MEMORANDUM

To: Executive Committee of Faculty Council (February 5, 2024)
Faculty Council (February 27, 2024)

From: Professor Lisa Romkey
Chair, Engineering Graduate Education Committee (EGEC)

Date: January 22, 2024

Re: **Engineering Graduate Education Committee Update**

REPORT CLASSIFICATION

This is a routine or minor policy matter that has been approved by the Engineering Graduate Education Committee (EGEC). It will be considered by the Executive Committee for approval and forwarding to Faculty Council for information.

MINOR MODIFICATION

Collaborative Specialization in Psychology, Psychiatry and Engineering (PsychEng)	Addition of the Aerospace MASc and PhD programs to the Collaborative Specialization in Psychology, Psychiatry and Engineering (PsychEng) (Appendix 1) • Addition of Peter Grant and Hugh Liu as core graduate faculty members to the collaborative specialization. • Addition of AER1601 (Aerospace Engineering and Operations Management) to the list of PsychEng elective courses in the collaborative specialization.
MEng Emphasis in Analytics	• Rename of Emphasis in Analytics to **Emphasis in Data Analytics and Machine Learning** (Appendix 2) • Addition of Elective Courses: BME1570 and MIE1520 • Removal of Elective Courses: ECE1778 and ECE1510

NEW COURSES APPROVED

BME1452	**Polymers for Biomedical Engineering**: Soft materials like polymers are powerful tools for biomedical engineering and have applications in drug delivery, regenerative medicine and biomedical devices. Polymer chemistry and structure can dictate material function and can be used to tune the way these materials interact with biological matter. This course introduces polymer material properties including rheology, gelation, solubility, and glassy phase transition in the context of designing materials for biomedical applications. Classes will alternate between lectures that focus on introducing these fundamental polymer concepts and discussion-based classes where we will explore the application of these concepts in innovative biomaterials in the literature.
BME1088	**Concepts in Immunoengineering**: Immunoengineering is an emergent field that has significantly impacted numerous areas in biomedical sciences. This course will provide brief overviews on fundamental immunological concepts that are recurrent in immunoengineering followed by more in depth coverage of vaccines, cancer immunotherapies, and advances in immunological understanding associated with these fields. The course material will draw from both textbook and scientific articles that will be delivered as lectures and group discussions.
CIV1520	**Travel Survey Methods:** This course provides the students with an understanding and knowledge of designing and implementing travel data collection studies. This course aims to provide comprehensive knowledge on all aspects of travel data collection necessary for the future professionals involved in planning, developing, operating, managing, and monitoring transportation systems. The course will equip the students with knowledge of basic concepts relevant to travel data collection and analysis, current practices in data collection, major steps involved in travel data collection for planning and management of transportation systems, and practical issues in travel data collection. **Note: Course Reinstatement**

RECOMMENDATION FOR FACULTY COUNCIL

For information.

UNIVERSITY OF TORONTO

University of Toronto
Minor Modification Proposal

Participation in a Collaborative Specialization

This template was developed by the Office of the Vice-Provost, Academic Programs and updated in March 2019. It should be used to bring forward all proposals to add or withdraw participation of a degree program from a graduate collaborative specialization for governance approval under the *University of Toronto Quality Assurance Process*.

Collaborative specialization:	Collaborative Specialization in Psychology, Psychiatry and Engineering (PsychEng)
Collaborative specialization director:	Prof. Li Shu
Lead Faculty:	Applied Science and Engineering
Degree program(s) being added:	MASc, PhD
Unit offering above degree program:	University of Toronto Institute of Aerospace Studies (UTIAS)
Dean's Office contacts:	Prof. Julie Audet, Vice-Dean, Graduate Studies Caroline Ziegler Faculty Governance and Programs Officer
Version date:	January 3, 2024
Effective date:	September 2024
Approvals:	PsychEng Committee – January 5, 2024 FASE Engineering Graduate Education Committee – January 11, 2024 FASE Council – February 27, 2024

Core Graduate Faculty Research Synopses

Core faculty members are those who are eligible to teach and/or supervise in the collaborative specialization, as appropriate. Core faculty members must hold graduate faculty membership in one of the participating degree programs. The process of identifying a graduate faculty member as a collaborative specialization core faculty

member is initiated by the faculty member or the collaborative specialization director. Both the faculty member's home unit chair/director and the collaborative specialization director must agree, as well as the faculty member involved. The collaborative specialization director is responsible for maintaining records of agreements concerning assignment of core faculty members to the collaborative specialization. Formal graduate faculty memberships in the collaborative specialization supporting units are not required for core faculty members.

