

ACADEMIC COUNCIL REPORT

ACTION REQUESTED:

Recommendation	<input checked="" type="checkbox"/>
Decision	<input checked="" type="checkbox"/>
Discussion/Direction	<input type="checkbox"/>
Information	<input type="checkbox"/>

DATE: 23 November 2021

FROM: Graduate Studies Committee

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

COMMITTEE MANDATE:

In accordance with Section c) of the Graduate Studies Committee (GSC) Terms of Reference, GSC has the responsibility “Examine proposals for new graduate degree and diploma programs” and “to recommend their approval, as appropriate, to Academic Council”.

And,

In accordance with Article 1.4 of By-Law Number 2 of the University of Ontario Institute of Technology “Academic Council will make recommendations to the Board on matters including:
a. the establishment or termination of degree programs”.

MOTION FOR CONSIDERATION:

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

BACKGROUND/CONTEXT & RATIONALE:

The objective of the proposed Master of Applied Science and Master of Engineering in Software Engineering (MAsc and MEng) is to expand students’ knowledge of software engineering through intensive state-of-the-art courses, projects, and/or a research thesis in their chosen area of interest. The MAsc is a thesis-based program for students interested in research and may wish to continue their education at the PhD level. The MEng is a course-based or a project-based program for working professionals and other students interested in advanced knowledge and skills in software engineering.

Software Engineering is a well-established field that will continue to grow as software systems and applications continue to enable everything we do from video conferencing platforms for telework from home, to autonomous vehicles. Professional Engineers Ontario (PEO) recognizes

this field and allows graduates of CEAB-accredited Software Engineering programs to be licensed engineers. The Faculty of Engineering and Applied Science (FEAS) offers a rapidly growing CEAB-accredited Software Engineering program at the undergraduate level; and graduate programs (MEng, MASc and PhD) in Electrical & Computer Engineering. Graduate programs in software engineering would be natural expansion of the undergraduate program in Software Engineering and other relevant programs offered by FEAS. The proposed programs also complement related graduate programs (in Computer Science and IT) offered at Ontario Tech University.

The mode of delivery will be in-class on-campus, similar to existing graduate programs offered by the Faculty of Engineering and Applied Science. The nature of the programs and their potential relevancy to industry, and the fact that software teams are international and geographically distributed, may lend itself well to blended learning in the future.

Aligned with Ontario Tech's mission of providing graduate programs that are technology-enriched and responsive to the needs to students and the evolving workplace, the proposed graduate programs in Software Engineering are a response to growth not only in the technology industry but across all industries. The proposed programs are designed to prepare graduates not for a singular job but rather a career path that involves life-long learning and multiple employment opportunities. The program will include a formal co-op option for MEng students.

Software Engineering is aligned with the institutional strength and focus in the areas of Engineering, Computer Science and IT disciplines, as well as the 'Skills and Job outcomes' section of Ontario Tech's 2020-2025 Strategic Mandate Agreement, as the proposed programs will produce graduates with practical skills that can be immediately applied in the workplace. Furthermore, the MEng program in particular is expected to attract a large number of domestic as well as international students (student enrolment).

RESOURCES REQUIRED:

The proposed programs draw on the existing expertise in Software Engineering in the Faculty of Engineering and Applied Science, and no new faculty members are required for this program beyond the on-going recruiting efforts for two new faculty members in Software Engineering. All core courses, software engineering electives, and software systems courses will be taught by core software engineering faculty members. General elective courses will be taught by core faculty members in the Faculty of Engineering and Applied Science.

Administrative support, including co-op, and academic advising will be provided by the existing Faculty offices and there is no requirement for additional space/infrastructure.

CONSULTATION AND APPROVAL:

Graduate Studies Committee for recommendation: October 2021

Final Faculty Council Approval: October 2021

Academic Resource Committee: May 2021, October 2021

NEXT STEPS:

- Pending the approval and recommendation of Academic Council the proposal will be presented to the Board of Governors for final approval
- The proposal must proceed through the following approval steps subsequent to AC:
 - Board of Governors
 - Ontario Universities Council on Quality Assurance
 - Ministry of Colleges and Universities
- The preferred date of implementation is the fall semester of 2022

SUPPORTING REFERENCE MATERIALS:

- New Program Proposal with Appendices
- Reports from External Review
- Academic Resource Committee Memo Re: Co-Op



New Graduate Program Proposal

Name of proposed program:	Software Engineering
Degree Designation/Credential:	Master of Applied Science (MASc) in Software Engineering Master of Engineering (MEng) in Software Engineering
Faculty (where the program will be housed):	Faculty of Engineering and Applied Science
Collaborating Faculty (if applicable):	N/A
Program Delivery Location:	North Oshawa Campus, 2000 Simcoe St. N.
Collaborating Institution(s) (if applicable):	N/A
Proposed Program Start Date:	Fall 2022
Proposal Contact:	Qusay.mahmoud@ontariotechu.ca
Submission Date:	October 2021
Approved by Dean: (signature and date)	Hossam Kishawy <small>Digitally signed by Hossam Kishawy DN: cn=Hossam Kishawy, o=OntarioTech, email=hossam.kishawy@ontariotechu.ca, c=CA Date: 2021.10.15 10:29:50 -0400</small>

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1 Introduction

a) Program Abstract

Please provide a brief overview of the proposed program, in 1000 characters or less, including:

- *A clear statement of the purpose of the program*
- *Any program components, such as fields or pathways (note that fields and pathways are not required)*
- *Any distinctive elements, including alternative modes of delivery (including online)*

According to the Software Engineering Body of knowledge (SEBOK), the ISO/IEC/IEEE Systems and SE Vocabulary defines software engineering as “the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is, the application of engineering to software”.

Software engineering (SE) is considered the newest branch of engineering, and according to the ACM/IEEE-CS Computing Curricula 2020, SE focuses on the development and use of rigorous methods for designing and constructing software artifacts that will reliably perform specified tasks.

The objective of the proposed graduate programs (MAsc and MEng) in software engineering is to expand students’ knowledge of software engineering through intensive state-of-the-art courses, projects, and/or a research thesis in their chosen area of interest. The MAsc is a thesis-based program for students interested in research and may wish to continue their education at the PhD level. The MEng is a course-based or a project-based program for working professionals and other students interested in advanced knowledge and skills in software engineering.

b) Background and Rationale

- *Identify what is being proposed and provide an academic rationale for the proposed program*
- *Explain the appropriateness of the program name and degree nomenclature; list any program specializations, pathways, etc. (QAF 2.1.1c)*
- *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 2.1.5)*
- *Describe the ways in which the program fits into the broader array of program offerings within the Faculty and the University*

This proposal is for two new graduate programs in Software Engineering: MSc and MEng.

Software Engineering is a well-established field that will continue to grow as software systems and applications continue to enable everything we do from video conferencing platforms for telework from home, to autonomous vehicles.

Due to the importance of Software Engineering as a field:

- Professional Engineers Ontario (PEO) recognizes this field and allows graduates of CEAB-accredited Software Engineering programs to be licensed engineers.
- Software Engineering Body of Knowledge (SWEBOK) has been developed and continually maintained by leaders in the field.
- ACM and IEEE Computer Society developed and released curriculum guidelines for undergraduate degrees in Software Engineering.
- Canada's national system for describing occupations (NOC – National Occupational Classification) uses NOC 2713 to describe the occupation of Software Engineers and Designers.

The Faculty of Engineering and Applied Science (FEAS) offers a rapidly growing CEAB-accredited Software Engineering program at the undergraduate level; and graduate programs (MEng, MAsc and PhD) in Electrical & Computer Engineering. Graduate programs in software engineering would be natural expansion of the undergraduate program in Software Engineering and other relevant programs offered by FEAS.

The mode of delivery will be in-class on-campus, similar to existing graduate programs offered by the Faculty of Engineering and Applied Science. The nature of the program and its potential relevancy to industry and the fact that software teams are international and geographically distributed may lend itself well to blended learning in the future.

The proposed program complements related graduate programs (in Computer Science and IT) offered at Ontario Tech University. More details are provided in Section (f).

c) Consistency of Program Objectives with University Mission, Vision, Integrated Academic and Research Plan, and Strategic Mandate Agreement (QAF 2.1.1a)

- *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

Embracing technology with a conscience to advance knowledge and promote sustainability.

University Mission

We equip future leaders to solve complex problems.

We respond to the needs of students, and the evolving world, by providing superior undergraduate, graduate, and lifelong learning experiences. To this end, 'what we do' to achieve our mission and to 'tell our story' is guided by a community-focused approach on our strategic priorities:

- **Tech with a conscience:** Innovating to improve lives and the planet by incorporating technology-enhanced learning strategies, and promoting the ethical development and use of technology for good through intensive research and inquiry.
- **Learning re-imagined:** Co-creating knowledge by adapting to the ever-changing educational landscape through the provision of flexible and dynamic learning and research opportunities.
- **Creating a sticky campus:** Cultivating student- and community-centric engagement opportunities by encouraging an inclusive culture for our institution through online and on-campus activities.

Partnerships: Uncovering innovative solutions for their most pressing problems through purposeful research and collaboration with industry, community, government and academic partners especially as it relates to all facets of global sustainability and well-being.

The objective of proposed graduate programs in Software Engineering is to expand students' knowledge of software engineering through intensive state-of-the-art courses, projects, and/or a research thesis in their chosen area of interest. The programs will prepare students for careers in research, development, and advanced software engineering systems for empowering humanity, and that address ethical, social, and economic concerns. To this end, the objectives of the proposed graduate programs are consistent with the University Vision to embrace technology with a conscience to advance knowledge and promote sustainability.

Aligned with Ontario Tech's mission of responding to the needs of students, and the evolving world, by providing superior undergraduate, graduate, and lifelong learning experiences, the proposed graduate programs are a response to growth not only in the technology industry but across all industries because as it has been said before 'every company is becoming a software company'. The proposed program is designed to prepare graduates not for a singular job but rather a career path that involves life-long learning and multiple employment opportunities.

The objective and the learning outcomes of the proposed graduate programs are human-centered with integrated EDI (equity, diversity, inclusion) components that fit perfectly with the four academic-research strategic priorities, namely: tech with a conscience; learning re-imagined; creating a sticky campus; and partnerships, as per the 2021- 20223 Strategic Integrated Academic-Research Plan.

The proposed graduate programs in Software Engineering contribute to Ontario Tech's 2020-2025 Strategic Mandate Agreement as they are aligned with the institutional strength and focus in the areas of Engineering, Computer Science and IT disciplines, as well as the 'Skills and Job outcomes' section as the proposed program will produce graduates with practical skills in software engineers that can be immediately applied in the workplace (Economic and community impact section). Furthermore, the MEng program includes a formal experiential learning component (co-operative education) and is expected to attract a large number of domestic and international students (student enrolment).

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*

Today, students who are interested in graduate studies in Software Engineering at Ontario Tech would find the MASc/MEng in Electrical & Computer Engineering (offered by the Faculty of Engineering and Applied Science), or the MSc in Computer Science (offered jointly by the Faculty of Science, Faculty of Business and IT, and Faculty of Engineering and Applied Science).

There are currently 13 students in the MASc (ECE) and very few students in the MEng (ECE) supervised by FEAS faculty members teaching in the undergraduate Software Engineering program and conducting scholarly activities in relevant areas of software engineering. While this may give the impression that the proposed MASc program results in 0 new students, consider the following:

- Many of our BEng software engineering graduates look elsewhere for graduate programs in Software Engineering, simply because the ECE program suggests it is more electrical or hardware focused.
- International students look specifically for graduate programs in Software Engineering.
- Government-funded international students would have scholarships specifically for Software Engineering.

- MEng will attract working professionals and other students who are interested in graduate studies in software engineering to advance their knowledge in the field, but are not necessarily looking for a thesis-based graduate program.
- The expedited pathway into the Master's program will be attractive to our undergraduate students.

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

Faculty members in the area of software engineering are currently supervising graduate students in the MASc and PhD (Electrical & Computer Engineering) programs. As of Fall 2020, there are 13 students in the MASc program (12 full-time and 1 part-time) focusing on software systems & engineering. While supervision of MASc (thesis-based) students depends on funding, this number provides a baseline for deriving the expected number of students. The new program is expected to attract new students in both MASc and MEng. Current students supervised by software engineering faculty members will be given the choice to transfer to the new program.

We anticipate an initial cohort of 15 students in the MASc program with a steady state of 20 by the third year of the program; and an initial cohort of 10 students in the MEng program with a steady state of 20 per year by the fourth year of offering. Total enrollment of the programs (MASc and MEng) are shown in Table 1.

Table 1: Projected Enrollment by Academic and Program Year

	Academic Year					
	2022-2023	2023-2024	2024-2025	2025-2026	2026-2027	2027-2028
Level of Study						
MASc year 1	15	17	20*	20	20	20
MASc year 2		15	17	20	20	20
MEng year 1	10	12	15	20*	20	20
MEng year 2		10	12	15	20	20
Total Enrolment	25	54	64	75	80	80

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
- 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 need for software will continue to grow as long as technologies for smartphones, computers, internet of things, cyber-physical systems, and self-driving driving vehicles, and other domains continue to advance. Hence, the demand for software engineers will continue to rise, and employment in this field is expected to grow 21% by 2028 which is faster than the average projected rate of growth for all occupations (5%). Source:

<https://builtin.com/recruiting/demand-for-software-engineers>

Canada's national system for describing occupations (NOC – National Occupational Classification) uses NOC 2713 to describe the occupation of Software Engineers and Designers. And under the Global Talent Stream, where skilled workers can expect their Canada work permits and Canada visa applications processed within two weeks. To this end, this occupation is marketed as Canada's most in-demand skilled workers.

NOC 2713 defines this occupation as (source: ontario.ca/page/labour-market): "Software engineers and designers research, design, evaluate, integrate and maintain software applications, technical environments, operating systems, embedded software, information warehouses and telecommunications software. They are employed in information technology consulting firms, information technology research and development firms, and information technology units throughout the private and public sectors, or they may be self-employed.

According to the Government of Canada job bank (<https://www.jobbank.gc.ca/marketreport/outlook-occupation/5485/ca>), "this occupation (Computer Software Engineer) is expected to face labour shortage conditions over the period of 2019-2028 at the national level". The same source estimates that "new job openings (arising from expansion demand and replacement demand) are expected to total 27,500, while 24,000 new job seekers (arising from school leavers, immigration and mobility) are expecting to be available to fill them". More than 1/3 of the jobs will be in Ontario.

Examples of industry positions for which graduates of the MSc and MEng programs in Software Engineering would be qualified for include:

Software Engineer (including Intermediate SE, Full-Stack SE, Senior SE, SE Team Lead, SE Manager)

Amazon, Ciena, Magic Leap, Randstad, Ticketmaster, CoreLogic

DevOps Engineer

HootSuite, RBC, Scotiabank, Randstad, D2L, Maple, Peak Power Inc., Thales Group, Avande, Rogers, Intellex

Software Developer

Thales Group, Revature, Ontario Institute for Cancer Research, Ontario Teachers', Varicent, FDM Group, various Banks
Software Designer

There are many other career paths for graduates of the proposed programs, including:

PhD student
Research assistant
Data scientist
Project manager

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

The proposed program complements the current graduate program offerings (in Computer Science and IT) and it is not expected that the program will affect enrolment in those programs.

