

York University

**New Program Brief of the Graduate Program in
Mechanical Engineering**

Submitted: December 22, 2014

1. Introduction

1.1 Provide a brief statement of the degree program(s) being proposed, including commentary on the appropriateness and consistency of the degree designation(s) and program name with current usage in the discipline or area of study.

This is a proposal for two different degrees, both housed within the Department of Mechanical Engineering: the Masters of Applied Science (M.A.Sc.) in Mechanical Engineering and Doctorate (Ph.D.) in Mechanical Engineering. Mechanical Engineering is the ideal name for the program as it is a well-recognized and known/understood program designation for what is planned for delivery in this proposal. Also, our survey of similar graduate programs showed that the degree designations as stated above are common to many similar programs in Ontario and Canada. The proposed first intake for both of these degree programs is September 2015.

Graduate study in Mechanical Engineering is considered as a cornerstone for any Engineering Faculty that is delivering an undergraduate Mechanical Engineering program. The research enabled by the graduate program will allow faculty members to remain up to date in the latest technological and scientific advances within the field of Mechanical Engineering, and contribute to the wider society by a higher level of scholarly activities and technology development. In addition, the enrolled graduate students will be an important partner in delivering the undergraduate program in Mechanical Engineering as they will be teaching assistants for laboratory demonstrations and tutorials. Furthermore, graduates of such a graduate program are needed to support today's technologically driven society and economy in Ontario and Canada so their employment prospects will be strong upon graduation. The American Society of Mechanical Engineer's Vision 2030 report¹ clearly indicated that employers value and require ever more employees with a graduate degree.

This proposal is also very timely considering the Reaching Higher and Putting Students First² plans through which the government of Ontario has expressed its commitment to the expansion of graduate student spaces by 6,000 through 2016. Furthermore, this proposal is in line with current expansion of engineering programs at York and the recent founding of the Lassonde School of Engineering as well as establishment of the Department of Mechanical Engineering and its first undergraduate intake in Fall 2014.

As normally practiced, the focus of the Mechanical Engineering graduate program will be broadly based to reflect the expertise of the current and the future faculty members, which will include areas such as kinematics, thermodynamics, solid mechanics, manufacturing, microsystems, control, advanced materials, heat transfer, design, fluid mechanics, energy and environment, and their applications to a wide array of systems and subsystems found in various machineries and devices or living organisms along with strong emphasis on technology commercialization to match with the recent trends in translational research conducted by the faculty members. The outcome of the research work done through the graduate program can be important in wide industrial sectors such as medical devices, automotive, aerospace, electronics packaging, manufacturing, shipping, transportation, energy production and usage, mechanics of human body and living organisms, mechatronics, nanotechnology, robotics, microsystems, sustainable building systems, control and industrial simulators, rehabilitation technology, etc. Graduates from a Mechanical Engineering program can expect to find employment in any of the above areas as well as related R&D, certification, inspection, maintenance, implementation and life-cycle management functions. Also they will be excellent champions in creating new ventures by translating their own research into commercialization.

Research intensification is a priority of the York University as stated in the University Academic Plan (UAP) 2010, and establishment of this proposed graduate program can form an important piece in such an endeavor especially in the context of the newly formed Lassonde School of Engineering. Also, in tune with the Lassonde School of Engineering philosophy, the graduate program in the Mechanical Engineering will promote a broader student learning and scholarly achievements by providing opportunities for enhancing graduate students' communication skills, awareness of intellectual property and entrepreneurship issues, professional ethics and

¹ "Vision 2030: Creating the future of Mechanical Engineering Education", ASME Annual Conference, Pittsburgh, USA, June 7, 2010.

² "Enrollment Increases", OCUFA Briefing Note, July 2011.

sustainability concepts so that they can deliver to the spirit of Renaissance Engineers™ that can make an impact for the communities within York University and beyond.

1.2 For graduate programs that wish to have a Quality Council endorsed field(s), please indicate the field(s) for each of the master's and PhD programs.

No fields are proposed for the program.

1.3 Provide a brief description of the method used of the development and preparation of the New Program Brief, including faculty and student input and involvement.

