ACADEMIC COUNCIL REPORT

ACTION REQUESTED:

Recommendation	☒
Decision	☒
Discussion/Direction	☐
Information	☐

DATE: **28 November 2023**

FROM: **Graduate Studies Committee**

SUBJECT: **New Program Proposal – Master of Engineering and Master of Applied Science in Mechatronics Engineering**

COMMITTEE MANDATE:
In accordance with the Graduate Studies Committee (GSC) Terms of Reference, GSC has the responsibility "to examine proposals for new graduate degree and diploma programs, major changes to existing programs and to recommend their approval, as appropriate, to the Academic Council".

MOTION FOR CONSIDERATION:
That pursuant to the recommendation of the Graduate Studies Committee, Academic Council hereby approves the Master of Engineering and Master of Applied Science in Mechatronics Engineering and recommends approval of the program to the Board of Governors.

BACKGROUND/CONTEXT & RATIONALE:
Mechatronics is the interdisciplinary field that combines aspects of mechanical, electrical, control, and software engineering in a concurrent manner. The bases of many modern systems are in fact mechatronic systems. A classic example of a mechatronic system is a robot. The Faculty of Engineering and Applied Science (FEAS) launched a standalone BEng and BEng and Management program in Mechatronics Engineering in 2016. The program has quickly grown to be the most popular engineering program at Ontario Tech. Based on the success it is proposed to launch MASc and MEng programs in Mechatronics Engineering to capitalize on this rapidly growing discipline. A graduate program in Mechatronics Engineering is needed to train the high-tech workforce of today and tomorrow that Ontario and Canada need to compete on a global stage.

The main objective of the MASc program is to prepare students for a career as a R&D engineer. Graduates of the program will be able to work as R&D engineers in advanced technology companies or government agencies or continue on in their education and pursue a doctorate degree.

The objectives of the MASc program are achieved through a combination of course work, supervised research, a research seminar, and a research thesis.

The main objective of the MEng program is to provide the opportunity for engineers in industry to upgrade and expand their skills, including developing research skills. Graduates of the program will be able to apply what they have learned in a variety of applications in industry.

The objectives of the MEng program are achieved through either a combination of course work and a project, or solely course work depending on which option the student selects. Note that all MEng students will be involved in research through research projects included in most of the courses.

The mode of delivery of the programs will be in person. This mode of delivery facilitates students' learning of complex subjects and allows for a better environment for the exchange of ideas. Also, due to the research component of the MASc, it is important that students be able to access research space on campus to complete their research.

The proposed program aligns well with the other offerings within FEAS, in particular it will provide a logical pathway for graduates from the BEng in Mechatronics Engineering to pursue post-graduate studies in the field. The proposed MASc and MEng in Mechatronics Engineering programs compliment the other graduate program offerings within FEAS.

RESOURCES REQUIRED:

It is anticipated that the majority of teaching in the program will be done by Tenure/Tenure Track (TTT) Faculty and Teaching Faculty within the Department of Automotive and Mechatronics Engineering as well as from the other three Departments within FEAS. There may be a limited need for Sessional Instructors depending on matters such as the number of courses offered, faculty on research leave, sick leave, etc.

A Graduate Program Director for the Department of Automotive and Mechatronics Engineering will be required. This faculty member will be responsible for the existing MASc and MEng programs in Automotive Engineering as well as the new MASc and MEng programs in Mechatronics Engineering program.

At the Academic Resource Committee meeting in November 2022, it was noted that two new faculty hires in FEAS were being considered to help support this new program.
No additional TA resource requirements without proportionate enrollment growth.

CONSULTATION AND APPROVAL:

- ✓ Academic Resource Committee Review: 21 November 2022
- ✓ FEAS Faculty Council: 5 October 2023
- ✓ Graduate Studies Committee (Recommendation): 24 October 2023
- Academic Council (Approval and Recommendation): 28 November 2023
- Board of Governors (Approval): 30 November 2023

Discussed in FEAS department graduate committee and department council for feedback.

NEXT STEPS:

- Pending the approval and recommendation of Academic Council, this proposal must then proceed through the following steps:
    - Approval by the Board of Governors
    - Ontario Universities Council on Quality Assurance

- Ontario Ministry of Colleges and Universities

SUPPORTING REFERENCE MATERIALS:

- New Program Proposal with Appendices
- Reports from External Review

New Graduate Program Proposal

Name of proposed program (as it will appear on the student's transcript):	Master of Applied Science in Mechatronics Engineering Master of Engineering in Mechatronics Engineering
Degree Designation/Credential (e.g. BA, BSc, BEng, etc.):	MASc MEng
Cost Recovery Program?	☐ Yes x No
Professional Program?	☐ Yes x No
For Graduate Diplomas	☐ Type 2 ☐ Type 3
Faculty (where the program will be housed):	Faculty of Engineering and Applied Science
Collaborating Faculty (if applicable):	N/A
Program Delivery Location:	Ontario Tech University North Campus
Collaborating Institution(s) (if applicable):	N/A
Proposed Program Start Date:	January 2024
Proposal Contact:	Scott Nokleby
Submission Date:	
Approved by Dean: (signature and date)	

For CIQE Use Only:

Date of Academic Council Approval:	
QAF Version Used:	2021 QAF
☐External reviewers' report ☐Program's and Dean's response (with date)* ☐Summary of changes	☐Final, revised proposal ☐CVs, course outlines, and other supporting material (as appendices)

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1 Introduction

a) Program Abstract

Please provide a brief overview of the proposed program, to be shared with the public, in 1000 characters or less, including:

- *A clear statement of the purpose of the program*
- *Any program components, such as fields, pathways, or micro-credentials (note that fields, pathways, and microcredentials are not required)*
- *Any distinctive elements, including alternative modes of delivery (including online)*
- *Note that this statement is for external purposes; what do you want potential students/advisors to know about this program?*

The master's programs lead to the degrees of Master of Applied Science (MASc) or Master of Engineering (MEng) in Mechatronics Engineering. The MEng program will have two options: MEng project-based which will consist of a combination of courses and a project and MEng course-based which will consist only of courses. A Co-op Option will also be available for MEng students.

There are four objectives common to the Faculty of Engineering and Applied Science graduate programs:

- Depth. To provide students with a detailed understanding for the practice and advanced study of advanced technologies related to automotive systems. This includes scientific principles, analysis techniques, and design methodologies.
- Breadth. To provide students with the broad and advanced education necessary for productive careers in the public or private sectors, as well as academia.
- Professionalism. To develop skills necessary for clear communication and responsible teamwork, and to inspire professional attitudes and ethics, so that students are prepared for modern work environments and lifelong learning.
- Learning Environment. To provide an environment that will enable students to pursue their goals through innovative graduate programs, which are rigorous, challenging, and supportive.

The main objective of the MASc program is to prepare students for a career as an R&D engineer. Graduates of the program will be able to work as R&D engineers in advanced technology companies or government agencies. They also may choose to continue their education and pursue a PhD degree. The objectives of the MASc program are achieved through a combination of course work, supervised research, a research seminar, and a research thesis.

The main objective of the MEng program is to provide the opportunity for engineers in industry to upgrade and expand their skills. Graduates of the

program will apply their education to various advanced technologies in high-tech industries. The objectives of the MEng program are achieved through a combination of course work and a project (MEng project-based), or solely course work (MEng course-based), depending on which option the student selects.

b) Background and Rationale

- *Identify what is being proposed, what are the program objectives, and provide an academic rationale for the proposed program*
- *Explain the appropriateness of the program name and degree nomenclature as they relate to the program objectives; list any program specializations, pathways, etc.* ***(QAF 2.1.2.1a/b)***
- *Describe the mode of delivery (in-class, hybrid, online) and how it will support students in achieving the Degree Level Expectations and learning objectives of the program* ***(QAF 2.1.2.2c)***
- *Describe the ways in which the program fits into the broader array of program offerings within the Faculty and the University*
- *Describe any unique curriculum or program innovations, creative components, or significant high impact practice*

Mechatronics is the interdisciplinary field that combines aspects of mechanical, electrical, control, and software engineering in a concurrent manner. The bases of many modern systems are in fact mechatronic systems. A classic example of a mechatronic system is a robot.

The Faculty of Engineering and Applied Science (FEAS) launched a standalone BEng and BEng and Management program in Mechatronics Engineering in 2016. The program has quickly grown to be the most popular engineering program at Ontario Tech. Based on the success it is proposed to launch MASc and MEng programs in Mechatronics Engineering to capitalize on this rapidly growing discipline. A graduate program in Mechatronics Engineering is needed to train the high-tech workforce of today and tomorrow that Ontario and Canada need to compete on a global stage.

The main objective of the MASc program is to prepare students for a career as a R&D engineer. Graduates of the program will be able to work as R&D engineers in advanced technology companies or government agencies or continue on in their education and pursue a doctorate degree.

The objectives of the MASc program are achieved through a combination of course work, supervised research, a research seminar, and a research thesis.

The main objective of the MEng program is to provide the opportunity for engineers in industry to upgrade and expand their skills, including developing research skills. Graduates of the program will be able to apply what they have learned in a variety of applications in industry.

The objectives of the MEng program are achieved through either a combination of course work and a project, or solely course work depending on which option the student selects. Note that all MEng students will be involved in research through research projects included in most of the courses.

The mode of delivery of the programs will be in person. This mode of delivery facilitates students' learning of complex subjects and allows for a better environment for the exchange of ideas. Also, due to the research component of the MASc, it is important that students be able to access research space on campus to complete their research.

The proposed program aligns well with the other offerings within FEAS, in particular it will provide a logical pathway for graduates from the BEng in Mechatronics Engineering to pursue post-graduate studies in the field. The proposed MASc and MEng in Mechatronics Engineering programs compliment the other graduate program offerings within FEAS.

c) Consistency of Program Objectives with University Mission, Vision, Integrated Academic and Research Plan, and Strategic Mandate Agreement (QAF 2.1.2.1c)

- *Describe how the program contributes to the University's Mission and Vision*
- *Explain how the program aligns with the goals and priorities outlined in the Faculty's(ies') and University's Integrated Plan. Identify how the program fits within one or more areas of strength or growth in Ontario Tech University's Strategic Mandate Agreement*

University Vision

With its foundation in technology, the sciences and professional practice, Ontario Tech University advances the discovery and application of knowledge that accelerates economic growth, regional development and social innovation and inspires graduates who will continue to make an impact on the world, as it is and as it will be.

University Mission

- Provide superior undergraduate and graduate programs that are technology-enriched and responsive to the needs of students and the evolving workplace.
- Conduct research that creates knowledge, solves problems, results in economic and social innovation and engages students.
- Facilitate life-long learning that is flexible, inclusive and emphasizes college university transfers.
- Develop academic and research collaborations with industry and community that stimulate and enhance the region and university at home and abroad.
- Cultivate a dynamic learning environment for students by promoting social engagement, fostering critical thinking and integrating experiences inside and outside the classroom.

Ontario Tech University is Canada's emerging leader in career-ready education and collaborative research that produces new and useful ideas. It will advance through a sharpened focus on three key goals as per the 2017- 2022 Strategic Plan:

Challenge: we will produce an inspire future leaders who have real-world skillsets.

Innovate: we will create new approaches, partnerships, and solutions to improve society.

Connect: we will build lasting relationships to make Ontario Tech a remarkable place for work and study.

The proposed programs align with the University's vision and mission by graduating students that will meet the needs of the evolving workplace. Graduates of the program will have the skills to not only work in the high-tech jobs of today, but those of the future as well. With the rapid rise of autonomous and intelligent systems in today's world, graduates of the MASc and MEng programs will be suited to work in this growing sector.

Ontario Tech's 2020-2025 Strategic Mandate Agreement (SMA) places a heavy emphasis on engineering education and training, of which the proposed programs match perfectly. Further, the co-op option will help contribute to the SMA in the area of experiential learning. Both programs will contribute to the skills and jobs outcomes portion of the SMA by training Highly-Qualified People (HQP) with the skills required by Canadian industries.

d) Student Demand

- *Provide evidence of student demand, including number of prospective student inquiries; applications and registrations for similar programs; results from surveys/focus groups of existing students, graduates, or professionals in the field*
- *Include information about domestic vs. international student interest*

Since the introduction of a standalone BEng program in Mechatronics Engineering in 2016, the program has grown rapidly to become one of the most popular engineering programs at Ontario Tech. Currently, graduates of this program who want to do a MASc or MEng in Mechatronics Engineering cannot do so directly, but instead must do a graduate program in our Mechanical Engineering program. This is less than ideal. Mechatronics Engineering not only includes aspects of Mechanical Engineering, but also aspects of Electrical and Software Engineering. These additional aspects are sometimes not given their due in a standalone Mechanical Engineering graduate program. Dedicated MASc and MEng programs in Mechatronics Engineering will better serve the needs of these graduates from BEng Mechatronics Engineering programs.

Currently, students who want a dedicated graduate program in Mechatronics Engineering are either forced to go to other institutions or simply choose not to pursue an advanced degree.

As more universities offer Mechatronics Engineering at the undergraduate level, the demand for dedicated graduate programs in Mechatronics Engineering will only grow.

At recent Ontario Tech virtual and in person open houses, there were a number of enquiries from both domestic and international students about graduate programs in Mechatronics Engineering. Some of these individuals expressed surprise that there was no graduate program available to them in Mechatronics Engineering at Ontario Tech.

Due to recent events in the United States, there has been a shift in international graduate student applications from the United States to Canada. In addition, new immigrants to Canada and international students are interested in upgrading their skills in order to obtain employment within Canada. These two trends are adding to the demand for increased graduate student spaces in Ontario, including in Mechatronics Engineering.

Enrolment Information

- *Please complete Table 1 and provide, in paragraph form, information regarding enrolment projections*
- *Please determine the academic year when the program enrollment will reach a steady-state and add an asterisk (*) in the corresponding box beside the number*

Table 1 shows the projected enrolment. It is assumed that on average MASc students will take two years to finish and MEng students will take one year to finish.

Note that the expected enrolment numbers for the MASc program have been set conservatively in the first few years. Actual enrollment may be higher, but is dependent on faculty members securing research funding to support their MASc students.

Table 1: Projected Enrollment by Academic and Program Year

	Academic Year					
	2023-2024	2024-2025	2025-2026	2026-2027*	2027-2028	2028-2029
Level of Study						
Master's year 1	6 MASc 10 MEng	8 MASc 15 MEng	10 MASc 20 MEng	10 MASc 20 MEng	10 MASc 20 MEng	10 MASc 20 MEng
Master's year 2	0	6 MASc	8 MASc	10 MASc	10 MASc	10 MASc

		10 MEng	15 MEng	20 MEng	20 MEng	20 MEng
Total Enrolment	16	39	53	60	60	60

e) Societal Need

- *Evidence of the need for graduates of the program and in which fields (within academic, public, and/or private sectors)*
- *Please indicate up to three occupations in which graduates from this proposed program may be employed using the Ontario Job Futures website; you may also wish to review the Durham Workforce Authority website and provide any relevant sector portfolio or local/community impact information*
- *For professional programs, a description of the program's congruence with current regulatory requirements*
- *Mention if any employers in the area support the need for this program and include a letter(s) of support as an additional appendix*

The growth of autonomous and intelligent systems in all aspects of everyday life, from transportation to health care to manufacturing to resource extraction, requires engineers with the skillset provided by an advanced degree in Mechatronics Engineering. Further, to be competitive in the world economy, Canada needs to leverage advanced technology to stay competitive with low labour cost countries. Mechatronics engineers can play a key role in the design and development of these technologies.

According to CareerExplorer[1], the number of positions for mechatronics engineers in the USA alone will grow 6.4% between 2016 and 2026. The website Interesting Engineering[2] lists automation and robotics engineer, which is essentially a mechatronics engineer, as one of the seven most in demand engineering jobs in 2019.

Graduates of this program may work in the robotics, automotive, aerospace, automation, resource, biomedical, and manufacturing industries to name a few.

f) Duplication

- *Describe how the program is distinct from other programs at Ontario Tech. Is it reasonable to anticipate this program might affect enrolment in other related programs? If so, how might this be addressed?*

The proposed program will have some impact on the existing MASc and MEng programs in Mechanical Engineering at Ontario Tech, but this impact will be offset by the expected demand for the new program. The standalone program

[1] Source: https://www.careerexplorer.com/careers/mechatronics-engineer/job-market/

[2] Source: https://interestingengineering.com/7-of-the-most-in-demand-engineering-jobs-for-2019

will allow Ontario Tech to better market the MASc and MEng programs for recruiting students.

- *Identify similar or complementary programs offered elsewhere in Ontario in Table 2. Please be brief but specific in the table. Avoid value-based statements*

Table 2: List of Similar Programs in Ontario

Institution Name	**Credential Level and Program Name**
University of British Columbia (UBC)	MEng – Mechatronics Design
Link to Program Web Page: https://mech.ubc.ca/graduate/prospective/applications-admissions/meng-mechatronics-design/	
Brief Program Description: From the website: Mechatronics Design combines the fields of mechanical and electrical engineering in the study of integrated modelling, analysis, design and manufacture of electromechanical and mechatronic systems. These principles can be applied in the following industries: transportation; manufacturing and production engineering; biomedical and healthcare technologies; energy; aviation and aerospace; automated office and household technologies; and computer systems.	
What differentiates the new program from this existing program: The new program will offer an MASc degree in addition to the MEng degree allowing students who wish to pursue a research-based degree the option to complete graduate studies in the area of Mechatronics Engineering. Further, the program will be available in Central Canada giving access to a wider pool of students.	
Institution Name	**Credential Level and Program Name**
Simon Fraser University (SFU)	MASc – Mechatronics Engineering
Link to Program Web Page: https://www.sfu.ca/students/calendar/2020/fall/programs/mechatronic-systems-engineering/master-of-applied-science.html	
Brief Program Description: From the website: The Master of Applied Science (MASc) is a full-time program to pursue advanced studies in the area of Mechatronics. The primary component of the program is the thesis, which reports the results of an independent research investigation or creative design carried out by the student. Candidates must have strong aptitude for research, including strong analytical and practical problem solving skills in multidisciplinary areas including mechanical, electrical, and systems engineering.	
What differentiates the new program from this existing program: The new program will off the MEng degree in addition to the MASc degree. Further, the program will be available in Central Canada giving access to a wider pool of students.	
Institution Name	**Credential Level and Program Name**
University of Waterloo	MASc – Mechanical and Mechatronics Engineering

Link to Program Web Page: https://uwaterloo.ca/mechanical-mechatronics-engineering/graduate-students/future-students/masc-and-phd and https://uwaterloo.ca/mechanical-mechatronics-engineering/graduate-students/future-students/meng-degree
Brief Program Description: From the website: The general Masters of Engineering (MEng) degree in Mechanical Engineering offered at the University of Waterloo is a course work program open to students who satisfy the admission requirements. The MEng Program takes three to six terms to complete (one to two years) as a full-time student or the maximum time limit for completion of Master's degree requirements totally on a part-time basis is fifteen terms.
What differentiates the new program from this existing program: The program is not Mechatronics Engineering specific, but more of a Mechanical Engineering program.

- *Provide additional overall comment on the justification for this duplication*

There are currently no standalone MASc and MEng programs in Mechatronics Engineering in Ontario. Some universities offer Mechatronics Engineering as an option within Mechanical Engineering, but an opportunity exists for Ontario Tech to be at the forefront of this rapidly growing engineering discipline. A standalone program, separate from a Mechanical Engineering program or Electrical Engineering program, will be attractive to students, especially those graduating from standalone Mechatronics Engineering programs in Ontario. In Ontario, in addition to Ontario Tech, McMaster, Queen's, Waterloo, and Western all offer standalone Mechatronics Engineering programs. However, none of these universities offer dedicated graduate level programs in Mechatronics Engineering. An opportunity exists to tap into this pool of graduates.

2 Program Requirements

a) Admission Requirements (QAF 2.1.2.5)

- *Outline the formal admission requirements; explain how these are appropriate for the program objectives and program learning outcomes: How will they help to ensure students are successful? How do they align with the learning outcomes of the program? (*
- *Explain any additional requirements for admission to the program such as minimum grade point average, special language, portfolio, etc. (and how the program recognizes prior work or learning experience, if applicable) (*
- *Indicate the programs from which students may be drawn*

In addition to the general admission requirements for graduate studies, applicants must meet the following program-specific requirements:

- Completion of an undergraduate engineering degree in a relevant field from an accredited engineering program at a Canadian university, or its equivalent from a recognized institution.
- Overall academic standing of at least a B (GPA: 3.0 on a 4.3 scale), with a minimum B in the last two full-time years (four semesters) of undergraduate work or equivalent. B+ is preferred for MASc applicants.

Applicants must possess maturity and self-motivation. Close technical contact with a research supervisor is essential in research-based engineering programs. Prior to being accepted into the program, MASc applicants must find a faculty member who specializes in their desired area of research and who is willing to act as their thesis research supervisor.

In terms of acceptable undergraduate degrees for the MASc and MEng programs in Mechatronics Engineering, students who have graduated from an undergraduate program in Mechatronics, Mechanical, Manufacturing, Automotive, or Electrical Engineering will be considered.

b) Program Learning Outcomes and Assessment of Student Knowledge (QAF 2.1.2.2 a/b/d, 2.1.2.3, 2.1.2.4)

- ***Connect with CIQE (ciqe@ontariotechu.ca) early in the program development to participate in learning outcome development sessions or arrange for assistance and review prior to the scheduling of the external site visit***
- *In Table 3 below, please describe what the student will know or be able to do (knowledge, methodologies, and skills) by the end of the program and indicate how that knowledge or skill will be demonstrated*
- *An example has been provided in purple in the first row and should be removed.*

Degree Level Expectations are set by the Quality Council of Ontario and should not be modified. For the list of and more information on these expectations, including a detailed description, visit their website.

Table 3: Program Learning Outcomes

Program Learning Outcomes By the end of the program, students graduating will be able to… (normally 6-8 outcomes per program with 12 being the maximum)	Degree Level Expectations (list all that apply; you must align with each expectation at least once)	Relevant courses (provide course code and course title)	Assessment of Learning Outcomes (e.g. test, rubric, self-assessment, etc.)

Explain advanced concepts, principles, and theories in mechatronics.	Depth and breadth of knowledge	ENGR 5001G, ENGR 5002G, elective courses	MASc thesis, MASc defence, MEng project, course projects, course assignments
Design and implement experiments.	Research and scholarship	ENGR 5001G, ENGR 5002G	MASc thesis, MEng project
Interpret experimental data and computational results.	Research and scholarship	ENGR 5001G, ENGR 5002G	MASc thesis, MEng project
Solve engineering problems and enhance existing practices through research.	Level of application of knowledge	ENGR 5001G, ENGR 5002G, elective courses	MASc thesis, MEng project, course projects
Adhere to social, professional, and ethical expectations involved in advanced education and research.	Professional capacity/autonomy	ENGR 5201G, ENGR 5002G, METE 5003G, core courses, elective courses	MASc thesis, MEng project, MASc seminars, course projects, course assignments
Describe the importance of, and develop the strategies for, further education and lifelong learning in the discipline.	Professional capacity/autonomy	METE 5003G, core courses, elective courses	MASc seminars, course projects, course assignments
Communicate mechatronics concepts, principles, and results effectively using written and verbal formats.	Communications skills	ENGR 5201G, ENGR 5002G, METE 5003G, core courses, elective courses	Course projects, course presentations, MASc seminars, MASc thesis, MASc defence, MEng project
Critically evaluate advanced information and knowledge and apply in engineering practice.	Awareness of limits of knowledge	ENGR 5201G, ENGR 5002G, METE 5003G, core courses, elective courses	Course projects, MASc seminars, MASc thesis, MEng project

- *Selecting a few examples from above, and with assistance from CIQE (ciqe@ontariotechu.ca), please provide further details on:*
  - *Appropriateness of the program's structure and the requirements to meet its objectives and program learning outcomes; Guidance on program objectives and program-level learning outcomes, including examples, is available here*

- *Appropriateness of the proposed methods for the assessment of student achievement of the intended program learning outcomes and Degree Level Expectations (How will students demonstrate they have learned and can do what we expect them to by the end of the program?); and*
- *Completeness and appropriateness of plans for monitoring and assessing:*
  - *The overall quality of the program*
  - *Whether the program is achieving in practice its proposed objectives;*
  - *Whether the students are achieving the program learning outcomes; and*
  - *How the resulting information will be documented and subsequently used to inform continuous program improvement*

Please see Guidance on Assessment of Teaching and Learning for advice on how to satisfy these criteria.