There must be at least one core graduate faculty member from each participating program whose teaching and/or research expertise relate to that of the collaborative specialization subject area.

Peter Grant
Publications: *(list two recent publications relevant to the focus of the collaborative specialization)*
- Teng, Tianhang & Grant, Peter. (2023). Human-in-the-loop Simulator Study of RPAS Teleoperation using Model Mediated Predictor Subjected to Atmospheric Turbulence and Time Delay. 10.2514/6.2023-2238.
- Grant, Peter & Moszczynski, Gregory & Schroeder, Jeffery. (2018). Post-stall Flight Model Fidelity Effects on Full Stall Recovery Training. 10.2514/6.2018-2937.

Hugh Liu
Publications: *(list two recent publications relevant to the focus of the collaborative specialization)*
- C. Qin, Q. Yu, H. S. H. Go and H. H. . -T. Liu, "Perception-Aware Image-Based Visual Servoing of Aggressive Quadrotor UAVs," in IEEE/ASME Transactions on Mechatronics, vol. 28, no. 4, pp. 2020-2028, Aug. 2023, doi: 10.1109/TMECH.2023.3276211.
- S Fan, HHT Liu (2013) Multi-UAV Cooperative Hunting in Cluttered Environments Considering Downwash Effects, Guidance, Navigation and Control, Vol. 03, No. 01, 2350004 https://doi.org/10.1142/S2737480723500048

Calendar Copy

Append calendar copy for entire collaborative specialization (changes shown in red).
For proposals adding new coursework-only participating programs, the calendar copy should clearly show that at least 30% of the courses taken towards the degree are in the area of specialization including the core course.

Psychology, Psychiatry and Engineering

Lead Faculty of the Collaborative Specialization
Applied Science and Engineering

Participating Degree Programs
Aerospace Studies – MASc, PhD
Civil Engineering — MASc, PhD
Electrical and Computer Engineering — MASc, PhD
Mechanical and Industrial Engineering — MASc, PhD
Medical Science — MSc, PhD
Psychology — MA, PhD

Supporting Units
Department of Mechanical and Industrial Engineering

Overview
The Collaborative Master's and Doctoral Specialization in Psychology, Psychiatry and Engineering (PsychEng) includes participating programs offered by the Departments of Mechanical and Industrial Engineering, Civil and Mineral Engineering, Electrical and Computer Engineering and the University of Toronto Institute of Aerospace Studies in the Faculty of Applied Science and Engineering; the Department of Psychology in the Faculty of Arts and Science; and the Institute of Medical Science in the Temerty Faculty of Medicine.

Engineering involves the creative application of science to the design of systems, processes, structures, and technologies. Psychology is a science that focuses on the mind and behaviour of people and animals to understand individuals and groups across

all levels of analyses, from the cellular to the cultural. Psychiatry the study and treatment of mental illness, emotional disturbance, and abnormal behaviour.

The Psychology, Psychiatry and Engineering collaborative specialization supports graduate students and faculty interested in contributing to the growing interdisciplinary scholarship at the nexus of psychology, psychiatry, and engineering. Fields of study that may benefit from this collaborative specialization include, but are not limited to human factors, design theory and methodology, artificial intelligence and information engineering, mental health, operations research, and robotics. This specialization strengthens ties between the three Faculties and may propel research of interest to both beyond what is possible individually.

Upon successful completion of the master's and/or doctoral degree requirements of the participating home graduate unit and the collaborative specialization, students will receive the notation "Completed Collaborative Specialization in Psychology, Psychiatry and Engineering" on their transcript.