The document has been developed through an extensive consultation process among current faculty members in the Mechanical Engineering Department and also with respective individuals in Osgoode Law School, Schulich Business School, and the Teaching Commons. These consultation processes involved one-to-one meetings and departmental meetings.

1.4 Indicate the Faculty/unit in which the program will be housed (for undergraduate programs™) or anchored (for graduate programs).

It will be housed in the Mechanical Engineering Department at the Lassonde School of Engineering.

The inception of Lassonde School of Engineering took place on November 2011, when Pierre Lassonde announced his founding \$25 million donation to create a home for Renaissance Engineering™. In July 2012, the Lassonde School of Engineering was formally launched with Dr. Janusz Kozinski as Founding Dean. In May 2013, students (graduates and undergraduates) and faculty members in the Department of Electrical Engineering & Computer Science and the Department of Earth & Space Science & Engineering (both previously part of the Faculty of Science and Engineering) joined the Lassonde School of Engineering. A new \$90M home of the Lassonde School of Engineering is under construction, to be occupied by September 2015, possible through donations from philanthropists Ignat Kaneff and Douglas Bergeron. Now the Lassonde School of Engineering has undergraduate programs in Mechanical Engineering and Civil Engineering. A new Chemical Engineering Department is planned to be opened in 2017.

2. General Objectives of the Program

2.1 Provide a brief description of the general objectives of the program.

The graduate program in Mechanical Engineering is focused on excellence in learning and professional development for students. This program aims not only to advance students' knowledge and expertise beyond Bachelor's level in the field of Mechanical Engineering, but also to enable and foster their independent research skills, creative activities and entrepreneurship skills. In addition to the focus placed on original research, students will be provided with opportunities for professional development through engaging in complementary education and training in areas such as law, business, ethics, technical writing, and communication. As such, the objectives of the graduate program are designed so that by the time of graduation, the M.A.Sc. students will obtain and demonstrate the skills and abilities below:

- (i) Acquisition of advanced knowledge through classroom learning in conventional and specialized subjects of Mechanical Engineering and related fields
- (ii) Ability for graduates to independently conduct research and creative activities with guidance, resulting in contributions to the body of knowledge of their chosen fields
- (iii) Diversification of knowledge and experience beyond the immediate research field by engaging in complementary education and training in areas such as teaching/mentoring and commercialization as well as public outreach activities
- (iv) Effective delivery and communication of scholarly findings with professionals and society at large in various forms, such as oral presentations (e.g. conferences and industrial forums) and disseminations (e.g. scholarly journals, patents and mass media outlets)
- (v) Commitment to implementation of professional and ethical standards as well as sustainable practices related to research and professional activities

Similarly, the Ph.D. students will obtain and demonstrate the following skills and abilities:

- (i) Acquisition of advanced knowledge through classroom learning in conventional and specialized subjects of Mechanical Engineering and related fields
- (ii) Ability for doctoral (Ph.D.) graduates to conduct research independently through defining, planning and solving of scientific problems to lead and advance knowledge in their field of specialization. Research outcomes should lead to creativity and competence at an international level
- (iii) Diversification of knowledge and experience beyond the immediate research field by engaging in complementary education and training in areas such as teaching/mentoring and commercialization as well as public outreach activities
- (iv) Effective delivery and communication of scholarly findings with professionals and society at large in various forms, such as oral presentations (e.g. conferences and industrial forums) and disseminations (e.g. scholarly journals, patents and mass media outlets)
- (v) Commitment to implementation of professional and ethical standards as well as sustainable practices related to research and professional activities

2.2 Describe how the general objectives of the program align with University and Faculty missions and academic plans.

Since York University's establishment in 1959, engineering programs were envisioned. More than a decade ago, the vision of engineering programs was initiated at York University with the School of Engineering established within the then Faculty of Science and Engineering in 2001 along with the Canadian Engineering Accreditation Board (CEAB) accreditation of its 3 engineering programs in the last decade. The recent establishment of the new Lassonde School of Engineering, since May 1, 2013, represents the second expansion plan for engineering at the university. Consistent with engineering planning document, the establishment of the graduate program in Mechanical Engineering will represent an important component for the engineering expansion at York University.