The learning outcomes for the MASc program are achieved through a combination of course work, supervised research, a research seminar, and a research thesis.

For example, the ability to explain advanced concepts, principles, and theories in mechatronics is taught in the various elective courses using many practical examples of problems solved in class to teach how advanced mechatronic systems work. This is followed by projects where students apply their knowledge to solve open-ended design problems. Student deliver written reports and presentations to communicate mechatronics concepts, principles, and results effectively using written and verbal formats. The ability to design and implement experiments is demonstrated in the completion of the MASc Thesis.

The objectives for the MEng program are achieved through either a combination of course work and a project, or solely course work depending on which option the student selects. Note that all MEng students will be involved in research through research projects included in many of the courses. Students will be exposed to both quantitative and qualitative research methodologies through these course-based research projects.

For example, the ability to communicate mechatronics concepts, principles, and results effectively using written and verbal formats is taught ENGR 5201G: Engineering Communications and Ethics. As for the MASc, in the MEng, the ability to explain advanced concepts, principles, and theories in mechatronics is taught in the various elective courses using many practical examples of problems solved in class to teach how advanced mechatronic systems work.

The combination of courses and/or projects and research, will be designed collaboratively between the student and an assigned faculty advisor/mentor. Each learner will have the opportunity to develop the prerequisites for specialized practice of, or for advanced study in, Mechatronics Engineering, including their scientific principles, analysis techniques, and design methodologies. Learning activities and materials in graduate courses will be

carefully designed to ensure that learners are deliberately exposed to study, the majority of which is at, or informed by, the forefront of engineering theory and practice.

The courses have been designed to give students in depth learning in Mechatronics Engineering, opportunity for advanced development of generic skills such as communication and teamwork, as well as participation in the scholarly activities of research, seminars, and presentations.

Throughout the curriculum, learning activities are planned, and student progress will be monitored to ensure that safety, professional guidelines, and ethical responsibilities relevant to engineering and for specific areas of advanced study are modelled developed, and evaluated.

The main avenue for assessing and monitoring the program effectiveness will be through the cyclical program review process. In addition, Ontario Tech's Academic Resource Committee requires a report one-year after start-up of a new program and, if there are areas of concerns raised, a subsequent 18-month report will be required. The one-year report will ask the program to review enrollment data, admission averages, and provide an analysis of successes and challenges encountered in the first year. After the first year of the program being implemented, it will be internally assessed by this committee and, if needed, recommendations will be made to enhance program effectiveness and student success. If required, the 18-month report will address key curricular and student data (e.g. GPA, retention data, etc.) as well as any outstanding recommendations from the one-year report. Pending the committee's review, further documentation may be required of the program for ongoing monitoring. The reports will be developed by the Graduate Program director in consultation with the Faculty Graduate Committee.

- *Describe the requirements and structure of the program. Is it full-time/part-time? Is this an online or partially online/hybrid program? What are the unique curriculum or program innovations or creative components in this program?*
- *Address how the program's structure, requirements, and program-level learning outcomes are appropriate in meeting the Degree Level Expectations.*

MASc Program

The objective of the MASc program in Mechatronics Engineering is to prepare students for careers in research, development, and advanced engineering. Graduates of the program will be able to work as engineers in research and development or other areas in advanced technology companies or government agencies, or continue their education and pursue a PhD degree. The objectives of the MASc program are achieved through a combination of course work, supervised research, a research seminar and a research thesis.

For the MASc in Mechatronics Engineering, students must complete five courses for a total of 15 credits and a thesis worth 15 credits. Students must also successfully complete METE 5003G - MASc Seminar for Mechatronics Engineering and ENGR 5001G - MASc Thesis.

Typically, the MASc program is full-time, but can be completed part-time in some cases.

Undergraduate courses

In addition to the required graduate courses, students may take only one senior year undergraduate engineering course (i.e., with prefix ENGR 4xxxU) in lieu of a graduate-level course, provided they have not already taken a similar course during their undergraduate degree and the course is approved by both the student's supervisor and the graduate program director.

Courses outside of the program

Courses in other graduate programs at the university may be taken provided that students have not taken similar courses during their undergraduate or master's degrees and the courses are approved by the graduate program director. At least half of a student's courses must be within their program in the Faculty of Engineering and Applied Science. Students who wish to take courses outside of their program must gain approval from the graduate program director. Students who are uncertain about the academic background needed for a graduate course should consult the course instructor before registering for the course.

Course listing

ENGR 5001G - MASc Thesis
ENGR 5004G - MASc/MEng Directed Studies
ENGR 5005G - Special Topics
ENGR 5010G - Advanced Optimization
ENGR 5012G - Advanced and Smart Materials
ENGR 5013G - Advanced Engineering Mathematics
ENGR 5200G - Programming Methodology and Abstraction for Engineers
ENGR 5201G - Engineering Communications and Ethics
ENGR 5240G - Advanced Dynamics
ENGR 5245G - Micro and Nano Manufacturing
ENGR 5260G - Advanced Robotics and Automation
ENGR 5261G - Advanced Mechatronics: MEMS and Nanotechnology
ENGR 5262G - Manipulator and Mechanism Design
ENGR 5263G - Advanced Control
ENGR 5271G - Innovative Design Engineering
ENGR 5273G - Design by Failure

ENGR 5410G - Project Management for Engineers
ENGR 5510G - Foundations of Software Engineering
ENGR 5520G - Software Development Methods and Tools
ENGR 5605G - Convex Optimization
ENGR 5910G - Embedded Real-Time Control Systems
ENGR 5915G - Discrete Time Control Systems
ENGR 5930G - Adaptive Control
ENGR 5940G - Intelligent Control Systems
ENGR 5945G - Mobile Robotic Systems
ENGR 5946G - Advanced Fluid Power Control and Simulation
METE 5003G - MASc Seminar for Mechatronics Engineering
METE 5101G - Artificial Intelligence and Machine Learning Methods and Applications
METE 5102G - Control Design in Robotic Systems
METE 5103G - Model Predictive Control
METE 5104G - Multivariable Feedback Control
METE 5105G - Nonlinear Control Systems
METE 5106G - Advanced System Dynamics
METE 5107G - Biomechatronic Systems
METE 5108G - Neuromechanics and Control of Human Movement
METE 5280G - Robotic Manipulators
METE 5300G - Mobile Robotics

MEng Program

The objective of the MEng program in Mechatronics Engineering is to provide the opportunity for engineers in industry to upgrade and expand their skills, including the development of research skills. Graduates of the program will be able to apply what they have learned in a variety of applications in industry, government, and academia.

The MEng program can be taken full-time or part-time.

MEng (course-based option):

For the course-based option, students must complete 10 courses worth a total of 30 credits.

Four core courses are required to be taken by all students in the MEng program. These courses are expected to be taken first before other graduate courses:

- ENGR 5013G - Advanced Engineering Mathematics
- ENGR 5200G - Programming Methodology and Abstraction for Engineers
- ENGR 5201G - Engineering Communications and Ethics
- ENGR 5410G - Project Management for Engineers

A minimum of three courses must be taken from the following list of core courses:

- ENGR 5260G - Advanced Robotics and Automation
- ENGR 5261G - Advanced Mechatronics: MEMS and Nanotechnology
- ENGR 5262G - Manipulator and Mechanism Design
- ENGR 5945G - Mobile Robotic Systems*
- METE 5107G - Biomechatronic Systems
- METE 5101G - Artificial Intelligence and Machine Learning Methods and Application
- METE 5102G - Control Design in Robotic Systems
- METE 5103G - Model Predictive Control
- METE 5106G - Advanced System Modeling Methods
- METE 5108G - Neuromechanics and Control of Human Movement
- METE 5280G - Robotic Manipulators
- METE 5300G - Mobile Robotics*

*Students can take ENGR 5945G or METE 5300G, but not both.

The remaining courses are expected to be taken from graduate courses listed in the student's program. Students are also provided the following allowance:

Undergraduate courses

MEng course-based students may take one senior year undergraduate course from the Faculty of Engineering and Applied Science in lieu of one graduate-level course, provided they have not taken similar courses during their undergraduate degree and the course is approved by the graduate program director.

Courses outside of the program

MEng course-based students may take up to two courses in other graduate programs at the university, provided that students have not taken similar courses during their undergraduate or master's degrees, and the courses are approved by the graduate program director. Students who wish to take courses outside of their program must gain approval from the graduate program director. Students who are uncertain about the academic background needed for a graduate course should consult the course instructor before registering for the course.

MEng (project-based option):

For the project-based option, students must complete 8 courses worth a total of 24 credits and a project worth 6 credits (ENGR 5002G - MEng/MEngM Project).

Four core courses are required to be taken by all students in the MEng program. These are expected to be taken first before other graduate courses:

- ENGR 5013G - Advanced Engineering Mathematics
- ENGR 5200G - Programming Methodology and Abstraction for Engineers
- ENGR 5201G - Engineering Communications and Ethics
- ENGR 5410G - Project Management for Engineers

A minimum of three courses must be taken from the following list of core courses:

- ENGR 5260G - Advanced Robotics and Automation
- ENGR 5261G - Advanced Mechatronics: MEMS and Nanotechnology
- ENGR 5262G - Manipulator and Mechanism Design
- ENGR 5945G - Mobile Robotic Systems*
- METE 5107G - Biomechatronic Systems
- METE 5101G - Artificial Intelligence and Machine Learning Methods and Application
- METE 5102G - Control Design in Robotic Systems
- METE 5103G - Model Predictive Control
- METE 5106G - Advanced System Modeling Methods
- METE 5108G - Neuromechanics and Control of Human Movement
- METE 5280G - Robotic Manipulators
- METE 5300G - Mobile Robotics*

*Students can take ENGR 5945G or METE 5300G, but not both.

The remaining courses are expected to be taken from graduate courses listed in the student's program.

Scope of the Project: The project should represent real-world problems. It can be an industry project or defined within a research laboratory or research space setting. The project must be supervised by one of the graduate faculty members in the student's program who are active in the research area.

Course listing

ENGR 5002G - MEng/MEngM Project
ENGR 5005G - Special Topics
ENGR 5010G - Advanced Optimization
ENGR 5012G - Advanced and Smart Materials
ENGR 5013G - Advanced Engineering Mathematics
ENGR 5200G - Programming Methodology and Abstraction for Engineers
ENGR 5201G - Engineering Communications and Ethics
ENGR 5240G - Advanced Dynamics
ENGR 5245G - Micro and Nano Manufacturing

ENGR 5260G - Advanced Robotics and Automation
ENGR 5261G - Advanced Mechatronics: MEMS and Nanotechnology
ENGR 5262G - Manipulator and Mechanism Design
ENGR 5263G - Advanced Control
ENGR 5271G - Innovative Design Engineering
ENGR 5273G - Design by Failure
ENGR 5410G - Project Management for Engineers
ENGR 5510G - Foundations of Software Engineering
ENGR 5520G - Software Development Methods and Tools
ENGR 5605G - Convex Optimization
ENGR 5910G - Embedded Real-Time Control Systems
ENGR 5915G - Discrete Time Control Systems
ENGR 5930G - Adaptive Control
ENGR 5940G - Intelligent Control Systems
ENGR 5945G - Mobile Robotic Systems
ENGR 5946G - Advanced Fluid Power Control and Simulation
METE 5003G - MASc Seminar for Mechatronics Engineering
METE 5101G - Artificial Intelligence and Machine Learning Methods and Applications
METE 5102G - Control Design in Robotic Systems
METE 5103G - Model Predictive Control
METE 5104G - Multivariable Feedback Control
METE 5105G - Nonlinear Control Systems
METE 5106G - Advanced System Dynamics
METE 5107G - Biomechatronic Systems
METE 5108G - Neuromechanics and Control of Human Movement
METE 5280G - Robotic Manipulators
METE 5300G - Mobile Robotics

- *Please attach, as an Appendix, the Program Learning Outcome Alignment Map to Degree Level Expectations*
- *If the program is to be accredited, include with the above information about the accreditation requirements and add the accreditation tables, if available, as an Appendix.*

- *Provide evidence that each graduate student is required to take a minimum of two-thirds of the course requirements from among graduate-level courses*
- *What is the program length? Provide a rationale for the length that ensures the program learning outcomes and requirements can be reasonably completed*

See Appendix A for the Program Learning Outcome Alignment Map to Degree Level Expectations.

MASc Program

Students are required to take five courses of which only one may be a fourth-year undergraduate course, i.e., a minimum of 80% of the courses are graduate level.

The program length for the MASc will be two years.

MEng Program

MEng course-based students must take 10 courses of which up to two may be fourth-year undergraduate courses, i.e., a minimum of 80% of the courses are graduate level.

MEng project-based students must take eight courses and all of them must be at the graduate level.

The program length for the MEng will be one to two years.

A list of new courses for the programs along with new course proposals can be found in Appendix B. A list of existing courses for the programs along with their course descriptions can be found in Appendix C.

- *Describe the ways in which the curriculum addresses the current state of the discipline (QAF 2.1.4a)*
- *For researched-focused graduate programs, provide a clear indication of the nature and suitability of the major research requirements for degree completion*

The courses available in the program cover the state-of-the-art in their respective topics and are taught by faculty members who are active researchers on those topics. This will help ensure the courses remain relevant and current.

For MASc students, the main focus is a research thesis supervised by a faculty member who is a subject matter expert. For MEng project-based students, the project features a research element that is also supervised by a faculty member who is a subject matter expert. In addition to the thesis and project, many courses feature a term project that is often research focussed.

- *Is there an experiential learning component (e.g. workplace learning, co-op, internship, field placements, service learning, mandatory professional practice) to the program? If yes, please describe this component in 2500 words or less. Include confirmed partners, duration of the experiential learning component(s), and projected number of placements (where applicable)*

While many of the courses in the MASc and MEng programs will provide experiential learning components, formal work-integrated learning is built into the MEng program in the form of a co-op internship for 4-8 months (i.e., one or

two co-op work terms). Co-operative education is a form of experiential learning that offers students a journey of self-discovery and transformative learning experiences, and the proposed co-op stream will allow the Faculty of Engineering and Applied Science to align with the Ontario Tech Mission to provide superior lifelong learning experiences.

The co-op stream would also be especially attractive to international students since off-campus employment through a co-op job will be a program requirement.

Applicants to the MEng program have the option of applying directly to the MEng co-op stream with an additional fee. In addition, students may apply to join the co-op stream during their first or second semester of study through the Engineering Co-op Office.

During their first or second semester of study, prior to their co-op placement, students in the co-op stream will be required to take ENGR 1000W - Professional Competencies for Engineers [0 credit, pass/fail], unless they have previously taken and passed this course at Ontario Tech during their undergraduate education.

Students will be able to take a co-op job after their first, second, or third semester of study, and must complete at least one co-op work term in order to qualify for the co-op designation to appear on their degree. At the end of a co-op work term, the student must submit a work term report using the guidelines provided by the Engineering Co-op Office.

Co-op work terms will be recorded on a student's transcript using a special course number similar to the process followed for undergraduate Engineering students in the Co-op stream.

An industrial co-op work term must be between 12 – 16 weeks of full-time paid work (35 – 40 hours per week) with a minimum of 420 hours. Students will be required to pay a co-op work term fee (this fee is set by the Board of Governors).

The Co-op stream of the MEng program will be supported by the Engineering Co-op Office.

- *Describe how the principles of Equity, Diversity, Inclusion, and Decolonization have been considered:*
    - *Does the program contain concepts, materials, or resources from scholars/professionals who are part of one or more historically marginalized groups?*
    - *Are multiple perspectives represented in the program, such as those offered by those who are Indigenous, Black, Persons of Colour, and/or 2SLGBTQIA+?*

- *How has accessibility been considered? More specifically, have the needs of students with disabilities been integrated into the program design (e.g., the ways that students are asked to demonstrate their learning)?*
- *Will this program provide space to allow for the discussion of other viewpoints outside the "dominant, Western narrative"?*
- *Have the principles of Universal Design been considered?*

- *Describe how the potential need to provide accessibility accommodations has been considered in the development of this program; please provide information beyond the services offered by Student Accessibility Services*

The Faculty of Engineering and Applied Science (FEAS) is fully committed to Equity, Diversity, and Inclusion (EDI), including in all its courses and all its research activities. The majority of the material covered in these programs is mathematical in nature and is generally subject to these principles.

As an example of its focus on EDI, FEAS has the Women in Engineering Society with the following goals[3]:

- We foster a welcoming and engaging space for female engineering students to create a sense of community on and off campus.
- We connect female students to future employers and engineering career opportunities across Canada, and showcase successful female engineering professionals.
- We equip our students with professional skills, connections, and inspiration to prepare them for their professional careers.
- We give back to the community by running outreach events to encourage and inspire young women to pursue an education in Engineering.

FEAS is committed to reconciliation with Indigenous peoples. Students in the MASc and MEng programs can take as one of their courses the fourth-year undergrad course:

ENGR 4570U/INDG 4570U - Indigenous Design and Technology
This course will explore design and technology of Indigenous peoples in Canada and the impacts on technology development. Two-Eyed Seeing (where with one eye we view the subject through Indigenous ways of knowing and with the other eye we view it through Western approaches) will be used to study the evolution of Indigenous design and technology and its influence on modern systems. Indigenous approaches to sustainability and its role in Indigenous design and technology will be investigated with the goal of engineers and designers incorporating this knowledge and methodologies in the development of new sustainable technologies.

[3] Source: https://engineering.ontariotechu.ca/current-students/current-undergraduate/women-in-engineering/about-us.php

For students who have accommodation needs, existing Student Accessibility Services (SAS) supports will be available to students who require specific accommodations.

c) Calendar Copy with Program Map(s)

- *Provide, as an Appendix using the template provided, a clear and full calendar copy. The template ensures consistency across all programs in the Academic Calendar*
- *Provide, as an Appendix, a full list of the all courses included in the program including course numbers, titles, and descriptions. Please indicate clearly whether they are new/existing. Include full course proposals for new courses, and the most recent course syllabi for existing courses. If you are making changes to existing courses, include instead a course change form. In an appendix noted below, you will note which faculty members are expected to teach in the program and who is responsible for developing any new courses.*

Please see Appendix D for the proposed Calendar copy.

Please see Appendices B and C for a full list of courses in the program.

3 Consultation

- *Describe the expected impact of the new program on the nature and quality of other programs delivered by the home and collaborating Faculty(ies) and any expected impact on programs offered by other Faculties*
- *Outline the process of consultation with the Deans of Faculties that will be implicated or affected by the creation of the proposed program*
- *Provide letters of support for the program from Deans at Ontario Tech and/or from other institutions/partners*
- *Describe any consultation undertaken with regard to the principles of Equity, Diversity, Inclusion, and Decolonization*

Consultation followed the University's process by requesting feedback on the Notice of Intent. No specific concerns were raised at this stage.

The development of the program was done in consultation with the faculty members within the Mechatronics Engineering area as well as the Department of Automotive and Mechatronics Engineering as whole. Further consultation was done within the Faculty of Engineering and Applied Science level at the FEAS Graduate Committee and FEAS Faculty Council. Feedback from these various levels of consultation has been incorporated into this proposal prior to proceeding with the program's formal approval.

The new program will slightly impact the enrollment of the existing MASc and MEng programs in Mechanical Engineering at Ontario Tech. However, it is anticipated that overall graduate student enrollment will increase as this

program can be marketed to students graduating from undergraduate Mechatronics Engineering programs in Ontario, across Canada, and around the world. Mechatronics is a rapidly growing engineering discipline with more and more undergraduate programs opening each year.

Does this Program contain any Indigenous content? ☐ Yes ☒ No ☐ Unsure
For more information on how Indigenous content is defined at Ontario Tech University and how to consult with the Indigenous Education Advisory Circle (IEAC), please refer to the Protocol for Consultation with the Indigenous Education Advisory Circle.

Has the IEAC been contacted ☐ Yes ☒ No

If yes, when?

What was the advice you received from the IEAC, and how has it been included in your proposal?

Did the IEAC ask you to return the proposal to them for review? ☐ Yes ☐ No

If yes, have they completed their review? ☐ Yes ☐ No ☐ N/A

4 Resource Requirements (QAF 2.1.2.6, 2.1.2.7, 2.1.2.8 a)

a) General Resource Considerations

- *Note here if this new program may impact enrolment agreements with other institutions/external partners that exist with the Faculty/Provost's office*
- *Indicate if the new program will require changes to any existing agreements with other institutions, or will require the creation of a new agreement. Please consult with CIQE (ciqe@ontariotechu.ca) regarding any implications to existing or new agreements.*

It is anticipated that the majority of teaching in the program will be done by Tenure/Tenure Track (TTT) Faculty and Teaching Faculty within the Department of Automotive and Mechatronics Engineering as well as from the other three Departments within FEAS. There may be a limited need for Sessional Instructors depending on matters such as number of courses offered, faculty on research leave, sick leave, etc.

A Graduate Program Director for the Department of Automotive and Mechatronics Engineering will be required. This faculty member will be responsible for the existing MASc and MEng programs in Automotive Engineering as well as the new MASc and MEng programs in Mechatronics Engineering program.

b) Faculty Members - Current and New Faculty Requirements

- *Complete as an Appendix, using the Faculty Information templates provided, charts chart detailing the list of faculty committed to the program and provide any additional details, in paragraph form below; the information in the Appendix or additional information must include clear evidence that faculty have the recent research or professional/clinical expertise needed to sustain the program, promote innovation, and foster an appropriate intellectual climate. This should also demonstrate how supervisory loads are distributed in light of qualifications and appointment status; if necessary, include this information below*
- *Include a brief statement to provide evidence of the participation of a sufficient number and quality of faculty who will actively participate in the delivery of the program and achieve the goals of the program and foster the appropriate academic environment, contribute substantively to the program, and commit to student mentoring*
- *Describe the role of any sessional/part-time faculty; provide an approximate percentage used in the delivery of the program and the plans to ensure the sustainability of the program and quality of the student experience*
- *Explain the provision of supervision of any experiential learning opportunities; how will supervisory loads be distributed?*
- ***If new faculty resources are needed, describe the plan and commitment to provide these resources to support the program and the rationale in section 4h)***

Due to the rapid growth of the BEng in Mechatronics Engineering program at Ontario Tech, the Department of Automotive and Mechatronics Engineering is currently hiring one TTT Faculty member in the area of Mechatronics Engineering. In addition to supporting the BEng in Mechatronics Engineering program, these new faculty members will also support the MASc and MEng programs as well. This new hire will bring the number of dedicate Mechatronics Engineering faculty members to eight, with a further six faculty members in Automotive Engineering that can also support the program through teaching courses. In addition, there are numerous faculty members within the Department of Electrical, Computer, and Software Engineering, Department of Energy and Nuclear Engineering, and the Department of Mechanical and Manufacturing Engineering who can also teach courses related to the program.