It is not unusual to find graduate programs in Computer Science and Software Engineering offered not only by the same university but the same department. As an example, the Department of Computing and Software at McMaster University offers graduate programs in Computer Science (MSc and PhD) as well as in Software Engineering (MEng, MAsC, PhD).

The aim of the proposed graduate programs in software engineering is to expand students' knowledge of software engineering through intensive state-of-the-art courses, projects, and/or a research thesis in their chosen area of interest. The program is focused on the applications of engineering principles to the software development lifecycle. On the other hand, the aim of the MSc program in Computer Science is to produce graduates that have a broad background in information technology. The proposed program and the existing programs in Computer Science are complementary, but the key differences are:

- The proposed program is specialized and focused on software engineering. The MSc program in CS is broad as it allows students to take 50% of their courses from outside the program.
- While the MSc program in CS has a 'Software Design' field (other fields in the program include: Digital Media, Information Science, Networks and IT Security), students are not allowed to take more than 2 courses from the same field.
- The MSc in CS is thesis-based. Working professionals interested in advancing their skills in the software engineering field may not be interested in a thesis-based option. The proposed programs in software engineering offer more options for students and professionals.
- Graduates of the Software Engineering program will be prepared to meet the PEO (Professional Engineers Ontario) requirements for becoming a licensed engineer.

There are many work opportunities in the field, and hence it is no surprise that graduates of both programs may be competing for the same job.

The Consortium for Graduate Education in Software Engineering – ConGESE, was formed to offer an advanced degree (MASc) in software engineering to part-time students, during working hours at the work site, with courses from six universities who are part of the consortium – this program was financially supported by IBM Canada, Nortel, and the Information Technology Research Centre. The participating universities included:

Carleton University
Queen's University
University of Ottawa
University of Toronto
University of Waterloo
University of Western Ontario

While the program was coordinated by ConGESE, the degrees were offered by the above universities. Exact dates of ConGESE operation are not known but believed to have been formed in the 1990s and died out and ConGESE has not offered courses for the past several years. There is no documented literature on what exactly went wrong, but perhaps lack of funding and burden of coordination.

Today, only a couple of universities in Ontario are offering graduate degree programs in Software Engineering, namely McMaster University (PhD, MASc, MEng) and Western University (MEng). Many other Ontario universities offer

graduate programs in Electrical & Computer Engineering (ECE) similar to what we currently have at Ontario Tech University.

Table 2 lists similar or contemporary programs offered elsewhere in Ontario.

Table 2: List of Similar Programs in Ontario

Institution Name	Credential Level and Program Name
McMaster University	PhD, MASc, MEng (Software Engineering)
Link to Program Web Page: https://gs.mcmaster.ca/program/computing-and-software/	
Brief Program Description: MEng: This program is intended for those interested in a career as a practicing professional in Computing and Software related fields MASc: This thesis-based program is focused on advancing knowledge of software lifecycle from design, implementation, and testing to documentation and maintaining, through intensive research in a chosen area of interest.	
What differentiates the new program from this existing program: McMaster’s MEng program is structured as 6 courses + project, whereas our program is more flexible offering students the choice between a course-based MEng (10 courses) or a project-based MEng (7 courses + project). While there is one additional course in our project-based program, this is in line with other MEng programs at Ontario Tech. McMaster’s programs have 6 specializations (Computer Systems, Health Informatics and Bioinformatics, Scientific Computing and Optimization, Security, Privacy, and Data Analytics, Software Quality, Theory and Methodologies of Computation) but our programs are more general giving the student more freedom but at the same time students can specialize in an area they are interested in through a thesis or a project.	
Institution Name	Credential Level and Program Name
University of Waterloo	Graduate Diploma in Software Engineering
Link to Program Web Page: https://uwaterloo.ca/graduate-studies-academic-calendar/archive-spring-2020/engineering/departement-electrical-and-computer-engineering/graduate-diploma-gdip-software-engineering	
Brief Program Description: According to the calendar description, this graduate diploma consists of 4 courses and is earned in conjunction with the MEng in Electrical and Computer Engineering. It looks like this diploma has been discontinued as it is no longer listed in the most recent calendar.	
What differentiates the new program from this existing program:	

The proposed program leads to MASc or MEng in Software Engineering. The program at Waterloo is a graduate diploma. One of the specializations in the MEng-ECE is 'Software' in which students must complete 3 specialized courses to earn that specialization.

Institution Name	Credential Level and Program Name
Western University	MEng in Software Engineering

Link to Program Web Page:
https://www.eng.uwo.ca/electrical/graduate/current_students/meng_programs/

Brief Program Description:
 No program description is provided except the requirements:
 In order to fulfil requirements of the MEng Program in Software Engineering you have to successfully complete either 8 required courses & 2 non-technical courses OR 6 required courses, 2 non-technical courses & a research project. The required courses for this program are listed below (a project is equivalent to two courses).

What differentiates the new program from this existing program:
 Other than the structure of the program, the crucial difference between the proposed program and the program at Western University is that the proposed program is truly software engineering program with learning outcomes aligned with the Software Engineering Body of Knowledge (SEBOK) whereas the required courses for the program at Western University are a collection of computing courses that, on the whole, do not align with the SEBOK.

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

Please see information described above.

2 Program Requirements

a) Admission Requirements

- *Outline the formal admission requirements; explain how these are appropriate for the program learning outcomes: How will they help to ensure students are successful? How do they align with the learning outcomes of the program? (QAF 2.1.2a)*
- *Explain any additional requirements for admission to the program such as special language, portfolio, etc. (and how the program recognizes prior work or learning experience, if applicable) (QAF 2.1.1b)*
- *Indicate the programs from which students may be drawn*

Admission requirements for MASc and MEng in Software Engineering.

In addition to general admission requirements for graduate studies
 [\(https://gradstudies.ontariotechu.ca/future_students/application_process_and](https://gradstudies.ontariotechu.ca/future_students/application_process_and)

[requirement/step%201/index.php](#)), applicants must meet the following program-specific requirements.

- Completion of an undergraduate software engineering, computer science, or other 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.

Prior to being accepted into the MASc program, applicants must find a professor who specializes in their desired area of research and who is willing to act as a supervisor. Close technical contact with a faculty member is an essential part of thesis-based graduate education in software engineering.

The proposed graduate program in Software Engineering will be of interest to students in Software Engineering, Computer/Electrical Engineering, Computer Science, and related programs. And hence, graduates of undergraduate programs in Computer Engineering, Electrical Engineering, Information Engineering, and related programs may meet the admission requirements depending on the courses they have taken. This will be at the discretion of the graduate program director.

Expedited pathway into the Master's program. 4th Year Software Engineering Students who have an average GPA of 3.3+ over their 2nd & 3rd years may be eligible for the expedited pathway into the Master's Program. The students may take up to 2 graduate courses from the Software Engineering program – these would be extra courses that are not counted as part of the undergraduate degree, meaning that students are not allowed to double-dip (i.e. count these courses as part of their undergraduate degree and graduate degree). If a grade of B+ or higher is obtained in these courses, advanced credit will automatically be granted upon registration in the MEng or MASc program in Software Engineering. Students who meet the admission requirements as described in Section 2 a) would be admitted into the MEng or MASc program following the completion of their undergraduate degree.

Students in the MEng program in Software Engineering who wish to transfer to the MASc program in Software Engineering should find a research supervisor and complete the necessary form for the transfer to be approved by the Graduate Program Director and SGPS.

b) Program Learning Outcomes and Assessment of Student Knowledge (QAF 2.1.1b, 2.1.6)

- **Connect with the Academic Planning Officer in CIQE (cique@ontariotechu.ca) early in the program development to review learning outcomes**
- *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 lists the program learning outcomes, which are adapted from the following referenced materials:

- The Software Engineering Body of Knowledge.
- ACM/IEEE-CS Software Engineering 2014 Curriculum Guidelines for Undergraduate Degree Programs in Software Engineering.
- Whitepaper (A Draft Reference Curriculum for a Master’s Degree in Software Engineering: A Joint Industry, Academic, and Government Initiative) of a panel discussion at the 2008 American Society for Engineering Education conference.
- iSSEc (Integrated Software & Systems Engineering Curriculum) project, Graduate Software Engineering 2009 (GSWE2009) Curriculum Guidelines for Graduate Degree Programs in Software Engineering.

Note that while the program learning outcomes are the same for MASc and MEng, the difference is really in the *level of exposure and application* of expectations for each learning outcome.

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.)
Show mastery of the software engineering knowledge and skills, and professional issues necessary to practice as a software engineer.	<ul style="list-style-type: none"> • Depth and breadth of knowledge 	ENGR 5510G ENGR 5520G	Courses incorporate formative and summative assessment tools such as assignments, tests, and exams to measure knowledge of software engineering methods and professional issues for practice.

Apply software engineering principles to conceptualize, design and implement research for the generation of new knowledge or product idea in at least one application domain.	<ul style="list-style-type: none"> • Level of application of knowledge • Research and scholarship 	MASc Thesis or MEng Project or ENGR 5590G Software Engineering Studio	Thesis, MEng project, or course projects.
Work effectively as part of a diversified team, including teams that are international and geographically distributed, to develop quality software artifacts, and to lead in one area of project development, such as project management, software analysis and design, system architecture, implementation, or quality assurance.	<ul style="list-style-type: none"> • Communication skills • Level of application of knowledge 	Most of the core and elective courses will have group projects.	Thesis and project reports and presentations, and demonstrations of software applications and tools will assess the student's ability to apply and integrate knowledge in software artifacts.
Reconcile conflicting project objectives, finding acceptable compromises within limitations of cost, time, knowledge, existing systems, and organizations.	<ul style="list-style-type: none"> • Awareness of limits of knowledge • Communication skills 	MASc Thesis or MEng Project or ENGR 5590G Software Engineering Studio, and other core and elective courses.	Courses incorporate formative and summative assessment tools such as assignments, tests, exams, and projects to measure knowledge of software engineering methods.
Design appropriate software engineering solutions that address ethical, social, gendered, legal, security, and economic concerns.	<ul style="list-style-type: none"> • Breadth and depth of knowledge • Level of application of knowledge • Autonomy/professional capacity 	Core and elective courses, plus thesis or project, or ENGR 5590G Software Engineering Studio.	Projects that require students to explore knowledge and tools not covered in previous courses, along with discussions to further assess ethical, social, legal and economics impacts of technology.
Analyze current significant software technology, articulate its strengths and weaknesses, compare it to alternative technologies, and specify and	<ul style="list-style-type: none"> • Awareness of limits of knowledge • Research and scholarship 	Any of the software engineering and software systems	Courses incorporate formative and summative assessment tools such as assignments, tests,

promote improvements or extensions to that technology.		electives, and project presentations or research seminar	exams, and project reports to assess the student's ability to apply and integrate knowledge in software artifacts, and project presentations to further ensure awareness of the limits of knowledge.
Learn new models, techniques, and technologies as they emerge, and appreciate the necessity of such continuing professional development.	<ul style="list-style-type: none"> Autonomy/professional capacity 	MAsc Thesis or MEng Project or ENGR 5590G Software Engineering Studio	Participating in discussions, along with self-directed projects that require students to explore knowledge and tools not covered in previous courses.

- *Selecting a few examples from above, explain in detail how the program design and requirements support the attainment of the Program Learning Outcomes (QAF 2.1.1b)*
- *With assistance from the Academic Planning Officer in CIQE (ciqe@ontariotechu.ca), please provide further details on the Assessment of the Program Learning Outcomes, as outlined in the Quality Council's Quality Assurance Framework Section 2.1.6 - Assessment of Teaching and Learning:*
 - *QAF 2.1.6a: 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?).*
 - *QAF 2.1.6b: Completeness of plans for documenting and demonstrating the level of performance of students, consistent with the Degree Level Expectations (How will the effectiveness of the program be assessed?)*

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

The learning outcomes of the MEng program are achieved through either a combination of course work and a project, or solely course work depending on the student's choice.

In addition, all students (MAsc or MEng) will have the opportunity to participate in research & development team projects through course projects included in most of the courses, through which students will be exposed to both quantitative and qualitative research methodologies.

Students in the MEng program will also have the opportunity to participate in teamwork in ENGR 5590G Software Engineering Studio (elective course for MASc) where students will utilize methods and tools they have learned in earlier courses to design and develop a large-scale software-intensive system. The project revolves around decomposing a large complex system into modules and classes that can be implemented, tested, deployed and maintained easily. Topics include information hiding, API design, managing complexity, error handling, testing, deployment and maintenance.

The courses are designed to give students in-depth learning in software engineering, and opportunities for advanced development of skills such as communication, teamwork and leadership, as well as participate in scholarly activities of research, seminars and presentations.

Several of the courses in the proposed program have a team project component, and students will be encouraged to form diversified teams to have diversified perspectives. Courses that cover requirements engineering will also cover topics related to integrating Equity, Diversity, and Inclusion (EDI) into the design and development of software systems and applications.

Ontario Tech University is committed to excellence in accessibility and diversity service provisions for all students, faculty and staff through a dedicated office for EDI (<https://inclusive.ontariotechu.ca>). All of our programs follow guidelines and EDI best practices provided by the University. The proposed programs, similar to all of our existing programs, will recruit a diverse student body from around the world.

The plan for assessing and monitoring the program effectiveness will be through the cyclical program review process, but also be in accordance with the requirements laid out by Ontario Tech's Academic Resource Committee that requires a report one-year after start-up and if there are areas of concerns 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.

An alignment of the Program Learning Outcomes to the Degree Level Expectations can be found in Appendix A.

- 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.

c) Program Structure and Content

- 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? (QAF 2.1.4b)
- Provide evidence that each graduate student is required to take a minimum of two-thirds of the course requirements from among graduate-level courses (QAF 2.1.6d)
- What is the program length? Provide a rationale for the length that ensures the program requirements can be reasonably completed
- Address how the program's structure will help students to meet the program learning outcomes and Degree Level Expectations (QAF 2.1.3a)

The requirements and structure of the program are described below for each of the MASc, MEng-Project and MEng-Course options.

Similar to existing graduate programs in Engineering at Ontario Tech University, the students can be full-time or part-time. Hence, the length of the program depends on the student status, but in general it is expected that students can complete the MASc program in 5 to 6 semesters, and the MEng program in 3 – 6 semesters of full-time study.

The program consists of core and elective courses. The program is structured so that students have a choice in course selection, and as you can see from the program learning outcomes, a mapping has been provided to demonstrate how learning outcomes are achieved through a combination of course work, supervised research, research seminar, and research thesis for the MASc program; or a combination of course work and a project, or solely course work depending on the student's choice in the MEng program.

Note that all core and elective courses are graduate level courses – the 'G' in the course number denotes it is a graduate level course.

MASc

The objective of the MASc program in Software Engineering is to prepare students for careers in research, development and advanced software engineering systems in a variety of application domains. Graduates of the program will be able to work as software engineers in research and development or other areas in advanced technology companies or government

agencies, or to continue their education and pursue a PhD degree – graduates of the program would be qualified and eligible for admission to our PhD program in Electrical & Computer Engineering in the field of Software Systems. Graduates of this program would also meet the admission requirements for the PhD program in Computer Science at our University, or any PhD program in CS, SE, or related field in Canada or elsewhere.