The 2010-2015 University Academic Plan (UAP) explicitly commits to the diversification of academic activities in line with creating a more comprehensive university, including teaching and research in the area of engineering. It also states that in order to achieve this objective, establishment of new programs in engineering is needed. Furthermore, the 2013-2018 York University Strategic Research Plan (YUSR) also emphasizes

the significance of engineering research. One of the primary goals highlighted in YUSRП is research intensification. In particular, the university will establish new and expanded research programs, which push exploration of smart technologies for a green environment and healthier lives, and enhance public safety and security, to complement the existing research foci in space and climate sciences, computation and connective media technologies. YUSRП also envisions that “the expansion of engineering and applied science research will see York University reaches the first tier for innovation in these areas within five years.” This proposed program forms one component of the second wave of expansion in engineering program offerings to include the major engineering disciplines, including Mechanical Engineering.

Mechanical Engineering is a diverse discipline that applies knowledge of design, manufacturing, as well as engineering and material sciences to advance the well-being of humankind. It derives its breadth in mechanical systems, sustainability, energy, health and biomedical devices, infrastructure, etc. In light of this, this proposed graduate program will allow York University to achieve its academic and strategic research plans for the expansion of engineering, and creating a more comprehensive University. It aims to satisfy the mission of York University to achieve excellence in research and teaching in applied and professional fields, as well as to prepare graduate students in their future careers through engaging them in complementary education and training in areas beyond their research. These will be done through (i) delivery of advanced knowledge through classroom learning experiences, (ii) training of Master’s and Doctoral students’ independent research skills to conduct research and creative activities, and (iii) development of graduate students’ skills in complementary areas.

By training graduate students and support research activities in cutting-edge pioneering research in emerging fields, such as micro-systems, advanced manufacturing and materials, bio-systems, and energy systems, etc., the program will fulfill the stated commitments “to paving the way to an expanded Engineering program” as stipulated in 2010-2015 UAP. The program’s objectives to train students to conduct creative and competent research at an international level and to possess professional and ethical standards as well as sustainable practices align with YUSRП’s vision of “facilitating the scientific and technological breakthroughs for the 21st century to meet the challenges of environmental sustainability, the prevention and treatment of disease, and the development of new materials and devices to make Canadian products competitive in the global marketplace”. With the first stream of Mechanical Engineering undergraduate program that started in Fall 2014, the development of the graduate program will also fulfill the needs for graduate students to support the undergraduate program through teaching assistantships. Therefore, the delivery of the proposed Mechanical Engineering graduate program is essential for the Department of Mechanical Engineering, the Lassonde School of Engineering, and York University.

In summary, the general objectives of the program are consistent with the Lassonde School of Engineering’s commitment to expose students to a rich research culture and provide opportunities for them to participate in research as part of their studies. It will also aspire to train graduate students to gain experiences and to recognize important areas beyond the core of their research disciplines. Examples of key complementary areas include: (i) engineering pedagogy; (ii) technology transfer, commercialization, and related matters; (iii) legal aspects; (iv) communications; and (v) ethical, societal, and safety obligations, etc. These will provide additional assets for graduate students to succeed in their future career paths, either in academia or industry. Through this entrepreneurship bend in the program, it is expected that the graduate students will themselves create new enterprises and they will be “job creators” rather than “job seekers”, which will eventually help the Province economy and will make Canada globally competitive.

3. Need and Demand

3.1 Identify similar programs offered at York and/or by other Ontario universities, with special attention paid to any innovative and distinguishing aspects of the proposed program.

There is no graduate program offered at York University that is similar to the one proposed here. There are a number of Mechanical Engineering graduate programs that are offered at many Ontario universities (i.e., Carleton University, University of Guelph, Lakehead University, McMaster University, University of Ottawa, Queen's University, Royal Military College of Canada, Ryerson University, University of Toronto, University of Ontario Institute of Technology, University of Waterloo, Western University, and University of Windsor). Nationally there are more Mechanical Engineering graduate programs. This is so, as this graduate program trains graduate students in frontier research areas and/or advanced engineering knowledge needed by Canadian industries and enterprises; graduates of Mechanical Engineering graduate programs are very much in demand in academic, private, government, and not-for-profit sectors.