Details about all Department of Automotive and Mechatronics Engineering faculty members involved in the program can be found in Appendix E and their CVs.

c) Additional academic and non-academic human resources

- *Give details regarding the nature and level of Sessional Instructor and TA support required by the program, the level of administrative and academic advising support, etc.*
- ***If new resources are needed, describe the plan and commitment to provide these resources to support the program and the rationale in section 4h)***

As this is a graduate program, there is currently no need for TA support. However, in future if the number of MEng students grows substantially, there may be a requirement for TA support for the core courses in the program. Note, these TA costs would be supported by the increased in funding from students enrolled in the MEng program. PhD students within the Faculty of Engineering and Applied Science would serve as the TA pool if the need arises. As noted above, the majority of instruction will be done by TTT Faculty and Teaching Faculty within FEAS. There may be a limited need for Sessional Instructors depending on matters such as the number of courses that need to be offered in a semester, or faculty on research leave, sick leaves, etc. The existing Graduate Program Assistants within FEAS will be sufficient for the planned enrolment for at least the first five years of the program.

d) Supporting information for online and hybrid programs

- *Describe the adequacy of the technological platform to be used for online delivery*
- *Describe how the quality of education will be maintained*
- *Describe how the program objectives will be met*
- *Describe how the program learning outcomes will be met*
- *Describe the support services and training for teaching staff that will be made available*
- *Describe the sufficiency and type of supports that will be available to students*
  - *How has accessibility been considered?*
  - *What strategies have been considered to accommodate students with disabilities?*
  - *Have the principles of Universal Design been considered?*
  - *Will course content be offered in both written and audible forms (e.g., closed captioning, transcriptions)?*
  - *Is course content designed logically and is it easy to follow with limited instruction?*
  - *Are assignment expectations clear (i.e., a rubric)?*
  - *Have the needs of students with limited or unreliable access to wi-fi been considered (e.g., breaking down pre-recorded lectures into maximum 10-minute videos)?*

N/A

e) Existing non-financial student supports

School of Graduate and Post-Doctoral Studies

Quality graduate and postdoctoral education combines teaching, research, professional development, disciplinary community involvement and personal growth. It is by nature a shared responsibility between students, faculty members, the programs and a large number of support units, with overarching administration being provided by the School of Graduate and Postdoctoral Studies.

The School of Graduate and Postdoctoral Studies (SGPS) furthers the scholarly mission of the university by providing academic and administrative support to the university's postgraduate educational, research, innovation and international activities. Our responsibilities include graduate program development, graduate enrolment management, oversight of academic and quality standards, and the implementation of policies and practices that enhance graduate/postdoctoral scholarly success, career readiness and personal growth. SGPS supports prospective, new and current graduate students through many administrative services including, but not limited to, recruitment, admission, registration, funding and scholarships, orientation, professional development workshops and events, and processing of final theses, projects and papers. SGPS is a single-point-of-contact, multifunctional administrative unit tailored to the complete "life-cycle" of graduate students, providing coordinated support to students and all other stakeholders.

Faculty-Specific Support

Academic Advising (if relevant)
Please provide details on your Faculty Academic Advising Office and supports for graduate students.

Student Life

Ontario Tech University, as a relatively small campus community, has a centralized delivery model for many student supports. All undergraduate students have access to an extensive support system that ensures a quality student experience. Each Faculty may provide additional, Faculty- or program-specific supports. In addition to the outlined services below, students may also take advantage of the Campus Bookstore, Housing and Living Resources as well as the Ontario Tech Student Union. Further information can be found at: http://studentlife.ontariotechu.ca/.

Student Learning Centre
Ontario Tech University fosters a high level of academic excellence by working with students, undergraduate and graduate, to achieve educational success. Faculty specific academic resources are available online and include tip sheets and videos. Academic specialists offer one-on-one support services in mathematics, writing, study skills, ESL and physics. With the additional support of peer tutors and workshops, the

Student Learning Centre can also accommodate the needs of a specific course or program.

Student Accessibility Services

Ontario Tech University ensures that students with disabilities have equal opportunities for academic success. Student Accessibility Services operates under the Ontario Human Rights Code and the Accessibility for Ontarians with Disabilities Act. Services and accommodation support are provided for students with documented disabilities and include:

- Adaptive technology training
- Alternate format course material
- Learning skills support
- Testing support
- Transition support for incoming students

Student Accessibility Services also provides inclusive peer spaces, support groups, and skills workshops for students.

Career Readiness

Ontario Tech University offers comprehensive career service assistance, co-op and internship support and a variety of valuable resources to help students along their career paths, including:

- Assistance with creating effective job-search documents
- Career counselling
- Co-op and internships
- Interview preparation
- Job market information
- Job search strategies

The Career Centre hosts a variety of events during the academic year including employer information and networking sessions, job fairs and interviews conducted by leading employers.

Student Engagement, Equity and Inclusion, and ***Indigenous Education and Cultural Services***

The university supports students' successful transition and provides opportunities to develop leadership and professional skills throughout their university career. Services provided include:

- Equity and inclusivity programming and support groups
- Indigenous Education and Cultural Services provides space and supports for students to connect with Indigenous culture and resources

- Opportunities to grow and develop leadership skills through the Ambassador and Peer Mentorship program
- Orientation and events through first year
- Peer mentoring
- Services and supports for international and exchange students
- Specialized programming for first-generation, graduate, Indigenous, international, mature, online, transfer and diploma-to-degree pathways students

Student Mental Health Services

Student Mental Health Services helps students learn how to better manage the pressures of student life. Students can:

- Access short term counselling and therapy services
- Access tools and resources online to learn about mental health and how to maintain good health and wellness
- Attend drop-in sessions
- Participate in events, activities or support groups that promote positive health and well-being
- Work with a mental health professional to address concerns

Students in distress will also be provided with support and counselling as needed. There is no cost to students and services are confidential. For those who need long-term counselling support or specialized mental health services, Ontario Tech University will provide referrals to assist the student in accessing resources in the local community or in the student's home community.

Athletics and Recreation Facilities

Ontario Tech University offers a number of recreation facilities and fitness opportunities to meet all lifestyles and needs. On-campus facilities include the state-of-the-art FLEX Fitness Centre which overlooks Oshawa Creek, five gymnasiums, a 200-metre indoor track, two aerobic/dance studios, the Campus Ice Centre, Campus Fieldhouse, a soccer pitch, a fastball diamond, squash courts and an indoor golf training centre. Students are able to participate in varsity and intramural sports as well as group fitness classes and personal training sessions.

Campus Health Centre

The Campus Health Centre provides assistance in numerous confidential health-care options including:

- A medical clinic with daily access to physician and nursing staff
- Treatment of disease, illness, and injury
- Allergy injections, immunizations, and influenza injections

- Complementary Health Services featuring acupuncture, chiropractic, custom orthotics, massage therapy, nutritional counselling, and physical therapy
- An on-site laboratory (blood work, STI testing, throat swabs, etc.)
- Gynaecological health-care and prescriptions

Student Awards and Financial Aid

Student Awards and Financial Aid (SAFA) is dedicated to helping students understand the variety of options available to finance their education. Budgeting and financial planning are essential to their success and SAFA is on hand to help create the right financial plan. Financial assistance can be in the form of bursaries, employment (both on-campus and off), parental resources, scholarships, student lines of credit and the Ontario Student Assistance Program (OSAP).

Information Technology Resources

Ontario Tech University is a leader among North American universities in implementing and using curriculum and industry specific software in a technology-enriched learning environment (TELE). Our unique environment is adapted to each discipline based on faculty requirements and input for optimal student learning. We are committed to providing the greatest value for students' investment in education and technology while studying at Ontario Tech University.

One of the greatest advantages of Ontario Tech University's approach to TELE is that all students have equal access to the same technology, resources and services. Whether you are inside or outside of the classroom, your course-specific software allows you to work on your own or with others and enjoy seamless access to all Ontario Tech online resources. TELE supports Bring-your-own-device (BYOD) which provides you with laptop standards when acquiring the right laptop for your program and software support services onsite and online. An annual fee for TELE covers a wide range of program-specific software, technical software support, exam support and virus protection.

IT Services strives to provide quality services to students at Ontario Tech. To support these objectives, the following components are included:

Wireless network
Wireless internet connection is available in public areas and open-air locations around the Ontario Tech campus where students congregate (North Oshawa and Downtown locations).

Wired network
To ensure the success of the technology-enriched learning environment, a comprehensive data network has been installed on campus. This includes network drops in lecture halls and designated areas as well as network drops for each residence suite.

Ontario Tech students benefit from networked classrooms and learning spaces. Each ergonomically-designed space has data network connection access and electrical connections to ensure battery regeneration. In addition, classrooms include electronic projection equipment and full multimedia support.

Exam support services
IT Services provide hardware, software and technical support during examinations. IT team will be equipped with loaner laptops in the event of major technical issues.

Laptop repairs
IT Services provide on campus repairs on eligible laptop models.

IT Service Desk
The IT Service Desk is equipped with certified technicians and experienced IT professionals offering technical support services on a drop-in, call-in or email basis.

General Use Workstations (GUWs)
Ontario Tech undergraduate students are able to use general workstations available at the library and have access to Bring Your Own Device Technology-Enriched Learning Environment (BYOD TELE) model course-specific software.

Software Support
Software Support specialists are available to students on-site and online to assist in downloading/installing University software and support any other software related issues.

Printing services
Printing services are available to students in the following areas: labs, classrooms, study common areas, the Learning Commons and the Library. All Ontario Tech students receive print credits every year, more Printpacks can be purchased through the Campus Bookstore if students require additional printing services.

Teaching & Learning Centre

The mission of the Teaching and Learning Centre (TLC) at Ontario Tech University is to empower faculty to reach their potential as educators and to create a culture where effective teaching is valued. We champion the scholarship of teaching and implementation of pedagogy. We create valuable teaching and learning professional development experiences. We move Ontario Tech University towards being a leader in teaching excellence, ultimately leading to greater student success.

The TLC provides faculty with a range of tools and facilities to assist them in providing a rich learning experience for students. Experts at the TLC provide support in various areas including curriculum development, multimedia design, learning technology and in the overall improvement of teaching practice.

In addition, the TLC funds teaching-related projects from the Teaching Innovation Fund (TIF) for proposals by faculty members aimed at developing new methods in teaching and learning. The TLC facilitates teaching awards at the University and supports faculty in their application for external awards and funding opportunities that focus on teaching and learning.

f) Graduate student financial support

- *Provide evidence that financial assistance will be sufficient to ensure quality and numbers of students*
- *Provide the teaching assistant hours and capacity within the Faculty*

Every MASc student offered admission to a graduate program in FEAS should be able to complete their program regardless of their financial status.

The minimum funding support for MASc students will be $16,000 per year, for two years, with funding coming from a variety of sources, including the following sources:

- Ontario Tech Scholarships/Bursaries
- External Awards – These include NSERC postgraduate awards and provincial awards
- Teaching Assistantships – MASc students will be eligible to earn up to approximately $10,000 per year through teaching assistantships
- Graduate Research Assistantships – Additional support from individual supervisors will be available to students
- Work-Study and Other Forms of Employment-Based Learning will be available
- Provincial Loan Programs are also available

It is expected that most funding for MASc students will come from Graduate Research Assistantships and Teaching Assistantships. Normally, funding will not be provided to part-time students.

MEng students will have access to financial support through provincial loan programs and work-study placements. Normally, additional funding will not be provided to MEng students.

g) Physical resource requirements

- *Please attach a report, as an Appendix, from the Library regarding existing library holdings and support for student learning; please contact your Subject Librarian as you begin your proposal to request a 'Library statement for new program proposal'*
- *Address any space/infrastructure requirements including information technology, laboratory space, equipment, etc.* ***If new space is required, please complete Table 4 (examples in purple); otherwise, please remove this Table***

- *Ideally, please provide information on the change in the number of faculty, students, administrative staff, etc. as well as information on changes in equipment and activities (additional space; the renovation of existing space; or will the current space allocation accommodate the new program)*
- ***If new resources are needed, add the plan and commitment to provide these resources to support the program and the rationale in section 4h)***

Please see Appendix F for the Library report. Existing classroom, lab, and office space will be utilized.

Table 4: Additional Space Requirements

Space Type	Number Required	Space Requirements (sq. ft)

h) Resource Summary

Provide a brief statement of the funding requirements and the rationale.

The MASc and MEng programs will be build upon the BEng in Mechatronics Engineering program in terms of instructors. One TTT Faculty member is currently being hired as part of the BEng program and they will also teach in the MASc and MEng programs. As this is a graduate program, there is currently no need for TA support. However, in future if the number of MEng students grows substantially, there may be a requirement for TA support for the core courses in the program. Note, these TA costs would be supported by the increased in funding from students enrolled in the MEng program. PhD students with the Faculty of Engineering and Applied Science would serve as the TA pool if the need arises. As noted previously, the majority of instruction will be done by TTT Faculty and Teaching Faculty within FEAS. There may be a limited need for Sessional Instructors depending on matters such as the number of courses that need to be offered in a semester, or faculty on research leave, sick leaves, etc. A Graduate Program Director for the Department of Automotive and Mechatronics Engineering will be required. This faculty member will be responsible for the existing MASc and MEng programs in Automotive Engineering as well as the new MASc and MEng programs in Mechatronics Engineering. The existing Graduate Program Assistants within the Faculty of Engineering and Applied Science will be sufficient for the planned enrolment for at least the first five years of the program.

Human Resource Requirements

Are additional faculty required to be able to offer this program? ☐ Yes ☒ No

If yes, what year will the faculty hire be required, and are there additional criteria associated with the hiring requirement (e.g. enrolment levels)?

Are additional staff required to be able to offer this program? ☐ Yes ☒ No

If yes, please outline what year the staff hire will be required and any additional criteria associated with the hiring requirement:

Space Requirements

Are there additional space requirements specific to being able to successfully launch this program? ☐ Yes ☒ No

If yes, please provide additional details:

Technology Requirements

Are there additional technology requirements specific to being able to successfully launch this program? ☐ Yes ☒ No

If yes, please provide additional details:

Additional Resource Requirements

Are there additional resource requirements not specified above that are required to successfully launch this program? If so, please outline them below:

None

The resource requirements outlined above have been reviewed and approved by the Academic Resource Committee (ARC): _____

(date of review)

5 Closing Statements Regarding Program Quality (QAF 2.1.2.8)

- *Please describe any additional evidence of the quality of the faculty (e.g. qualifications, funding, honours, awards, research, innovation and scholarly record) not already discussed*
- *Please provide any other evidence that the program and faculty will ensure the intellectual quality of the student experience*

The faculty members who are involved in the proposed programs are all subject matter experts in Mechatronics Engineering who currently teach in the Canadian Engineering Accredition Board (CEAB) accredited BEng in Mechatronics Engineering program. All faculty members are registered Professional Engineers in Canada or are in the process becoming registered.

The TTT Faculty members all have active research programs supported by both government granting agencies as well as industrial sponsors. In addition, they are experienced in graduate student supervision and graduate teaching. The faculty are all qualified to ensure the intellectual quality of the student experience.

Details about the faculty members qualifications and research can be found in Appendix E and their CVs.

APPENDICES

Please include at minimum the below. Additional Appendices may be added, as appropriate. Appendices should ultimately be listed, attached, and labelled (A, B, C, etc.) in the order in which they first are mentioned in the document.

Program Learning Outcome Alignment Map to DLEs
Accreditation tables (if applicable)
Calendar Copy with Program Maps (please use template)
List of Program Courses, New Course Proposals, Required Course Changes, Course Syllabi for Existing Courses (can each be attached as separate appendices)
Detailed Listing of Faculty Committed to the Program (please use template)
Library Report

Items to be separate documents sent to CIQE:

New Program Funding and Tuition form (for CIQE use only)
Budget Spreadsheet (for ARC use only)
CVs for all faculty committed to the program (to be provided to the external reviewers)

Appendix A – Program Learning Outcome Alignment Map to DLEs

	Explain advanced concepts, principles, and theories in mechatronics.	Design and implement experiments.	Interpret experimental data and computational results.	Solve engineering problems and enhance existing practices through research.	Adhere to social, professional, and ethical expectations involved in advanced education and research.	Describe the importance of, and develop the strategies for, further education and lifelong learning in the discipline.	Communicate mechatronics concepts, principles, and results effectively using written and verbal formats.	Critically evaluate advanced information and knowledge and apply in engineering practice.
Depth and Breadth of Knowledge	x							
Research and Scholarship		x	x					
Level of Application of Knowledge				x				
Communication Skills							x	
Awareness of Limits of Knowledge								x
Autonomy/Professional Capacity					x	x		

Appendix B – New Course Proposals and Required Course Changes

The following courses are new courses in the programs:

METE 5003G - MASc Seminar for Mechatronics Engineering
METE 5101G - Artificial Intelligence and Machine Learning Methods and Applications
METE 5102G - Control Design in Robotic Systems
METE 5103G - Model Predictive Control
METE 5104G - Multivariable Feedback Control
METE 5105G - Nonlinear Control Systems
METE 5106G - Advanced System Modeling Methods
METE 5107G - Biomechatronic Systems
METE 5108G - Neuromechanics and Control of Human Movement
METE 5280G - Robotic Manipulators
METE 5300G - Mobile Robotics

The following course requires a credit restriction to be added:

ENGR 5945G - Mobile Robotic Systems (credit restriction with the new course METE 5300G)

NEW COURSE TEMPLATE

For changes to existing courses see Course Change Template

New courses must be entered into Curriculog prior to Faculty Council. Please use this template to provide the information to your Curriculog contact.

Faculty: Faculty of Engineering and Applied Science	
This new course is associated with: ☐ Minor Program Adjustment ☐ Major Program Modification ☒ New Program ☐ None	
Will this course appear anywhere other than the course description section of the Calendar?	☒ **Yes** ☐ **No**

If you answered yes to the above, please complete:

A new core course for an existing program, specialization or minor*: Minor Program Adjustment*

A new elective course for an existing program, specialization or minor, listed in the program map*: Course Placement*

A new course (core or elective) related to a Major Program Modification*: Major Program Modification*

A new course (core or elective) related to a New Program*: New Program proposal*

Programs impacted: [Please list all impacted programs including any applicable fields or specializations.]

MASc in Mechatronics Engineering

Calendar start date: (When the course should first appear in the Academic Calendar 2020-2021)

2024-2025

Registration start date: (The first time the course will be open for registration e.g. Fall 2020)

Winter 2024

Additional supporting information (optional; please indicate if you are attaching any additional documentation)

N/A

Subject Code: METE	**Course Number:** 5003G
Full Course Title: MASc Seminar for Mechatronics Engineering	
Short-Form Course Title (max. 30 characters)**:** MASc Seminar for Mechatronics	

Course Description

Participation in a program of seminars by internal and external speakers on current research topics in the area of Mechatronics Engineering. All MASc students will be required to give a seminar on their thesis research during the second year of their program.

Credit Hours: 3		
Contact Hours – please indicate total number of hours for each component		
Lecture: 3		**Lab:**
Tutorial:		**Other:**
Cross-listings		
Prerequisites for Calendar		
Prerequisites for Banner		
Co-requisites		
Prerequisites with concurrency (pre or co-requisite)		
Credit restrictions		☐ **Equivalency***
Recommended Prerequisites		
Course Restrictions		
Course Type	☒ **Core** ☐ **Elective** ☐ **Core or Elective**	
Is the course: ☐ Undergraduate ☒ Graduate ☐ Professional (e.g. some Education courses)		
Grading scheme	☐ **N (normal alpha grade)** ☒ **P (pass/fail)**	

***Equivalency:** Two courses are similar enough in content that they are considered equivalent so students can register in either course but they will only receive credit for one course in their program.

Course instructional method:

CLS (In Class Delivery)		HYB (In Class and Online Delivery)	x
IND (Individual Studies)		OFF (Off Site)	
WB1 (Virtual Meet Time – Synchronous)		WEB (Fully Online – Asynchronous)	
Not Applicable			

Teaching and assessment methods:

Attendance in a series of seminars by internal and external speakers on various engineering topics. Students must attend a minimum of 10 seminars during their program of study. In addition, students are required to give a seminar on their thesis research during the second year of their program. Students are to keep track of their attendance via a log sheet. A faculty member within FEAS must sign-off on the attendance of a student at a given seminar.

Learning outcomes: (for assistance developing course learning outcomes, please refer to the Teaching and Learning website, or contact them at teachingandlearning@ontariotechu.ca.)

Upon successful completion of this course, the students should be able to: • Recognize and be guided by the social, professional, and ethical issues involved in advanced education and research • Understand contemporary issues as well as professional and ethical responsibilities • Recognize the need and ability to further their education through lifelong learning

- Articulate their research ideas and results via an oral presentation

Does this course contain any experiential learning components? ☐ **Yes** ☒ **No**

If yes:

Case Study		Simulated Workplace Project	
Consulting project/workplace project		Applied Research	
Field Experiences			
Other Types of Experiences:			

We have consulted with all impacted areas: ☐ **Yes** ☒ **NA**

Process of consultation, if applicable:

Have you considered the principles of Equity, Diversity, Inclusion, or Decolonization included when creating this new course? ☒ **Yes** ☐ **No** **Please explain:**

The Faculty of Engineering and Applied Science (FEAS) is fully committed to Equity, Diversity, and Inclusion (EDI), including in all of its courses. In this course, students will be exposed to a wide range of ideas and topics from a diverse group of presenters. For students who have accommodation needs, existing Student Accessibility Services (SAS) supports will be available to students who require specific accommodations.

Does this course contain any Indigenous content? ☐ **Yes** ☒ **No** ☐ **Unsure**

For more information on how Indigenous content is defined at Ontario Tech University and how to consult with the Indigenous Education Advisory Circle (IEAC), please refer to the Protocol for Consultation with the Indigenous Education Advisory Circle.

Has the IEAC been contacted? ☐ **Yes** ☒ **No**

If yes, when?

What was the advice you received from the IEAC, and how has it been included in your proposal?

Did the IEAC ask you to return the proposal to them for review? ☐ **Yes** ☐ **No**

If yes, have they completed their review? ☐ **Yes** ☐ **No** ☐ **N/A**

Financial Implications

None

Pre-Faculty Council Approval Dates (e.g. Curriculum Committee, Program Committee):

NEW COURSE TEMPLATE

For changes to existing courses see Course Change Template

New courses must be entered into Curriculog prior to Faculty Council. Please use this template to provide the information to your Curriculog contact.

Faculty: Faculty of Engineering and Applied Science	
This new course is associated with: ☐ Minor Program Adjustment ☐ Major Program Modification ☒ New Program ☐ None	
Will this course appear anywhere other than the course description section of the Calendar?	☒ **Yes** ☐ **No**

If you answered yes to the above, please complete:

A new core course for an existing program, specialization or minor*: Minor Program Adjustment*

A new elective course for an existing program, specialization or minor, listed in the program map*: Course Placement*

A new course (core or elective) related to a Major Program Modification*: Major Program Modification*

A new course (core or elective) related to a New Program*: New Program proposal*

Programs impacted: [Please list all impacted programs including any applicable fields or specializations.]

MASc in Mechatronics Engineering
MEng in Mechatronics Engineering

Calendar start date: (When the course should first appear in the Academic Calendar 2020-2021)

2024-2025

Registration start date: (The first time the course will be open for registration e.g. Fall 2020)

Winter 2024

Additional supporting information (optional; please indicate if you are attaching any additional documentation)

N/A

Subject Code: METE	**Course Number:** 5101G
Full Course Title: Artificial Intelligence and Machine Learning Methods and Applications	
Short-Form Course Title (max. 30 characters)**:** AI & ML Methods & Applications	

Course Description

In this course, students will briefly review fundamental artificial intelligence and machine learning methods such as regression methods and decision trees. Students will develop skills to implement advanced machine learning concepts through coding projects. Data transformation and management methods including kernels, principal component analysis, and manifold learning will be discussed as well as ensemble methods and reinforcement learning strategies. Different artificial neural network structures, deep learning methods, regression, and convolution networks will be presented. Heuristic methods to handle non-linear problems in the context of machine learning will be introduced.