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 Software Engineering, students must complete five courses for a total of 15 credits and a thesis worth 15 credits:

- ENGR 5510G – Foundations of Software Engineering
- ENGR 5520G – Software Development Methods and Tools
- One course from Software Engineering Electives
- One course from Software Systems Electives
- One course from General Electives
- ENGR 5007G – MASc Seminar for ECSE
- ENGR 5001G – MASc Thesis

MEng (project-based)

The objective of the MEng program in Software Engineering is to provide the opportunity for students as well as software engineers in industry to upgrade and expand their skills, including 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. Depending on which option the student selects, the objective of the MEng program can be achieved through either a combination of course work and a project or solely course work. MEng students have exposure to research through projects included in most of the graduate courses.

- ENGR 5510G – Foundations of Software Engineering
- ENGR 5520G – Software Development Methods and Tools
- ENGR 5590G – Software Engineering Studio
- One course from Software Engineering Electives
- One course from Software Systems Electives
- One course from General Electives
- One course from any of the Electives categories
- ENGR 5002G – MEng/MEngM Project

MEng (course-based)

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

- ENGR 5510G – Foundations of Software Engineering
- ENGR 5520G – Software Development Methods and Tools

- ENGR 5590G – Software Engineering Studio
- One course from Software Engineering Electives
- One course from Software Systems Electives
- One course from General Electives
- The remaining four courses can be from any of the Electives categories

Course listing

Graduate courses offered are listed below. Courses related to software engineering are numbered as ENGR 55xxG. Courses related to software and computer systems are numbered as ENGR 57xxG.

The courses are organized as:

- Core courses: required courses for all students in the MASc and MEng programs
- Software Engineering Electives: specialized courses for Software Engineering
- Systems Electives: courses related to software and computer systems
- General Electives: related courses that may be of interest
- Other: courses related to thesis, project, or research seminar

Core Courses:

- ENGR 5510G - Foundations of Software Engineering
- ENGR 5520G – Software Development Methods and Tools

Software Engineering Electives:

- ENGR 5550G - Software Testing and Quality Assurance
- ENGR 5560G - Software Security and Dependability
- ENGR 5570G - Software Maintenance and Evolution
- ENGR 5590G - Software Engineering Studio
- CSCI 6110G - Software Modelling Techniques and Languages for Industry Applications
- CSCI 6120G - Empirical Software Engineering

Software Systems Electives

- ENGR 5730G - Advanced Algorithms and Data Structures
- ENGR 5750G - Software Quality Management
- ENGR 5740G - User Interface Design
- ENGR 5770G - Service Computing
- ENGR 5775G - Knowledge Discovery and Data Mining
- ENGR 5785G - Real-Time Data Analytics for Internet of Things
- ENGR 5790G - Safety-Critical Software Systems
- CSCI 5100G - Development of Concurrent Software

General Electives

- ENGR 5010G - Advanced Optimization

- ENGR 5140G - Project Management for Engineers
- ENGR 5360G - Automotive Electronics and Software
- ENGR 5427G - Operations Research
- ENGR 5660G - Communication Networks
- ENGR 5650G - Adaptive Systems and Applications
- ENGR 5670G - Cryptography and Secure Communications
- ENGR 5910G - Embedded Real-Time Control Systems
- ENGR 5940G - Intelligent Control Systems
- ENGR 5005G - Special Topics
- ENGR 5710G - Network Computing
- ENGR 5720G - Pervasive and Mobile Computing
- CSCI 5750G - Information Visualization
- CSCI 5120G - Principles of Distributed Computing

Other

- ENGR 5001G - MASC Thesis
- ENGR 5002G - MEng/MEngM Project
- ENGR 5007G - MASC Seminar for ECSE

Note: Courses are offered on the basis of demand with the expectation that most courses will be offered at a minimum of once every two years.

- *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 program requirements are structured around core and elective courses. As you can see from the description of core and SE elective courses, these new courses cover the state of the art in software engineering, from agile methodology to the latest tools and cloud-based development.

For MASC and MEng-Project, a research component is an integral part of the program, and in such cases the student work is supervised by a faculty member with expertise in the subject matter.

- *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 programs (MAsc and MEng) 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, students in the Co-op stream will be required to take ENGR1000W – Professional Competencies for Engineers [0 credit, pass/fail], unless they have previously taken and passed this course at Ontario Tech University perhaps during their undergraduate education.

Students would be able to take a co-op job after the 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 our Engineering Co-op office.

Co-op work terms will be recorded on the student 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 our Engineering Co-op office.

- *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 accessibility accommodations offered by Student Accessibility Services to current graduate students will be sufficient for students in the proposed program.

d) 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 B for proposed calendar copy.

Please see Appendix 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*

Following the recommendation of the Academic Resource Committee, the following consultation process was used:

Several meetings were held with core software engineering faculty members in the Department of Computer, Electrical and Software Engineering / Faculty of Engineering and Applied Science. Feedback from this consultation shaped the proposal into its current form. In addition:

- a) There is a consensus that once this program is approved, the 'Software Systems' field may need to be removed from the MAsc-ECE program.
- b) Faculty members who have associate graduate faculty status in the CS program may keep that status for the purpose of graduate student advisory committees. The Dean of the Faculty of Engineering and Applied Science discuss CS program committee with the Deans of Science and FBIT and it was suggested that FEAS no longer needs to be part of the CS graduate program committee.

- c) The MITS program is growing and cross-listed (ENGR/CSCI) courses have been recently removed based on MITS program request.

Consultation with non-FEAS graduate faculty in ECE:

- a) An email was sent to eight faculty members (CS and MITS) who are graduate faculty of ECE or serving as GPD for CS or MITS, with a link to the proposal and shared document for collecting feedback. They were also invited to be graduate faculty in the proposed program.
- b) Several faculty members provided comments, overly positive with one faculty member interested in being on the graduate faculty for the program. The GPD for the CS program provided comments, and shared the proposal with internal CS graduate faculty. The comments have been addressed in the proposal.

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 2.1.7, 2.1.8, 2.1.10)

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.*

Not aware of relevant enrolment agreements with other institutions/external partners.

b) Faculty Members - Current and New Faculty Requirements

- *Complete as an Appendix, using the Faculty Information templates provided, charts detailing the list of faculty committed to the program and provide any additional details, in paragraph form, if necessary 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.*
- *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*
- *Describe the role of any sessional faculty,*
- *Explain the provision of supervision of experiential learning opportunities; how will supervisory loads be distributed?*
- ***Describe the plan and commitment to provide additional faculty resources to support the program, if needed***
- *Indicate that faculty CVs are included in an Appendix, and please provide CVs for all faculty committed to the program*

The proposed program draws on the existing expertise in Software Engineering in the Faculty of Engineering and Applied Science, with no new faculty members are required for this program beyond the on-going recruiting efforts for two new faculty members in Software Engineering. All core courses, software engineering electives, and software systems courses will be taught by core software engineering faculty members. General elective courses will be taught by core faculty members in the Faculty of Engineering and Applied Science.

All faculty members listed in Appendix D are tenured, tenure-track, or teaching faculty with continuing contracts. As mentioned earlier, recruiting efforts are in-progress to bring two tenured/tenure-track faculty members in software engineering.

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.*
- ***Please describe the plan and commitment to provide additional resources to support the program, if needed***

All courses will be taught by core software engineering faculty or other faculty members in the Faculty of Engineering and Applied Science.

No TA support is provided for graduate-level courses.

Administrative and academic advising will be provided by the existing Faculty graduate programs assistant office.

d) 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

Academic advising for students in the proposed MSc and MEng programs will be provided by a graduate program director (GDP), and administrative support for academic advising is provided by the Graduate Programs Assistant in the Faculty of Engineering and Applied Science.

Student Life

All graduate students have access to an extensive support system that ensures a quality student experience. In addition to the outlined services below, students may also take advantage of the Campus Childcare Centre, Campus Bookstores, Housing

and Living Resources, as well as the Student Union. Further information can be found at: <http://studentlife.ontariotechu.ca/>

Student Learning Centre

The Student Learning Centre fosters a high level of academic excellence in the Ontario Tech University community by working with all Ontario Tech University students, undergraduate and graduate, to achieve educational success. Foundational knowledge and prerequisite skills are essential to all university-level courses, and competency with these skills is vital for strong academic performance. Faculty specific academic resources are available online and include tip sheets and videos. The subject specialists offer in-person support services in mathematics, writing, study skills, ESL and physics. With the additional support of peer tutors and workshops, the Centre can further accommodate the needs of a specific course or program.

Student Accessibility Services

Student Accessibility Services (SAS) works collaboratively to ensure that students with disabilities have equal opportunities for academic success. SAS operates under the Ontario Human Rights Code (OHRC) and the Accessibility for Ontarians with Disabilities Act (AODA). Services are provided for students with documented disabilities. Accommodation supports include but are not limited to:

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

SAS also provides inclusive peer spaces, support groups, and skills workshops for students.

Careers and Internships

The Career Centre offers comprehensive career service assistance, co-op and internship support and resources, 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 internship job search advising
- Interview preparation
- Job market information
- Job search strategies

A variety of events are hosted on campus during the academic year including employer information and networking sessions, job fairs, and interviews conducted by leading employers.

Student Engagement and Equity

Student Engagement and Equity supports students' successful transition into the university and provides opportunities for them to develop leadership and professional skills throughout their university career. Services provided through Student Engagement and Equity include:

- Orientation and events through first year
- Specialized programming for first-generation, graduate, Indigenous, international, mature, online, transfer, and diploma-to-degree pathways students
- Services and supports for international and exchange students
- Equity and inclusivity programming and support groups
- Assistance and advice for living off-campus
- Peer mentoring to help students through first year
- Opportunities to grow and develop leadership skills through the Ambassador and Peer Mentorship program

Student Mental Health Services

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

- Attend a drop-in session
- Participate in events and activities or support groups that promote positive health and well-being
- Access tools and resources online to learn about mental health and how to maintain good health and wellness
- Work with a mental health professional to address concerns
- Contact the Student Lifeline for immediate help and assistance
- Get answers to frequently asked questions about mental health

Student Mental Health Services offers short-term counselling and therapy services to students. 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
- Complementary Health Services featuring acupuncture, chiropractic, custom orthotics, massage therapy, nutritional counselling and physical therapy
- Treatment of disease, illness and injury
- Allergy injections, immunizations and influenza injections
- 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 Student Awards and Financial Aid 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

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 a 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.

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.

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 University 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 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 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.

e) 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*
- *Refer to the Business Plan (Section 4g) where appropriate*

The primary sources of funding for the MASc program (thesis-based) will be teaching assistantships, research assistantships, and/or graduate research assistantships. These are available to both Canadian and international students. The minimum level of funding is currently \$16,000/year.

Funding is not provided to part-time students and/or students in the MEng professional program.

A limited number of graduate scholarships to high-achieving full-time entering a research-based master's or doctoral program is awarded by the School of Graduate and Postdoctoral Studies. Students will be assessed for eligibility at the time of admission, and application isn't required.

f) 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.*
- *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)*
- ***The plan and commitment to provide additional resources to support the program, if needed***

Library report is in Appendix E.

No new requirement for additional space/infrastructure.

g) Business Plan

- *Provide a brief statement of the funding requirements. Please submit a copy of the full Excel document to CIQE, as an attachment.*
- *Complete the highlighted sections of the [New Program Funding and Tuition](#) form and submit the form to CIQE as soon as possible*

There are no new funding requirements for the proposed programs. The Academic Resource Committee has reviewed the budget sheets for each program and a budget summary provided to the external reviewers.

5 Closing Statements Regarding Program Quality (QAF 2.1.10)

- *Please describe the appropriateness of the collective faculty expertise to contribute substantively to the proposed program; areas of faculty strength and expertise, innovation, and scholarly record will contribute to the quality of the program and student experience*
- *Please explain how the program structure and faculty research will ensure the intellectual quality of the student experience*
- *Refer to the Faculty Appendices, and provide information on how the research experience, current projects, and funding contribute to the quality of the program*

The proposed program draws on the existing expertise in Software Engineering in the Faculty of Engineering and Applied Science, with no new faculty members are

required for this program beyond the on-going recruiting efforts for two new faculty members in Software Engineering.

The current software engineering faculty expertise is the core faculty for supporting the CEAB-accredited undergraduate program in Software Engineering in the Faculty of Engineering and Applied Science, and in addition they are offering graduate courses and supervising graduate students, 13 in the MASc-ECE program.

The core faculty in software engineering has a track record of offering successful courses at the undergraduate and graduate levels, with research expertise in many areas of software engineering such as intelligent systems, embedded systems, Internet of Things, machine learning & artificial intelligence, and software engineering education. Appendix D shows information about faculty members expertise, research areas, and funding; CVs for graduate faculty are also included.

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.

Appendix A – Program Learning Outcome Alignment Map to Degree Level Expectations

Appendix B – Calendar Copy

Appendix C – List of Courses in the Program, New Course Proposals, Required Course Changes

Appendix D – Faculty Information

Appendix E – Library Report

Appendix A - Program Learning Outcome Alignment Map to Degree Level Expectations

Degree Level Expectation	Program Learning Outcome
Depth and Breadth of Knowledge	Show mastery of the software engineering knowledge and skills, and professional issues necessary to practice as a software engineer.
	Design appropriate software engineering solutions that address ethical, social, legal, security, and economic concerns.
Research and Scholarship	Apply software engineering principles to conceptualize, design and implement research for the generation of new knowledge or product idea in at least one application domain.
	Be able to analyze current significant software technology, articulate its strengths and weaknesses, compare it to alternative technologies, and specify and promote improvements or extensions to that technology.
Application of Knowledge	Apply software engineering principles to conceptualize, design and implement research for the generation of new knowledge or product idea in at least one application domain.
	Work effectively as part of a team, including teams that may be international and geographically distributed, to develop quality software artifacts, and to lead in one area of project development, such as project management, software analysis and design, system architecture, implementation, or quality assurance.
	Design appropriate software engineering solutions that address ethical, social, legal, security, and economic concerns.
Professional Capacity/Autonomy	Design appropriate software engineering solutions that address ethical, social, legal, security, and economic concerns.
	Be able to learn new models, techniques, and technologies as they emerge, and appreciate the necessity of such continuing professional development.
Communication Skills	Work effectively as part of a team, including teams that may be international and geographically distributed, to develop quality software artifacts, and to lead in one area of project development, such as project management, software analysis and design, system architecture, implementation, or quality assurance.
	Reconcile conflicting project objectives, finding acceptable compromises within limitations of cost, time, knowledge, existing systems, and organizations
Awareness of Limits of Knowledge	Reconcile conflicting project objectives, finding acceptable compromises within limitations of cost, time, knowledge, existing systems, and organizations.
	Be able to analyze current significant software technology, articulate its strengths and weaknesses, compare it to alternative technologies, and specify and promote improvements or extensions to that technology.