The current Mechanical Engineering graduate programs offered at Ontario universities fall into two types of programming: The first type offers students opportunities to pursue research-based graduate work at Master's and Doctoral levels. Master's degree distinctions include M.Sc., M.A.Sc., and M.E.Sc.. The second type is a course-based program, either on a full-time or part-time basis, with typical degree distinction as M.Eng. It offers advanced mechanical engineering courses to train students as professional mechanical engineers. The proposed graduate program planned at York University focuses on the first type of the graduate programs, as will be discussed below. However, for context, an analysis of the current offering of Mechanical Engineering programs in either of the above two categories is presented for Ontario universities.

Research-Based Graduate Program: The research-based graduate program (Master's and Ph.D.) is intended for students that are interested in pursuing advanced studies and research at postgraduate level. It typically takes 24 months and 48 months for Master's students and Ph.D. students, respectively, to complete. Master's students must complete four to five one-term graduate courses or equivalent, and successfully defend a thesis at a Master's oral exam. Ph.D. students must complete three to five one-term graduate courses or equivalent. It also usually requires annual committee meetings to assess the student's progress. These can include: (i) qualifying exam within 12 months of registration to the program, and (ii) annual progress review meetings in subsequent years. Similar to Master's students, Ph.D. students will also need to successfully defend a thesis at a Ph.D. oral exam. This type of program aims to train each graduate student in a particularly chosen major research area under the supervision of a professor with the related areas of expertise. It strives to develop graduate students' professional and research independence, creativity, leadership, and the capacity for continuing professional and intellectual growth.

The research-based graduate program has two versions: The first version is a fully traditional program in which graduate students will focus on a research area within the discipline of Mechanical Engineering. Such a program is offered at all Ontario universities that were examined. The second version is one that students are participating in an interdisciplinary research program that is jointly offered by multiple departments or institutions. It provides students with an educational environment that spans among different disciplines. Examples of collaborative graduate programs include: Biomedical Engineering (i.e., Department of Mechanical and Industrial Engineering and Institute of Biomaterials and Biomedical Engineering at the University of Toronto), Engineering-International Development Studies (e.g., School of Engineering and International Development Studies at the University of Guelph), Environmental Engineering (i.e., Department of Chemical Engineering and Applied Chemistry, Department of Civil Engineering, Department of Materials Science and Engineering, and Department of Mechanical and Industrial Engineering at the University of Toronto), Health Care, Technology, and Place (i.e., involves 10 departments at the University of Toronto), Nanotechnology (i.e., involves 7 departments at the University of Waterloo), Mechanical and Aerospace Engineering (i.e., Ottawa-Carleton Institute for Mechanical and Aerospace Engineering), and Resuscitation Science (i.e., involves 14 departments at the University of Toronto), etc.

Graduate students enrolled in the research-based graduate program will receive a variety of financial supports in the form of research assistantship, teaching assistantship, and/or scholarships, etc. However, the course-based graduate program usually expects the candidate to be financially self-supporting. Therefore, sometimes

it has limitation for graduate students who are committed to build a research career, be it in academics or in research intensive federal, provincial and corporate laboratories.

The proposed graduate program will be a research-based graduate program. The mission of the proposed Mechanical Engineering graduate program at York University is to train graduate students and support research activities in advanced areas of core disciplines (e.g., thermofluids, solid mechanics and materials, statics, kinematics and dynamics, manufacturing, as well as control/measurements) and cutting-edge pioneering research in emerging and interdisciplinary areas (e.g., micro-systems, advanced manufacturing and materials, bio-systems, and energy systems, etc.). Various studies as mentioned in the sections 1.1 and 2.2 of this proposal have shown that both students and receptor community (e.g., future employers in industry) will benefit tremendously by having students developed an array of soft skills (e.g., teamwork, written and oral competency, independence, entrepreneurship and leadership), familiarity with business of engineering, basic understanding of legal, ethical, and intellectual property matters in engineering, as well as societal and environmental aspects of engineering, and its globalization through the research conducted by the current faculty members in the department. As such we have designed the curriculum, which is described in the later sections, and assemble our faculty to accomplish this mission systemically.