Contact and Address
Collaborative Specialization in Psychology, Psychiatry and Engineering
Department of Mechanical and Industrial Engineering
University of Toronto
5 King's College Road
Toronto, Ontario M5S 3G8
Canada

Web: gradstudies.engineering.utoronto.ca/collaborative-specialization-psychology-engineering-psycheng
Email: psych_eng@mie.utoronto.ca
Telephone: (416) 946-3028
Fax: (416) 978-7753

Psychology, Psychiatry and Engineering: Master's Level

Admission Requirements
- Applicants who wish to enrol in the collaborative specialization must apply to and be admitted to both the collaborative specialization and a graduate degree program in one of the collaborating graduate units.

- Applicants must provide:
    - A statement of purpose that describes background experience relating to psychology, psychiatry, and engineering, and motivation for pursuing studies in PsychEng. Complete the online registration form.
    - A supervisor's letter of recommendation in support of the student's application to PsychEng.

Specialization Requirements
- Two sessions of APS1305H PsychEng Seminar Series — Master's Level (Credit/No Credit) worth 0.0 full-course equivalent (FCE).
- Two PsychEng elective half courses (1.0 FCE). One of the courses must be from another discipline. Students from one discipline (psychology, psychiatry, or engineering) should first consult with the instructor before registering for a course in the other discipline to ensure adequate fit in terms of interest and preparation. Psychology and Medical Science students must complete at least one graduate course in Engineering, and Engineering students must complete at least one graduate course in either Psychology or Medical Science.
- A thesis focused on a topic in the area of the collaborative specialization.
- All students enrolled in the collaborative specialization must complete the requirements of the collaborative specialization, in addition to those requirements for the degree program in their home graduate unit. The collaborative specialization director and/or specialization committee is/are responsible for certifying the completion of the collaborative specialization requirements. The home graduate unit is solely responsible for the approval of the student's home degree requirements.

Psychology, Psychiatry and Engineering: Doctoral Level

Admission Requirements
- Applicants who wish to enrol in the collaborative specialization must apply to and be admitted to a doctoral-level graduate degree program in one of the collaborating graduate units.
- Applicants must provide:
    - A statement of purpose that describes the applicant's background experience relating to psychology, psychiatry, and engineering, and motivation for pursuing studies in PsychEng. Complete the online registration form.

        o   A supervisor's letter of recommendation in support of the student's application to PsychEng.

Specialization Requirements

- Two sessions of APS1308Y *PsychEng Seminar Series — PhD Level* (Credit/No Credit) worth 0.0 full-course equivalent (FCE).
- Two PsychEng elective half courses (1.0 FCE). One of the courses must be from another discipline. Students from one discipline (psychology, psychiatry, or engineering) should first consult with the instructor before registering for a course in the other discipline to ensure adequate fit in terms of interest and preparation. Psychology and Medical Science students must complete at least one graduate course in Engineering, and Engineering students must complete at least one graduate course in either Psychology or Medical Science.
- A thesis focused on a topic in the area of the collaborative specialization.
- Students who have completed the PsychEng collaborative specialization at the master's level must take the core seminar course at the PhD level, which requires a higher level of participation, i.e., present more frequently and/or take a leadership role in seminar activities such as the discussion of research papers. Students take two further (different) PsychEng electives during their doctoral program, and their research will be at a level appropriate to a PhD degree.
- All students enrolled in the collaborative specialization must complete the requirements of the collaborative specialization, in addition to those requirements for the degree program in their home graduate unit. The collaborative specialization director and/or specialization committee is/are responsible for certifying the completion of the collaborative specialization requirements. The home graduate unit is solely responsible for the approval of the student's home degree requirements.