Appendix B – Calendar Copy

Software Engineering

Graduate faculty

- Anwar Abdalbari*, BSc, MSc, PhD
- Sanaa Alwidian, BSc, MSc, PhD
- Akramul Azim, BSc, MSc, PhD
- Jeremy Bradbury, BSc, MSc, PhD
- Mikael Eklund, BSc, MSc, PhD
- Khalid Elgazzar, BSc, MSc, PhD
- Khalid Hafeez*, BSc, MSc, PhD
- Hossam Gaber, BSc, MSc, PhD
- Patrick Hung, BSc, MPhil, MAsc, PhD
- Ramiro Liscano, BScEng, MScEng, PhD
- Qusay H. Mahmoud, BSc, MCS, PhD
- Masoud Makrehchi, BSc, MSc, PhD
- Shahryar Rahnamayan, BSc, MS, PhD
- Ying Zhu, BSc, MSc, PhD
- **One new tenure-track/tenured hire in Software Engineering is underway

*Teaching-focused faculty members who will be teaching core and elective graduate courses only.

Program information

Software engineering is considered the newest branch of engineering, and according to the ACM/IEEE-CS Computing Curricula 2020, software engineering focuses on the development and use of rigorous methods for designing and constructing software artifacts that will reliably perform specified tasks.

The **Master of Applied Science (MASc)** in Software Engineering is a thesis-based Master's program for students interested in research-oriented studies and may want to continue their education at the PhD level.

The **Master of Engineering (MEng)** in Software Engineering is a course-based or a project-based master's program that aims to provide the opportunity for students as well as software professionals to expand their knowledge and skills in software engineering.

The objective of either program is to expand students' knowledge of software engineering through intensive state-of-the-art courses, projects, and/or a research thesis in their chosen area of interest. The program will prepare students for careers in research, development and advanced software engineering systems in a variety of application domains. Graduates of the program will be able to work as software

engineers in research and development or other areas in advanced technology companies or government agencies, or continue their education at the PhD level.

Graduates of the MEng and MAsC in Software Engineering program will be able to:

- Show mastery of the software engineering knowledge and skills, and professional issues necessary to practice as a software engineer in a variety of application domains.
- Show mastery of software engineering in at least one speciality or application domain.
- Work effectively as part of a diversified team, including teams that are international and geographically distributed, to develop quality software artifacts, and to lead in one area of project development, such as project management, software analysis and design, system architecture, implementation, or quality assurance.
- Reconcile conflicting project objectives, finding acceptable compromises within limitations of cost, time, knowledge, existing systems, and organizations.
- Design appropriate software engineering solutions that address ethical, social, gendered, legal, security, and economic concerns.
- Be able to analyze current significant software technology, articulate its strengths and weaknesses, compare it to alternative technologies, and specify and promote improvements or extensions to that technology.
- Be able to learn new models, techniques, and technologies as they emerge, and appreciate the necessity of such continuing professional development.

The learning outcomes are achieved through a set of core and elective courses and other activities as defined in the respective program curriculum, including course work, supervised research, research seminar, research thesis, project, or solely course work depending on the student's choice of program.

The courses are designed to give students in-depth learning in software engineering, and opportunities for advanced development of skills such as communication, teamwork and leadership, as well as participate in scholarly activities of research, seminars and presentations.

Admission requirements

In addition to the general admission requirements for graduate studies (add a link to them), Software Engineering applicants (for MAsC or MEng) must meet the following program-specific requirements:

MAsC or MEng in Software Engineering

- Completion of an undergraduate software engineering, computer science, or other 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.

P.S. Graduates of undergraduate programs in Computer Engineering, Electrical Engineering, Information Engineering, and related programs may meet the admission requirements depending on the courses they have taken. This will be at the discretion of the graduate program director.

Prior to being accepted into the MASc program, applicants must find a professor who specializes in their desired area of research and who is willing to act as a supervisor. Close technical contact with a faculty member is an essential part of thesis-based graduate education in software engineering.

MEng students (once in the program) who select the MEng-Project option must find a professor who is willing to act as a project supervisor.

The expedited pathway into the **Master's** program is intended for current 4th Year Software Engineering Students at Ontario Tech University who have an average GPA of 3.3+ over their 2nd & 3rd years. The students may take up to 2 graduate courses from the Software Engineering program – these would be extra courses that are not counted as part of the undergraduate degree. If a grade of B+ or higher is obtained in these courses, advanced credit will automatically be granted upon registration in the MEng or MASc program in Software Engineering. Students who meet the admission requirements as described above would be admitted into the MEng or MASc program following the completion of their undergraduate degree.

Students in the MEng program in Software Engineering who wish to transfer to the MASc program in Software Engineering should find a research supervisor and complete the necessary form for the transfer to be approved by the Graduate Program Director and SGPS.

Part-time studies

The MASc and MEng programs are intended to be full-time programs, but to facilitate accessibility part-time study may be permitted. The typical part-time student is already employed in the software industry and bring a level of practical experience to the program. It is essential that part-time students seek approval from their faculty advisor or the graduate program directory regarding their study plan.

Degree requirements

MASc Program

All MASC students are required to successfully complete five courses (for a total of 15 credits) and a thesis (15 credits). Before defending their thesis, students must present the results of their research in a seminar. The MASC degree requirements are summarized below.

- ENGR 5510G – Foundations of Software Engineering
- ENGR 5520G – Software Development Methods and Tools
- One course from Software Engineering Electives
- One course from Software Systems Electives
- One course from General Electives
- ENGR 5007G – MASC Seminar for ECSE
- ENGR 5001G – MASC Thesis

MEng Program

All MEng students are required to successfully complete ten courses (course-based option) or seven courses plus a project (project-based option). The MEng degree requirements are summarized below:

- ENGR 5510G – Foundations of Software Engineering
- ENGR 5520G – Software Development Methods and Tools
- ENGR 5590G – Software Engineering Studio
- For the course-based option:
 - One course from Software Engineering Electives
 - One course from Software Systems Electives
 - One course from General Electives
 - The remaining four courses can be from any of the Electives categories
- For the project-based option:
 - One course from Software Engineering Electives
 - One course from Software Systems Electives
 - One course from General Electives
 - One course from any of the Electives categories
 - ENGR 5002G – MEng/MEngM Project

For both, MASC and MEng, No courses at the undergraduate level or outside the program are allowed.

Course listing

Graduate courses offered are listed below. Courses related to software engineering are numbered as ENGR 55xxG. Courses related to software and computer systems are numbered as ENGR 57xxG.

The courses are organized as:

- Core courses: required courses for all students in the MASC and MEng programs

- Elective categories
 - Software Engineering Electives: specialized courses for Software Engineering
 - Software Systems Electives: courses related to software and computer systems
 - General Electives: related courses that may be of interest
- Other: courses related to thesis, project or research seminar

Core Courses

- ENGR 5510G - Foundations of Software Engineering
- ENGR 5520G - Software Development Methods and Tools

Software Engineering Electives

- ENGR 5550G - Software Testing and Quality Assurance
- ENGR 5560G - Software Security and Dependability
- ENGR 5570G - Software Maintenance and Evolution
- ENGR 5590G - Software Engineering Studio
- CSCI 6110G - Software Modelling Techniques and Languages for Industry Applications
- CSCI 6120G - Empirical Software Engineering

Software Systems Electives

- ENGR 5730G - Advanced Algorithms and Data Structures
- ENGR 5750G - Software Quality Management
- ENGR 5740G - User Interface Design
- ENGR 5770G - Service Computing
- ENGR 5775G - Knowledge Discovery and Data Mining
- ENGR 5785G - Real-Time Data Analytics for Internet of Things
- ENGR 5790G - Safety-Critical Software Systems
- CSCI 5100G - Development of Concurrent Software

General Electives

- ENGR 5010G - Advanced Optimization
- ENGR 5140G - Project Management for Engineers
- ENGR 5360G - Automotive Electronics and Software
- ENGR 5427G - Operations Research
- ENGR 5660G - Communication Networks
- ENGR 5650G - Adaptive Systems and Applications
- ENGR 5670G - Cryptography and Secure Communications
- ENGR 5910G - Embedded Real-Time Control Systems
- ENGR 5940G - Intelligent Control Systems
- ENGR 5004G – MAsc/MEng Directed Studies
- ENGR 5005G - Special Topics
- ENGR 5710G - Network Computing
- ENGR 5720G - Pervasive and Mobile Computing
- CSCI 5750G - Information Visualization

- CSCI 5120G - Principles of Distributed Computing

Other

- ENGR 5001G - MAsc Thesis
- ENGR 5002G - MEng/MEngM Project
- ENGR 5007G - MAsc Seminar for ECSE

Appendix C – List of Courses in the Program

New Courses

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.

Credit hours: 3

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.

Credit hours: 3

ENGR 5550G – Software Testing and Quality Assurance

This course will introduce students to techniques and tools to verify, validate, and evaluate software systems and their quality. Topics include inspection and code reviews, debugging, testing methodologies such as unit testing, classical white box and black box testing, integration and system testing, test automation, IEEE software testing standards, verification of implementation against requirements and design, timing analysis and verification, automated verification, formal verification, software model checking, safety analysis, trustworthiness and reliability, quality assurance.

Credit hours: 3

ENGR 5560G – Software Security and Dependability

This course introduces students to methods and tools for software security and dependability, reliability engineering process, and fault tolerance. Topics include software security and privacy, software vulnerabilities and attacks, access control models, identity and access management, security engineering process and the secure

software development lifecycle, run-time software monitoring, principles of software dependability techniques, software fault tolerance, error-resilient computing.

Credit hours: 3

ENGR 5570G – Software Maintenance and Evolution

This course introduces students to the fundamental developments in software evolution and common maintenance practices including techniques, methodologies and tools. Students will learn about the challenges of software maintenance and evolution, and the techniques, methods and tools that can be used to build large scale software systems that are easier to understand, maintain, reuse, and evolve in a cost-effective manner. Topics include taxonomy of software evolution and maintenance, maintenance and evolution models, reengineering, reverse engineering, legacy systems, change impact analysis, refactoring.

Credit hours: 3

ENGR 5590G – Software Engineering Studio

This course features a team project allowing students to utilize the methods and tools they have learned in earlier courses to design and develop a large-scale software-intensive system. The project revolves around decomposing a large complex system into modules and classes that can be implemented, tested, deployed and maintained easily. Topics include information hiding, API design, managing complexity, error handling, testing, deployment and maintenance, software project management, software engineering code of ethics and professional practice.

Prerequisites: ENGR 5510G and ENGR 5520G

Credit hours: 3

Existing courses – the following list of courses already exist in the graduate calendar.

- ENGR 5710G - Network Computing
- ENGR 5720G - Pervasive and Mobile Computing
- ENGR 5730G - Advanced Algorithms and Data Structures
- ENGR 5750G - Software Quality Management
- ENGR 5740G - User Interface Design
- ENGR 5770G - Service Computing
- ENGR 5775G - Knowledge Discovery and Data Mining
- ENGR 5785G - Real-Time Data Analytics for Internet of Things
- ENGR 5790G - Safety-Critical Software Systems
- ENGR 5010G - Advanced Optimization
- ENGR 5140G - Project Management for Engineers
- ENGR 5360G - Automotive Electronics and Software
- ENGR 5427G - Operations Research
- ENGR 5660G - Communication Networks

- ENGR 5650G - Adaptive Systems and Applications
- ENGR 5670G - Cryptography and Secure Communications
- ENGR 5910G - Embedded Real-Time Control Systems
- ENGR 5940G - Intelligent Control Systems
- ENGR 5004G – MAsc/MEng Directed Studies
- ENGR 5005G - Special Topics
- ENGR 5001G – MAsc Thesis
- ENGR 5002G – MEng/MEngM Project
- ENGR 5007G – MAsc Seminar for ECE*

*Note: Course change template is provided to change the title of ENGR 5007G from “MAsc Seminar for ECE” to “MAsc Seminar for ECSE”, to avoid creating a seminar course specifically for the graduate program in software engineering.

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: Engineering and Applied Science	
This new course is associated with:	
<input type="checkbox"/> Minor Program Adjustment <input type="checkbox"/> Major Program Modification <input checked="" type="checkbox"/> New Program <input type="checkbox"/> None	
Will this course appear anywhere other than the course description section of the Calendar?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> 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.]

New course for the new programs: MAsc in Software Engineering MEng in Software Engineering

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

2022-2023

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

Fall 2022

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

--

Subject Code: ENGR	Course Number: 5510G *ensure the course code has not been previously used
Full Course Title: Foundations of Software Engineering	
Short-Form Course Title (max. 30 characters): Foundations of SE	

Course Description

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.

Credit Hours: 3	
Contact Hours – please indicate total number of hours for each component	
Lecture: 3	Lab: 0
Tutorial: 0	Other: 0
Cross-listings	
Prerequisites for Calendar	
Prerequisites for Banner	
Co-requisites	
Prerequisites with concurrency (pre or co-requisite)	
Credit restrictions	<input type="checkbox"/> Equivalency*
Recommended Prerequisites	
Course Restrictions	
Course Type	<input checked="" type="checkbox"/> Core <input type="checkbox"/> Elective <input type="checkbox"/> Core or Elective
Is the course:	<input type="checkbox"/> Undergraduate <input checked="" type="checkbox"/> Graduate <input type="checkbox"/> Professional (e.g. some Education courses)
Grading scheme	<input checked="" type="checkbox"/> N (normal alpha grade) <input type="checkbox"/> P (pass/fail)

***Equivalency:** If it is equivalent, students can retake either course. If it is not equivalent, students are not allowed to register in the restricted course.

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:

A wide range of methods will be used to assess students' understanding, attainment of learning outcomes including: in-class discussions, presentations, exams, assignments, and projects.

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 will:

- Have knowledge of the full software engineering lifecycle and knowledge areas as defined in the Software Engineering Body of Knowledge (SEBOK);

- Be aware of trends in software engineering;
- Be able to gather and analyze software requirements;
- Apply state-of-the-art techniques for the analysis of software requirements;
- Be aware of professional practice and software engineering economics.

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:

The proposal for the new graduate programs in software engineering along with new course templates were shared with eight faculty members (CS and MITS) who are graduate faculty of ECE or serving as GPD for CS or MITS. Feedback from the consultation process shaped the proposal in its current form.

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):

ECSE Department Council: Feb 22, 2021 (motion approved)

FEAS Graduate Committee: Feb 26, 2021 (for information)

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: Engineering and Applied Science	
This new course is associated with:	
<input type="checkbox"/> Minor Program Adjustment <input type="checkbox"/> Major Program Modification <input checked="" type="checkbox"/> New Program <input type="checkbox"/> None	
Will this course appear anywhere other than the course description section of the Calendar?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> 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.]

New course for the new programs: MAsc in Software Engineering MEng in Software Engineering

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

2022-2023

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

Fall 2022

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

--

Subject Code: ENGR	Course Number: 5520G *ensure the course code has not been previously used
Full Course Title: Software Development Methods and Tools	
Short-Form Course Title (max. 30 characters): Software Dev Methods and Tools	

Course Description

This course surveys the practical software development methods and tools 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.