Credit Hours: 3		
Contact Hours – please indicate total number of hours for each component		
Lecture: 3		**Lab:**
Tutorial:		**Other:**
Cross-listings		
Prerequisites for Calendar		
Prerequisites for Banner		
Co-requisites		
Prerequisites with concurrency (pre or co-requisite)		
Credit restrictions		☐ **Equivalency***
Recommended Prerequisites		
Course Restrictions		
Course Type	☐ **Core** ☒ **Elective** ☐ **Core or Elective**	
Is the course: ☐ Undergraduate ☒ Graduate ☐ Professional (e.g. some Education courses)		
Grading scheme	☒ **N (normal alpha grade)** ☐ **P (pass/fail)**	

***Equivalency:** Two courses are similar enough in content that they are considered equivalent so students can register in either course but they will only receive credit for one course in their program.

Course instructional method:

CLS (In Class Delivery)	x	HYB (In Class and Online Delivery)	
IND (Individual Studies)		OFF (Off Site)	
WB1 (Virtual Meet Time – Synchronous)		WEB (Fully Online – Asynchronous)	
Not Applicable			

Teaching and assessment methods:

Assignments, midterms, projects, and/or the final exam as determined by the instructor.

Learning outcomes: (for assistance developing course learning outcomes, please refer to the Teaching and Learning website, or contact them at teachingandlearning@ontariotechu.ca.)

Upon successful completion of this course, the students should be able to: • Demonstrate strong comprehension of advanced artificial intelligence and machine learning concepts • Apply and optimize the design of artificial intelligence and machine learning methods for engineering problems

- Developed technical skills to use standard tools for ease of machine learning and artificial intelligence implementations

Does this course contain any experiential learning components? ☐ **Yes** ☒ **No**

If yes:

Case Study		Simulated Workplace Project	
Consulting project/workplace project		Applied Research	
Field Experiences			
Other Types of Experiences:			

We have consulted with all impacted areas: ☐ **Yes** ☒ **NA**

Process of consultation, if applicable:

Have you considered the principles of Equity, Diversity, Inclusion, or Decolonization included when creating this new course? ☒ **Yes** ☐ **No** **Please explain:**

The Faculty of Engineering and Applied Science (FEAS) is fully committed to Equity, Diversity, and Inclusion (EDI), including in all of its courses. The material covered in this course is mathematical in nature and is generally subject to these principles. However, when generating models with human data where low diversity in the sample data can affect decision-making results, special attention will be given to EDI principles and will be openly discussed with students. For students who have accommodation needs, existing Student Accessibility Services (SAS) supports will be available to students who require specific accommodations.

Does this course contain any Indigenous content? ☐ **Yes** ☒ **No** ☐ **Unsure**

For more information on how Indigenous content is defined at Ontario Tech University and how to consult with the Indigenous Education Advisory Circle (IEAC), please refer to the Protocol for Consultation with the Indigenous Education Advisory Circle.

Has the IEAC been contacted? ☐ **Yes** ☒ **No**

If yes, when?

What was the advice you received from the IEAC, and how has it been included in your proposal?

Did the IEAC ask you to return the proposal to them for review? ☐ **Yes** ☐ **No**

If yes, have they completed their review? ☐ **Yes** ☐ **No** ☐ **N/A**

Financial Implications

None

Pre-Faculty Council Approval Dates (e.g. Curriculum Committee, Program Committee):

NEW COURSE TEMPLATE

For changes to existing courses see Course Change Template

New courses must be entered into Curriculog prior to Faculty Council. Please use this template to provide the information to your Curriculog contact.

Faculty: Faculty of Engineering and Applied Science	
This new course is associated with: ☐ Minor Program Adjustment ☐ Major Program Modification ☒ New Program ☐ None	
Will this course appear anywhere other than the course description section of the Calendar?	☒ **Yes** ☐ **No**

If you answered yes to the above, please complete:

A new core course for an existing program, specialization or minor*: Minor Program Adjustment*

A new elective course for an existing program, specialization or minor, listed in the program map*: Course Placement*

A new course (core or elective) related to a Major Program Modification*: Major Program Modification*

A new course (core or elective) related to a New Program*: New Program proposal*

Programs impacted: [Please list all impacted programs including any applicable fields or specializations.]

MASc in Mechatronics Engineering
MEng in Mechatronics Engineering

Calendar start date: (When the course should first appear in the Academic Calendar 2020-2021)

2024-2025

Registration start date: (The first time the course will be open for registration e.g. Fall 2020)

Winter 2024

Additional supporting information (optional; please indicate if you are attaching any additional documentation)

N/A

Subject Code: METE	**Course Number:** 5102G
Full Course Title: Control Design in Robotic Systems	
Short-Form Course Title (max. 30 characters)**:** Control Design Robotic Systems	

Course Description

This course deals with the topic of control design in robotic systems. Specifically, the course addresses the theories and techniques required to design controllers for robot manipulator systems. The detailed topics include: vectors/coordinate transforms, kinematics, robot dynamics, position control (such as PD control, computed torque control, adaptive control, sliding mode control, time-delayed control, disturbance observer) and force control (such as impedance control, hybrid force control). Students will design the introduced controllers and analyze robot dynamics and control performance through MATLAB/Simulink based simulations.

Credit Hours: 3		
Contact Hours – please indicate total number of hours for each component		
Lecture: 3		**Lab:**
Tutorial:		**Other:**
Cross-listings		
Prerequisites for Calendar		
Prerequisites for Banner		
Co-requisites		
Prerequisites with concurrency (pre or co-requisite)		
Credit restrictions		☐ **Equivalency***
Recommended Prerequisites		
Course Restrictions		
Course Type	☐ **Core** ☒ **Elective** ☐ **Core or Elective**	
Is the course: ☐ Undergraduate ☒ Graduate ☐ Professional (e.g. some Education courses)		
Grading scheme	☒ **N (normal alpha grade)** ☐ **P (pass/fail)**	

***Equivalency:** Two courses are similar enough in content that they are considered equivalent so students can register in either course but they will only receive credit for one course in their program.

Course instructional method:

CLS (In Class Delivery)	x	HYB (In Class and Online Delivery)	
IND (Individual Studies)		OFF (Off Site)	
WB1 (Virtual Meet Time – Synchronous)		WEB (Fully Online – Asynchronous)	
Not Applicable			

Teaching and assessment methods:

Assignments, midterms, projects, and/or final exam as determined by the instructor.

Learning outcomes: (for assistance developing course learning outcomes, please refer to the Teaching and Learning website, or contact them at teachingandlearning@ontariotechu.ca.)

Upon successful completion of this course, the students should be able to:

- Understand coordinate transformations in robotics
- Understand kinematic and dynamic modeling for a robotic manipulator
- Learn control design theories and techniques for robot manipulator systems

- Design position control algorithms for robot manipulator systems by applying the techniques of PD control, computed torque control, adaptive control, sliding mode control, time-delayed control, and disturbance observer
- Design force control algorithms for robot manipulator systems based on impedance control and hybrid force control techniques
- Conduct simulations to analyze the dynamics of robot manipulator systems and evaluate the performance of designed controllers

Does this course contain any experiential learning components? ☐ **Yes** ☒ **No**

If yes:

Case Study		Simulated Workplace Project	
Consulting project/workplace project		Applied Research	
Field Experiences			
Other Types of Experiences:			

We have consulted with all impacted areas: ☐ **Yes** ☒ **NA**

Process of consultation, if applicable:

Have you considered the principles of Equity, Diversity, Inclusion, or Decolonization included when creating this new course? ☒ **Yes** ☐ **No** **Please explain:**

The Faculty of Engineering and Applied Science (FEAS) is fully committed to Equity, Diversity, and Inclusion (EDI), including in all of its courses. The material covered in this course is mathematical in nature and is generally subject to these principles. For students who have accommodation needs, existing Student Accessibility Services (SAS) supports will be available to students who require specific accommodations.

Does this course contain any Indigenous content? ☐ **Yes** ☒ **No** ☐ **Unsure**

For more information on how Indigenous content is defined at Ontario Tech University and how to consult with the Indigenous Education Advisory Circle (IEAC), please refer to the Protocol for Consultation with the Indigenous Education Advisory Circle.

Has the IEAC been contacted? ☐ **Yes** ☒ **No**

If yes, when?

What was the advice you received from the IEAC, and how has it been included in your proposal?

Did the IEAC ask you to return the proposal to them for review? ☐ **Yes** ☐ **No**

If yes, have they completed their review? ☐ **Yes** ☐ **No** ☐ **N/A**

Financial Implications

None

Pre-Faculty Council Approval Dates (e.g. Curriculum Committee, Program Committee):

NEW COURSE TEMPLATE

For changes to existing courses see Course Change Template

New courses must be entered into Curriculog prior to Faculty Council. Please use this template to provide the information to your Curriculog contact.

Faculty: Faculty of Engineering and Applied Science	
This new course is associated with: ☐ Minor Program Adjustment ☐ Major Program Modification ☒ New Program ☐ None	
Will this course appear anywhere other than the course description section of the Calendar?	☒ **Yes** ☐ **No**

If you answered yes to the above, please complete:

A new core course for an existing program, specialization or minor*: Minor Program Adjustment*

A new elective course for an existing program, specialization or minor, listed in the program map*: Course Placement*

A new course (core or elective) related to a Major Program Modification*: Major Program Modification*

A new course (core or elective) related to a New Program*: New Program proposal*

Programs impacted: [Please list all impacted programs including any applicable fields or specializations.]

MASc in Mechatronics Engineering
MEng in Mechatronics Engineering

Calendar start date: (When the course should first appear in the Academic Calendar 2020-2021)

2024-2025

Registration start date: (The first time the course will be open for registration e.g. Fall 2020)

Winter 2024

Additional supporting information (optional; please indicate if you are attaching any additional documentation)

N/A

Subject Code: METE	**Course Number:** 5103G
Full Course Title: Model Predictive Control	
Short-Form Course Title (max. 30 characters)**:** Model Predictive Control	

Course Description

Model Predictive Control (MPC) theory will be introduced and developed in this project-based course. System identification modeling and control of linear and non-linear systems will be practiced with the implementation and design of different types of MPC algorithms, including: Simplified MPC, Dynamic Matrix Control, General Predictive Control and other MPC conditioning methodologies.

Credit Hours: 3		
Contact Hours – please indicate total number of hours for each component		
Lecture: 3		**Lab:**
Tutorial:		**Other:**
Cross-listings		
Prerequisites for Calendar		
Prerequisites for Banner		
Co-requisites		
Prerequisites with concurrency (pre or co-requisite)		
Credit restrictions		☐ **Equivalency***
Recommended Prerequisites		
Course Restrictions		
Course Type	☐ **Core** ☒ **Elective** ☐ **Core or Elective**	
Is the course: ☐ Undergraduate ☒ Graduate ☐ Professional (e.g. some Education courses)		
Grading scheme	☒ **N (normal alpha grade)** ☐ **P (pass/fail)**	

***Equivalency:** Two courses are similar enough in content that they are considered equivalent so students can register in either course but they will only receive credit for one course in their program.

Course instructional method:

CLS (In Class Delivery)	x	HYB (In Class and Online Delivery)	
IND (Individual Studies)		OFF (Off Site)	
WB1 (Virtual Meet Time – Synchronous)		WEB (Fully Online – Asynchronous)	
Not Applicable			

Teaching and assessment methods:

Assignments, midterms, projects, and/or final exam as determined by the instructor.

Learning outcomes: (for assistance developing course learning outcomes, please refer to the Teaching and Learning website, or contact them at teachingandlearning@ontariotechu.ca.)

Upon successful completion of this course, the students should be able to: • Use system identification tools to develop and validate models of real-world systems • Leverage models to implement MPC control schemes for linear and non-linear systems • Select, design, and tune MPC controllers for control application requirements • Compare and communicate MPC controller response performance effectively

Does this course contain any experiential learning components? ☒ **Yes** ☐ **No**

If yes:

Case Study	x	Simulated Workplace Project	
Consulting project/workplace project		Applied Research	
Field Experiences			
Other Types of Experiences:			

We have consulted with all impacted areas: ☐ **Yes** ☒ **NA**

Process of consultation, if applicable:

Have you considered the principles of Equity, Diversity, Inclusion, or Decolonization included when creating this new course? ☒ **Yes** ☐ **No** **Please explain:**

The Faculty of Engineering and Applied Science (FEAS) is fully committed to Equity, Diversity, and Inclusion (EDI), including in all of its courses. The material covered in this course is mathematical in nature and is generally subject to these principles. For students who have accommodation needs, existing Student Accessibility Services (SAS) supports will be available to students who require specific accommodations.

Does this course contain any Indigenous content? ☐ **Yes** ☒ **No** ☐ **Unsure**

For more information on how Indigenous content is defined at Ontario Tech University and how to consult with the Indigenous Education Advisory Circle (IEAC), please refer to the Protocol for Consultation with the Indigenous Education Advisory Circle.

Has the IEAC been contacted? ☐ **Yes** ☒ **No**

If yes, when?

What was the advice you received from the IEAC, and how has it been included in your proposal?

Did the IEAC ask you to return the proposal to them for review? ☐ **Yes** ☐ **No**

If yes, have they completed their review? ☐ **Yes** ☐ **No** ☐ **N/A**

Financial Implications

None

Pre-Faculty Council Approval Dates (e.g. Curriculum Committee, Program Committee):

NEW COURSE TEMPLATE

For changes to existing courses see Course Change Template

New courses must be entered into Curriculog prior to Faculty Council. Please use this template to provide the information to your Curriculog contact.

Faculty: Faculty of Engineering and Applied Science	
This new course is associated with: ☐ Minor Program Adjustment ☐ Major Program Modification ☒ New Program ☐ None	
Will this course appear anywhere other than the course description section of the Calendar?	☒ **Yes** ☐ **No**

If you answered yes to the above, please complete:

A new core course for an existing program, specialization or minor*: Minor Program Adjustment*

A new elective course for an existing program, specialization or minor, listed in the program map*: Course Placement*

A new course (core or elective) related to a Major Program Modification*: Major Program Modification*

A new course (core or elective) related to a New Program*: New Program proposal*

Programs impacted: [Please list all impacted programs including any applicable fields or specializations.]

MASc in Mechatronics Engineering
MEng in Mechatronics Engineering

Calendar start date: (When the course should first appear in the Academic Calendar 2020-2021)

2024-2025

Registration start date: (The first time the course will be open for registration e.g. Fall 2020)

Winter 2024

Additional supporting information (optional; please indicate if you are attaching any additional documentation)

N/A

Subject Code: METE	**Course Number:** 5104G
Full Course Title: Multivariable Feedback Control	
Short-Form Course Title (max. 30 characters)**:** Multivariable Feedback Control	

Course Description

This course will cover multi-input, multi-output (MIMO) control systems. Specific topics include: elements of linear system theory; limitations in single-input, single-output (SISO) systems; limitations in MIMO systems; uncertainty and robustness; stability analysis of MIMO systems; control design (for example H-infinity, LQG); and model reduction.

Credit Hours: 3		
Contact Hours – please indicate total number of hours for each component		
Lecture: 3		**Lab:**
Tutorial:		**Other:**
Cross-listings		
Prerequisites for Calendar		
Prerequisites for Banner		
Co-requisites		
Prerequisites with concurrency (pre or co-requisite)		
Credit restrictions		☐ **Equivalency***
Recommended Prerequisites		
Course Restrictions		
Course Type	☐ **Core** ☒ **Elective** ☐ **Core or Elective**	
Is the course: ☐ Undergraduate ☒ Graduate ☐ Professional (e.g. some Education courses)		
Grading scheme	☒ **N (normal alpha grade)** ☐ **P (pass/fail)**	

***Equivalency:** Two courses are similar enough in content that they are considered equivalent so students can register in either course but they will only receive credit for one course in their program.

Course instructional method:

CLS (In Class Delivery)	x	HYB (In Class and Online Delivery)	
IND (Individual Studies)		OFF (Off Site)	
WB1 (Virtual Meet Time – Synchronous)		WEB (Fully Online – Asynchronous)	
Not Applicable			

Teaching and assessment methods:

Assignments, midterms, projects, and/or final exam as determined by the instructor.

Learning outcomes: (for assistance developing course learning outcomes, please refer to the Teaching and Learning website, or contact them at teachingandlearning@ontariotechu.ca.)

Upon successful completion of this course, the students should be able to:

- Apply concepts of dynamics, electric circuits, actuators and power electronics, and other engineering concepts to model, analyze, and simulate complex MIMO control systems
- Apply concepts of linear algebra to assess and study the stability of complex dynamic systems and control systems
- Use appropriately engineering practice techniques, skills, and modern engineering tools

- Apply knowledge of calculus, science, and engineering to develop and analyze control systems
- Design and conduct simulations and analyze and interpret experimental data
- Communicate their work effectively

Does this course contain any experiential learning components? ☐ **Yes** ☒ **No**

If yes:

Case Study		Simulated Workplace Project	
Consulting project/workplace project		Applied Research	
Field Experiences			
Other Types of Experiences:			

We have consulted with all impacted areas: ☐ **Yes** ☒ **NA**

Process of consultation, if applicable:

Have you considered the principles of Equity, Diversity, Inclusion, or Decolonization included when creating this new course? ☒ **Yes** ☐ **No** **Please explain:**

The Faculty of Engineering and Applied Science (FEAS) is fully committed to Equity, Diversity, and Inclusion (EDI), including in all of its courses. The material covered in this course is mathematical in nature and is generally subject to these principles. For students who have accommodation needs, existing Student Accessibility Services (SAS) supports will be available to students who require specific accommodations.

Does this course contain any Indigenous content? ☐ **Yes** ☒ **No** ☐ **Unsure**

For more information on how Indigenous content is defined at Ontario Tech University and how to consult with the Indigenous Education Advisory Circle (IEAC), please refer to the Protocol for Consultation with the Indigenous Education Advisory Circle.

Has the IEAC been contacted? ☐ **Yes** ☒ **No**

If yes, when?

What was the advice you received from the IEAC, and how has it been included in your proposal?

Did the IEAC ask you to return the proposal to them for review? ☐ **Yes** ☐ **No**

If yes, have they completed their review? ☐ **Yes** ☐ **No** ☐ **N/A**

Financial Implications

None

Pre-Faculty Council Approval Dates (e.g. Curriculum Committee, Program Committee):

NEW COURSE TEMPLATE

For changes to existing courses see Course Change Template

New courses must be entered into Curriculog prior to Faculty Council. Please use this template to provide the information to your Curriculog contact.

Faculty: Faculty of Engineering and Applied Science	
This new course is associated with: ☐ Minor Program Adjustment ☐ Major Program Modification ☒ New Program ☐ None	
Will this course appear anywhere other than the course description section of the Calendar?	☒ **Yes** ☐ **No**

If you answered yes to the above, please complete:

A new core course for an existing program, specialization or minor*: Minor Program Adjustment*

A new elective course for an existing program, specialization or minor, listed in the program map*: Course Placement*

A new course (core or elective) related to a Major Program Modification*: Major Program Modification*

A new course (core or elective) related to a New Program*: New Program proposal*

Programs impacted: [Please list all impacted programs including any applicable fields or specializations.]

MASc in Mechatronics Engineering
MEng in Mechatronics Engineering

Calendar start date: (When the course should first appear in the Academic Calendar 2020-2021)

2024-2025

Registration start date: (The first time the course will be open for registration e.g. Fall 2020)

Winter 2024

Additional supporting information (optional; please indicate if you are attaching any additional documentation)

N/A

Subject Code: METE	**Course Number:** 5105G
Full Course Title: Nonlinear Control Systems	
Short-Form Course Title (max. 30 characters)**:** Nonlinear Control Systems	

Course Description

This course will cover nonlinear state space control systems. Specific topics include: dynamic systems; input-output analysis; stability and observability of nonlinear systems; Lyapunov stability and applications; dynamics systems and bifurcations; linearization by state feedback; and introduction to geometric control.

Credit Hours: 3		
Contact Hours – please indicate total number of hours for each component		
Lecture: 3		**Lab:**
Tutorial:		**Other:**
Cross-listings		
Prerequisites for Calendar		
Prerequisites for Banner		
Co-requisites		
Prerequisites with concurrency (pre or co-requisite)		
Credit restrictions		☐ **Equivalency***
Recommended Prerequisites		
Course Restrictions		
Course Type	☐ **Core** ☒ **Elective** ☐ **Core or Elective**	
Is the course: ☐ Undergraduate ☒ Graduate ☐ Professional (e.g. some Education courses)		
Grading scheme	☒ **N (normal alpha grade)** ☐ **P (pass/fail)**	

***Equivalency:** Two courses are similar enough in content that they are considered equivalent so students can register in either course but they will only receive credit for one course in their program.

Course instructional method:

CLS (In Class Delivery)	x	HYB (In Class and Online Delivery)	
IND (Individual Studies)		OFF (Off Site)	
WB1 (Virtual Meet Time – Synchronous)		WEB (Fully Online – Asynchronous)	
Not Applicable			

Teaching and assessment methods:

Assignments, midterms, projects, and/or final exam as determined by the instructor.

Learning outcomes: (for assistance developing course learning outcomes, please refer to the Teaching and Learning website, or contact them at teachingandlearning@ontariotechu.ca.)

Upon successful completion of this course, the students should be able to:

- Apply concepts of dynamics, electric circuits, actuators and power electronics, and other engineering concepts to model, analyze, and simulate complex nonlinear dynamic systems
- Apply concepts of linear algebra to assess and study the stability of complex dynamic systems and control systems
- Use appropriately engineering practice techniques, skills, and modern engineering tools
- Apply knowledge of calculus, science, and engineering to develop and analyze control systems

- Design and conduct simulations and analyze and interpret experimental data
- Communicate their work effectively

Does this course contain any experiential learning components? ☐ **Yes** ☒ **No**

If yes:

Case Study		Simulated Workplace Project	
Consulting project/workplace project		Applied Research	
Field Experiences			
Other Types of Experiences:			

We have consulted with all impacted areas: ☐ **Yes** ☒ **NA**

Process of consultation, if applicable:

Have you considered the principles of Equity, Diversity, Inclusion, or Decolonization included when creating this new course? ☒ **Yes** ☐ **No** **Please explain:**

The Faculty of Engineering and Applied Science (FEAS) is fully committed to Equity, Diversity, and Inclusion (EDI), including in all of its courses. The material covered in this course is mathematical in nature and is generally subject to these principles. For students who have accommodation needs, existing Student Accessibility Services (SAS) supports will be available to students who require specific accommodations.

Does this course contain any Indigenous content? ☐ **Yes** ☒ **No** ☐ **Unsure**

For more information on how Indigenous content is defined at Ontario Tech University and how to consult with the Indigenous Education Advisory Circle (IEAC), please refer to the Protocol for Consultation with the Indigenous Education Advisory Circle.

Has the IEAC been contacted? ☐ **Yes** ☒ **No**

If yes, when?

What was the advice you received from the IEAC, and how has it been included in your proposal?

Did the IEAC ask you to return the proposal to them for review? ☐ **Yes** ☐ **No**

If yes, have they completed their review? ☐ **Yes** ☐ **No** ☐ **N/A**

Financial Implications

None

Pre-Faculty Council Approval Dates (e.g. Curriculum Committee, Program Committee):

NEW COURSE TEMPLATE

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Faculty: Faculty of Engineering and Applied Science	
This new course is associated with: ☐ Minor Program Adjustment ☐ Major Program Modification ☒ New Program ☐ None	
Will this course appear anywhere other than the course description section of the Calendar?	☒ **Yes** ☐ **No**

If you answered yes to the above, please complete:

A new core course for an existing program, specialization or minor*: Minor Program Adjustment*

A new elective course for an existing program, specialization or minor, listed in the program map*: Course Placement*

A new course (core or elective) related to a Major Program Modification*: Major Program Modification*

A new course (core or elective) related to a New Program*: New Program proposal*

Programs impacted: [Please list all impacted programs including any applicable fields or specializations.]