Innovative and Distinguishing Aspects: The proposed graduate program in the Department of Mechanical Engineering at York University has two unique aspects, which will prepare graduate students in their respective research areas and beyond. These aspects include: (1) helping graduate students to develop independent research skills to conduct advanced research and creative activities at international level; and (2) exposing graduate students to important complementary areas (e.g., engineering pedagogy, technology transfer and commercialization, legal aspects, communications, intellectual property, as well as professional, ethical, and environmental obligations, etc.) beyond their research. Together, they will provide graduate students opportunities to not only bridge fundamental sciences to technology development in the context of their thesis research, but also gain a breath of skills, values, and experiences in ethics, sustainability, entrepreneurship, commercialization and communications, etc.. These complementary areas, beyond those obtained from their research activities, are needed in their future career paths. The program also aligns with the vision set out for the Lassonde School of Engineering to create Renaissance Engineers™ – entrepreneurial engineers with a social conscience and a sense of global citizenship. Currently, the research-based graduate program available in different post-secondary institutes in Canada only focus on the foundation knowledge of the mechanical engineering discipline, with seldom emphasis on “soft skills” and “entrepreneurship” within the academic curriculum. The proposed research-based graduate program in Mechanical Engineering provides comprehensive training opportunities for the graduate students in foundation knowledge of the discipline (through compulsory core mechanical engineering courses) and the understanding of the bigger role engineers play in the society (through compulsory complementary courses in law, business, and engineering education).

Course-Based Graduate Program: For the second type of Mechanical Engineering graduate program at Ontario universities, i.e. course-based Master of Engineering program (M.Eng.), it is designed for students who wish to pursue their Mechanical Engineering education beyond the undergraduate level but do not wish to pursue a thesis-based research program. The Lassonde School of Engineering is planning to offer a course-based M.Eng. program, which will be coming forward under a separate proposal.

3.2 Provide brief description of the need and demand for the proposed program, focusing as appropriate on student interest, social need, potential employment opportunities for graduates, and/or needs expressed by professional associations, government agencies or policy bodies.

As articulated in the report *State of the Nation 2012*³, “business innovation [in a country] is an engine of productivity growth, increased international competitiveness and higher living standards. It is underpinned by investments in R&D, machinery and equipment (especially information and communications technologies (ICT)) and intangible assets”. However, based on most of the measures provided, Canada has lagged behind many competitor countries in business innovation and continues to rank at the middle (to bottom) among countries of the Organisation for Economic Co-operation and Development (OECD). Particularly, business enterprise expenditures on research and development (BERD, i.e. the R&D conducted by firms in Canada) as a percentage of Gross Domestic Product (GDP) has been on an almost continuous decline for the past

³ Science, Technology and Innovation Advisory Council report to the government of Canada

decade, and has raised a lot of concerns for Canada's economy. Higher education expenditures on R&D (HERD) as a percentage of GDP in Canada has fluctuated over the last decade but increased slightly since 1990's. Canada continues to perform poorly in effective transfer of generated knowledge from higher education institutions to the companies that are able to translate it into useful products. In order to break into the ranks of the world's top-five performing countries, five important Science, Technology and Innovation (STI) indicators have been identified by the STI advisory council to the government, that Canada should focus on:

- a) BERD as a share of GDP
- b) Business investment in ICT
- c) HERD as a share of GDP
- d) Science and engineering doctoral degrees granted per 100,000 population
- e) Share of human resources in science and technology

As predicted above, Canada's future as an innovation-based global economy depends on training educated talents with R&D expertise, interdisciplinary skills, entrepreneurial characteristics and understanding of professional and societal needs at a global level. Students graduated at Masters and doctoral levels gain extensive experience in research and hence, are frontiers of conducting R&D at higher education institutions (i.e. HERD) and supply the workforce needed for R&D activities inside the business sector (i.e. BERD). Although Canada and more particularly Ontario continue to be among the world leaders in undergraduate-level education, when it comes to training of graduate students, the province lags behind other jurisdictions and the competing countries. Ontario needs to close the gaps in conducting more R&D, training more graduate students and providing them with opportunities to follow their careers in the province and at the same time providing opportunities for them to create new ventures.