Psychology, Psychiatry and Engineering Courses

Core Courses

Course Code	Course Title
APS1305H	PsychEng Seminar Series — Master's Level (Credit/No Credit)
APS1308Y[0]	PsychEng Seminar Series — Doctoral Level (Credit/No Credit)

Elective Courses

- **Civil Engineering**

Course Code	Course Title
CIV1320H	Indoor Air Quality

- **Electrical and Computer Engineering**

Course Code	Course Title
ECE1774H	Sensory Cybernetics (suitable for Engineering students only)
ECE1778H	Creative Applications for Mobile Devices
JEB1444H	Neural Engineering (suitable for Engineering students only)

- **Mechanical and Industrial Engineering**

Course Code	Course Title
MIE1070H	Intelligent Robots for Society
MIE1402H	Experimental Methods in Human Factors Research
MIE1403H	Analytical Methods in Human Factors Research
MIE1412H	Human-Automation Interaction

MIE1415H	Analysis and Design of Cognitive Work
MIE1444H	Engineering for Psychologists and Psychiatrists
MIE1505H	Enterprise Modelling
MIE1510H	Formal Techniques in Ontology Engineering
MIE1720H	Creativity in Conceptual Design

- **University of Toronto Institute of Aerospace Studies**

Course Code	Course Title
AER1601H	Aerospace Engineering and Operations Management

- **Medical Science**

Course Code	Course Title
MSC1006H	Neuroanatomy
MSC1085H	Molecular Approaches to Mental Health and Addictions
MSC1087H	Neuroimaging Methods Using Magnetic Resonance Imaging
MSC1089H	The Biopsychosocial Basis of Mental Health and Addictive Disorders
MSC6000H	Special Topics Reading Course

- **Psychology**

Course Code	Course Title
PSY1000H	Directed Studies
Department of Psychology courses offered in the 5000 series; contact the department for exclusions.	

[0] *Course that may continue over a program. Credit is given when the course is completed.*

To Add or Withdraw a Participating Degree Program
in a Collaborative Specialization

ADDENDUM to MEMORANDUM of AGREEMENT

COLLABORATIVE MA, MASc, MSc, AND PhD SPECIALIZATION IN PSYCHOLOGY, PSYCHIATRY AND ENGINEERING
Effective Date September 2024

I indicate with my signature below that I have read the Memorandum of Agreement for the collaborative specialization. The graduate unit agrees to the participation of the degree program(s) named below. The graduate unit and participating graduate degree program agree to abide by the terms and conditions of the Memorandum of Agreement.

Unit, Participating Graduate Degree Program

UTIAS - University of Toronto Institute of Aerospace Studies
MASc, PhD

Collaborative Specialization Requirements and Degree Program Requirements

[Clarify how the collaborative specialization requirements are accommodated within the home degree program requirements. Following the format below, explain if the collaborative specialization requirements are in addition to the home program requirements or if they may be counted towards regular home degree program requirements, often with elective room. In addition, for coursework-only participating programs, show that at least 30% of the courses taken towards the degree must be in the area of specialization including the core course(s).]

UTIAS MASc students are required to complete five courses (2.5 FCEs) including AER 1800H (Research Seminar in Aerospace Science and Engineering) as well as JDE 1000H (Ethics in Research), a one-day graduate seminar series (0.0 FCE). UTIAS PhD students are required to complete four technical courses and JDE 1000H.

Thus, UTIAS MASc and PhD students are required to complete 2.5 and 2.0 FCEs, respectively. Other than AER 1800H for MASc students, there are no required courses

across the department. Therefore, courses taken for the collaborative specialization may also count towards degree requirements.

All PsychEng graduate students are required to complete:

1. Two terms of a CR/NCR core seminar course worth 0.0 FCE:
   APS1305 at the Master level, or
   APS1308 at the PhD level.
2. One PsychEng-relevant graduate course (0.5 FCE) in the home discipline, and
3. One graduate-course in the "other" faculty.

That is, UTIAS graduate students will complete one (0.5 FCE) graduate course in Psychology (Faculty of Arts and Science) or Medical Science (Temerty Faculty of Medicine).

Psychology and Medical Science students must complete at least one (0.5 FCE) graduate course in the Faculty of Applied Science and Engineering.

A UTIAS course that non-engineers can complete is AER 1601H Aerospace Engineering and Operations Management.