MASc in Mechatronics Engineering
MEng in Mechatronics Engineering

Calendar start date: (When the course should first appear in the Academic Calendar 2020-2021)

2024-2025

Registration start date: (The first time the course will be open for registration e.g. Fall 2020)

Winter 2024

Additional supporting information (optional; please indicate if you are attaching any additional documentation)

N/A

Subject Code: METE	**Course Number:** 5106G
Full Course Title: Advanced System Dynamics	
Short-Form Course Title (max. 30 characters)**:** Advanced System Dynamics	

Course Description

In this course, students will be introduced to linear graph theory and its application to the modelling of rigid body dynamics and kinematics. Graph theory will be used to derive systems of equations to simulate and analyze the multibody dynamics and kinematics of complex systems. Non-linear system dynamic formulation and simulation will be covered with electro-mechanical application examples.

Credit Hours: 3			
Contact Hours – please indicate total number of hours for each component			
Lecture: 3		**Lab:**	
Tutorial:		**Other:**	
Cross-listings			
Prerequisites for Calendar			
Prerequisites for Banner			
Co-requisites			
Prerequisites with concurrency (pre or co-requisite)			
Credit restrictions		☐ **Equivalency***	
Recommended Prerequisites			
Course Restrictions			
Course Type	☐ **Core** ☒ **Elective** ☐ **Core or Elective**		
Is the course: ☐ Undergraduate ☒ Graduate ☐ Professional (e.g. some Education courses)			
Grading scheme	☒ **N (normal alpha grade)** ☐ **P (pass/fail)**		

***Equivalency:** Two courses are similar enough in content that they are considered equivalent so students can register in either course but they will only receive credit for one course in their program.

Course instructional method:

CLS (In Class Delivery)	x	HYB (In Class and Online Delivery)	
IND (Individual Studies)		OFF (Off Site)	
WB1 (Virtual Meet Time – Synchronous)		WEB (Fully Online – Asynchronous)	
Not Applicable			

Teaching and assessment methods:

Assignments, midterms, projects, and/or the final exam as determined by the instructor.

Learning outcomes: (for assistance developing course learning outcomes, please refer to the Teaching and Learning website, or contact them at teachingandlearning@ontariotechu.ca.)

Upon successful completion of this course, the students should be able to: • Model systems using linear graph theory • Generate equations for complex system configurations • Simulate non-linear system dynamics

Does this course contain any experiential learning components? ☐ **Yes** ☒ **No**

If yes:

Case Study		Simulated Workplace Project	
Consulting project/workplace project		Applied Research	
Field Experiences			
Other Types of Experiences:			

We have consulted with all impacted areas: ☐ **Yes** ☒ **NA**

Process of consultation, if applicable:

Have you considered the principles of Equity, Diversity, Inclusion, or Decolonization included when creating this new course? ☒ **Yes** ☐ **No** **Please explain:**

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Does this course contain any Indigenous content? ☐ **Yes** ☒ **No** ☐ **Unsure**

For more information on how Indigenous content is defined at Ontario Tech University and how to consult with the Indigenous Education Advisory Circle (IEAC), please refer to the Protocol for Consultation with the Indigenous Education Advisory Circle.

Has the IEAC been contacted? ☐ **Yes** ☒ **No**

If yes, when?

What was the advice you received from the IEAC, and how has it been included in your proposal?

Did the IEAC ask you to return the proposal to them for review? ☐ **Yes** ☐ **No**

If yes, have they completed their review? ☐ **Yes** ☐ **No** ☐ **N/A**

Financial Implications

None

Pre-Faculty Council Approval Dates (e.g. Curriculum Committee, Program Committee):

NEW COURSE TEMPLATE

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Faculty: Faculty of Engineering and Applied Science	
This new course is associated with: ☐ Minor Program Adjustment ☐ Major Program Modification ☒ New Program ☐ None	
Will this course appear anywhere other than the course description section of the Calendar?	☒ **Yes** ☐ **No**

If you answered yes to the above, please complete:

A new core course for an existing program, specialization or minor*: Minor Program Adjustment*

A new elective course for an existing program, specialization or minor, listed in the program map*: Course Placement*

A new course (core or elective) related to a Major Program Modification*: Major Program Modification*

A new course (core or elective) related to a New Program*: New Program proposal*

Programs impacted: [Please list all impacted programs including any applicable fields or specializations.]

MASc in Mechatronics Engineering
MEng in Mechatronics Engineering

Calendar start date: (When the course should first appear in the Academic Calendar 2020-2021)

2024-2025

Registration start date: (The first time the course will be open for registration e.g. Fall 2020)

Winter 2024

Additional supporting information (optional; please indicate if you are attaching any additional documentation)

N/A

Subject Code: METE	**Course Number:** 5107G
Full Course Title: Biomechatronic Systems	
Short-Form Course Title (max. 30 characters)**:** Biomechatronic Systems	

Course Description

This course addresses design, modeling, and control of mechatronic systems (i.e., mechanics, electronics, computer science, and system integration) with medical and biomechanical devices. Function and coordination of human motion shapes the core of the course. Detailed topics include biomechanics of human movement, biomedical signal acquisition, control and sensor interfaces and actuators, functional electrical stimulation, robotics for medical and rehabilitation applications, exoskeletons, upper and lower extremities smart artificial mechanical systems, and clinical engineering research. Students will complete problem analysis for related case studies. Students will identify the underlying cause of the problem and describe and explain possible conceptual design solutions. They will assess their conceptual designs and will develop the introduced controllers and analyze the mechatronic systems performance through simulation.

Credit Hours: 3		
Contact Hours – please indicate total number of hours for each component		
Lecture: 3	**Lab:**	
Tutorial:	**Other:**	
Cross-listings		
Prerequisites for Calendar		
Prerequisites for Banner		
Co-requisites		
Prerequisites with concurrency (pre or co-requisite)		
Credit restrictions	☐ **Equivalency***	
Recommended Prerequisites		
Course Restrictions		
Course Type	☐ **Core** ☒ **Elective** ☐ **Core or Elective**	
Is the course: ☐ Undergraduate ☒ Graduate ☐ Professional (e.g. some Education courses)		
Grading scheme	☒ **N (normal alpha grade)** ☐ **P (pass/fail)**	

***Equivalency:** Two courses are similar enough in content that they are considered equivalent so students can register in either course but they will only receive credit for one course in their program.

Course instructional method:

CLS (In Class Delivery)	x	HYB (In Class and Online Delivery)	
IND (Individual Studies)		OFF (Off Site)	
WB1 (Virtual Meet Time – Synchronous)		WEB (Fully Online – Asynchronous)	
Not Applicable			

Teaching and assessment methods:

Assignments, midterms, projects, and/or the final exam as determined by the instructor.

Learning outcomes: (for assistance developing course learning outcomes, please refer to the Teaching and Learning website, or contact them at teachingandlearning@ontariotechu.ca.)

By the end of this course, students should be able to:

- Understand concepts of statics, kinematics, and kinetics in human movement

- Evaluate movement and estimate force on human structures
- Process (debug, filter, and analyze) biological signals, including Electromyographic (EMG-muscles') signals, Electroencephalogram (ECG) signals (heart vital signal), electroencephalogram (EEG signals), etc.
- Understand the operation of biomedical signal acquisition instrumentation systems
- Gain an understating of the principles of functional electrical stimulation (FES)
- Discuss the various uses of FES in the rehabilitation of persons with neurological limitations
- Identify and describe healthcare robotics and artificial actuators, including Assistive, rehabilitative, and surgical robots
- Understand the concepts of sensing in assistive motor control systems
- Develop the analytical and experimental skills necessary to design and implement biomechatronic systems

Does this course contain any experiential learning components? ☒ **Yes** ☐ **No**

If yes:

Case Study	x	Simulated Workplace Project	
Consulting project/workplace project		Applied Research	
Field Experiences			
Other Types of Experiences:			

We have consulted with all impacted areas: ☐ **Yes** ☒ **NA**

Process of consultation, if applicable:

Have you considered the principles of Equity, Diversity, Inclusion, or Decolonization included when creating this new course? ☒ **Yes** ☐ **No** **Please explain:**

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Does this course contain any Indigenous content? ☐ **Yes** ☒ **No** ☐ **Unsure**

For more information on how Indigenous content is defined at Ontario Tech University and how to consult with the Indigenous Education Advisory Circle (IEAC), please refer to the Protocol for Consultation with the Indigenous Education Advisory Circle.

Has the IEAC been contacted? ☐ **Yes** ☒ **No**

If yes, when?

What was the advice you received from the IEAC, and how has it been included in your proposal?

Did the IEAC ask you to return the proposal to them for review? ☐ **Yes** ☐ **No**

If yes, have they completed their review? ☐ **Yes** ☐ **No** ☐ **N/A**

Financial Implications

None

Pre-Faculty Council Approval Dates (e.g. Curriculum Committee, Program Committee):

NEW COURSE TEMPLATE

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Faculty: Faculty of Engineering and Applied Science	
This new course is associated with: ☐ Minor Program Adjustment ☐ Major Program Modification ☒ New Program ☐ None	
Will this course appear anywhere other than the course description section of the Calendar?	☒ **Yes** ☐ **No**

If you answered yes to the above, please complete:

A new core course for an existing program, specialization or minor*: Minor Program Adjustment*

A new elective course for an existing program, specialization or minor, listed in the program map*: Course Placement*

A new course (core or elective) related to a Major Program Modification*: Major Program Modification*

A new course (core or elective) related to a New Program*: New Program proposal*

Programs impacted: [Please list all impacted programs including any applicable fields or specializations.]

MASc in Mechatronics Engineering
MEng in Mechatronics Engineering

Calendar start date: (When the course should first appear in the Academic Calendar 2020-2021)

2024-2025

Registration start date: (The first time the course will be open for registration e.g. Fall 2020)

Winter 2024

Additional supporting information (optional; please indicate if you are attaching any additional documentation)

N/A

Subject Code: METE	**Course Number:** 5108G
Full Course Title: Neuromechanics and Control of Human Movement	
Short-Form Course Title (max. 30 characters)**:** Neuromechanics of Human Movement	

Course Description

This course combines principles of mechanical system dynamics and control with motor neuroscience and musculoskeletal biomechanics to model and simulate how humans integrate sensory information, estimate, plan, control, and adapt movements. The topics include system dynamics to model human movement, concepts of inverse dynamics and forward dynamics and the general way to describe rigid-body motion in the Newton-Euler or Lagrange formulation, musculoskeletal and nervous systems interaction, neural strategies for the control of postures and motion, numerical and computational methods to simulate human movement, motor control learning and planning, and multisensory integration and filtering for the body state estimation.

Credit Hours: 3		
Contact Hours – please indicate total number of hours for each component		
Lecture: 3		**Lab:**
Tutorial:		**Other:**
Cross-listings		
Prerequisites for Calendar		
Prerequisites for Banner		
Co-requisites		
Prerequisites with concurrency (pre or co-requisite)		
Credit restrictions		☐ **Equivalency***
Recommended Prerequisites		
Course Restrictions		
Course Type	☐ **Core** ☒ **Elective** ☐ **Core or Elective**	
Is the course: ☐ Undergraduate ☒ Graduate ☐ Professional (e.g. some Education courses)		
Grading scheme	☒ **N (normal alpha grade)** ☐ **P (pass/fail)**	

***Equivalency:** Two courses are similar enough in content that they are considered equivalent so students can register in either course but they will only receive credit for one course in their program.

Course instructional method:

CLS (In Class Delivery)	x	HYB (In Class and Online Delivery)	
IND (Individual Studies)		OFF (Off Site)	
WB1 (Virtual Meet Time – Synchronous)		WEB (Fully Online – Asynchronous)	
Not Applicable			

Teaching and assessment methods:

Projects, assignments, midterms and/or final exam as determined by the instructor.

Learning outcomes: (for assistance developing course learning outcomes, please refer to the Teaching and Learning website, or contact them at teachingandlearning@ontariotechu.ca.)

By the end of this course, students should be able to: • Understand concepts of kinematics and kinetics in human movement • Derive the equations of motion for the upper and lower extremities of the human body • Explain optimal feedback control theory and its application to human movement

- Discuss the effect of perturbation and changes in systems that are involved in controlling postures on the stability
- Develop mathematical models of postural control and control of movement in MATLAB
- Implement multisensory integration and Kalman filtering to improve posture state estimation
- Understand multi-rate and V-shaped learning models
- Employ learning models to predict motor adaptation to kinematic and dynamic perturbations

Does this course contain any experiential learning components? ☒ **Yes** ☐ **No**

If yes:

Case Study		Simulated Workplace Project	
Consulting project/workplace project		Applied Research	x
Field Experiences			
Other Types of Experiences:			

We have consulted with all impacted areas: ☐ **Yes** ☒ **NA**

Process of consultation, if applicable:

Have you considered the principles of Equity, Diversity, Inclusion, or Decolonization included when creating this new course? ☒ **Yes** ☐ **No** **Please explain:**

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Does this course contain any Indigenous content? ☐ **Yes** ☒ **No** ☐ **Unsure**

For more information on how Indigenous content is defined at Ontario Tech University and how to consult with the Indigenous Education Advisory Circle (IEAC), please refer to the Protocol for Consultation with the Indigenous Education Advisory Circle.

Has the IEAC been contacted? ☐ **Yes** ☒ **No**

If yes, when?

What was the advice you received from the IEAC, and how has it been included in your proposal?

Did the IEAC ask you to return the proposal to them for review? ☐ **Yes** ☐ **No**

If yes, have they completed their review? ☐ **Yes** ☐ **No** ☐ **N/A**

Financial Implications

None

Pre-Faculty Council Approval Dates (e.g. Curriculum Committee, Program Committee):

NEW COURSE TEMPLATE

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Faculty: Faculty of Engineering and Applied Science	
This new course is associated with: ☐ Minor Program Adjustment ☐ Major Program Modification ☒ New Program ☐ None	
Will this course appear anywhere other than the course description section of the Calendar?	☐ **Yes** ☒ **No**

If you answered yes to the above, please complete:

***A new core course for an existing program, specialization or minor**: Minor Program Adjustment*

***A new elective course for an existing program, specialization or minor, listed in the program map**: Course Placement*

***A new course (core or elective) related to a Major Program Modification**: Major Program Modification*

***A new course (core or elective) related to a New Program**: New Program proposal*

Programs impacted: [Please list all impacted programs including any applicable fields or specializations.]

MASc in Mechatronics Engineering
MEng in Mechatronics Engineering

Calendar start date: (When the course should first appear in the Academic Calendar 2020-2021)

2024-2025

Registration start date: (The first time the course will be open for registration e.g. Fall 2020)

Winter 2024

Additional supporting information (optional; please indicate if you are attaching any additional documentation)

N/A

Subject Code: METE	**Course Number:** 5280G
Full Course Title: Robotic Manipulators	
Short-Form Course Title (max. 30 characters)**:** Robotic Manipulators	

Course Description

Industrial robots; robot kinematics, differential kinematics; statics, dynamics and control of robot arms; noncontact and contact sensors; actuators; real-time joint control; task planning and programming of industrial robots; applications of robots.

Credit Hours: 3		
Contact Hours – please indicate total number of hours for each component		
Lecture: 3		**Lab:** 2 (bi-weekly)
Tutorial: 1		**Other:**
Cross-listings	MANE 4280U - Robotics and Automation	
Prerequisites for Calendar		
Prerequisites for Banner		
Co-requisites		
Prerequisites with concurrency (pre or co-requisite)		
Credit restrictions		☐ **Equivalency***
Recommended Prerequisites		
Course Restrictions		
Course Type	☐ **Core** ☒ **Elective** ☐ **Core or Elective**	
Is the course: ☐ Undergraduate ☒ Graduate ☐ Professional (e.g. some Education courses)		
Grading scheme	☒ **N (normal alpha grade)** ☐ **P (pass/fail)**	

***Equivalency:** Two courses are similar enough in content that they are considered equivalent so students can register in either course but they will only receive credit for one course in their program.

Course instructional method:

CLS (In Class Delivery)	x	HYB (In Class and Online Delivery)	
IND (Individual Studies)		OFF (Off Site)	
WB1 (Virtual Meet Time – Synchronous)		WEB (Fully Online – Asynchronous)	
Not Applicable			

Teaching and assessment methods:

Assignments, labs, midterms, projects, and/or final exam as determined by the instructor.

Learning outcomes: (for assistance developing course learning outcomes, please refer to the Teaching and Learning website, or contact them at teachingandlearning@ontariotechu.ca.)

Upon successful completion of this course, the students should be able to: • Classify industrial robots and know the uses of industrial robots. • Analyze the kinematics associated with complex robot motion. • Establish the dynamics of robot arms and how to control the arms. • Understand the basics on non-contact and contact sensors as used in robots. • Analyze actuators and real-time joint control systems. • Establish the methodology for the task planning and programming of industrial robots.

- Work with a wide variety of applications of industrial robots.

Does this course contain any experiential learning components? ☐ **Yes** ☒ **No**

If yes:

Case Study		Simulated Workplace Project	
Consulting project/workplace project		Applied Research	
Field Experiences			
Other Types of Experiences:			

We have consulted with all impacted areas: ☐ **Yes** ☒ **NA**

Process of consultation, if applicable:

Have you considered the principles of Equity, Diversity, Inclusion, or Decolonization included when creating this new course? ☒ **Yes** ☐ **No** **Please explain:**

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Does this course contain any Indigenous content? ☐ **Yes** ☒ **No** ☐ **Unsure**

For more information on how Indigenous content is defined at Ontario Tech University and how to consult with the Indigenous Education Advisory Circle (IEAC), please refer to the Protocol for Consultation with the Indigenous Education Advisory Circle.

Has the IEAC been contacted? ☐ **Yes** ☒ **No**

If yes, when?

What was the advice you received from the IEAC, and how has it been included in your proposal?

Did the IEAC ask you to return the proposal to them for review? ☐ **Yes** ☐ **No**

If yes, have they completed their review? ☐ **Yes** ☐ **No** ☐ **N/A**

Financial Implications

None

Pre-Faculty Council Approval Dates (e.g. Curriculum Committee, Program Committee):

NEW COURSE TEMPLATE

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Faculty: Faculty of Engineering and Applied Science	
This new course is associated with: ☐ Minor Program Adjustment ☐ Major Program Modification ☒ New Program ☐ None	
Will this course appear anywhere other than the course description section of the Calendar?	☒ **Yes** ☐ **No**

If you answered yes to the above, please complete:

A new core course for an existing program, specialization or minor*: Minor Program Adjustment*

A new elective course for an existing program, specialization or minor, listed in the program map*: Course Placement*

A new course (core or elective) related to a Major Program Modification*: Major Program Modification*

A new course (core or elective) related to a New Program*: New Program proposal*

Programs impacted: [Please list all impacted programs including any applicable fields or specializations.]

MASc in Mechatronics Engineering
MEng in Mechatronics Engineering

Calendar start date: (When the course should first appear in the Academic Calendar 2020-2021)

2024-2025

Registration start date: (The first time the course will be open for registration e.g. Fall 2020)

Winter 2024

Additional supporting information (optional; please indicate if you are attaching any additional documentation)

N/A

Subject Code: METE	**Course Number:** 5300G
Full Course Title: Mobile Robotics	
Short-Form Course Title (max. 30 characters)**:** Mobile Robotics	

Course Description

Students will learn the basics of mobile robotics through a series of open-ended projects in a hands-on learning environment. Topics covered, include: locomotion; mobile robot kinematics; perception; mapping and localization; and path planning, obstacle avoidance, and navigation.

Credit Hours: 3		
Contact Hours – please indicate total number of hours for each component		
Lecture: 3		**Lab:** 3
Tutorial:		**Other:**
Cross-listings	METE 4300U – Introduction to Mobile Robotics	
Prerequisites for Calendar		
Prerequisites for Banner		
Co-requisites		
Prerequisites with concurrency (pre or co-requisite)		
Credit restrictions	ENGR 5945G – Mobile Robotic Systems	☒ **Equivalency***
Recommended Prerequisites		
Course Restrictions		
Course Type	☐ **Core** ☒ **Elective** ☐ **Core or Elective**	
Is the course: ☐ Undergraduate ☒ Graduate ☐ Professional (e.g. some Education courses)		
Grading scheme	☒ **N (normal alpha grade)** ☐ **P (pass/fail)**	

***Equivalency:** Two courses are similar enough in content that they are considered equivalent so students can register in either course but they will only receive credit for one course in their program.

Course instructional method:

CLS (In Class Delivery)	x	HYB (In Class and Online Delivery)	
IND (Individual Studies)		OFF (Off Site)	
WB1 (Virtual Meet Time – Synchronous)		WEB (Fully Online – Asynchronous)	
Not Applicable			

Teaching and assessment methods:

Assignments, labs, midterms, projects, and/or final exam as determined by the instructor.

Learning outcomes: (for assistance developing course learning outcomes, please refer to the Teaching and Learning website, or contact them at teachingandlearning@ontariotechu.ca.)

Upon successful completion of this course, the students should be able to: • Understand the fundamentals of mobile robot locomotion including wheeled and legged systems • Understand the kinematics and low-level control of mobile robotic systems • Become familiar with methods of robotic perception and sensor data interpretation • Become familiar with various localization schemes • Understand the principles and methods of mapping, obstacle avoidance, path planning, and navigation

Does this course contain any experiential learning components? ☒ **Yes** ☐ **No**

If yes:

Case Study		Simulated Workplace Project	
Consulting project/workplace project		Applied Research	X
Field Experiences			
Other Types of Experiences:			

We have consulted with all impacted areas: ☐ **Yes** ☒ **NA**

Process of consultation, if applicable:

Have you considered the principles of Equity, Diversity, Inclusion, or Decolonization included when creating this new course? ☒ **Yes** ☐ **No** **Please explain:**

The Faculty of Engineering and Applied Science (FEAS) is fully committed to Equity, Diversity, and Inclusion (EDI), including in all of its courses. The material covered in this course is mathematical in nature and is generally subject to these principles. For students who have accommodation needs, existing Student Accessibility Services (SAS) supports will be available to students who require specific accommodations.

Does this course contain any Indigenous content? ☐ **Yes** ☒ **No** ☐ **Unsure**

For more information on how Indigenous content is defined at Ontario Tech University and how to consult with the Indigenous Education Advisory Circle (IEAC), please refer to the Protocol for Consultation with the Indigenous Education Advisory Circle.

Has the IEAC been contacted? ☐ **Yes** ☒ **No**

If yes, when?

What was the advice you received from the IEAC, and how has it been included in your proposal?

Did the IEAC ask you to return the proposal to them for review? ☐ **Yes** ☐ **No**

If yes, have they completed their review? ☐ **Yes** ☐ **No** ☐ **N/A**

Financial Implications

None

Pre-Faculty Council Approval Dates (e.g. Curriculum Committee, Program Committee):

COURSE CHANGE TEMPLATE

For new courses see New Course Template
Changes to courses must be entered into Curriculog prior to Faculty Council. Please use this template to provide the information to your Curriculog contact. If you are uncertain about a change or definitions of terms used on this form, please reach out to your Curriculog contact, or ciqe@ontariotechu.ca.