Governments of Canada and Ontario have already taken action towards the support for R&D to boost innovation, technological advancement and prosperity for tech-driven industries. R&D-driven economy in Ontario is reflected in the spending dollar amounts and government regulations and decisions in this domain. According to Statistics Canada⁴, the dollar amount of R&D performed by business and higher education institutions (dominant sectors) has risen significantly since 1990; from \$5 billion in 1990 to \$15.6 billion in 2012 for the business and from \$3 billion in 1990 to \$11.5 billion in 2012 for the higher education sectors. According to *Research and Development in Ontario 2011* report⁵, more than \$13.9 billion Canadian Dollar in BERD and HERD is spent every year in Ontario. Large enterprises such as Atomic Energy of Canada, Bombardier, Ford Canada, Magna, GlaxoSmithKline, Research In Motion and Xerox Canada are conducting cutting-edge R&D in Ontario. Ontario is attractive to these and many other small and medium enterprises (SMEs) due to its exceptional research talent (>100,000 researchers), R&D cost competitiveness (generous R&D tax incentive programs) and government support for innovation.

As discussed before, to support Ontario's (and Canada's) mission of prosperous economy, it is highly important to train graduate-level students with R&D talents who can directly contribute to advancement of innovation in key economic growth sectors in Ontario. Ministry of Research and Innovation stated in the *Ontario's innovation Agenda* report that bio-economy and clean technologies, advanced health technologies and pharmaceutical research and manufacturing are among the highlighted areas of strong economic growth where Ontario already holds a position of global importance and/or can quickly mobilize existing resources and skills to do so. In connection to this, aerospace, automotive, clean energy, clean technology, materials and medical technologies are among the key economic sectors in Ontario as identified by Ontario Investment and Trade Centre where Mechanical Engineers can contribute significantly.

Mechanical engineers play an important role in fulfilment of R&D needs in the above-mentioned key economic areas. Ontario's aerospace industry generates approximately \$6.5B in sales annually. Ontario is home to five of the world's top automakers, as well as 350+ innovative part manufacturers who are making the lighter, stronger and safer cars of the future. Cars that are made of totally recyclable materials and run on green, renewable clean energies. In 2009, a priority was placed by Green Energy and Green Economy Act (GEA) establishing Ontario as the North American leader in producing and using clean and renewable sources of energy including wind, water, solar, biomass and biogas power. Since then, the number of wind turbines has been increased from 10 in 2003 to more than one thousand in Ontario. We produced more energy from wind and solar than from coal in 2011. Ontario is also a global leader in the field of clean water technologies and water protection. For instance, two of the world's leading water and wastewater treatment technologies (UV purification and membrane filtration) were developed in Ontario. Ontario is the largest hub of biomedical

⁴ Statistics Canada, CANSIM Table 358-0001, December 2012.

⁵ By Ontario Investment and Trade Center

activity in Canada and the fourth largest biomedical research centre in North America. Professional post-graduate-level Mechanical Engineers can play significant roles in R&D conductance, innovation and advancement of the technologies discussed above in Ontario. In this regards, development of graduate Mechanical Engineering programs with focused research areas on core (e.g. thermodynamics, fluid mechanics, materials, and solid mechanics) and interdisciplinary (e.g. sustainable energy systems, dynamics and control of electro-mechanical systems, advanced manufacturing and materials, micro-systems and bio-systems) fields of Mechanical Engineering is of great importance. This has been taken into consideration in designing the proposed Mechanical Engineering program at York University.