University of Toronto Institute of Aerospace Studies

MASc in Aerospace Studies
Participating Degree Program Requirements:

# Required FCEs	= ___0.5___	(line 1)
# Elective FCEs	= ___2.0___	(line 2)
Total	= ___2.5___	(line 3)

PhD in Aerospace Studies

Participating Degree Program Requirements:

Required FCEs   = ___0___ (line 1)

Elective FCEs   = ___2.0___ (line 2)

Total   = ___2.0___ (line 3)

Collaborative Specialization Requirements:

For participating programs requiring a major research paper, essay, thesis or other major activity (e.g., practicum):

(leave blank if adding coursework-only participating program)

The topic must be in the area of the collaborative specialization and under the supervision of a graduate faculty member associated with the collaborative specialization.

Collaborative Specialization Requirements: # FCEs   = ___1.0___ (line 4)

Line 4 (CS FCEs) must be equal to or less than line 2 (participating program elective courses)
___1.0___ < or = ___2.0___
line 4   line 2

For coursework-only participating programs:

(leave blank if adding participating program with a major research paper, essay, thesis or other major activity)

At least 30% of the courses taken towards the degree must be in the area of specialization including the core course(s).

Collaborative Specialization Requirements:

 # Core course(s) FCEs   = _____ (line 5)

 # Additional course(s) FCEs   = _____ (line 6)

Total   = _____ (line 7)

_____ X 30% = _____ (line 8)
line 3

Line 7 (CS FCEs) must be equal to or greater than line 8 (30% of the courses taken towards the participating degree program)

_____ > or = _____
    line 7   *line 8*

Line 7 (CS FCEs) must be equal to or less than line 2 (participating program elective courses)

_____ > or = _____
    line 4   *line 2*

Resources to be provided by the participating unit/program:

None are required.

University of Toronto
Minor Modification Proposal

Participation in a Collaborative Specialization

SIGNATURES – ADDENDUM to MEMORANDUM of AGREEMENT

Graduate director of participating unit/program:

Date: October 30, 2023

Prasanth B. Nair

Professor and Associate Director, Graduate Studies

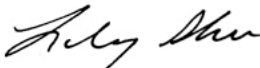Institute for Aerospace Studies

Director of participating unit/program:

Date: January 8/2024

Chris Damaren

Professor and Director
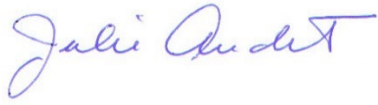
Institute for Aerospace Studies

Director of Collaborative Specialization:

Date: October 30, 2023

Li Shu

Professor of Mechanical and Industrial Engineering

Director of Collaborative Specialization in Psychology, Psychiatry and Engineering

Dean/Vice-Dean of lead Faculty:

_____   Date: January 3, 2024

Julie Audet

Professor and Vice-Dean, Graduate Studies

Faculty of Applied Science & Engineering

University of Toronto
Minor Modification Proposal

Change to an Existing Graduate Program
or Collaborative Specialization

This template was developed by the Office of the Vice-Provost, Academic Programs and updated on March 6, 2018. It should be used to bring forward all proposals for minor modifications to program or admissions requirements for existing graduate programs or collaborative specializations under the University of Toronto's Quality Assurance Process.

Program/Collaborative Specialization being modified:	Emphasis: Analytics (MEng only), open to students enrolled in the following graduate programs: • Chemical Engineering & Applied Chemistry, MEng • Civil Engineering, MEng • Electrical & Computer Engineering, MEng • Materials Science & Engineering, MEng • Mechanical & Industrial Engineering, MEng
Graduate units:	Above five
Faculty:	Applied Science & Engineering
Dean's office contact:	Julie Audet, Vice-Dean, Graduate Studies
Version date:	January 3, 2024

1   Summary

	Changing admission requirements	X	Renaming field, concentration or emphasis*
X	Changing program requirements		Renaming of program or collaborative specialization (please notify VPAP before governance)
	Changing timing of program requirements		Creating a new emphasis
			Changes to programs affecting an MOA

* Anything with a changed/new name requires consultation with VPAP Office prior to governance; if name change implies significant change to what is being offered or how it is being offered, this may be a major modification or new program.