Credit Hours: 3	
Contact Hours – please indicate total number of hours for each component	
Lecture: 3	Lab: 0
Tutorial: 0	Other: 0
Cross-listings	
Prerequisites for Calendar	
Prerequisites for Banner	
Co-requisites	
Prerequisites with concurrency (pre or co-requisite)	
Credit restrictions	<input type="checkbox"/> Equivalency*
Recommended Prerequisites	
Course Restrictions	
Course Type	<input checked="" type="checkbox"/> Core <input type="checkbox"/> Elective <input type="checkbox"/> Core or Elective
Is the course:	<input type="checkbox"/> Undergraduate <input checked="" type="checkbox"/> Graduate <input type="checkbox"/> Professional (e.g. some Education courses)
Grading scheme	<input checked="" type="checkbox"/> N (normal alpha grade) <input type="checkbox"/> P (pass/fail)

***Equivalency:** If it is equivalent, students can retake either course. If it is not equivalent, students are not allowed to register in the restricted course.

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:

A wide range of methods will be used to assess students' understanding, attainment of learning outcomes including: in-class discussions, presentations, exams, assignments, and projects.

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, students will:

- Have knowledge about practical software development methods and tools for analysis, design, construction and measurement of large-scale software-intensive systems;

- Apply state-of-the-art methods and tools for the design and construction of software systems;
- Apply test-driven development techniques;
- Have knowledge and apply version control, continuous integration and DevOps;
- Be aware of trends in development methods and tools.

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:

The proposal for the new graduate programs in software engineering along with new course templates were shared with eight faculty members (CS and MITS) who are graduate faculty of ECE or serving as GPD for CS or MITS. Feedback from the consultation process shaped the proposal in its current form.

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):

ECSE Department Council: Feb 22, 2021 (motion approved)

FEAS Graduate Committee: Feb 26, 2021 (for information)

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: Engineering and Applied Science	
This new course is associated with:	
<input type="checkbox"/> Minor Program Adjustment <input type="checkbox"/> Major Program Modification <input checked="" type="checkbox"/> New Program <input type="checkbox"/> None	
Will this course appear anywhere other than the course description section of the Calendar?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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.]

New course for the new programs: MAsc in Software Engineering MEng in Software Engineering

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

2022-2023

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

Fall 2022

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

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Subject Code: ENGR	Course Number: 5550G *ensure the course code has not been previously used
Full Course Title: Software Testing and Quality Assurance	
Short-Form Course Title (max. 30 characters): Software Testing and QA	

Course Description

This course will introduce students to techniques and tools to verify, validate, and evaluate software systems and their quality. Topics include inspection and code reviews, debugging, testing methodologies such as unit testing, classical white box and black box testing, integration and system testing, test automation, IEEE software testing standards, verification of implementation against requirements and design, timing analysis and verification, automated verification, formal verification, software model checking, safety analysis, trustworthiness and reliability, quality assurance.

Credit Hours: 3	
Contact Hours – please indicate total number of hours for each component	
Lecture: 3	Lab: 0
Tutorial: 0	Other: 0
Cross-listings	
Prerequisites for Calendar	
Prerequisites for Banner	
Co-requisites	
Prerequisites with concurrency (pre or co-requisite)	
Credit restrictions	ENGR 5750 Software Quality Management <input type="checkbox"/> Equivalency*
Recommended Prerequisites	
Course Restrictions	
Course Type	<input type="checkbox"/> Core <input checked="" type="checkbox"/> Elective <input type="checkbox"/> Core or Elective
Is the course:	<input type="checkbox"/> Undergraduate <input checked="" type="checkbox"/> Graduate <input type="checkbox"/> Professional (e.g. some Education courses)
Grading scheme	<input checked="" type="checkbox"/> N (normal alpha grade) <input type="checkbox"/> P (pass/fail)

***Equivalency:** If it is equivalent, students can retake either course. If it is not equivalent, students are not allowed to register in the restricted course.

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:

A wide range of methods will be used to assess students' understanding, attainment of learning outcomes including: in-class discussions, presentations, exams, assignments, and projects.

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

Upon successful completion of this course, students will:

- Have knowledge of the techniques and tools to verify, validate, and evaluate software systems;

- Apply tools to verify and validate software components and systems;
- Understand the value of inspection and code reviews
- Utilize debugging and testing methodologies such as unit testing, classical white box and black box testing, integration and system testing, test automation;
- Be aware of IEEE software testing standards;
- Apply some techniques for verification of implementation against requirements and design timing analysis and verification, automated verification, formal verification;
- Be able to design, develop and test for trustworthiness and reliability.

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:

The proposal for the new graduate programs in software engineering along with new course templates were shared with eight faculty members (CS and MITS) who are graduate faculty of ECE or serving as GPD for CS or MITS. Feedback from the consultation process shaped the proposal in its current form.

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):

ECSE Department Council: Feb 22, 2021 (motion approved)

FEAS Graduate Committee: Feb 26, 2021 (for information)

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: Engineering and Applied Science	
This new course is associated with:	
<input type="checkbox"/> Minor Program Adjustment <input type="checkbox"/> Major Program Modification <input checked="" type="checkbox"/> New Program <input type="checkbox"/> None	
Will this course appear anywhere other than the course description section of the Calendar?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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.]

New course for the new programs: MAsc in Software Engineering MEng in Software Engineering

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

2022-2023

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

Fall 2022

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

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Subject Code: ENGR	Course Number: 5560G *ensure the course code has not been previously used
Full Course Title: Software Security and Dependability	
Short-Form Course Title (max. 30 characters): Software Sec and Dependability	

Course Description

This course introduces students to methods and tools for software security and dependability, reliability engineering process, and fault tolerance. Topics include software security and privacy, software vulnerabilities and attacks, access control models, identity and access management, security engineering process and the secure software development lifecycle, run-time software monitoring, principles of software dependability techniques, software fault tolerance, error-resilient computing.

Credit Hours:	
Contact Hours – please indicate total number of hours for each component	
Lecture: 3	Lab: 0
Tutorial: 0	Other: 0
Cross-listings	
Prerequisites for Calendar	
Prerequisites for Banner	
Co-requisites	
Prerequisites with concurrency (pre or co-requisite)	
Credit restrictions	<input type="checkbox"/> Equivalency*
Recommended Prerequisites	
Course Restrictions	
Course Type	<input type="checkbox"/> Core <input checked="" type="checkbox"/> Elective <input type="checkbox"/> Core or Elective
Is the course:	<input type="checkbox"/> Undergraduate <input checked="" type="checkbox"/> Graduate <input type="checkbox"/> Professional (e.g. some Education courses)
Grading scheme	<input checked="" type="checkbox"/> N (normal alpha grade) <input type="checkbox"/> P (pass/fail)

***Equivalency:** If it is equivalent, students can retake either course. If it is not equivalent, students are not allowed to register in the restricted course.

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:

A wide range of methods will be used to assess students' understanding, attainment of learning outcomes including: in-class discussions, presentations, exams, assignments, and projects.

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, students will:

- Have knowledge of state-of-the-art methods and tools for software security and dependability, reliability engineering process, and fault tolerance;

- Be able to design secure and dependable software systems;
- Apply techniques for developing security and privacy-aware software systems;
- Be able to test for software vulnerabilities;
- Aware of various techniques for access control, identity and access management;
- Be able to apply the security engineering process and the secure software development lifecycle.

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:

The proposal for the new graduate programs in software engineering along with new course templates were shared with eight faculty members (CS and MITS) who are graduate faculty of ECE or serving as GPD for CS or MITS. Feedback from the consultation process shaped the proposal in its current form.

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):

ECSE Department Council: Feb 22, 2021 (motion approved)

FEAS Graduate Committee: Feb 26, 2021 (for information)

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: Engineering and Applied Science	
This new course is associated with:	
<input type="checkbox"/> Minor Program Adjustment <input type="checkbox"/> Major Program Modification <input checked="" type="checkbox"/> New Program <input type="checkbox"/> None	
Will this course appear anywhere other than the course description section of the Calendar?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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.]

New course for the new programs: MAsc in Software Engineering MEng in Software Engineering

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

2022-2023

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

Fall 2022

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

--

Subject Code: ENGR	Course Number: 5570G *ensure the course code has not been previously used
Full Course Title: Software Maintenance and Evolution	
Short-Form Course Title (max. 30 characters): Software Maint and Evolution	

Course Description

This course is concerned with the fundamental developments in software evolution and common maintenance practices including techniques, methodologies and tools. Students will learn about the challenges of software maintenance and evolution, and the techniques, methods and tools that can be used to build large scale software systems that are easier to understand, maintain, reuse, and evolve in a cost-effective manner. Topics include taxonomy of software evolution and maintenance, maintenance and evolution models, reengineering, reverse engineering, legacy systems, change impact analysis, refactoring.

Credit Hours: 3	
Contact Hours – please indicate total number of hours for each component	
Lecture: 3	Lab: 0
Tutorial: 0	Other: 0
Cross-listings	
Prerequisites for Calendar	
Prerequisites for Banner	
Co-requisites	
Prerequisites with concurrency (pre or co-requisite)	
Credit restrictions	<input type="checkbox"/> Equivalency*
Recommended Prerequisites	
Course Restrictions	
Course Type	<input type="checkbox"/> Core <input checked="" type="checkbox"/> Elective <input type="checkbox"/> Core or Elective
Is the course:	<input type="checkbox"/> Undergraduate <input checked="" type="checkbox"/> Graduate <input type="checkbox"/> Professional (e.g. some Education courses)
Grading scheme	<input checked="" type="checkbox"/> N (normal alpha grade) <input type="checkbox"/> P (pass/fail)

***Equivalency:** If it is equivalent, students can retake either course. If it is not equivalent, students are not allowed to register in the restricted course.

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:

A wide range of methods will be used to assess students' understanding, attainment of learning outcomes including: in-class discussions, presentations, exams, assignments, and projects.

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

Upon successful completion of this course, students will:

- Have knowledge of the fundamental developments in software evolution and common maintenance practices including techniques, methodologies and tools;
- Understand the challenges of software maintenance and evolution;

- Understand the taxonomy of software evolution and maintenance, reengineering, reverse engineering, legacy systems, change impact analysis, and refactoring;
- Apply techniques, methods and tools that can be used to build large scale software systems that are easier to understand, maintain, reuse, and evolve in a cost-effective manner.

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:

The proposal for the new graduate programs in software engineering along with new course templates were shared with eight faculty members (CS and MITS) who are graduate faculty of ECE or serving as GPD for CS or MITS. Feedback from the consultation process shaped the proposal in its current form.

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):

ECSE Department Council: Feb 22, 2021 (motion approved)

FEAS Graduate Committee: Feb 26, 2021 (for information)

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: Engineering and Applied Science	
This new course is associated with:	
<input type="checkbox"/> Minor Program Adjustment <input type="checkbox"/> Major Program Modification <input checked="" type="checkbox"/> New Program <input type="checkbox"/> None	
Will this course appear anywhere other than the course description section of the Calendar?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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.]

New course for the new programs: MAsc in Software Engineering MEng in Software Engineering

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

2022-2023

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

Fall 2022

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

--

Subject Code: ENGR	Course Number: 5590G *ensure the course code has not been previously used
Full Course Title: Software Engineering Studio	
Short-Form Course Title (max. 30 characters): Software Engineering Studio	

Course Description

This course features a team project allowing students to utilize the methods and tools they have learned in earlier courses to design and develop a large-scale software-intensive system. The project revolves around decomposing a large complex system into modules and classes that can be implemented, tested, deployed and maintained easily. Topics include information hiding, API design, managing complexity, error handling, testing, deployment and maintenance, software project management, software engineering code of ethics and professional practice.

Credit Hours: 3	
Contact Hours – please indicate total number of hours for each component	
Lecture: 3	Lab: 0
Tutorial: 0	Other: 0
Cross-listings	
Prerequisites for Calendar	ENGR 5510G and ENGR 5520G
Prerequisites for Banner	
Co-requisites	
Prerequisites with concurrency (pre or co-requisite)	
Credit restrictions	<input type="checkbox"/> Equivalency*
Recommended Prerequisites	
Course Restrictions	
Course Type	<input type="checkbox"/> Core <input type="checkbox"/> Elective <input checked="" type="checkbox"/> Core or Elective
Is the course:	<input type="checkbox"/> Undergraduate <input checked="" type="checkbox"/> Graduate <input type="checkbox"/> Professional (e.g. some Education courses)
Grading scheme	<input checked="" type="checkbox"/> N (normal alpha grade) <input type="checkbox"/> P (pass/fail)

***Equivalency:** If it is equivalent, students can retake either course. If it is not equivalent, students are not allowed to register in the restricted course.

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:

A wide range of methods will be used to assess students' understanding, attainment of learning outcomes including: in-class discussions, presentations, exams, assignments, and projects.

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, students will:

- Be able to effectively work in teams;

- Have knowledge on how to decompose a large complex system into modules and classes that can be implemented, tested, deployed and maintained easily;
- Be able to apply state-of-the-art software design techniques and tools for the development of a large scale software system;
- Be able to utilize and apply software project management, software engineering code of ethics and professional practice.

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:

The proposal for the new graduate programs in software engineering along with new course templates were shared with eight faculty members (CS and MITS) who are graduate faculty of ECE or serving as GPD for CS or MITS. Feedback from the consultation process shaped the proposal in its current form.

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):

ECSE Department Council: Feb 22, 2021 (motion approved)

FEAS Graduate Committee: Feb 26, 2021 (for information)

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.

Faculty: Engineering and Applied Science	
Course Level	<input type="checkbox"/> Undergraduate <input checked="" type="checkbox"/> Graduate

COURSE CHANGES (check all that apply)

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

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

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

To accommodate the new graduate program in Software Engineering without adding a new course (MASC Seminar for Software Engineering). Change: ENGR 5007G – MASc Seminar for ECE To ENGR 5007G – MASc Seminar for ECSE

FINANCIAL IMPLICATIONS

None.

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

Fall 2022

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

Fall 2022

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

--

COURSE INFORMATION

Subject Code: ENGR	Course Number: 5007G
Full Course Title: MASC Seminar for ECSE	
Short-Form Course Title (max. 30 characters): MASC Seminar for ECSE	

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	
Prerequisites for Banner	
Co-requisites	
Prerequisites with concurrency (pre or co-requisite)	
Credit restrictions	<input type="checkbox"/> Equivalency*
Recommended Prerequisites	
Course Restrictions	
Course Type	<input type="checkbox"/> Core <input type="checkbox"/> Elective <input type="checkbox"/> Core or Elective
Grading scheme	<input type="checkbox"/> N (normal alpha grade) <input type="checkbox"/> P (pass/fail)

***Equivalency:** If it is equivalent, students can retake either course. If it is not equivalent, students are not allowed to register in the restricted course.

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)

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.)

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)

WE HAVE CONSULTED WITH ALL IMPACTED AREAS? Yes NA

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 D – Faculty Information

Please include here only those currently at the institution and affiliated with the program. Examples in purple to be removed.