The need for training more graduate students (including Mechanical Engineers) with research experience who can conduct R&D activities in the abovementioned key business sectors in Canada/Ontario has increased during the past few years. Ontario universities train more than 52,000 graduate students with a 45% increase in provincially-funded students that has happened over the past decade (Ontario Ministry of Training, Colleges and Universities (MTCU). MTCU has also announced its intention to create 6,000 new graduate spaces until 2015-16 to address the needs for graduate studies. These post-graduate trainees are highly needed in a variety of business sectors such as the ones discussed above. According to a survey of firms conducted by EKOS Research Associates Inc. in 2011 and published in the report *Innovation Canada: A Call To Action*, firms that performed in-house R&D had hired 59% graduate-degree employees to conduct their activities. Although this clearly demonstrates the need for talents with higher education in Canada, only 18% of the responding firms had Ph.D. holders performing R&D projects. In 2010, Canada was ranked 15th among 20 countries in training doctoral-level graduates in the Science and Engineering disciplines (Organization for Economic Co-operation and Development). It is articulated in the report *State of the Nation 2012*⁶ that “given the importance of doctoral talent to the creation and application of new knowledge, this is another indicator where Canada should focus concerted attention on enhancing its performance [to be competitive among OECD countries]”. The question is in what programs these post-graduate trainees are more dominantly sought? According to MTCU, Engineering and Applied Science as well as Health Professions have been among the highest demanded and fastest growing graduate programs in the past decade. The new 6,000 graduate spaces envisioned until 2015-16 by MTCU will be concentrated in these high-demand programs. Additionally, as speculated by the report *Prism Economics and Analysis, The Engineering Labour Market in Canada: Projections to 2020*⁷, engineering industry trends until 2020 are going to be dominated by strength in mining, oil and gas as well as manufacturing in Ontario with growth factors exceeding 25%. However, “output and employment losses in manufacturing across the last decade often exceeded 30% so that projected recovery of 25% or more is not enough to restore activity to previous peak levels”. In particular, Mechanical Engineers were reported among the top 3 national engineering labour forces with the highest levels of loss projected until 2020. This clearly shows the importance of the number of Mechanical Engineers that have to be trained and replaced when these losses happen. It is worth mentioning that the total number of engineers needed from 2011 to 2020 in Ontario is predicted to be twice as much as any other province in Canada. The permanent losses to the engineering labour force occur as the older engineers stop working, so in addition to the need for hiring newly-graduated Mechanical Engineers at the undergraduate level, the losses at higher professional ranks have to be replaced by either more experienced engineers or labour forces with post-graduate levels of training and education. Post-graduate Mechanical Engineers may also advance to administrative or managerial positions, become self-employed consultants, start new engineering enterprise, conduct research or may teach at the post-secondary levels.

Post-graduate education in Mechanical Engineering in Canada is also demanded by prospective students at both national and international levels. Engineers Canada stated that in 2011, 13,814 M.Sc., M.A.Sc., and M.E.Sc. as well as 8,173 Ph.D. students enrolled in graduate programs in various engineering disciplines across Canada with a 4.3% growth when compared to enrollments in 2010. At Master’s level, Mechanical Engineering was ranked 3rd with approximately 2,000 enrolments (~15% of total). At the Ph.D. level, Mechanical Engineering programs across Canada attracted the second largest pool of graduate students with approximately 1,300 enrolments (~16% of total). It is worth mentioning that over 37% of these graduate students chose Ontario as their higher education destination in 2011. This clearly demonstrates the enthusiasm and demand of students and the importance of post-graduate education in Mechanical Engineering at Ontario-based universities.

As discussed earlier in this section, post-graduate mechanical engineers may choose to work in a variety of industries, including natural resources (forestry, agriculture, oil and gas, mining), energy (thermal and

⁶ State of the Nation 2012 – Canada’s Science, Technology and Innovation System: Aspiring to Global Leadership, Science Technology and Innovation Council, 2013.

⁷ Engineers Canada

hydroelectric power stations, solar, wind and biofuels), processing (petrochemical refining, food and beverage production), manufacturing (automotive, aerospace, robotics, biomedical technologies, appliances, furnishings and telecommunication equipment), construction (mechanical systems such as elevators or air conditioning, heating and ventilation systems), transportation (road, rail, air, marine, space vehicles and systems) and utility systems (water, natural gas and electricity). According to Engineers Canada and statistics shown in Fig 3.1, the index of employment for Mechanical Engineers in Ontario will continue a steady growth until 2018. The 2009 recession less severely influenced the professional, scientific and managerial Mechanical Engineers' employment and a more steady growth is predicted in the next 5 years for this group. This directly benefits the post-graduate Mechanical Engineering students who are best suited for taking professional, scientific and managerial roles in their careers. In addition, the training received through the proposed graduate program in Mechanical Engineering will help the graduates to seamlessly work with researchers in social and natural sciences and will play a pivotal role in filling the much needed gap in understanding technology uptake issues in communities, both local and global.

