MECH 687 at McGill in the same term.

5 Industrial Stage

The member of the Aerospace Engineering Committee in charge of coordinating McGill's involvement in the Industrial Stages is Professor Mathias Legrand.

A minimum of 18 credits in the Aerospace Program must be completed before the beginning of the stage. Students are responsible for obtaining their own stage. One resource students can use is the internship database available through the McGill Institute of Aerospace Engineering[2]. Masters in Aerospace Engineering students can become members of the MIAE upon their request to the MIAE coordinator. Once a member, students can apply for internships and take part in industry networking and other activities provided by the MIAE to its student members[3]. The duration of the Industrial Stage is fifteen (15) weeks.

It is the candidate's responsibility to ensure that the following two documents are forwarded, by the Supervisor, to the Graduate Student Affairs Coordinator (MD 270) in the Department of Mechanical Engineering at McGill University:

1. a *desensitized* report of his/her findings and accomplishments during the Stage be submitted both to the company supervisor and the Aerospace Engineering Committee at McGill;
2. a Stage Evaluation Form.

MECH 688 – Industrial Stage An integral component of the Program is to be completed under the supervision of an experienced engineer in the facilities of a participating company. An evaluation of the candidate's performance during the work period becomes part of the student's record.

6 Aerospace Engineering Project Course

Only in the case where a degree candidate is unable to arrange for a suitable Industrial Stage is it possible for him/her to apply for the Aeronautical Project Course towards the completion of his/her degree requirements.

MECH 681 – Aeronautics Project The project is undertaken under the direct supervision of at least one staff member. Examination entails the writing of a report, which is examined internally.

7 Advanced Courses

In addition to the core course requirements in section 3, students are required to take Advanced Courses that have been selected in collaboration with, and approved by, the convenor for their specialization.

While it is not mandatory for a candidate to choose Advanced Courses from within the student's chosen area of specialization, it is expected that the following lists of courses (that do not include core courses) will form the basis of his/her preference. Course descriptions for all courses are available in the graduate calendar. Courses offered at the other participating universities may also be suitable as advanced courses. It should be reminded that a minimum of two (2) advanced courses are to be taken outside of McGill, at least at two (2) other participating universities.

The courses listed below may not be available every year.

[2] http://www.mcgill.ca/miae

[3] Because there is a limited number of internships available per term and recruitment is competitive, the MIAE cannot guarantee that each student will be successful in obtaining an internship.

7.1 Aeronautics and Space Engineering and Structures and Materials

CHEE 582	Polymer Science & Engineering
MECH 515	Unsteady Gas Dynamics 1
MECH 530	Mechanics of Composite Materials
MECH 531	Aeroelasticity
MECH 535	Turbomachinery and Propulsion
MECH 536	Aircraft Structures
MECH 537	High Speed Aerodynamics
MECH 538	Unsteady Aerodynamics
MECH 539	Computational Aerodynamics
MECH 543	Design with Composite Materials
MECH 544	Processing of Composite Materials
MECH 546	Finite Element Methods in Solid Mechanics
MECH 550	Vibrations of Continuous Systems
MECH 565	Fluid Flow and Heat Transfer Equipment
MECH 566	Fluid-Structure Interactions
MECH 579	Multidisciplinary Design Optimization
MECH 616	Viscous Flow and Boundary Layer Theory
MECH 620	Advanced Computational Aerodynamics
MECH 635	Fracture & Fatigue
MECH 650	Fundamentals of Heat Transfer
MECH 652	Dynamics of Combustion
MECH 654	Computational Fluid Flow and Heat Transfer
MECH 656	Fundamentals of Turbulent Flow
MIME 565	Aerospace Metallic Materials and Manufacturing Processes

7.2 Avionics and Control

ECSE 505	Nonlinear Control Systems
ECSE 506	Stochastic Control and Decision Theory
ECSE 507	Optimization and Optimal Control
ECSE 510	Random Processes and Systems
ECSE 512	Digital Signal Processing 1
ECSE 513	Robust Control Systems
ECSE 521	Digital Communications 1
ECSE 527	Optical Engineering
ECSE 528	Telecommunication Network Architecture
ECSE 529	Image Processing and Communication
ECSE 531	Real Time Systems
ECSE 532	Computer Graphics
ECSE 545	Microelectronics Technology
ECSE 565	Introduction to Power Electronics
ECSE 573	Microwave Electronics
ECSE 596	Optical Waveguides
COMP 538	Person-Machine Communication
COMP 557	Fundamentals of Computer Graphics