Faculty: Faculty of Engineering and Applied Science	
Course Level	☐ **Undergraduate** ☒ **Graduate**

COURSE CHANGES (check all that apply)

☐	Contact hours	☐	Cross-listings
☐	Co-requisites	☐	Experiential Learning
☐	Course description	☐	Grade Mode (N – alpha grade, P – Pass/Fail)
☐	Course Instructional Method (CLS, HYB, WB1, WEB)	☐	Learning outcomes
☐	Course number or course Subject code	☐	Prerequisites
☐	Course title (include new short form title)	☐	Delete course from Academic Calendar
☒	Credit restrictions and/or Equivalencies	☐	Teaching and assessment methods
☐	Credit weighting	☐	Course restrictions
☐	Deleting an Elective Shown in the Program Map	☐	Other (please specify):

IS THIS COURSE CHANGE ASSOCIATED WITH A PROGRAM PROPOSAL? ☒ **Yes** ☐ **No**

REASON FOR CHANGE AND WAYS IN WHICH IT MAINTAINS/ENHANCES COURSE/PROGRAM OBJECTIVES

As part of the new MASc/MEng in Mechatronics Engineering, the content of the new course METE 5300G – Mobile Robotics is too similar to the content of the existing course ENGR 5945G – Mobile Robotic Systems. Note METE 5300G is being created to allow the offering of a joint fourth-year/graduate course on mobile robotics.

FINANCIAL IMPLICATIONS

CALENDAR START DATE (When the course should first appear in the Academic Calendar e.g. 2020-2021)

2024-2025

REGISTRATION START DATE (The first time the course will be open for registration e.g. Fall 2020)

Fall 2024

ADDITIONAL SUPPORTING INFORMATION (optional; please indicate if you are attaching any additional documentation)

N/A

COURSE INFORMATION

Subject Code: ENGR	**Course Number:** 5945G
Full Course Title: Mobile Robotic Systems	
Short-Form Course Title (max. 30 characters): Mobile Robotic Systems	

CHANGE TO CALENDAR DESCRIPTION (if required)

Current	**Proposed**

CHANGE TO CREDIT AND CONTACT HOURS [if applicable, indicate changes to total contact hours only; changes to frequency (e.g. 1x3 hours to 2X1.5 hours) not required]:

Credit Hours	
Lecture	Lab
Tutorial	Other

OTHER CHANGES (if applicable)

Cross-listings	
Prerequisites for Calendar and Banner	
Co-requisites	
Prerequisites with concurrency (pre or co-requisite)	
Credit restrictions	METE 5300G – Mobile Robotics ☒ **Equivalency***
Recommended Prerequisites	
Course Restrictions	
Course Type	☐ **Core** ☐ **Elective** ☐ **Core or Elective**
Grading scheme	☐ **N (normal alpha grade)** ☐ **P (pass/fail)**

***Equivalency:** Two courses are similar enough in content that they are considered equivalent so students can register in either course but they will only receive credit for one course in their program.

CHANGES TO COURSE INSTRUCTIONAL METHOD (if applicable):

CLS (In Class Delivery)		HYB (In Class and Online Delivery)	

IND (Individual Studies)		OFF (Off Site)	
WB1 (Virtual Meet Time – Synchronous)		WEB (Fully Online – Asynchronous)	
Not Applicable			

CHANGES TO TEACHING AND ASSESSMENT METHODS (if applicable)

N/A

CHANGES TO LEARNING OUTCOMES (if applicable; for assistance developing course learning outcomes, please refer to the Teaching and Learning website, or contact them at teachingandlearning@ontariotechu.ca.)

N/A

DOES THIS COURSE CONTAIN ANY EXPERIENTIAL LEARNING COMPONENTS?
If yes:

Case Study		Simulated Workplace Project	
Consulting project/workplace project		Applied Research	
Field Experiences			
Other Types of Experiences:			

CONSULTATION (Curriculog contact to complete an Impact Report)

N/A

DOES THIS COURSE CHANGE IMPACT BOTH THE UNDERGRADUATE AND GRADUATE CALENDARS?
☐ **Yes** ☒ **No**

WE HAVE CONSULTED WITH ALL IMPACTED AREAS? ☐ **Yes** ☒ **NA**
Please describe:

ARE THERE ANY CONSIDERATIONS FOR THE PRINCIPLES OF EQUITY, DIVERSITY, INCLUSION, OR DECOLONIZATION INCLUDED WITH THIS COURSE CHANGE? ☐ **Yes** ☒ **No** **Please explain:**

N/A

DOES THIS COURSE CONTAIN ANY INDIGENOUS CONTENT? ☐ **Yes** ☒ **No** ☐ **Unsure**
For more information on how Indigenous content is defined at Ontario Tech University and how to consult with the Indigenous Education Advisory Circle (IEAC), please refer to the Protocol for Consultation with the Indigenous Education Advisory Circle.

HAS THE IEAC BEEN CONTACTED? ☐ **Yes** ☐ **No**

If yes, when?

WHAT WAS THE ADVICE YOU RECEIVED FROM THE IEAC, AND HOW HAS IT BEEN INCLUDED IN YOUR PROPOSAL?

DID THE IEAC ASK YOU TO RETURN THE PROPOSAL TO THEM FOR REVIEW? ☐ **Yes** ☐ **No**

IF YES, HAVE THEY COMPLETED THEIR REVIEW? ☐ **Yes** ☐ **No** ☐ **N/A**

Pre-Faculty Council Approval Dates (e.g. Curriculum Committee, Program Committee):

Appendix C – Existing Course Descriptions

The following courses are existing courses in the programs:

ENGR 5001G - MASc Thesis
ENGR 5002G - MEng/MEngM Project
ENGR 5004G - MASc/MEng Directed Studies
ENGR 5005G - Special Topics
ENGR 5010G - Advanced Optimization
ENGR 5012G - Advanced and Smart Materials
ENGR 5013G - Advanced Engineering Mathematics
ENGR 5200G - Programming Methodology and Abstraction for Engineers
ENGR 5201G - Engineering Communications and Ethics
ENGR 5240G - Advanced Dynamics
ENGR 5245G - Micro and Nano Manufacturing
ENGR 5260G - Advanced Robotics and Automation
ENGR 5261G - Advanced Mechatronics: MEMS and Nanotechnology
ENGR 5262G - Manipulator and Mechanism Design
ENGR 5263G - Advanced Control
ENGR 5271G - Innovative Design Engineering
ENGR 5273G - Design by Failure
ENGR 5410G - Project Management for Engineers
ENGR 5510G - Foundations of Software Engineering
ENGR 5520G - Software Development Methods and Tools
ENGR 5605G - Convex Optimization
ENGR 5910G - Embedded Real-Time Control Systems
ENGR 5915G - Discrete Time Control Systems
ENGR 5930G - Adaptive Control
ENGR 5940G - Intelligent Control Systems
ENGR 5945G - Mobile Robotic Systems
ENGR 5946G - Advanced Fluid Power Control and Simulation

ENGR 5001G - MASc Thesis
The thesis is the major component of the MASc program and is carried out under the direction of the student's supervisor. The thesis may involve an investigation that is fundamental in nature or may be applied incorporating creative design. Through the thesis, candidates are expected to give evidence of competence in research and a sound understanding of the area of specialization involved. The student will receive a grade of either pass or fail.

ENGR 5002G - MEng/MEngM Project
The master's project provides students with the opportunity, under the supervision of a faculty member, to integrate and synthesize knowledge gained throughout their program of study. The chosen topic will be dependent on the area of specialization of the student. The student will receive a grade of either pass or fail.

ENGR 5004G - MASc/MEng Directed Studies
Faculty permission may be given for supervised research projects, individual study, or directed readings. MASc/ MEng students wishing to pursue a course of directed studies must, with a faculty member who is willing to supervise such a course, formulate a proposal accurately describing the course content, the learning goals, the intended method and extent of supervision, and the method by which work will be evaluated. This course may only be taken once.

ENGR 5005G - Special Topics
Presents material in an emerging field or one not covered in regular offerings. This course may be taken more than once, provided the subject matter is substantially different.

ENGR 5010G - Advanced Optimization
The objective of this course is to understand the principles of optimization and its application to engineering problems. Topics covered include the steepest descent and Newton methods for unconstrained optimization; golden section, quadratic, cubic and inexact line searches; conjugate and quasi-Newton methods; the Fletcher-Reeves algorithm; fundamentals of constrained optimization theory; simplex methods for linear programming; modern interior-point methods; active-set methods and primal-dual interior point methods for quadratic and convex programming; semi-definite programming algorithms; sequential quadratic programming; and interior-point methods for non-convex optimization. In addition, implementation issues and current software packages/algorithms for optimization will be covered. Global optimization, including genetic algorithms and simulated annealing, will be introduced.

ENGR 5012G - Advanced and Smart Materials
The core material will consist of basic features of physical transducer behaviour, mathematical constitutive models and material properties, characterization methods and experimental data, sensor and actuator devices, translation of material behaviour to device behaviour, solid state devices, nonsolid state devices (motors and pumps), mesoscale and MEMS devices, and adaptive structures. However, due to the rapid evolutions in the field, the syllabus will be

dynamic to respond to the new developments in materials and their applications. The topics will be continually reviewed and monitored for currency. Selected topics from the following list will also be covered: fundamental principles, mechanisms and applications of piezoelectric materials, 'negative' materials, conductive polymers, advanced composites, shape memory materials, magnetorheological fluids and intelligent textiles.

ENGR 5013G - Advanced Engineering Mathematics
Review of fundamentals of linear algebra; eigenvalue, singular value, Cholesky and QR decompositions; properties and applications; Topelitz matrices; Laplace transforms; Fourier analysis; conformal transformation; selected topics in ordinary and partial differential equations.

ENGR 5200G - Programming Methodology and Abstraction for Engineers
This course is intended for MEng students with little or no programming experience. It provides students with a solid foundation of programming techniques and tools for engineering computer applications. Students will gain an understanding and hands-on knowledge of popular programming language facilities, common data structures, manipulating data, programming style, testing and debugging, version control, and other good software engineering principles such as encapsulation and abstraction. The course will start with simple fundamental programming constructs but moves quickly to advanced topics to enable students to build and enhance their programming skills and develop applications to accomplish useful goals.

ENGR 5201G - Engineering Communications and Ethics
Engineers must be able to analyze, interpret, and create a variety of communications for a wide range of audiences. In this course, students will learn the principles of professional oral, written, visual, and interpersonal communication required to effectively communicate engineering innovations in an engineering career. Students will become familiar with common forms of engineering communications, such as research papers, reports, briefs, memos, proposals, academic posters, emails, and conference presentations. In addition, students will gain practical experience producing informative, persuasive, and professional written and oral communication of their own. Students will also learn the ethical aspects of engineering practice, research ethics and best practices in ethics, academic integrity, and proper engineering citation.

ENGR 5245G - Micro and Nano Manufacturing
This course will cover principles of fabrication and characterization technologies in micro and nano scale to learn major applications and principles of micro/nano systems in photonics, ICs and MEMS, and biomedical devices. The course will address specific techniques, such as photolithography, thin-film deposition, Chemical Vapor Deposition (CVD), Physical Vapor Deposition (PVD), advanced lithography, etc. The optical, electron and probe microscopy techniques for imaging at the micro and nano scale will be discussed. Also, the current status and future of micro and nano manufacturing in the field of microelectronics, photonics and biomedical engineering will be discussed in this course.

ENGR 5260G - Advanced Robotics and Automation
This course builds upon the knowledge students have gained in a first robotics course to cover more advanced kinematics topics and their application to more complex robotic systems such as redundant manipulators and parallel mechanisms. Topics covered include point, direction, line and screw motion descriptions; homogeneous transformations; line and screw coordinates; quaternion representations; inverse displacement solutions by analytic, root finding, hybrid and numerical methods; appropriate frames of reference; screw systems and transforms; local and globally optimum solutions of redundant rates; over determined and near degenerate solutions; singularity analysis; and parallel manipulator kinematics.

ENGR 5261G - Advanced Mechatronics: MEMS and Nanotechnology
This course is designed to be an introduction to micro-electromechanical systems (MEMS) and nanotechnology and their applications. Topics covered include introduction to MEMS and nanotechnology, working principles of MEMS and nanotechnology, design and fabrication of MEMS and nano-systems, microfabrication and micromachining, materials for MEMS and nanotechnology and applications of MEMS and nanotechnology.

ENGR 5262G - Manipulator and Mechanism Design
This course is designed to teach students the necessary skills to design or synthesize mechanisms and manipulators to perform desired tasks. Topics covered include synthesis of mechanisms for function generation, path generation and rigid body guidance; graphical, analytical and optimization based methods of synthesis; mechanism cognates, Chebychev spacing, Burmister curves; manipulator joint layout synthesis for spatial positioning and orientation; conditions of singularity and uncertainty; and solution of nonlinear problems of kinetics involved in mechanism synthesis using compatibility equations, 1/2 angle substitutions and dialytic elimination.

ENGR 5263G - Advanced Control
This course builds upon the knowledge students have gained in a first control course to cover more materials in advanced control systems. Topics covered include a. State variables and state space models: relations between state space models and the transfer function models (controllable and observable canonical forms, and diagonal form), Jordan form, solutions of linear state equations, transition matrix. b. Controllability and observability: definition and criteria, state feedback and output feedback, pole assignment via state feedback, design of servo controlled systems. c. State estimation and observer: observer state-variable feedback control. d. Multi-input multi-output (MIMO) systems: pole assignment via state feedback. e. Introduction to nonlinear systems: describing functions for kinds of nonlinear systems (on/off, dry friction, dead one, saturation and hystersis), phase plane trajectories, concept of limit cycle. f. Stability analysis: Lyapunov function and Lyapunov stability criterion. g. Introduction to optimal control: linear quadratic regulator (LQR), Riccati equation, properties of LQR systems. h. Sampled data systems: pulse transfer function, zero and first order hold systems, stability and root locus in the z-plane, transformations, Routh Hurwitz stability criterion in the z-plane, system compensation in the z-plane using root locus and generalized PID controllers.

ENGR 5271G - Innovative Design Engineering
This course introduces students to the theory, tools and techniques of innovative design engineering and creative problem-solving. The design process in engineering is considered and addressed by stressing its most creative aspects, especially problem definition and concept generation, through emphasis on current industry best practices. A short history of creative engineering solutions, effective methods for communicating new ideas, techniques for creative solutions, and cost effectiveness and tools for innovation are considered and thoroughly addressed. The course involves fundamental coverage of principles of inventive problem solving (TRIZ). TRIZ provides a dialectic way of thinking, i.e., to understand the problem as a system, to make an image of the ideal solution first and to solve contradictions. The course involves hands-on use of computer-aided design (CAD) tools and project management software in engineering applications.

ENGR 5273G - Design by Failure
This course examines the nature of design failure and shows how analysis of failure can be used in improving new designs. Through analysis of historical and contemporary case studies of catastrophes well known worldwide, students acquire learning experiences from past mistakes to avoid repeating them in the future. The course covers Shippaigaku, the Japanese way to research accidents, scandals and other failures to uncover the root cause, reveal the scenario that led to the unwanted event and describe what happened so students can clearly repeat the steps in their mind and propose ways to avoid those mistakes in the future. Various other methods for failure mode identification are also covered.

ENGR 5410G - Project Management for Engineers
This course prepares engineers for the effective application of project management to their work. It covers the following topics: project integration, project scope, cost management, time management, engineering quality, human resources, project communications, risk management and procurement management. The course uses the Project Management Institute's (PMI) Project Management Body of Knowledge (PMBOK) with relevant examples from nuclear, software and other fields of engineering. Special emphasis is placed on Risk Management, particularly in the area of safety-critical engineering projects. The student will be well-positioned both to apply the knowledge in their area of engineering and to write the PMI's Project Management Professional (PMP) examination.

ENGR 5510G - Foundations of Software Engineering
This course introduces students to the state-of-the-art in software engineering covering all areas from the Software Engineering Body of knowledge, along with trends in software engineering. Topics include lifecycle models and methodologies, software requirements and design, architectural styles, software specification and implementation, testing and quality assurance, maintenance, evolution, professional practice and economics, and emerging trends in software engineering.

ENGR 5520G - Software Development Methods and Tools
This course surveys the practical software development methods and tools methods for analysis, design, construction and measurement of large-scale software-intensive systems. Topics include methods and tools for program development to meet specifications, application development frameworks, test-driven development, model-based software development, state machine methods, concurrency control, module specification techniques such as first-order logic, trace specification, weakest preconditions. Trends in development methods and tools such as virtualized environments and containers, version control, continuous integration, DevOps.

ENGR 5605G - Convex Optimization
This course concentrates on recognizing and solving convex optimization problems that arise in engineering. The topics covered in this course include basics of convex analysis, such as convex sets, convex functions and convex optimization problems; log-concave and log-convex functions; quasi-convex and quasi-concave functions; convexity with respect to generalized inequality; least-squares; linear and quadratic programs; semi-definite programming; geometric programming; minimax; extemal volume; optimality conditions; Lagrange dual functions and problems; duality theory; theorems of alternative and applications; algorithms for solving unconstrained and constrained optimization problems; interior-point methods; applications to signal processing, control, digital and analog circuit design; computational geometry; and statistics.

ENGR 5915G - Discrete Time Control Systems
This course covers sample-and-hold systems, discretization of analog systems, discrete-time systems analysis and design and effects of sampling on controllability and observability, pulse transfer function, zero and first order hold systems, stability and root locus in the z-plane, transformations, Routh-Hurwitz stability criterion in the z-plane, pole-placement for discrete time systems and generalized PID controllers.

ENGR 5930G - Adaptive Control
This is a course on the general principles of adaptive control and learning. This course will cover real-time parameter estimation, deterministic self-turning regulators, stochastic and predictive self-tuning regulators, model reference adaptive systems, gain-scheduling, properties of adaptive systems, robust adaptive control schemes, adaptive control of nonlinear systems, and practical issues and implementation.

ENGR 5940G - Intelligent Control Systems
With the advance of increasingly faster computing hardware and cheaper memory chips, computational intelligence, also known as a part of soft computation, is becoming more and more important in control engineering. This course will equip students with the essential knowledge and useful resources to solve some of the systems control problems not easily solved using conventional control methods. This course will cover fundamentals of fuzzy set theory, structures of fuzzy logic controllers, structures of neural networks, learning algorithms and genetic algorithms.

ENGR 5945G - Mobile Robotic Systems
This course covers kinematics models and motion control for mobile robots; navigation, including path planning, obstacle avoidance and techniques for decomposition, localization using odometry, map representation, map building and introduction to probabilistic map-based localization; Kalman filter localization and other localization systems; computer vision, including imaging and image representation, feature extraction, pattern recognition, motion from 2D image sequences, image segmentation, sensing and object pose computation, and virtual reality.

ENGR 5946G - Advanced Fluid Power Control and Simulation
The fluid power systems (FPS) plays an indispensable role in motion and force actuation for various applications in industrial sectors such as automotive, automation, construction, and agriculture. The objective of this course is to introduce advanced technologies on FPS, to understand the principles of FPS modeling and control design, and to learn computational skills using the commercial simulation software, Amesim, that enables modeling/analysis/control of physical multi-domain systems (i.e., mechanical, thermal, fluid, control, electromechanical and mechatronics) and provides a co-simulation interface with Matlab/Simulink. The course covers topics in both theories (introduction to electro-hydraulic actuator (EHA) applications, operational principles of FPS, core components of FPS including independent-metering valve, electro-hydraulic circuit analysis, and design of control algorithms using several control techniques such as fuzzy logic, sliding mode control, etc.) and computer simulations (modeling of mechanical/hydraulic parts/FPS systems, planar mechanical model, co-simulation with Amesim plant model and Matlab/Simulink control model, and data analysis techniques).

Appendix D – Calendar Copy

Mechatronics Engineering, MASc

General information

The Master of Applied Science (MASc) in Mechatronics Engineering allows a student to study all of the main areas associated with mechatronics engineering. Mechatronics engineering is an interdisciplinary discipline featuring aspects of mechanical engineering, electrical engineering, software engineering, and controls. Opportunities exist for graduate students to explore these areas. Topics can vary widely and may include robotics, autonomous systems, biomechatronics, controls, and artificial intelligence and machine learning.

Admission requirements

In addition to the general admission requirements for graduate studies, applicants must meet the following program-specific requirements:

Completion of an undergraduate engineering degree in a relevant field from an accredited engineering program at a Canadian university, or its equivalent from a recognized institution. Overall academic standing of at least a B (GPA: 3.0 on a 4.3 scale), with a minimum B in the last two full-time years (four semesters) of undergraduate work or equivalent. B+ is preferred for MASc applicants.

Applicants must possess maturity and self-motivation. Close technical contact with a research supervisor is essential in research-based engineering programs. Prior to being accepted into the program, MASc applicants must find a faculty member who specializes in their desired area of research and who is willing to act as their thesis research supervisor.

A current list of graduate faculty is available on the Faculty of Engineering and Applied Science's website.

Part-time studies

To facilitate access to all potential students, part-time studies are permitted.

Degree requirements

The objective of the MASc program in Mechatronics Engineering is to prepare students for careers in research, development, and advanced engineering. Graduates of the program will be able to work as engineers in research and development or other areas in advanced technology companies or government agencies, or continue their education and pursue a PhD degree. The

objectives of the MASc program are achieved through a combination of course work, supervised research, a research seminar, and a research thesis.

For the MASc in Mechatronics Engineering, students must complete five courses for a total of 15 credits and a thesis worth 15 credits. Students must also successfully complete METE 5003G - MASc Seminar for Mechatronics Engineering and ENGR 5001G - MASc Thesis.

Undergraduate courses

In addition to the required graduate courses, students may take only one senior year undergraduate engineering course (i.e., with prefix ENGR 4xxxU) in lieu of a graduate-level course, provided they have not already taken a similar course during their undergraduate degree and the course is approved by both the student's supervisor and the graduate program director.

Courses outside of the program

Courses in other graduate programs at the university may be taken provided that students have not taken similar courses during their undergraduate or master's degrees and the courses are approved by the graduate program director. At least half of a student's courses must be within their program in the Faculty of Engineering and Applied Science. Students who wish to take courses outside of their program must gain approval from the graduate program director. Students who are uncertain about the academic background needed for a graduate course should consult the course instructor before registering for the course.

Course listing

The following list shows all courses relevant to the MASc in Mechatronics Engineering graduate program:

ENGR 5001G - MASc Thesis
ENGR 5004G - MASc/MEng Directed Studies
ENGR 5005G - Special Topics
ENGR 5010G - Advanced Optimization
ENGR 5012G - Advanced and Smart Materials
ENGR 5013G - Advanced Engineering Mathematics
ENGR 5200G - Programming Methodology and Abstraction for Engineers
ENGR 5201G - Engineering Communications and Ethics
ENGR 5240G - Advanced Dynamics
ENGR 5245G - Micro and Nano Manufacturing
ENGR 5260G - Advanced Robotics and Automation
ENGR 5261G - Advanced Mechatronics: MEMS and Nanotechnology
ENGR 5262G - Manipulator and Mechanism Design
ENGR 5263G - Advanced Control

ENGR 5271G - Innovative Design Engineering
ENGR 5273G - Design by Failure
ENGR 5410G - Project Management for Engineers
ENGR 5510G - Foundations of Software Engineering
ENGR 5520G - Software Development Methods and Tools
ENGR 5605G - Convex Optimization
ENGR 5910G - Embedded Real-Time Control Systems
ENGR 5915G - Discrete Time Control Systems
ENGR 5930G - Adaptive Control
ENGR 5940G - Intelligent Control Systems
ENGR 5945G - Mobile Robotic Systems
ENGR 5946G - Advanced Fluid Power Control and Simulation
METE 5003G - MASc Seminar for Mechatronics Engineering
METE 5101G - Artificial Intelligence and Machine Learning Methods and Applications
METE 5102G - Control Design in Robotic Systems
METE 5103G - Model Predictive Control
METE 5104G - Multivariable Feedback Control
METE 5105G - Nonlinear Control Systems
METE 5106G - Advanced System Dynamics
METE 5107G - Biomechatronic Systems
METE 5108G - Neuromechanics and Control of Human Movement
METE 5280G - Robotic Manipulators
METE 5300G - Mobile Robotics

Mechatronics Engineering, MEng

General information

The Master of Engineering (MEng) in Mechatronics Engineering allows a student to study all of the main areas associated with mechatronics engineering. Mechatronics engineering is an interdisciplinary discipline featuring aspects of mechanical engineering, electrical engineering, software engineering, and controls. Opportunities exist for graduate students to explore these areas. Topics can vary widely and may include robotics, autonomous systems, bio-mechatronics, controls, and artificial intelligence and machine learning.