This proposal covers two main changes to the emphasis:
1) Rename the Emphasis in Analytics to Emphasis in Data Analytics and Machine Learning.
2) Update the list of elective courses in the emphasis as new courses have been created and some courses are no longer offered since the last update in October 2021.

2   Effective Date of Change

September 2024

3   Academic Rationale

The goal of the emphasis name change is to make it easier for prospective graduate students to immediately see the relevance of this emphasis to data science and machine learning, as the term "Analytics" on its own was unclear to some as its interpretation can vary from one field to the other. Data Analytics involves the algorithmic processing of data for purposes of description (what happened), prediction (what will happen), or prescription (what should be done). Machine Learning focuses on the computational and statistical methods for learning patterns and associations and obtaining insights from data. Data Analytics and Machine Learning collectively represent the forefront of technology innovation powering a wide range of applications including personalized e-commerce, cybersecurity, intelligent logistics and scheduling, financial investing, digital marketing, adaptive user interfaces, and health applications including medical imaging analysis.

Consequently, the revised name also better reflects the topics covered in the core courses and the list of elective courses.

4   Impact on Students

As indicated above, the name change will benefit current and prospective students as it will clarify the topics they will study in the emphasis. An updated list of electives will also make it possible to offer more choices and flexibility for students interested in completing the emphasis.

5   Consultation

The change was discussed and proposed within MIE's graduate curriculum committee (subcommittee AI/ML including current core course emphasis instructors) based on prospective and current student feedback.

6   Resources

There are no resource implications.

7 Governance Approval

Unit sign-off	Mechanical & Industrial Engineering Curriculum Committee (November 3, 2023)
Dean's office sign-off	Julie Audet, Vice-Dean, Graduate (January 3, 2024)
Faculty/division council approval (or delegated body) if applicable	Engineering Graduate Education Committee (EGEC) on behalf of the Council of the Faculty of Applied Science & Engineering (January 11, 2024)

Appendix A: Calendar Entry (revisions in red)

Emphasis: Data Analytics and Machine Learning (MEng only)

To be admitted to the emphasis in Data Analytics and Machine Learning, MEng students must first successfully complete a **prerequisite course APS1070H (0.5 full-course equivalent [FCE])**.

Subsequently, to earn the emphasis, students must successfully complete **four additional half courses (2.0 FCEs)** from the list of core courses or elective courses. These must include at least one core course; the remaining courses must be selected from the list of elective courses.

Students must have completed the prerequisite course APS1070H before taking any of the core courses.

Prerequisite Course

APS1070H *Foundations of Data Analytics and Machine Learning*.

Core Courses

CHE1147H *Data Mining in Engineering*
ECE1513H *Introduction to Machine Learning* (exclusions: CSC311H1, CSC2515H, ECE421H1, ECE1504H)
MIE1624H *Introduction to Data Science and Analytics* (exclusion: MIE1626H)
MIE1626H *Data Science Methods and Statistical Learning* (exclusion: MIE1624H)
MSE1065H *Application of Artificial Intelligence in Materials Design* (exclusion: MSE1063H)

Elective Courses

APS502H1, APS1005H, APS1017H, APS1022H, APS1040H, APS1050H, APS1051H, APS1052H, APS1053H, APS1080H, BME1570
CEM1002H
CHE507H1, CHE1108H, CHE1148H, CHE1434H
CIV1504H, CIV1506H, CIV1507H, CIV1532H, CIV1538H
ECE537H1, ECE1504H (exclusions: CSC311H1, CSC2515H, ECE421H1, ECE521H1, ECE1513H), ECE1505H, ~~ECE1510H,~~ ECE1657H, ~~ECE1778H,~~ ECE1779H, ECE1786H
MIE562H1, MIE1077H, MIE1413H, MIE1501H, MIE1512H, MIE1513H, MIE1517H, MIE1520H (exclusion: ECE1786H), MIE1620H, MIE1621H, MIE1622H, MIE1623H, MIE1625H, MIE1628H, MIE1653H, MIE1666H, MIE1721H, MIE1723H, MIE1727H, MIE1769H, MSE1063H (exclusion: MSE1065H)