Faculty members by home unit, rank, and supervisory privileges

Name and Faculty Status/Rank*	Terminal Degree	Home Faculty/Unit	Areas of Expertise	Supervisory Privileges and Role in New Program**	Total Graduate Teaching (including New Program)***
Qusay H. Mahmoud, Professor (tenure)	PhD	FEAS	Intelligent software systems, cybersecurity	Full* Teaching core courses	1 graduate course per academic year
Khalid Elgazzar, Assistant Professor (tenure-track)	PhD	FEAS	Internet of Things, Real-time data analytics, mobile and ubiquitous computing	Full*, Teaching core courses	1 graduate course per academic year
Akramul Azim, Assistant Professor (tenure track)	PhD	FEAS	Embedded systems, Real-time systems, Software quality, Intelligent software systems, Cyber-physical systems	Full*, Teaching core courses	1 graduate course per academic year
Anwar Abdalbari, Assistant Teaching Professor	PhD	FEAS	Software Development, Image processing, Medical Image Processing, Software Project Management	Teaching core and elective courses only	N/A

Ramiro Liscano Professor (tenure)	PhD	FEAS	Pervasive Computing Distributed Systems Sensor Networks	Full* Teaching core courses	1 graduate course per academic year
Khalid Hafeez	PhD	FEAS	Networking and security Internet of things	Teaching core and elective courses only	
Masoud Makrehchi	PhD	FEAS	Artificial Intelligence, Machine Learning, Natural Language Processing, Social Computing	Full*, Teaching core courses	1 graduate course per academic year
Shahryar Rahnamayan, Professor (tenure)	PhD	FEAS	Evolutionary Computation, Machine Learning, Large-scale Optimization, Multi-objective Optimization	Full* Teaching core courses	1 graduate course per academic year
Mikael Eklund	PhD	FEAS	Embedded Systems, Health Informatics, Biomedical Engineering, Software Enabled Control	Full*, Teaching core courses	1 graduate course per academic year

*Tenure, tenure track, teaching-focused, continuing sessional, special appointment, emeritus, etc.

**Note if faculty will be teaching and or supervising in the program, indicate primary supervisor by asterisks

***Bold indicates core course developer for New Program

Graduate Thesis supervisory records/experience by faculty member

Name	Completed (last 5 years)			Current		
	Master's	Ph.D.	PDF	Master's	Ph.D.	PDF
Akramul Azim	3	1	0	7	3	0
Anwar Abdalbari	0	0	0	0	0	0
Khalid Elgazzar	3	2	0	6	4	1
Masoud Makrehchi	6	4	0	0	1	0
Mikael Eklund	3	1	0	3	1	0
Qusay H. Mahmoud	7	3	0	4	3	0
Ramiro Liscano	9	2	0	2	2	0
Shahryar Rahnamayan	10	6	5	3	5	1

Publication records at Ontario Tech by year and outlet (current and last 5 years)

Year	Faculty Member	Articles	Books	Book Chapters	Reports	Conference Presentations
2015-2020	Qusay H. Mahmoud	17 journals 49 conferences	0	0	0	49

2018-2020	Khalid Elgazzar	10 journals 19 conferences		1	0	19
2015-2020	Akramul Azim	17 journals 22 conferences	0	0	0	22
2015-2020	Anwar Abdalbari	4 journals 9 conferences	0	0	0	5
2015-2020	Ramiro Liscano	6 journals 29 conferences	0	2	1	29
2015-2020	Masoud Makrehchi	12 journals 18 conferences	0	1	0	18
2015-2020	Khalid Hafeez	6 journals 10 conferences	0	0	0	11
2015-2020	Shahryar Rahnamayan	25 journals 71 conferences	0	0	0	71
2015-2020	Mikael Eklund	4 journals 12 conferences	0	0	0	12

Research funding (by FEAS/Software Engineering faculty members) at Ontario Tech by source and year

Year	Faculty Members	Canadian Granting Councils	Canadian Government	International Government	Others
2015	2	\$64,000.00			\$64,000.00
2016	4	\$90,969.00		\$35,000.00	\$125,969.00
2017	3	\$78,000.00			\$78,000.00
2018	5	\$215,350.00		\$22,350.00	\$237,700.00
2019	5	\$358,450.00		\$156,150.00	\$514,600.00
2020	6	\$252,100.00		\$194,373.00	\$446,473.00

New Program Assessment: MASc/MEng in Software Engineering

Library Statement of Support Provided to Ontario Tech University

Prepared by: Kate Gibbings, Engineering and Applied Science Liaison Librarian, March 8, 2021



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Summary

Ontario Tech University Library's holdings provide a solid foundation of resources to support the MASc/MEng in Software 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 deep coverage of Software Engineering subject areas such as software development, software testing and quality assurance, pervasive and mobile computing, algorithms and data structures, data mining, Internet of Things, user interface design, communication networks, cryptography and secure communications, and control systems.

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
Subscription resources	Provide access to McGraw Hill's Access Engineering digital resources	\$12,000 Note: this resource request is also included in the B.Eng Industrial Engineering and Energy Engineering assessments. This resources includes content to support all FEAS program areas	Ongoing
Total		\$12,000	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. Additionally, our collections include extensive online resources including e-books and online databases that are selected to meet curricular. 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 95% 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 Software Engineering, given the existing Bachelor of Engineering in Software Engineering 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 deep coverage of Software Engineering subject areas such as software development, software testing and quality assurance, pervasive and mobile computing, algorithms and data structures, data mining, Internet of Things, user interface design, communication networks, cryptography and secure communications, and control systems.

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.

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

Membership in these consortia allows us to provide access to more than 100,000 online journals that span all disciplines. Our holdings in disciplines related to Software Engineering are strong. 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 University Press
- SIAM
- Springer
- Taylor & Francis
- Wiley

We provide access, through subscription, to most of the highly ranked journals in Software Engineering related categories, according to Clarivate’s Journal Citation Reports database (2019).

By subject category:

Subject Category	Ontario Tech Access	Select Titles
Computer Science, Software Engineering	48 of top 50	<ul style="list-style-type: none"> • Communications of the ACM • IEEE Transactions on Software Engineering • IEEE Transactions on Service Computing • Journal of Network and Computer Applications • Advances in Engineering Software
Computer Science, Information Systems	49 of top 50	<ul style="list-style-type: none"> • IEEE Wireless Communications • IEEE Internet of Things Journal • IEEE Transactions on Dependable and Secure Computing • Computers & Security
Electrical Engineering	49 of top 50	<ul style="list-style-type: none"> • IEEE Network • IEEE Vehicular Technology Magazine • IEEE Transactions on Knowledge and Data Engineering • IEEE Pervasive Computing

Books & E-Books

As noted, we provide access to more than 100,000 print books and 865,000 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:

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

A new Demand Driven Acquisition pilot program launched in 2020-21 enables students and faculty to access thousands of e-book titles across Engineering disciplines. Purchases are based on usage of the content, enabling us to maximize the value of our collections budget and ensure that the e-books we acquire are being used. This is the first example of Demand Driven Acquisitions at Ontario Tech, and the results of this program will help inform our collection management strategy going forward.

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 Software Engineering. There are no major subject gaps in the collection, but we must add individual e-book and print titles from key publishers who are not well represented in our larger subscribed package collections. 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 and others, print titles are still important and it is necessary to continuously update our holdings to keep pace with new technologies and research developments.

Subject	# Print Books	# E-Books
Software Development; Software Maintenance	297	5,595
Software Testing and Quality Assurance	71	731
Software Security and Dependability	465	6,594
Network Computing; Distributed Systems	582	13,464

Subject	# Print Books	# E-Books
Pervasive and Mobile Computing	86	1,893
Algorithms and Data Structures	114	4,401
User Interface Design	10	4,522
Computer Applications; Applications Software	39	11,615
Data Mining; Knowledge Discovery	133	6,206
Internet of Things	34	3,487
Communication Networks	996	11,741
Adaptive Systems	22	250
Cryptography and Secure Communications	148	4,959
Real-time Control Systems	2	51
Intelligent Control Systems	25	440
Operations Research	55	6,685
Optimization	95	4,862
Project Management	200	1,420
Engineering Economics	20	1,812

Search Tools

Our Library subscriptions provide access to many research databases and indexes to the literature in Software 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 & Business	Relevant Databases: Standards
<ul style="list-style-type: none"> • ACM • ASME • ASTM Digital Library • Computers & Applied Sciences Complete • Engineering Village (Inspec and Compendex) • Elsevier ScienceDirect • IEEE Xplore • SciTech Premium Collection • SpringerLINK 	<ul style="list-style-type: none"> • ABI/Inform • Business Source Complete • Journal Citation Reports • Mergent • Scopus • Statista • Web of Science 	<ul style="list-style-type: none"> • 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 we can purchase individual electronic standards by faculty and graduate student request from hundreds of publishers.

Archival Holdings

Our Library Archives include extensive holdings related to the history of engineering in Canada. Through relationships with national engineering organizations, the Archival collections include holdings from the Engineering Institute of Canada, Canadian Society of Senior Engineers, and the Canadian Academy of Engineering, among others. We also hold collections of professional papers from the personal collections of individual engineers.

A complete list of Archival collections, descriptions and finding aids are available on our website:

<https://guides.library.uoit.ca/archives>

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).

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

Multimedia Resources

We acquire 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 Faculty of Engineering and Applied Science.

Relevant Streaming Video Collections for Software Engineering

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

Select Multimedia Titles

- Emerging IT Trends and Their Impact on Security Policies. (2017). WatchIT.
- The Mobile First Approach to Application Development. (2017). WatchIT.

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 team 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 provide 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

We provide 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.dcuoit.ca>).

We also provide 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>). Our Research Data Management guide (<http://guides.library.uoit.ca/rdm>) supports 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 team 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).

Our Research Metrics guide (<http://guides.library.uoit.ca/researchmetrics>) provides background information and support for these tools.

Theses & Dissertations

The Ontario Tech community has access to national and international thesis and dissertation databases via Library subscriptions. 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, Librarians provide 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 supports 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 directly 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 Software Engineering include:

- Library Research for Engineering Students: <https://guides.library.uoit.ca/engineering>
- Software Engineering: <https://guides.library.uoit.ca/soft-eng>
- Electrical Engineering: <https://guides.library.uoit.ca/elec-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 4,319 times. The Library's Citation guide was viewed 6,447 times.

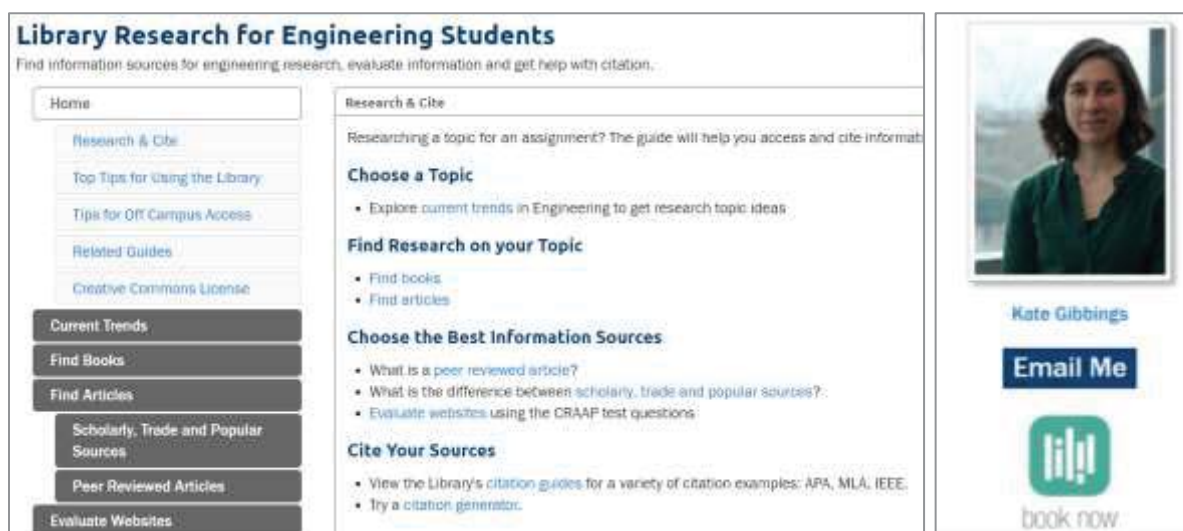


Figure 1 Library Research for Engineering Students Guide

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.

Online course reserves are also available through the new Leganto Course Readings system in Canvas.

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 Software Engineering program for years 1-5 is as follows:

- Year 1: 15 MASc students, 10 MEng students
- Years 4-5: 40 MASc students, 40 MEng 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 a MASc/MEng in Software Engineering program. Our suite of services and programs will meet the needs of students and faculty in this program. The addition of the McGraw Hill Access Engineering resource will support students across all Engineering programs, including the MASc/MEng in Software Engineering.

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 Master of Applied Science and Master of Engineering in Software Engineering Program at Ontario Tech University

Dr. Daniel Amyot
School of Electrical Engineering and Computer Science
University of Ottawa
800 King Edward St.,
Ottawa, Ontario, Canada, K1N 6N5

Dr. Medhat Moussa
School of Engineering
University of Guelph
50 Stone Road East,
Guelph, ON Canada N1G 2W1

1. OUTLINE OF THE REVIEW

Please indicate whether this review was conducted by desk audit or site visit. For those reviews that included a site visit, please indicate the following:

- Who was interviewed
- What facilities were seen
- Any other activities relevant to the appraisal

This review was conducted by a virtual site visit. Over two days, we interviewed individuals at different levels and roles. The interviews included the dean, associate dean for new programs, ECE department chair, many faculty members who are associated with the Software Engineering program, students (both UG and Grad), and staff both at the department level and faculty/University level who are involved in supporting graduate studies.

In addition to interviews we visited, virtually, research facilities linked to the SE area of research.

The details of the agenda and an updated list of participants can be found below.