Admission requirements

In addition to the general admission requirements for graduate studies, applicants must meet the following program-specific requirements:

Completion of an undergraduate engineering degree in a relevant field from an accredited engineering program at a Canadian university, or its equivalent from a recognized institution. Overall academic standing of at least a B (GPA: 3.0 on a 4.3 scale), with a minimum B in the last two full-time years (four semesters) of undergraduate work or equivalent.

Applicants must possess maturity and self-motivation. Close technical contact with a faculty member is an essential part of graduate education in engineering. MEng applicants who select the MEng-Project option must find a professor who is willing to act as a project supervisor. In the event the MEng-Project applicant cannot find a project supervisor, the applicant may be considered for admission into the MEng-Course option.

A current list of graduate faculty is available on the Faculty of Engineering and Applied Science's website.

Part-time studies

To facilitate access to all potential students, part-time studies are permitted. Engineers in local industries and government agencies, for example, may wish to access the MEng program through part-time studies.

Degree requirements - MEng (course-based option)

For the MEng course-based option, students must complete 10 courses worth a total of 30 credits.

Four core courses are required to be taken by all students in the MEng program. These courses are expected to be taken first before other graduate courses:

- ENGR 5013G - Advanced Engineering Mathematics
- ENGR 5200G - Programming Methodology and Abstraction for Engineers
- ENGR 5201G - Engineering Communications and Ethics
- ENGR 5410G - Project Management for Engineers

A minimum of three courses must be taken from the following list of core courses:

- ENGR 5260G - Advanced Robotics and Automation
- ENGR 5261G - Advanced Mechatronics: MEMS and Nanotechnology
- ENGR 5262G - Manipulator and Mechanism Design
- ENGR 5945G - Mobile Robotic Systems*
- METE 5107G - Biomechatronic Systems
- METE 5101G - Artificial Intelligence and Machine Learning Methods and Application
- METE 5102G - Control Design in Robotic Systems
- METE 5103G - Model Predictive Control
- METE 5106G - Advanced System Modeling Methods
- METE 5108G - Neuromechanics and Control of Human Movement
- METE 5280G - Robotic Manipulators
- METE 5300G - Mobile Robotics*

*Students can take ENGR 5945G or METE 5300G, but not both.

The remaining courses are expected to be taken from graduate courses listed in the student's program. Students are also provided the following allowance:

Undergraduate courses

MEng course-based students may take one senior year undergraduate course from the Faculty of Engineering and Applied Science in lieu of one graduate-level course, provided they have not taken similar courses during their undergraduate degree and the course is approved by the graduate program director.

Courses outside of the program

MEng course-based students may take up to two courses in other graduate programs at the university, provided that students have not taken similar courses during their undergraduate or master's degrees, and the courses are approved by the graduate program director. Students who wish to take courses outside of their program must gain approval from the graduate program director. Students who are uncertain about the academic background needed for a graduate course should consult the course instructor before registering for the course.

Degree requirements - MEng (project-based option)

For the MEng project-based option, students must complete 8 courses worth a total of 24 credits and a project worth 6 credits (ENGR 5002G - MEng/MEngM Project).

Four core courses are required to be taken by all students in the MEng program. These are expected to be taken first before other graduate courses:

- ENGR 5013G - Advanced Engineering Mathematics
- ENGR 5200G - Programming Methodology and Abstraction for Engineers
- ENGR 5201G - Engineering Communications and Ethics
- ENGR 5410G - Project Management for Engineers

A minimum of three courses must be taken from the following list of core courses:

- ENGR 5260G - Advanced Robotics and Automation
- ENGR 5261G - Advanced Mechatronics: MEMS and Nanotechnology
- ENGR 5262G - Manipulator and Mechanism Design
- ENGR 5945G - Mobile Robotic Systems*
- METE 5107G - Biomechatronic Systems
- METE 5101G - Artificial Intelligence and Machine Learning Methods and Application
- METE 5102G - Control Design in Robotic Systems
- METE 5103G - Model Predictive Control
- METE 5106G - Advanced System Modeling Methods
- METE 5108G - Neuromechanics and Control of Human Movement
- METE 5280G - Robotic Manipulators
- METE 5300G - Mobile Robotics*

*Students can take ENGR 5945G or METE 5300G, but not both.

The remaining courses are expected to be taken from graduate courses listed in the student's program.

Scope of the Project: The project should represent real-world problems. It can be an industry project or defined within a research laboratory or research space setting. The project must be supervised by one of the graduate faculty members in the student's program who are active in the research area.

Course listing

The following list shows all courses relevant to the MEng in Mechatronics Engineering graduate program:

ENGR 5002G - MEng/MEngM Project
ENGR 5005G - Special Topics

ENGR 5010G - Advanced Optimization
ENGR 5012G - Advanced and Smart Materials
ENGR 5013G - Advanced Engineering Mathematics
ENGR 5200G - Programming Methodology and Abstraction for Engineers
ENGR 5201G - Engineering Communications and Ethics
ENGR 5240G - Advanced Dynamics
ENGR 5245G - Micro and Nano Manufacturing
ENGR 5260G - Advanced Robotics and Automation
ENGR 5261G - Advanced Mechatronics: MEMS and Nanotechnology
ENGR 5262G - Manipulator and Mechanism Design
ENGR 5263G - Advanced Control
ENGR 5271G - Innovative Design Engineering
ENGR 5273G - Design by Failure
ENGR 5410G - Project Management for Engineers
ENGR 5510G - Foundations of Software Engineering
ENGR 5520G - Software Development Methods and Tools
ENGR 5605G - Convex Optimization
ENGR 5910G - Embedded Real-Time Control Systems
ENGR 5915G - Discrete Time Control Systems
ENGR 5930G - Adaptive Control
ENGR 5940G - Intelligent Control Systems
ENGR 5945G - Mobile Robotic Systems
ENGR 5946G - Advanced Fluid Power Control and Simulation
METE 5003G - MASc Seminar for Mechatronics Engineering
METE 5101G - Artificial Intelligence and Machine Learning Methods and Applications
METE 5102G - Control Design in Robotic Systems
METE 5103G - Model Predictive Control
METE 5104G - Multivariable Feedback Control
METE 5105G - Nonlinear Control Systems
METE 5106G - Advanced System Dynamics
METE 5107G - Biomechatronic Systems
METE 5108G - Neuromechanics and Control of Human Movement
METE 5280G - Robotic Manipulators
METE 5300G - Mobile Robotics

Appendix E – Faculty

Faculty Member	Title	Department
Murat Aydin	Associate Teaching Professor	Automotive and Mechatronics Engineering
Meaghan Charest-Finn	Assistant Professor	Automotive and Mechatronics Engineering
Moustafa El-Gindy	Professor	Automotive and Mechatronics Engineering
Zeinab El-Sayegh	Assistant Professor	Automotive and Mechatronics Engineering
Yuping He	Professor	Automotive and Mechatronics Engineering
Haoxiang Lang	Associate Professor	Automotive and Mechatronics Engineering
Xianke Lin	Associate Professor	Automotive and Mechatronics Engineering
Nasim Moallemi	Associate Teaching Professor	Automotive and Mechatronics Engineering
Scott Nokleby	Professor	Automotive and Mechatronics Engineering
Shabnam Pejhan	Assistant Professor	Automotive and Mechatronics Engineering
Greg Rohrauer	Associate Professor	Automotive and Mechatronics Engineering
Jaho Seo	Associate Professor	Automotive and Mechatronics Engineering
Aaron Yurkewich	Assistant Professor	Automotive and Mechatronics Engineering

New Program Assessment: MASc/MEng in Mechatronics Engineering

Library Statement of Support Provided to Ontario Tech University

Prepared by: Kate Gibbings, Engineering and Applied Science Liaison Librarian, February 9, 2021

OntarioTech Library

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Summary

Ontario Tech University Library's holdings provide a solid foundation of resources to support the MASc/MEng in Mechatronics Engineering program.

Library collections have been developed in support of the Faculty of Engineering and Applied Science's undergraduate and graduate program areas of Automotive, Electrical and Computer, Manufacturing, Mechanical, Mechatronics and Software Engineering; as well as Engineering Management. There is also deep coverage of subjects related to Mechatronics, including Automation, Robotics, Control systems, Engineering design, Materials, Nanotechnology and Artificial Intelligence.

Our research and special collections total more than 102,131 print volumes and 100,754 e-journal subscriptions. The Library provides access to more than 865,736 e-books and primary source materials. Collection strengths support the research and instructional programs at Ontario Tech University.

Resource Requirements

The following resources are required to address specific gaps in our collections, as well as maintain and continue to expand our collections across relevant Engineering disciplines.

Resource	Rationale	Budget Requirement	OTO or Ongoing
Books & Ebooks	Address gaps in specific subject areas relevant to the curriculum, support ongoing collection development across relevant Engineering disciplines	$2,500	Ongoing
Total		**$2500**	**Ongoing**

Introduction

The Library supports the teaching, learning and research missions of Ontario Tech University and Durham College. Ontario Tech students have access to a joint collection of more than 102,131 print books purchased for both Ontario Tech and Durham College. Additionally, the Library provides access to online resources including e-books and online databases that are selected to meet the teaching and research needs of Ontario Tech programs. Students and faculty are served by a team of subject specialist librarians and trained library technicians who provide an array of research and teaching support services including information literacy instruction, workshops, research help and reference service.

Library Collections

The Library's collections expenditures for the fiscal year 2019-20 totaled $1,664,480. Approximately 85% of the collections budget is allocated for the purchase of subscription online resources. The remainder of the budget is allocated for the acquisition of print and online resources to support the curriculum including journals, books and e-books, multimedia and other specialized material.

Our collections are well placed to support the MASc/MEng in Mechatronics Engineering, given the existing Bachelor of Engineering in Mechatronics and the new program's inclusion of existing graduate courses.

Library collections have been developed in support of the Faculty of Engineering and Applied Science's undergraduate and graduate program areas of Automotive, Electrical and Computer, Manufacturing, Mechanical, Mechatronics and Software Engineering; as well as Engineering Management. There is also deep coverage of subject related to Mechatronics, including Automation, Robotics, Control systems, Engineering design, Materials, Nanotechnology and Artificial Intelligence.

Suggestions for purchases from members of the University community are welcome. Faculty and students are encouraged to suggest material for purchase by contacting their Subject Librarian or by submitting our online suggest a purchase form. All recommended purchases are evaluated according to the Collection Development Policy and with consideration to budget constraints.

Consortial Licensing

By virtue of our membership in two key consortia, Ontario Tech University Library is able to take advantage of the increased bargaining power of a collective through which we subscribe to a wide array of scholarly content. Canada Research Knowledge Network (CRKN) is comprised of 81 libraries across Canada that include world-class research institutions, innovative teaching-focused institutions, as well as two national libraries, and Canada's largest public library system. CRKN is dedicated to expanding digital content for the academic research and teaching enterprise in Canada. Through the coordinated leadership of librarians, researchers, administrators and other stakeholders in the research community, CRKN undertakes large-scale content acquisition and licensing initiatives in order to build knowledge infrastructure, research, and teaching capacity in Canada's universities.

The Ontario Council of University Libraries (OCUL) is a consortium of Ontario's 21 university libraries which works together to maximize our collective expertise and resources. OCUL enhances information

services in Ontario and beyond through collective purchasing and shared digital information infrastructure, collaborative planning, advocacy, assessment, research, partnerships, communications, and professional development.

Journals

The Library almost exclusively acquires online journals and provides access to more than 100,754 across all disciplines. The Library's collection of academic journals in disciplines related to Mechatronics Engineering is strong, including coverage related to Automation, Control Systems, and Robotics; as well as Mechanical, Electrical and Manufacturing Engineering.

Students and researchers can access nearly complete journal suites, in many cases including archives, from publishers such as:

- ACM
- ASME
- ASTM
- Elsevier
- IEEE
- IOP
- Oxford
- RSC
- SIAM
- Springer
- Taylor & Francis
- Wiley

The Library provides access, through subscription, to most of the highly ranked journals in Mechanical, Electrical and Mechatronics-related categories, according to Clarivate's Journal Citation Reports database (2019).

By subject category:

Subject Category	Ontario Tech Access	Select Titles
Automation and Control Systems	48 of top 50	• IEEE-ASME Transactions on Mechatronics • IEEE Transactions on Automatic Control • Automatica • Mechatronics
Robotics	24 of top 28	• IEEE Transactions on Robotics • Robotics and Computer-Integrated Manufacturing • International Journal of Robotics Research • Autonomous Robots

Subject Category	Ontario Tech Access	Select Titles
Mechanical Engineering	46 of top 50	• Advances in Applied Mechanics • International Journal of Machine Tools and Manufacture • International Journal of Mechanics and Materials in Design • Journal of Sound and Vibration • Engineering Failure Analysis
Electrical Engineering	49 of top 50	• IEEE Transactions on Pattern Analysis and Machine Intelligence • IEEE Industrial Electronics Magazine • Proceedings of the IEEE • IEEE Transactions on Control Systems Technology

Books & E-Books

The Library at Ontario Tech University provides access to 102,131 print books and 865,736 e-books that support teaching, learning and research across all programs and disciplines. Students and faculty have access to collections of books and e-books from major academic publishers, including:

- Butterworth-Heinemann
- Cengage
- CRC Press
- Elsevier (including Woodhead)
- IEEE
- IET
- Industrial Press
- McGraw-Hill
- Morgan & Claypool
- Pearson
- Routledge/Taylor & Francis
- Springer
- Wiley

The following table highlights Library holdings by subject heading for print books and e-books related to the proposed courses for the MASc/MEng in Mechatronics Engineering. Gaps identified in the Library's holdings in the following subjects will be areas of focus for collection development:

- Smart materials
- Design by failure
- Design for product end of life
- Fluid power control and simulation

While e-books are a preferred format due to their accessibility for students, not all titles or publishers are available for the Library to license in electronic format. For this reason, selecting print books in many of the subject areas below will also be a collection development focus, particularly for key publishers that do not license many e-book titles to libraries.

Subject	# Print Books	# E-Books
Robotics and automation	275	15,716
Automatic control; control theory; control and systems theory; adaptive control systems; intelligent control systems; feedback control systems; discrete time control systems	265	7,420
Engineering design	196	3,104
Microelectronics and nanotechnology	145	5,983
Optimization; convex optimization	95	4,657
Materials; smart materials	1,107	25,065
Computer-aided design	77	1,673
Dynamics	417	13,638
Vibrations	78	2,314
Acoustics and noise control	43	1,355
Failure analysis	1	24
Sustainable mobility systems (Transportation – energy conservation; electric vehicles; hybrid vehicles; fuel cell vehicles; biofuels)	101	713
Product life cycle	24	173
Fluid power technology	15	43
Artificial intelligence	121	19,877
Engineering management	57	440

Search Tools

The Library subscribes to many research databases and indexes that provide access to the literature in Mechatronics Engineering. Systematic searching of these resources enables students and faculty to

access journals and other academic resources such as conference proceedings, theses and dissertations, trade publications and reports.

Highly Relevant Databases: Engineering & Science Focus	Relevant Databases: Multidisciplinary	Relevant Databases: Standards
• ACM • ASME • ASTM Digital Library • Engineering Village (Inspec and Compendex) • Elsevier ScienceDirect • IEEE Xplore • SciTech Premium Collection • SpringerLINK	• Scopus • Web of Science • Journal Citation Reports • Statista	• CSA OnDemand • ASME Standards • ASTM Standards • Techstreet Enterprise

Other Resources

Standards and Codes

In addition to single-publisher collections for CSA, ASME and ASTM standards, the Library subscribes to the Techstreet platform. Through Techstreet, the Library can purchase individual electronic standards by faculty and graduate student request from hundreds of publishers.

Statistics & Data Resources

To support research that requires statistics and datasets, the Library subscribes to four main resources. Statista provides access to Canadian and international statistics and data from over 18,000 sources including industry reports. Datasets are available from Statistics Canada's Data Liberation Initiative (DLI), odesi, and the Interuniversity Consortium for Political and Social Research (ICPSR).

The Library also provides access to Dataverse, a repository that supports research data management and open access data requirements for Tri-Agency research funding compliance.

Multimedia Resources

The Library acquires DVD and streaming video resources that are relevant to Faculty of Engineering and Applied Science programs. Multimedia resources are selected individually or as part of standing subscriptions. Faculty may request streaming videos which the Library can license through its streaming platforms.

The Library's collection includes 1,081 DVDs and 109,200 Streaming Video titles. Of these multimedia resources, the following are particularly relevant to the curriculum in Mechatronics Engineering.

Relevant Streaming Video Collections

Streaming Video Collection	Relevant Titles
Kanopy	Engineering: 254 videos
CBC Curio	Math, Science & Technology: 1,203

Select Multimedia Titles

- Robotics. (2015). The Great Courses.
- Charging the Road: Is the Electric Vehicle Ready to Take on Gas? (2019). CBC.

Library Services

A range of library services support teaching, learning and research at the University. Students and faculty in the Faculty of Engineering and Applied Science have access to services in-person, online and via email or telephone.

Research Support

The Library plays a vital role in supporting student and faculty research at Ontario Tech.

Reference Service & Research Consultations

Students and faculty have access to research support in-person and online, via telephone, email and through online chat help. In the 2019-20 academic year, library staff answered 14,630 research questions from the Ontario Tech community.

Librarians are available for individualized research consultations with students and faculty, in person or online. These consultations are tailored to meet the needs of individual researchers and can cover a range of topics from basic introductions to more advanced search techniques and support for literature reviews.

Open Access & Research Data Management

The Library provides support to faculty and students in complying with the Tri-Agency Open Access Policy (SSHRC, NSERC, CIHR). Faculty and students can make their work open by publishing in an open access or hybrid journal, by depositing their work in a subject repository, or by depositing their work in Ontario Tech's institutional repository, E-Scholar (https://ir.library.dc-uoit.ca).

The Library provides direct support to Faculties through dedicated subject specialist/liaison librarians and online guidance with the Library's Open Access Guide (http://guides.library.uoit.ca/openaccess). The Library has a Research Data Management guide (http://guides.library.uoit.ca/rdm) to support faculty and students in creating data management plans and sharing research data.

During the 2019-20 academic year, these guides were viewed 572 times.

Research Metrics & Impact

The Library supports various departments on campus by fielding requests for reports on author, article, journal and institutional metrics. Subscribed tools include: Web of Science, Scopus and Journal Citation Reports (JCR).

The Library's Research Metrics guide (http://guides.library.uoit.ca/researchmetrics) provides background information and support for these tools.

Theses & Dissertations

The Library ensures that the Ontario Tech community has access to national and international thesis and dissertation databases. Access to PQDT (ProQuest Dissertations and Theses) and the Theses Canada Portal is provided through the Library website. The Library plays a key role in the dissemination and

preservation of Ontario Tech theses, managing copies in the institutional open-access digital repository, E-Scholar, as well as maintaining print copies in the Library archives.

Teaching & Learning Support

As partners in teaching and learning at Ontario Tech, the Library provides a range of instructional and curriculum supports, both in person and online.

Information Literacy Instruction

In collaboration with teaching faculty, Librarians deliver customized information literacy instruction that support the development of students' 21st century skills to successfully search, evaluate and ethically use scholarly resources in their course requirements. These library services are aligned with the Association of College and Research Libraries (ACRL) Framework for Information Literacy for Higher Education. Information literacy sessions are tailored to the specific requirements of the course or assignment and may be delivered synchronously or asynchronously to classes, in person or online. Library information literacy modules are available in the Canvas Learning Management System and can be adapted and added direct into courses, or instructors can opt for asynchronous recordings.

In the 2019-20 academic year, 203 students in the Faculty of Engineering and Applied Science received instructional support from a Librarian. Information literacy instruction is integrated in the Faculty of Engineering and Applied Science in the following courses:

- COMM 1050: Technical Communications
- ENGR 5003: MASc Seminar for Automotive and Mechanical Engineering
- ENGR 5007: MASc Seminar for ECE
- ENGR 5945G: Mobile Robotic Systems

Ideally, Information Literacy instruction is scaffolded across the required curriculum, enabling students to build increasingly sophisticated research skills throughout their program of study. Graduate student would benefit from information literacy instruction in courses that they are likely to take early in their program. This will prepare them to complete literature reviews for theses and other purposes, and to do background research for design projects. They would build skills in finding and using journal articles, technical documents, industry reports and trade publications.

Co-curricular Workshops

In addition to information literacy instruction that is integrated into the curriculum, the Library offers co-curricular workshops that help develop student and faculty skills. Library workshops are available through the Graduate Professional Skills series, which is well attended by Engineering students. Some examples of workshops offered to Ontario Tech students in the past include:

- Starting Off Strong: Library Resources 101
- Organizing Your Literature Search with a Citation Manger
- Trending Topics: How to Find Highly Cited Journals, Articles and Authors
- Making an Impact: Your Research Identity
- Open Access and Sharing Your Research

Workshop offerings are regularly updated in response to the changing needs of the community.

Online Research Guides

Subject specialist librarians create custom Research Guides for each subject area that are available from the Library website. Research Guides include program and course guides that are directly related to the program and course curriculum, as well as topic guides that have cross-disciplinary relevance. Research Guides of particular importance to students in Mechatronics Engineering include:

- Library Research for Engineering Students: https://guides.library.uoit.ca/engineering
- Electrical Engineering: https://guides.library.uoit.ca/elec-eng
- Mechanical Engineering: https://guides.library.uoit.ca/mech-eng
- Manufacturing Engineering: https://guides.library.uoit.ca/man-eng
- Standards and Codes: https://guides.library.uoit.ca/standards
- Patents: https://guides.library.uoit.ca/patents

During the 2019-20 academic year, these guides were viewed a combined 4,559 times. The Library's Citation guide was viewed 6,447 times.

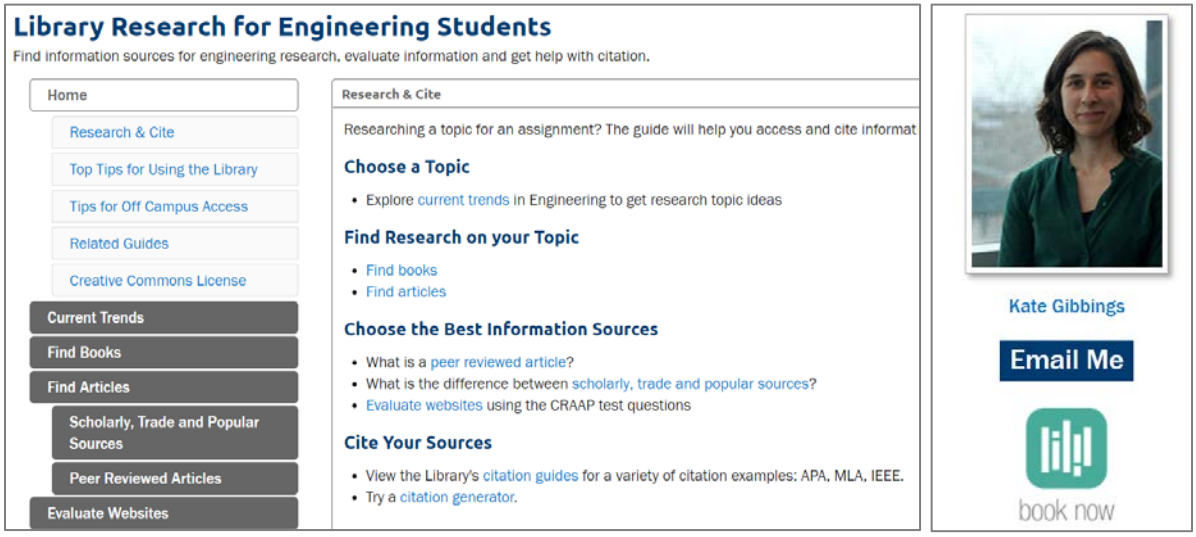

Figure 1 Library Research for Engineering Students Guide

Copyright & Academic Integrity

The Library provides copyright advice for faculty and students. Library staff advise on license terms and the integration of content into the Learning Management System (LMS). The Library also helps faculty find, evaluate and integrate Open Educational Resources into their courses.

