# MEMORANDUM

**To:**        Executive Committee of Faculty Council (November 3, 2016)
            Faculty Council (December 1, 2016)

**From:**      Professor Markus Bussmann
            Chair, Engineering Graduate Education Committee (EGEC)

**Date:**      October 20, 2016

**Re:**        **EGEC Information Report**

## REPORT CLASSIFICATION

This is a routine or minor policy matter that will be considered by the Executive Committee for approving and forwarding to Faculty Council for information.

## NEW COURSES APPROVED

APS1040H    Quality Control for Engineering Management
AER1217     Development of Autonomous Unmanned Aerial Systems

## NEW EMPHASIS APPROVED

Emphasis in Aerial Robotics – see attached

## MINOR MODIFICATIONS

CIV1260H    Chemistry of Cements and Concrete  (previously taught as CIV1299)
CIV1262H    Microscopy Applied to Concrete and Geomaterials (previously taught as
    CIV1298H Special Studies in Civil Engineering - Building)

## RECOMMENDATION FOR FACULTY COUNCIL

For information.

# University of Toronto
# Minor Modification
# Change to an Existing Graduate Program

*This template should be used to bring forward all proposals for minor modifications to program or admissions requirements for existing graduate programs under the University of Toronto's Quality Assurance Process.*

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|---|---|
| **Program being modified:** | Aerospace Engineering MEng, MASc, PhD |
| **Graduate Unit:** | Institute for Aerospace Studies – Aerospace Science and Engineering |
| **Faculty / Academic Division:** | Applied Science & Engineering |
| **Dean's Office Contact:** | Markus Bussmann, Vice-Dean, Graduate |
| **Version Date:** | 13 October 2016 |

## 1 Summary

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|---|---|---|---|
| | *Changing Admission Requirements* | | *Renaming Field, Concentration or Emphasis* |
| | *Changing Program Requirements or Length* | | *Renaming of Program* |
| | *Changing Timing of Program Requirements* | X | *Creating a New Emphasis* |
| | *Adding/Removing Option (i.e. part-time, flex-time)* | | *Changes to Programs Affecting an MOA* |

This is to request the creation of a new Emphasis in Aerial Robotics in conjunction with the CREATE program in Aerial Robotics and the Centre for Aerial Robotics Research and Education supported by the Dean's Strategic Fund. The goal of the emphasis is to recognize specialized work by graduate students in fields related to aerial robots, otherwise known as UAVs or drones. Briefly, the requirements are:

- Students complete two required courses: AER1216 (Fundamentals of UAVs) *and* AER1217 (Design of UAVs)

- PhD, MASc students complete one other course from the approved course list which will be updated on a regular basis or other related courses approved by professors, *and* one MASc/PhD thesis relevant to UAV.

- MEng students complete one other course from the approved list or other related courses approved by professors and one MEng project (typically AER 1810) related to UAVs.

## 2 Effective Date of Change

September 2016

## 3 Academic Rationale

Aerial robots hold great promise for applications as diverse as natural resource monitoring, delivery of small packages, infrastructure inspection, agriculture, mineral exploration, journalism, and search & rescue operations. This is the most vibrant sector of the aerospace industry, growing more quickly than any other segment. Given Canada's vast geographical landscape and natural resources, the Canadian commercial or civil UAV market is expected to grow rapidly.

This Emphasis in Aerial Robotics aims to provide students a range of interdisciplinary technical training needed for advancing the field of unmanned aerial vehicles. The emphasis will also attract a larger number of students; representatives of the industrial partners have already expressed an interest in using the MEng program to train their current employees on topics related to UAVs.

## 4 Impact on Students

This emphasis will offer PhD, MASc and MEng students the opportunity to be recognized for completing several courses relating to control, autonomy, navigation, airframe optimization and sensory feedback in the context of aerial robots. Completion of the requirements will be acknowledged with a certificate.

## 5 Consultation

This proposal was prepared in consultation with the UTIAS graduate unit and the Faculty of Applied Science and Engineering at the University of Toronto.

## 6 Resources

None.

## 7 Governance Approval

| Unit Sign-Off | Graduate Coordinators and Chairs of UTIAS, October 2016 |
|---|---|
| Dean's Office Sign-Off | Markus Bussmann, Vice-Dean, Graduate Studies, October 2016 |
| Faculty/Division Council Approval (or delegated body) if applicable | Approved by the Engineering Graduate Education Committee (EGEC) on behalf of the Council of the Faculty of Applied Science & Engineering on Tuesday, October 18th, |

| | 2016, and presented to the Council of the Faculty of Applied Science & Engineering for information on December 1, 2016 |
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# Appendix A: Calendar Entry
*Please use track-changes to indicate where changes have been made.*

## Emphasis: Aerial Robotics

- Students can earn an Emphasis in Aerial Robotics by completing the required courses, as follows:

    o AER1216 (Fundamentals of UAVs) *and* AER1217 (Design of UAVs)

- PhD and MASc students will complete **one** other course from the approved course list which will be updated on a regular basis or other related courses approved by professors, *and* **one** MASc/PhD thesis relevant to UAV.

- MEng students will complete **one** other course from the approved list or other related courses approved by professors and **one** MEng project course related to UAV.

    Note that a course may only be counted toward one emphasis.

    *The following courses are approved as of 2016-17*

    **UTIAS**
    o AER501H – Advanced Mechanics of Structures
    o AER503H – Aeroelasticity
    o AER506H – Spacecraft Dynamics and Control 1
    o AER510H – Aerospace Propulsion
    o AER521H – Mobile Robotics and Perception
    o AER525H - Robotics
    o AER1214 - Airplane Dynamics
    o AER1215 - Aerodynamics and Flight Mechanics of Rotorcraft
    o AER1202H - Advanced Flight Dynamics
    o AER1211H - Human Control of Flight Systems
    o AER1303H – Advanced Fluid Mechanics
    o AER1308H – Introduction to Modern Flow Control
    o AER1316H - Fundamentals of Computational
    o AER1324H – Introduction to Turbulence
    o AER1403H - Advanced Aerospace Structures
    o AER1410H – Topology Optimization
    o AER1415 - Computational Optimization
    o AER1503H – Spacecraft Dynamics and Control II
    o AER1513H - State estimation for Aerospace Vehicles
    o AER1514H – Mobile Robotics

**CSC**
- CSC2503 – Foundations of Computational Vision
- CSC2545 – Kernel Methods & Support Vector Machines
- CSC411H – Machine Learning

**ECE**
- ECE537H1 – Random Processes
- ECE1512H – Digital Image Processing and Applications
- ECE1505H – Convex Optimization
- ECE1747H – Parallel Programming
- ECE1762H – Algorithms and Data Structures

**MIE**
- MIE1740H – Smart Materials and Structures
- MIE1742H – Composite Materials Design
- MIE1068H – Applied Nonlinear Control
- MIE1809H – Advanced Mechatronics
- MIE506H1 – MEMS