Day 1: Tuesday August 3, 2021	
10:00-10:30am	<p>Welcome - Review of Agenda:</p> <ul style="list-style-type: none">• Dr. Lori Livingston, Provost & VP Academic• Dr. Hossam Kishawy, Dean of Faculty of Engineering & Applied Science• Dr. Min Dong, Associate Dean• Dr. Vijay Sood, ECSE dept chair• Dr. Masoud Makrehchi, past ECSE dept chair• Dr. Qusay Mahmoud, Chair of New Program Committee• Joel Stewart, Graduate Program Assistant• Kimberley McCartney, Curriculum and Pathways Analyst, CIQE

10:45-Noon	<p>Overview of the program:</p> <ul style="list-style-type: none"> ● Dr. Hossam Kishawy, Dean of Faculty of Engineering & Applied Science ● Dr. Langis Roy, Dean of Graduate and Postdoctoral Studies ● Dr. Min Dong, Associate Dean ● Dr. Vijay Sood, ECSE dept chair ● Dr. Masoud Makrehchi, past ECSE dept chair ● Dr. Qusay Mahmoud, Chair of New Program Committee
12:45-1:15pm	<p>Tour of research labs and other facilities</p> <ul style="list-style-type: none"> ● Dr. Qusay Mahmoud, Chair of New Program Committee
1:15-1:45pm	<p>Meeting with FEAS Staff</p> <ul style="list-style-type: none"> ● Joel Stewart, Graduate Program Assistant
1:45-2:15pm	<p>Meeting with SGPS Staff</p> <ul style="list-style-type: none"> ● Alena Shah – Manager SGPS ● Beth Stewart – Senior Admission Officer ● Kurshid Dain – SGPS Finance Coordinator
2:30-2:45pm	<p>Conclusion and summary of Day 1</p> <ul style="list-style-type: none"> ● Dr. Hossam Kishawy, Dean of Faculty of Engineering & Applied Science ● Dr. Min Dong, Associate Dean ● Dr. Vijay Sood, ECSE dept chair ● Dr. Masoud Makrehchi, past ECSE dept chair ● Dr. Qusay Mahmoud, Chair of New Program Committee
Day 2: Wednesday August 4, 2021	
10:00-10:15am	<p>Welcome to Day 2</p> <ul style="list-style-type: none"> ● Dr. Qusay Mahmoud, Chair of New Program Committee CIQE staff
10:15-11:15am	<p>Meeting with faculty members</p> <ul style="list-style-type: none"> ● Dr. Akramul Azim ● Dr. Anwar Abdalbari ● Dr. Mikael Eklund ● Dr. Khalid Elgazzar ● Dr. Hossam Gaber ● Dr. Khalid Hafeez ● Dr. Patrick Hung ● Dr. Ramiro Liscano ● Dr. Masoud Makrehchi ● Dr. Shahryar Rahnamayan
11:30-Noon	<p>Meeting with Current ECE MAsc & MEng students</p> <ul style="list-style-type: none"> ● Ms. Deepak Saggi ● Mr. Aakash Gangoli ● Mr. Prasanth Kakarlapudi
12:30-1:00pm	<p>Meeting with Senior Undergraduate Software Engineering students</p> <ul style="list-style-type: none"> ● Ms. Christina Chung ● Mr. Ahmed Mousa ● Mr. Tagmeer Sing

1:00-2:00pm	Conclusion and discussion of issues <ul style="list-style-type: none"> ● Dr. Hossam Kishawy, Dean of Faculty of Engineering & Applied Science ● Dr. Min Dong, Associate Dean ● Dr. Vijay Sood, ECSE dept chair ● Dr. Masoud Makrehchi, past ECSE dept chair ● Dr. Qusay Mahmoud, Chair of Internal Assessment Team
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2. EVALUATION CRITERIA

NOTE: Reviewers are asked to provide feedback on each of the following Evaluation Criteria ([Quality Assurance Framework 2021, page 17](#)).

2.1 Program Objectives

- *Clarity of the program's objectives*
- *Appropriateness of degree nomenclature given the program's objectives*
- *Consistency of the program's objectives with the institution's mission and academic plans*

The two programs are named properly, and their objectives are clear and consistent with the institution's mission and academic plans. It is clear that there is a market pull for these programs due to the significant increase in demand for well-trained software engineers. In addition, interviews with researchers and undergraduate students revealed that there is a need for a program to attract graduate students, especially international ones, to do research in software engineering. The current ECE department graduate program is quite healthy with significant opportunities for expansion.

2.2 Program requirements

- *Appropriateness of the program's structure and the requirements to meet its objectives and program-level learning outcomes*
- *Appropriateness of the program's structure, requirements and program-level learning outcomes in meeting the undergraduate or graduate Degree Level Expectations*
- *Appropriateness of the proposed mode(s) of delivery to facilitate students' successful completion of the program-level learning outcomes*
- *Ways in which the curriculum addresses the current state of the discipline or area of study*

There are different requirements for the MASc and MEng programs in Software Engineering (SE). For the MASc, the requirements are a combination of course work, supervised research, a research seminar and a research thesis. The students must complete five courses for a total of 15 credits and a thesis worth 15 credits. These five courses include two core courses and three courses from the electives lists. For the MEng programs, there are two options: course-based and project-based. For the course-based option, students must complete 10 courses in which 3 are core and the rest are selected from several elective lists. For the project-based, students must

complete 7 courses and a project in which three courses are core and the rest are selected from various elective lists. This structure is appropriate for the various degrees and differences in learning outcomes. The MASc degree has a strong focus on developing research talents while the MEng degree is more focused on training and broad skill development. Many of the courses have projects which will enable students to build a portfolio of software applications using different platforms.

The programs have structures similar to those of other Canadian universities, at times with minor differences (e.g., 8 courses + project instead of 7 courses with a project for the project-based MEng).

2.3 Program requirements for graduate programs only

- *Clear rationale for program length that ensures that students can complete the program level learning outcomes and requirements within the proposed time*
- *Evidence that each graduate student in the program is required to take a minimum of two-thirds of the course requirements from among graduate-level courses*
- *For research-focused graduate programs, clear indication of the nature and suitability of the major research requirements for degree completion*

The proposal indicates that students' expected completion time for the MASc is 5-6 terms while for the MEng it is 3-6 terms. For the MASc, the 5-6 terms is a reasonable time. The MEng is likely to be 4-5 terms. All the courses in either degree are graduate-level courses. For the MASc, the thesis component comprises half of the credits in the degree which is appropriate for research focused degree and similar to comparable degrees elsewhere in Canada.

In the absence of a PhD program in Software Engineering, the program proposal and the publicity surrounding the programs should be explicit about what PhD programs will MASc students be eligible to. We recommend an explicit mention that graduates of the MASc program in Software Engineering will be eligible for admission to the PhD programs in Electrical & Computer Engineering and in Computer Science.

2.4 Assessment of teaching and learning

- *Appropriateness of the methods for assessing student achievement of the program-level learning outcomes and degree level expectations*
- *Appropriateness of the plans to monitor and assess:*
 - The overall quality of the program*
 - Whether the program is achieving in practice its proposed objectives*
 - Whether its students are achieving the program-level learning outcomes*
 - How the resulting information will be documented and subsequently used to inform continuous program improvement*

The proposed methods for assessing the achievement of learning outcomes and degree level expectations, summarized in Table 3, are appropriate and similar to other graduate programs in Canadian universities. The assessment of the team-related program learning outcome could likely be re-formulated to be more team-specific, but this is minor. The monitoring, assessment, and continuous improvement plans are in line with current practices for other graduate degrees at Ontario Tech, including existing programs offered by the Department of Computer, Electrical and Software Engineering.

A significant number of courses in the proposed program have experiential learning opportunities that will help develop the students' skill level in software engineering.

As is done in other such programs elsewhere, we recommend that a co-op internship of one or two terms be added to the MASc program and (especially) to the MEng program (this could result in four program variants instead of two).

- For the MASc, this internship can be either at the beginning of the degree or at the end. This will depend on the research project needs (so research programs are not interrupted by the co-op term) and should be decided in consultation with the advisor.
- For the MEng project-based, this co-op internship can be linked with the required project through MITACS or similar training-based R&D grants. A similar arrangement can be explored for course-based MEng.

Co-op internships will allow better connection with the industry and may lead to other collaborative funding opportunities. They will be of special interest to international students looking for funding opportunities (as their tuition fees are higher) and for Canadian-based industrial experience, which will in turn augment their chances of having good industry positions after graduating. If the co-op internship is part of the degree, then many work permit issues will be avoided for international students.

In addition, we recommend considering the creation of an "industrial research project" graduate course (3 credits), which could be unpaid (unlike co-op) but would still be done in collaboration with an industrial advisor on an industrial research topic, and co-supervised and marked by a faculty member. This course could count as an elective and provide industrial experiential learning for students (especially international ones) who cannot participate in co-op internships. This is also offered in other Canadian universities.

2.5 Admission requirements

- *Appropriateness of the program's admission requirements given the program's objectives and program-level learning outcomes*
- *Sufficient explanation of alternative requirements, if applicable, for admission into a graduate, second-entry or undergraduate program, e.g., minimum grade point average, additional languages or portfolios, and how the program recognizes prior work or learning experience*

The program requires applicants to have:

- Completed 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

These requirements are suitable and consistent with the program objectives and learning outcomes. Given that Engineers with different backgrounds might be interested in a career switch to Software Engineering, there might be an opportunity in the future for the Master of Engineering programs to include a remedial/retooling entry pathway to allow engineers from other non-related fields to be admitted. In addition, we recommend clarifying the admission requirements regarding undergraduate computer science students and about the admission in May (rather than at each semester).

The program also allows undergraduate students to take up to two graduate courses from the proposed SE program. Advanced credit will automatically be granted upon registration in the MEng or MASc program in Software Engineering if a grade of B+ or higher is obtained in these courses. This accelerated pathway is meant to encourage excellent UG students to be enrolled in graduate studies. We agree that this is an important initiative. However, the two courses will not count toward students' undergraduate degrees. We recommend that other options be considered to enable students to have these courses count as part of the undergraduate degree and graduate degree if they chose to pursue one. This is already done in other Canadian universities as a means to encourage Software Engineering students to pursue graduate studies.

There is also an opportunity to intensify the publicity for graduate programs to undergraduate students (who only seem to know them through informal mentions by some professors, according to our interviews) and be proactive in recruiting local students. For instance, we recommend considering proactive and automatic admission of good local undergraduate software engineering and computer science to the new programs, and to extend the validity of such admission to two years in case they want to work in industry first. This could also mitigate an issue raised regarding the exodus of many students to other programs and universities. Registration to graduate courses by undergraduate students should also be better facilitated as it is perceived as difficult at the moment.

2.6 Resources for all programs

Given the program's planned /anticipated class sizes and cohorts as well as its program-level learning outcomes:

- *Participation of a sufficient number and quality of core faculty who are competent to teach and/or supervise in and achieve the goals of the program and foster the appropriate academic environment*
- *If applicable, discussion/explanation of the role and approximate percentage of adjunct and part-time faculty/limited term appointments used in the delivery of the program and the associated plans to ensure the sustainability of the program and quality of the student experience*
- *If required, provision of supervision of experiential learning opportunities*
- *Adequacy of the administrative unit's planned utilization of existing human, physical and financial resources, including implications for the impact on other existing programs at the university*
- *Evidence that there are adequate resources to sustain the quality of scholarship and research activities produced by students, including library support, information technology support, and laboratory access*
- *If necessary, additional institutional resource commitments to support the program in step with its ongoing implementation*

The ECE department has an excellent mix of expertise in the area of software engineering, with the required skills needed to teach and supervise students in that discipline. The department is adding two new faculty positions in this area, which are indeed necessary. This should lead to sustainable programs in the medium term.

We recommend that additional resources be provided to maintain the quality of the graduate program as the number of MEng students increases (as such numbers have increased in other universities beyond the predictions in the proposal):

1. Provide additional resources to hire teaching assistants to support courses with significant experiential learning opportunities like term projects. These projects are very important to the quality of the program in this field (which is really "hands-on") and additional investments will quickly become necessary to maintain quality.
2. Provide additional support for counselling to help course-based MEng students navigate their program of studies and help resolve any problems faced during their journey. This will be particularly valuable for international MEng students who will need help during their first year.

2.7 Resources for graduate programs only

Given the program's planned /anticipated class sizes and cohorts as well as its program-level learning outcomes:

- *Evidence that faculty have the recent research or professional/clinical expertise needed to sustain the program, promote innovation, and foster an appropriate intellectual climate*
- *Where appropriate to the program, evidence that financial assistance for students will be sufficient to ensure adequate quality and numbers of students*

- *Evidence of how supervisory loads will be distributed, in light of qualifications and appointment status of the faculty*

The proposed program draws on the existing expertise in Software Engineering in the Faculty of Engineering and Applied Science, and no new faculty members are required for this program beyond the ongoing recruiting efforts for two new faculty members in Software Engineering (one of whom is already hired). All core courses, software engineering electives, and software systems courses will be taught by core software engineering faculty members. General elective courses will be taught by core faculty members in the Faculty of Engineering and Applied Science.

All faculty members listed in the proposal are tenured, tenure-track, or teaching faculty with continuing contracts. Most of the faculty have excellent research and funding records with excellent lab facilities. We do not anticipate any issues supporting the MASc thesis-based degree. For the MEng, the expected enrollment numbers of 80 students could have a significant workload impact on graduate courses as well as supervisory load. We recommend that the department allocate additional TA resources to support that increase enrollment in graduate courses. We also recommend enabling qualified teaching faculty and post-docs to be allowed to supervise and/or mark graduate projects.

There are relevant and suitable policies for supporting MASc students properly, and there exist mechanisms for emergency financial support at the university level. International MEng students, despite claims of sufficient self-funding at the time of admission, may find themselves in financial needs at times, and access to teaching assistantships and to (possibly) paid co-op internships should be considered priorities for supporting them.

The laboratory facilities that we visited (virtually), especially the Software and Informatics Research Center (SIRC) and the IoT Research Center, are very good, well funded, and quite exciting from a software engineering perspective. The graduate students from the MASc and MEng programs will be well served by them.

We have observed one major strength in Machine Learning and Artificial Intelligence among many faculty members that was not documented in the program proposal. This strength could be better exploited with an explicit elective course on that topic, especially in a Software Engineering context (e.g., AI/ML for SE, SE for AI/ML) among the course offerings.

One need that was observed is better access and support for cloud computing resources, and we recommend further investigating solutions at that level.

2.8 Quality and other indicators

- *Evidence of quality of the faculty (e.g., qualifications, funding, honours, awards, research, innovation and scholarly record; appropriateness of*

- collective faculty expertise to contribute substantively to the program and commitment to student mentoring)*
- *Any other evidence that the program and faculty will ensure the intellectual quality of the student experience*

NOTE: *Reviewers are urged to avoid using references to individuals. Rather, they are asked to assess the ability of the faculty as a whole to deliver the program and to comment on the appropriateness of each of the areas of the program (fields) that the university has chosen to emphasize, in view of the expertise and scholarly productivity of the faculty.*

The quality of the faculty members involved in the MASc and MEng programs is very high. Most are already established researchers in Software Engineering (even without an explicit graduate program in that field), with a history of good funding and HQP supervision in other programs. The newer professors already have impressive and promising records.

We observed many grants from NSERC (Discovery, CRD, URF, Engage, and others), MITACS, OCE, and others among the non-teaching faculty members. We also saw many research, teaching, and service awards, as well as one Canada Research Chair. In addition to many publications in top venues and relevant research projects, we even saw many patents among six professors.

The faculty members collectively have the knowledge and expertise required to support the new programs as well as exciting research opportunities for future Software Engineering students. We do not expect issues on that side.

3. OTHER ISSUES

There is a lack of details on how the program will address issues of Equity, Diversity, and Inclusion (EDI). It seems that the university template used to develop the proposal lacked such a section. We recommend addressing this issue in a revised proposal and in a revised template for future evaluations.

There are also discrepancies between Table 1 and the budgets provided separately in terms of numbers/ratios, and in dropouts. We recommended aligning these numbers. There are also costs (e.g., additional teaching assistantship hours) that could be considered in such budgets.

We have observed good relationships between the professors and administrators of the Faculty of Science, the Faculty of Business and IT, and the Faculty of Engineering and Applied Science, which is excellent. In addition to co-supervisions, the sharing of courses in both directions (from SE to others, and from others to SE) is anticipated, and this will help optimize resources at the university level. One follow-up opportunity is to consider sharing relevant graduate seminars from the three

Faculties. The mandatory seminar could also evolve towards covering the basics of qualitative and quantitative research.

4. SUMMARY AND RECOMMENDATIONS

Please provide a summary of your conclusions and a numbered list of your recommendations.