The Library's research support services including our citation guides help students avoid plagiarism and comply with the University's Academic Conduct policy.

Course Reserves

Instructors can place material that is in high demand on course reserve in the library. Reserve material is available to students on shorter loan periods, ensuring equitable access to required textbooks and readings.

In addition to print material, instructors may also place material from the library's online holdings on electronic reserve. Electronic reserves are subject to copyright compliance and licensing restrictions.

3D Printing & Equipment Loans

Students have access to 3D printers and 3D printing workshops and can borrow equipment such as laptops and device chargers.

Library Staffing

The anticipated intake for students in the Mechatronics Engineering program for years 1-5 is as follows:

- Year 1: 10-15 students
- Years 2-5: 20-25 students

The Library anticipates that there will be additional staffing requirements associated with growth in graduate and undergraduate degree programs across the University. These requests will be part of the regular budget planning process, following a fulsome and strategic analysis of our staffing needs.

Conclusion

The Library is well-positioned to support the Mechatronics Engineering program. Our suite of services and programs will meet the needs of students and faculty in this program.

We look forward to working in collaboration with students and faculty in this new program.

REVIEWERS' REPORT FOR NEW PROGRAMS

Reviewers' Report on the Proposed MEng and MASc Programs in Mechatronics Engineering at Ontario Tech University

Dr. Brian Surgenor, P.Eng.
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Queen's University
Kingston, Ontario K7L 3N6

Dr. Reza Fotouhi, P.Eng.
Department of Mechanical Engineering
College of Engineering
University of Saskatchewan
Saskatoon, Saskatchewan S7N 5A9

1. OUTLINE OF THE REVIEW

The review was a remote site visit, conducted over two days on April 17 and 18, 2023, that involved interviews with the following:

- Administrators:
  - Dr. Lori Livingston (Provost),
  - Dr. Hossam Kishawy (FEAS Dean),
  - Dr. Scott Nokleby (Chair New Program Committee),
  - Dr. Theodore Christou (Grad Studies Dean),
  - Dr Greg Rohrauer (Chair Dept, Automotive and Mechatronics)
  - Dr. Hidayat Shahid (Faculty Labs) and
  - Mr. Govind Rehal (Manager Tech Services)
- Faculty members:
  - Dr. Haoxiang Lang,
  - Dr. Shabnam Pejhan,
  - Dr. Meaghan Charest-Finn,
    Dr. Aaron Yurkewich,
  - Dr. Jaho Seo
  - Dr. Nasim Moallemi
- Staff members:
  - Ms. Michelle Cholak, FEAS Graduate Program Assistant
  - Ms. Bramsha Panchadcharam, FEAS Graduate Program Assistant
  - Ms. Holly MacPherson, Manager SGPS
  - Ms. Beth Stewart, Senior Admission Officer, SGPS
  - Ms. Kurshid Dain – SGPS Finance Coordinator

Slides of the labs associated with the undergraduate mechatronics program were shown to give an indication of the facilities.

2. EVALUATION CRITERIA

2.1 Program Objectives

The objectives of these programs are clearly stated as:

> *"The main objective of the MASc program is to prepare students for a career as an R&D engineer. Graduates of the program will be able to work as R&D engineers in advanced technology companies or government agencies. They also may choose to continue their education and pursue a PhD degree. The objectives of the MASc*

program are achieved through a combination of course work, supervised research, a research seminar, and a research thesis.

The main objective of the MEng program is to provide the opportunity for engineers in industry to upgrade and expand their skills. Graduates of the program will apply their education to various advanced technologies in high-tech industries. The objectives of the MEng program are achieved through a combination of course work and a project (MEng project-based), or solely course work (MEng course-based), depending on which option the student selects."

The degree requirements are appropriate and are like other similar Canadian programs.

The objectives of these programs seem to be aligned with the institution's mission, at least in the following two directions:

- Provide superior undergraduate and graduate programs that are technology-enriched and responsive to the needs of students and the evolving workplace.
- Conduct research that creates knowledge, solves problems, results in economic and social innovation and engages students.

2.2 Program requirements

Structure and learning outcomes of the programs are appropriate as they are modelled after existing MEng and MASc programs in the Faculty of Engineering and Applied Science (FEAS). Thus, five courses plus a thesis for the MASc program. Ten courses for the course-based MEng program. Eight courses for the project-based MEng program. MEng students are required to take four core courses (ENGR 5013F, 5200G, 5201G and 5410G). Mechatronics is a broad field of research. There will be ten new courses to ensure that the area is well covered.

2.3 Program requirements for graduate programs only

The nature and suitability of the major research requirements are clearly stated:

"For MASc students, the main focus is a research thesis supervised by a faculty member who is a subject matter expert. For MEng project-based students, the project features a research element that is also supervised by a faculty member who is a subject matter expert. In addition to the thesis and project, many courses feature a term project that is often research focused."

Length of the programs are appropriate as they are modelled after existing MEng and MASc programs in FEAS. Both programs are expected to take two years to complete. MEng students are expected to take two to three courses per term. Students are permitted to take one senior level undergraduate course (with approval of supervisor and program director). This is consistent with the university requirement that a minimum of two-thirds of the courses taken are at the graduate level. At least half of a student's courses must be within their program in FEAS (as listed in **Appendices B** and **C** of the Proposal).

There are two concerns related to graduate program requirements: a) no requirement for a student to take at least half of their courses as METE and b) limited oversight on whether the full set of courses selected by a student fit with the objectives of the program. This concern is addressed further in **Section 5** of this report.

2.4 Assessment of teaching and learning

The MSc program requires five courses (3 credits each) plus a thesis (15 credits), and a seminar in which three courses should be from Engineering courses. The MEng program requires eight courses (3 credits each) plus a project (6 credits), in which four courses should be from Engineering courses; or ten courses (3 credits each), and no project. This is similar with other master programs in Canada.

Methods for the assessment of teaching and learning are modelled after existing MEng and MASc programs in FEAS.

Program Learning Outcomes are listed on **Table 3** in the Proposal, as follows:

- Explain advanced principles, and theories mechatronics.
- Design and implement experiments.
- Interpret experimental data and computational results.
- Solve engineering problems and enhance existing practices through research.
- Adhere to social, professional, and ethical expectations involved in advanced education and research.
- Describe the importance of, and develop the strategies for, further education and lifelong learning in the discipline.
- Communicate mechatronics concepts, principles, and results effectively using written and verbal formats.
- Critically evaluate advanced information and knowledge and apply in engineering practice.

The learning outcome are appropriate for Mechatronic advanced degree programs. However, courses listed in **Table 3** need to be more specific to the program, they seem a bit general.

Assessment of program learning are like other programs at Ontario Tech University (OTU), through assignments, exams, term projects, thesis, and defences. The assessments are consistent with other similar programs and institutions.

On the question of "How the resulting information will be documented and subsequently used to inform continuous program improvement", not much is mentioned in the Proposal. This comment will be repeated in Section 5 as a recommendation to provide more detail in the Proposal.

Overall, the proposed programs seem of good quality, and will likely be successful, if there are enough students enroll in these programs as predicated in the Proposal. Although, prediction of enrollments may be a bit exaggerated.

2.5 Admission requirements

Admission requirements are modelled after existing MEng and MASc programs in FEAS. The Proposal states:

> *"The admissions requirements for the program are the same as those for other master's programs at Ontario Tech, namely:*
>
> - *Hold a four-year honours degree or its equivalent from a recognized institution in the same area of graduate study or a closely related subject.*
> - *Overall academic standing of at least a B average (GPA: 3.0 on a 4.3 scale or 73 to 76 per cent), with a minimum B average in the last two full-time years (four semesters) of undergraduate work or equivalent.*

In terms of acceptable undergraduate degrees for the MASc and MEng programs in Mechatronics Engineering, students who have graduated from an undergraduate program in Mechatronics, Mechanical, Manufacturing, Automotive, or Electrical Engineering will be considered."

Also, more is stated in **Appendix D** of the Proposal, where admission requirements for the programs are given as:

"In addition to the general admission requirements for graduate studies, applicants must meet …:
Applicants must possess maturity and self-motivation. Close technical contact with a research supervisor is essential in research-based engineering programs. Prior to being accepted into the program, MASc applicants must find a faculty member who specializes in their desired area of research and who is willing to act as their thesis research supervisor."

For admission requirements, the wording in the body of the Proposal and the wording in **Appendix D** differ somewhat. One recommendation is to confirm which is the correct wording.

Also, English language requirements are stated in the following link:
https://gradstudies.ontariotechu.ca/future_students/application_process_and_requirement/step%203/english-language-proficiency.php
Perhaps, the Proposal can include this link, or its content to be clear.

Overall, the programs' admission requirements are appropriate and consistent with the objectives and program-level learning outcomes.

2.6 Resources

Given the program's planned/anticipated class sizes and the offering of ten new graduate courses, there were concerns that the five faculty members currently assigned to the program will become overloaded. The addition of a sixth member (currently in the search phase) will help to mitigate this concern. However, those faculty interviewed felt that the new courses could be covered under the terms of the current faculty workload agreement. Note that a faculty member who was identified to support the program left after the Proposal was written. Hence the Proposal refers to the addition of a seventh (not sixth) faculty member. Thus, most of the instruction will be done by Tenure Track Faculty and Teaching Faculty within FEAS. As is normal practise, the Proposal acknowledges that there may be a limited need for Sessional Instructors depending on matters such as the number of courses that need to be offered in a given semester, or faculty on research leave or sick leaves. It is agreed that the existing complement of Graduate Program Assistants within FEAS will be sufficient for at least the first five years of the program, given the enrolment projections.

As an explicit form of experiential learning, MEng students have the option to take a co-op internship for four to eight months. This option is not unique to the proposed MEng program and is supported by the Engineering Co-op Office.

With respect to physical resources, it was stated that existing classroom, laboratory and office space were adequate to meet the needs of the new programs. No new space has been requested. The laboratories that we were shown support this statement. With respect to the Library, **Appendix F** in the Proposal confirms that the existing OTU library holdings and facilities can provide the resources needed to support the new programs. There are no extraordinary Information Technology Resources beyond what is available to all students at OTU.

2.7 Resources for graduate programs

Financial assistance for students follows the model of existing MEng and MASc programs in the FEAS. Supervisor workloads will also follow the examples of existing MEng and MASc programs. Evidence that faculty have the research expertise and professional backgrounds to sustain and promote the programs are covered in **Section 2.8** of this report.

1.8 Quality and other indicators

A review of the faculty CV's provides evidence of the quality of the faculty (*e.g.*, qualifications, funding, honours, awards, research, innovation, and scholarly record). All faculty member interviewed, or CV included in the Proposal have PhD degree, many of them are active researchers, and have expertise in control and mechatronics.

We interviewed the following faculty members:

- Dr. Haoxiang Lang, PhD (2012) started in 2015 at OTU; teaches 2 undergraduate courses (UG), and 2 Graduate Course (GC) in alternate years (Advanced Control; Robotics & Automation); 1 each year.
- Dr. Shabnam Pejhan, PhD (2017), started in 2022 at OTU; teaches 2 UG, and 1 GC (Biomechatronic).
- Dr. Aaron Yurkewich, (CV not included?), started in 2023 at OTU; doesn't teach any UG for now, and will teach 1 GC (possibly Biomechatronic system; Neuromechanical and human movement).
- Dr. Meaghan Charest-Finn, PhD (2020), started in 2021 at OTU; teaches 3 UG, and no GC , and will teach 1 GC (possibly METE 5101G- Artificial Intelligence and Machine Learning Methods and Application).
- Dr. Jaho Seo, PhD (2011), started in 2017 at OTU; teaches 2 UG, and 1 GC , and will teach 1 GC (dvanced power control; alternatively Control design and robotic system)
- Dr. Nasim Moallemi, PhD (2015), started in 2018 at OTU; teaches 4 UG, and no GC, as she is in teaching position; she can teach 1 new GC (possibly Advanced Nonlinear control; or AI and signal processing). The department should consider possible contract implication for this and similar cases (i.e. Dr. Aydin given below).

Other Faculty members (whom their CVs were included)

- Dr. Murat Aydin, PhD (1999), Associate Teaching Professor, started 2021 at OTU
- Dr. Moustafa El-Gindy, PhD (1980), started 2015 at OTU
- Dr. Zeinab El-Sayegh, PhD (2020), started 2021 at OTU
- Dr. Yuping He, PhD (2003), started 2017 at OTU
- Dr. Xianke Lin, PhD (2014), started 2017 at OTU
- Dr. Scott Nokleby, PhD (2003), started 2004 at OTU
- Dr. Greg Leo Rohrauer, PhD (1999), started 2005 at OTU

Clerical support staff members who were interviewed indicated this extra load will not affect their ability to handle admission process efficiently. They indicated there is no admin backlog currently, and they will not anticipate such a backlog happens because of this initiative.

3. EQUITY, DIVERSITY, INCLUSION, AND DECOLONIZATION

Reasonably good statements are provided in the Proposal, which address Equity, Diversity, Inclusion, and Decolonization. Some of them are highlights below:

> *"The Faculty of Engineering and Applied Science (FEAS) is fully committed to Equity, Diversity, and Inclusion (EDI), including in all its courses and all its research activities.*
>
> *An example of its focus on EDI, FEAS has the Women in Engineering Society with several stated goals (see page 21 for details).*
>
> *FEAS is committed to reconciliation with Indigenous peoples. Students in the MASc and MEng programs can take as one of their courses a fourth-year undergrad course (ENGR 4570U/INDG 4570U - Indigenous Design and Technology).*
>
> *For students who have accommodation needs, existing Student Accessibility Services (SAS) supports will be available to students who require specific accommodations."*

4. OTHER ISSUES

The only other issue to be addressed is the uniqueness of the programs.

The Proposal identifies three programs that are considered similar to what has been proposed: MASc at Simon Fraser, MEng at UBC and MEng/MASc at Waterloo.

The closest match for the proposed MASc program is the MASc in Mechatronic Systems Engineering offered by the School of Mechatronics Systems Engineering at Simon Fraser University *https://www.sfu.ca/students/calendar/2020/fall/programs/mechatronic-systems-engineering/master-of-applied-science.html* SFU does not offer an MEng program in this area. As with the proposed OTU program, the SFU program is five courses (includes a seminar course) plus a thesis.

The closest match for the proposed MEng project-based program is the MEng in Mechatronics Design offered by the Department of Mechanical Engineering at UBC: *https://mech2.sites.olt.ubc.ca/files/2022/06/MECD-Program-and-Registration-Guidelines-2022W-V.2.pdf* UBC does not offer a MASc program in this area. Students in the UBC MEng program are required to take eight courses plus a mechatronics-based project course. Three of the eight courses are mechatronics in nature and are considered core. This is an important observation as it relates to our recommendation that OTU requires their MEng course-based students to take three courses that are mechatronics in nature. UBC students who are unable to find projects in the summer/fall of the 2nd year, are permitted to take two graduate courses (equivalent to 6 credits) to satisfy the project requirement on a case by case basis. This is like the OTU's MEng course-based proposal.

The Department of Mechanical and Mechatronics Engineering at the University of Waterloo offers both MEng and MAS*c* programs*: https://uwaterloo.ca/mechanical-mechatronics-engineering/graduate-students/future-students/masc-and-phd*. Their undergraduate program is definitely mechatronics in nature. But the graduate courses listed at the Masters level are very much mechanical in nature.

At OTU, MASc students will receive a minimum of $10,000 funding from the department for TA work; the department leaders indicated that they have sufficient budget for TA expenses for the added

MASc new students joining in the future because of these new programs. M.Eng. students do not have such financial commitment for the department.

The conclusion is that there are no similar programs in Ontario.

5. SUMMARY AND RECOMMENDATIONS

Ontario Tech University should be lauded for proposing a novel and much needed graduate program in the area of mechatronics. The demand for graduates in this area is high.

We only have one major recommendation and that has to do with the MEng students.

R1) Course registration can be done by the student, without any requirement for faculty or supervisor approval, as long as the course appears in **Appendix B** (new courses) or **Appendix C** (existing courses). This is cause for concern with the MEng program, particularly with Course-Based students who take ten courses, four of which are required (engineering mathematics, programming methodology, communications, project management). The six remaining courses don't have to be mechatronics in nature and consequently the MEng looks more like a mechanical degree than a mechatronics degree. We recommend that MEng students, both course-based and project-based, be required to take at least three courses that are mechatronics in nature. **Table 1** in this report shows one possible list.

This is not a concern with the MASc students. For the MASc students, one assumes that the student will follow the practice of consulting with their supervisor as to which courses they should take. For the MEng project-based students, if the project is a mechatronics subject, the project can replace one of these three required courses.

There are three other recommendations to consider.

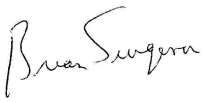
R2) Clarify whether or not Dr. Moallemi and Dr. Aydin are contractually eligible and/or required to teach graduate courses.

R3) For the admission requirements, confirm which wording is preferred, the wording given in **Appendix D** or the wording given in the Proposal.

R4) In **Section 2.4 (**assessment of teaching and learning), more detail should be provided on how the resulting information will be documented and used for continuous program improvement.

Table 1. Courses that are mechatronics in nature

Course Number	Course Name
ENGR 5260G, ***or*** METE 5280G	Advanced Robotics and Automation, ***or*** Robotics and Automation
ENGR 5261G	Advanced Mechatronics: MEMS and Nanotechnology
ENGR 5262G	Manipulator and Mechanism Design
ENGR 5945G, ***or*** METE 5300G	Mobile Robotic Systems, ***or*** Mobile Robotics
METE 5102G	Control Design in Robotic Systems
METE 5107G	Biomechatronic Systems
METE 5101G	Artificial Intelligence and Machine Learning Methods and Application
METE 5108G	Neuromechanics and Control of Human Movement

Signature: 

Date: May 20, 2023

Signature: 

Date: May 20, 2023

Faculty Response to the External Review for the _____ Master of Applied Science in Mechatronics Engineering and Master of Engineering in Mechatronics Engineering

Submitted By:

Scott Nokleby
July 2023

Hossam Kishawy
July 2023

Introduction

Brief comments on the external reviewers report and the program review process in general.

We would like to thank the reviewers for taking the time to review the program and meet with the Faculty to discuss our proposal. The reviewers have provided useful feedback/recommendations that we have implemented completely in the final version of the proposal.

Summary of Recommendations and Faculty Responses

- *Restate the recommendations summarized in the external reviewers' report and provide the Program's comments and responses*
- *The Dean should then provide summative comments/responses from an overarching Faculty perspective for each recommendation and program response*

Recommendation 1
Course registration can be done by the student, without any requirement for faculty or supervisor approval, as long as the course appears in Appendix B (new courses) or Appendix C (existing courses). This is cause for concern with the MEng program, particularly with Course-Based students who take ten courses, four of which are required (engineering mathematics, programming methodology, communications, project management). The six remaining courses don't have to be mechatronics in nature and consequently the MEng looks more like a mechanical degree than a mechatronics degree. We recommend that MEng students, both course-based and project-based, be required to take at least three courses that are mechatronics in nature. Table 1 in this report shows one possible list. This is not a concern with the MASc students. For the MASc students, one assumes that the student will follow the practice of consulting with their supervisor as to which courses they should take. For the MEng project-based students, if the project is a mechatronics subject, the project can replace one of these three required courses.

Program's Response
We agree with this recommendation. MEng students, both course-based and project-based, will be required to take a minimum of three courses from the following approved list of core courses:

ENGR 5260G - Advanced Robotics and Automation
ENGR 5261G - Advanced Mechatronics: MEMS and Nanotechnology
ENGR 5262G - Manipulator and Mechanism Design
ENGR 5945G - Mobile Robotic Systems*
METE 5107G - Biomechatronic Systems
METE 5101G: Artificial Intelligence and Machine Learning Methods and Application
METE 5102G: Control Design in Robotic Systems
METE 5103G : Model Predictive Control
METE 5106G: Advanced System Modeling Methods
METE 5108G: Neuromechanics and Control of Human Movement
METE 5280G: Robotics and Automation
METE 5300G: Mobile Robotics*

*Students can take ENGR 5945G or METE 5300G, but not both.

Dean's response
I agree with the recommendation and the response.

Recommendation 2
Clarify whether or not Dr. Moallemi and Dr. Aydin are contractually eligible and/or required to teach graduate courses.

Program's Response
Both Dr. Moallemi and Dr. Aydin are eligible to teach graduate courses. Teaching assignments are determined by the Dean based on the needs of the undergraduate and graduate programs.

Dean's response
I agree with the recommendation and the response.

Recommendation 3
For the admission requirements, confirm which wording is preferred, the wording given in Appendix D or the wording given in the Proposal.

Program's Response
The preferred wording is in Appendix D, which is consistent for all our engineering master's programs. What was written in the proposal was a summary of the wording in Appendix D. The proposal section has been updated to contain the same wording as Appendix D.

Dean's response
I agree with the recommendation and the response.

Recommendation 4
In Section 2.4 (assessment of teaching and learning), more detail should be provided on how the resulting information will be documented and used for continuous program improvement.

Program's Response
The main avenue for assessing and monitoring the program effectiveness will be through the cyclical program review process. In addition, Ontario Tech's Academic Resource Committee requires a report one-year after start-up of a new program and, if there are areas of concerns raised, a subsequent 18-month report will be required. The one-year report will ask the program to review enrollment data, admission averages, and provide an analysis of successes and challenges encountered in the first year. After the first year of the program being implemented, it will be internally assessed by this committee and, if needed, recommendations will be made to enhance program effectiveness and student success. If required, the 18-month report will address key curricular and student data (e.g. GPA, retention data, etc.) as well as any outstanding recommendations from the one-year report. Pending the committee's review, further documentation may be required of the program for ongoing monitoring. The reports will be developed by the Graduate Program director in consultation with the Faculty Graduate Committee.

The above has been added to the proposal.

Dean's response

I agree with the recommendation and the response.

Suggested Revisions for the Proposal following External Review

- *Program to list all suggested revisions to the proposal*
- *For each suggested revision, the Dean should include a comment indicating whether the revision will proceed. If the revision will not proceed, please indicate a rationale*

- The proposal was updated to address Recommendation 1 by incorporating a list of approved core courses and requiring MEng Course-Based and MEng Project-Based students to take a minimum of three course from the list. These changes are reflected in Section 2 and Appendix D of the proposal.

  Dean's comment: The revision will proceed.

- The proposal was updated to address Recommendation 3 by incorporating the admission requirements wording of Appendix D into Section 2 of the proposal.

  Dean's comment: The revision will proceed.

- The proposal was updated to address Recommendation 4 by elaborating on the continuous improvement proposed for the program in Section 2 of the proposal.

  Dean's comment: The revision will proceed.

Summary of Changes Made to the Proposal Following External Review

List all revisions to the proposal and appendices, noting the Section number from the document. Include this form with the final proposal.

- The proposal was updated to address Recommendation 1 by incorporating a list of approved core courses and requiring MEng Course-Based and MEng Project-Based students to take a minimum of three course from the list. These changes are reflected in Section 2 and Appendix D of the proposal.

- The proposal was updated to address Recommendation 3 by incorporating the admission requirements wording of Appendix D into Section 2 of the proposal.

- The proposal was updated to address Recommendation 4 by elaborating on the continuous improvement proposed for the program in Section 2 of the proposal.