NOTE: *The responsibility for arriving at a recommendation on the final classification of the program belongs to the Appraisal Committee. Individual reviewers are asked to refrain from making recommendations in this respect.*

In summary, the proposed MASC and MEng programs are well designed and developed, and they will answer a real need identified by students (local and international) and by the industry in general, where software engineers with advanced research and technical skills are in high demand. The programs are also realistic and feasible within the identified resources. The HQP trained through these programs will have successful and exciting careers in industry, the government, and academia. These new programs should be beneficial to the students, the professors involved, Ontario Tech, and society in general.

We do not have recommendations that are blockers for these programs. The following recommendations (sorted according to the section order) are actually meant to further improve the programs based on our knowledge of similar programs in other Canadian universities, and on opportunities observed at Ontario Tech:

1. We recommend an explicit mention that graduates of the MASC program in Software Engineering will be eligible for admission to the PhD programs in Electrical & Computer Engineering and in Computer Science (see section 2.3).
2. We strongly recommend that a co-op internship of one or two terms be added to the MASC program and (especially) to the MEng programs (see Section 2.4).
3. We recommend considering the creation of an “industrial research project” graduate course (3 credits), which could be unpaid (unlike co-op) but would still be done in collaboration with an industrial advisor on an industrial research topic, and co-supervised and marked by a faculty member (see Section 2.4).
4. We recommend clarifying the admission requirements regarding i) the explicit eligibility of undergraduate computer science students and ii) admissions in May rather than at each semester (see Section 2.5).
5. We strongly recommend that options be considered to enable undergraduate engineering and computer science students who take graduate courses in Software Engineering to have these courses count as part of their

undergraduate degree *and* graduate degree if they chose to pursue one (see Section 2.5).

6. We recommend considering proactive and automatic admission of good local undergraduate software engineering and computer science to the new programs, and to extend the validity of such admission to two years in case they want to work in industry first (see Section 2.5).
7. We strongly recommend that additional resources (teaching assistants and administration/counselling) be provided to maintain the quality of the graduate program as the number of MEng students increases (see Sections 2.6 and 2.7).
8. We recommend enabling qualified teaching faculty and post-docs to be allowed to supervise and/or mark graduate projects (see Section 2.7).
9. We recommend better exploiting one major strength in Machine Learning and Artificial Intelligence among many faculty members by considering an explicit elective course on that topic, especially in a Software Engineering context, e.g., AI/ML for SE, SE for AI/ML (see Section 2.7).
10. We recommend addressing how the programs will address issues of Equity, Diversity, and Inclusion (EDI) in a revised proposal and in a revised template for future evaluations (see Section 3).
11. We strongly recommend aligning the numbers found in Table 1 with those provided in the external budget, so discrepancies are eliminated (see Section 3).
12. We recommend considering the sharing of relevant graduate seminars from the Faculties of Science, Business and IT, and Engineering and Applied Science (see Section 3). The mandatory seminar could also evolve towards covering the basics of qualitative and quantitative research (see Section 3).

Medhat Moussa

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Date: September 1st, 2021

Signature: Daniel August.

Date: September 1st, 2021



Faculty Response to the External Review for the

Master of Applied Science (MASc) in Software Engineering
Master of Engineering (MEng) in Software Engineering

Submitted By:

(Program chair: Qusay H. Mahmoud)
(Dean: Hossam Kishawy)

September 24, 2021

Introduction

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

The program chair, Dean and the rest of the program committee thank the external reviewers for a comprehensive report covering all aspects of the proposed new programs, and thoughtful recommendations. As mentioned by the external reviewers, the proposed programs are innovative, address a need (students and industry), and have quality faculty members and established researchers. In this document, we restate the recommendations of the external reviewers and provide our responses (program's and Dean's).

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

We recommend an explicit mention that graduates of the MASc program in Software Engineering will be eligible for admission to the PhD programs in Electrical & Computer Engineering and in Computer Science (see section 2.3).

Program's Response

Graduates of the thesis-based MASc program in Software Engineering would certainly be qualified and eligible for admission to our PhD program in Electrical & Computer Engineering (ECE) in the field of Software Systems. We also believe that such graduates meet the admission requirements for the PhD program in Computer Science (CS), or any PhD program in CS, SE, or a related field in Canada or elsewhere. This has been clarified in the proposal.

Dean's response

[The Dean agrees with the program's response.](#)

Recommendation 2

We strongly recommend that a co-op internship of one or two terms be added to the MASc program and (especially) to the MEng programs (see Section 2.4).

Program's Response

Students in our current MASc (and PhD) programs have opportunities for work-integrated learning through their thesis research advisors working with industry partners through MITACS or other programs, and therefore we do not see the need to add co-op to the MASc programs as students in the program will be funded by faculty advisors. However, we see a great benefit to adding work-integrated learning through a co-op internship stream to the MEng program to be highly regarded by students, especially for international recruitment. We made the necessary changes to the proposal to add a co-op stream to the MEng program.

Dean's response

[The Dean supports adding the co-op to the MEng program.](#)

Recommendation 3

We recommend considering the creation of an “industrial research project” graduate course (3 credits), which could be unpaid (unlike co-op) but would still be done in collaboration with an industrial advisor on an industrial research topic, and co-supervised and marked by a faculty member (see Section 2.4).

Program’s Response

Students in the MASc program will have opportunities to work with their thesis supervisor on industry research, and some of the courses have a major project component. Students in the MEng program are required to take ENGR 5590G - Software Engineering Studio, where they will have the opportunity to work in teams on state-of-the-art projects that may have an industry sponsor.

Dean’s response

[The Dean agrees with the program’s response.](#)

Recommendation 4

We recommend clarifying the admission requirements regarding i) the explicit eligibility of undergraduate computer science students and ii) admissions in May rather than at each semester (see Section 2.5).

Program’s Response

This has been clarified in the proposal (Section 2a – admission requirements). As for the start date, our existing graduate programs allow students to start in May/September/January and this provides needed flexibility.

Dean’s response

[The Dean agrees with the program’s response.](#)

Recommendation 5

We strongly recommend that options be considered to enable undergraduate engineering and computer science students who take graduate courses in Software Engineering to have these courses count as part of their undergraduate degree and graduate degree if they chose to pursue one (see Section 2.5).

Program’s Response

While this leads to allowing students to double-dip, it would be unique to the proposed programs (it is not available in any of our other graduate programs) and would give an advantage only to graduates of our undergraduate Software Engineering program. The accelerated Master’s program (Section 2(a) of the proposal) is meant to allow our undergraduate Software Engineering students to take up to 2 extra courses that are not counted as part of the undergraduate degree, but advanced credit will automatically be granted upon registration in the proposed MEng or MASc program. We do have students who utilize the opportunity to complete a course while on a co-op work term and such students will have a light fourth year allowing them to take extra courses at the graduate level if you wish to pursue our proposed MEng or MASc program.

Dean’s response

[This recommendation can be considered in the future and if approved it will apply to all MEng across the engineering programs.](#)

Recommendation 6

We recommend considering proactive and automatic admission of good local undergraduate software engineering and computer science to the new programs, and to extend the validity of such admission to two years in case they want to work in industry first (see Section 2.5).

Program's Response

This would be attractive for our Software Engineering students, but should not be extended to computer science or IT students to avoid any perceived competing environment for graduate programs with Ontario Tech students in CS/MITS/SE. We leave it to SGPS to implement for the proposed MEng program, because admission into the MASc program is dependent on professors' funding availability and hence extending an offer of admission for two years may not be feasible.

Dean's response

The Dean agrees with the program's response.

Recommendation 7

We strongly recommend that additional resources (teaching assistants and administration/counselling) be provided to maintain the quality of the graduate program as the number of MEng students increases (see Sections 2.6 and 2.7).

Program's Response

Current practice in the Faculty of Engineering and Applied Science is to assign teaching assistants to undergraduate courses, but if the number of MEng students in the proposed program grows by a large number, then this issue will be addressed at that time. As for administrative support, a new administrative assistant has been recently hired to help with our programs.

Dean's response

Currently the majority of the graduate courses don't have high enrollment. Typical numbers are between 5 to 10 students. If enrollment grows to a level where support is needed this comment will be considered.

Recommendation 8

We recommend enabling qualified teaching faculty and post-docs to be allowed to supervise and/or mark graduate projects (see Section 2.7).

Program's Response

We have included teaching faculty as graduate faculty for the proposed programs so they can teach in the program. Students in the MEng project-based program will have to find a graduate faculty advisor, in consultation with the graduate program director, to supervise their MEng project. Faculty members with active research programs may have industry projects that would benefit the MEng students and their projects, but if the need arises for qualified teaching faculty to supervise MEng projects, then this can be addressed then.

Dean's response

The Dean agrees with the reviewers, and our system at Ontario Tech allows qualified Teaching Faculty to engage in our graduate programs. At Ontario Tech we have a wide range of Teaching Faculty members with different educational backgrounds and level of exposure to state-of-the-art technology and research. Although research is not a requirement for the Teaching Faculty members, qualified Teaching Faculty members are allowed to join their respective graduate programs. Those who are qualified may then be assigned to teach graduate courses if needed, but priority is given to the Tenured/Tenure-Track (TTT) professors. i.e, research professors.

It is important to state here that the MEng Project is not a course project and that it is equivalent to three graduate courses. The project is expected to provide students with much more advanced experience and skills than what students can get from a course project. A typical MEng Project is expected to be related to the state-of-the-art technology in their respective fields or is related to an existing industrial problem. Thus, MEng Project supervisors are expected to be active researchers and preferably researchers who have industrial collaboration to provide the students with the needed skills required in industry.

The MEng students can join a research group and work closely with MAsc and PhD students and work on a smaller portion of a larger research project. MEng Project supervision for TTT Faculty is an opportunity to supervise HQP, which is needed for grant applications. PhD students and Post-Docs cannot be designated as MEng Project supervisors but can work with MEng Project students under the supervision of a TTT Faculty supervisor.

Recommendation 9

We recommend better exploiting one major strength in Machine Learning and Artificial Intelligence among many faculty members by considering an explicit elective course on that topic, especially in a Software Engineering context, e.g., AI/ML for SE, SE for AI/ML (see Section 2.7).

Program's Response

The program includes some relevant elective courses (e.g., ENGR5775G – Knowledge Discovery and Data Mining; ENGR5785G – Real-Time Data Analytics for IoT; and ENGR5010G Advanced Optimization). While students working on team projects as well as research students in the MAsc program may be working on AI and machine learning topics, it is a good idea to highlight our AI/ML strength in advertising the program. Faculty members will be encouraged to offer AI/ML for SE as a special topics course (ENGR5005G – Special Topics), which is part of the program.

Dean's response

The Dean agrees with the program's response.

Recommendation 10

We recommend addressing how the programs will address issues of Equity, Diversity, and Inclusion (EDI) in a revised proposal and in a revised template for future evaluations (see Section 3).

Program's Response

While this is covered partially in the Student Engagement and Equity section on page 26, Ontario Tech University is committed to excellence in accessibility and diversity service provisions for all students, faculty, and staff through a dedicated office for EDI (<https://inclusive.ontariotechu.ca>). All our programs follow guidelines and EDI best practices provided by the University. The proposed programs, like all our existing programs, will recruit a diverse student body from around the world.

A couple of the learning outcomes (Table 3) have been edited to include working in diversified teams, and designing appropriate software engineering solutions that address ethical, social, gendered, legal, security, and economic concerns. To this end, several of the courses in the proposed program have a team project component, and students will be encouraged to form diversified teams to have diversified perspectives. Courses that cover requirements engineering will also cover topics related to integrating EDI into the design and development of software systems and applications.

Dean's response

[The Dean supports the statement by Program.](#)

Recommendation 11

We strongly recommend aligning the numbers found in Table 1 with those provided in the external budget, so discrepancies are eliminated (see Section 3).

Program's Response

The numbers in the Excel file have been aligned with the numbers in Table 1: projected enrollment.

Dean's response

[The Dean agrees with the program's response.](#)

Recommendation 12

We recommend considering the sharing of relevant graduate seminars from the Faculties of Science, Business and IT, and Engineering and Applied Science (see Section 3). The mandatory seminar could also evolve towards covering the basics of qualitative and quantitative research (see Section 3).

Program's Response

The seminar course is a required component in all our MSc and PhD programs. Students in the proposed MSc program will be required to complete ENGR 5007G – Seminar for ECSE. While the Computer Science graduate programs do not have a similarly structured seminar, the students are required to deliver a public seminar (one for MSc and two for PhD), and students in the MITS program are required to complete the seminar course MITS5900G, and hence two-way sharing the scheduling of student presentations in all seminars is an excellent idea as it will promote the research culture on campus and offer graduate students

and professors more networking and collaboration opportunities. Hence, we concur with the recommendation of sharing relevant graduate seminar presentations between all Faculties.

Evolving the seminar to cover topics related to the basics of qualitative and quantitative approaches has been discussed in the past. The seminar course for the proposed MASc program is currently structured like all other MASc programs – to be offered towards the end of the program before the thesis defense, but this recommendation will re-open the discussion for the seminar course, its content and placement in all our MASc programs.

Dean's response

Sharing graduate courses is always encouraged and currently there are few graduate courses shared between Software Engineering and Computer Science.

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*

Please check the document 'Summary of Changes Made to Proposal from External Report'.



Summary of Changes Made to the Proposal Following External Review

List all revisions, noting the Section number from the proposal document. Include this form with the final proposal.

1. The admission requirements in Section 2(a) have been clarified to explicitly state the eligibility of Computer Science students as well as students from other disciplines. (Recommendation 4)
2. The Accelerated Master's program in Section 2(a) has been edited to clearly state that undergraduate students do not double-dip by having the graduate courses count towards the undergraduate degree and graduate degree. While this is against the external reviewers' recommendation, this is in line with the policies of graduate programs at other institutions that allow undergraduate students to take graduate courses including the institution of one of the external reviewers. (Recommendation 5) The name of this option has been changed to Expedited Pathway to provide clarity.
3. The program learning outcomes (Table 3) in Section 2(b) and the text following the table have been revised to address EDI. (Recommendation 10)
4. Section 2(c) has been edited to clearly state that graduates of the proposed MASc program would be qualified and eligible for admission into our PhD program in Electrical & Computer Engineering in the field of Software Systems. (Recommendation 1).
5. A co-op stream has been added to the MEng program in Section 2(c). (Recommendation 2)
6. Revised the budget (external excel file) – the numbers have been aligned with the numbers in Table 1: projected enrollment. (Recommendation 11).



ACADEMIC RESOURCE COMMITTEE

Re: Resources for New Co-op Program

Date: October 2021

The proposal for the new Master's in Software Engineering notes the addition of a new co-op option.

Ontario Tech is committed to providing the dedicated support needed for students in this program. The University will be exploring an institutional approach to more effectively support experiential, co-op, and work integrated learning program innovations and expansions towards achievement of our Learning Re-imagined goals. Staff resources dedicated to these programs will be examined as part of this process to ensure the required supports across campus are coordinated, scalable, of high quality, and financially sustainable.

The Academic Resource Committee recommends approval of the proposal, with the understanding that University resources will be reviewed and allocated as necessary to successfully support all experiential, co-op, and work integrated learning program innovations.