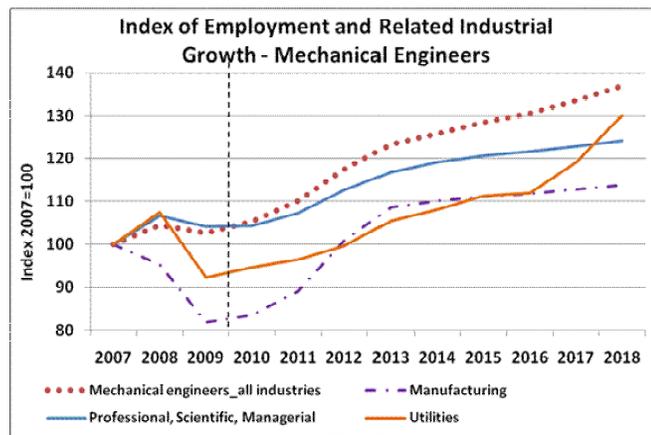


Figure 3.1 – Employment growth projected by Engineers Canada in Ontario for Mechanical Engineers ⁸(the graph is taken from EC website).

Women are typically underrepresented in graduate programs in mechanical engineering despite their increasing overall presence in undergraduate STEM disciplines. The research-based program, proposed here, provides opportunities for graduate students to work at the interface of science and engineering, making it a welcoming academic program that will benefit and attract students representative of a wide range of backgrounds and interests. Furthermore, the different compulsory and complementary courses offered within the program reflect a wide array of disciplinary knowledge including, for example, the art of writing, legal aspects, and teaching and pedagogy. The aim is to provide all students with attractive offerings for developing skill sets that move beyond what has historically been the "nuts and bolts" of mechanical engineering. In addition, the program will work in collaboration with the School of Gender, Sexuality, and Women's Studies in the Faculty of Liberal Arts and Professional Studies to integrate course offerings designed to foster a critical and interdisciplinary understanding of gender and equity in the study and practice of engineering.

⁸ <http://www.engineerscanada.ca/accreditation>

4. Program Content and Curriculum

4.1 Describe the program requirements, including the ways in which the curriculum addresses the current state of the discipline or area of study. Identify any unique curriculum or program innovations or creative components.

The current state of Mechanical Engineering graduate programs and the discipline in general were discussed in Section 3.1. In brief, Mechanical Engineering programs at the Masters level offer students opportunities to either pursue a course-based degree or to engage in research in addition to completing courses. Students enrolled in doctoral programs in Mechanical Engineering follow the second model and are heavily involved in a type of research that advances knowledge. The proposed Mechanical Engineering graduate program at York University also pursues the research-oriented model for both the Masters and doctoral-level students. Graduate students will be involved in research- and course-based activities as separately discussed in sections 4.1.1 and 4.1.2 for Master's and doctoral students, respectively.

By using a combination of course- and research-based activities, this program aims to advance graduate students' conceptual understanding of fundamental aspects of the Mechanical Engineering discipline, to enhance their analytical, interpretative, methodological and expository skills and to enable and foster their independent research abilities and creative activities in core and interdisciplinary areas of Mechanical Engineering. The core areas are considered as (a) Thermo-fluids (like fluid dynamics, heat transfer); (b) Mechanics (like continuum mechanics, statics, kinematics and dynamics); (c) Design and Control/Measurement; and (d) Manufacturing (like advanced manufacturing, nanomaterials). The interdisciplinary areas are sustainable energy systems, dynamics and control of electro-mechanical systems, advanced manufacturing and materials, micro-systems and bio-systems. From the program offering point of view, the core and interdisciplinary areas are clubbed as "Core Mechanical Engineering Courses". Therefore, the rubric for the core courses will be MECH6XYY, where X will signify the core area (X=1 for thermos-fluids, X=2 for mechanics, X= 3 for design; X = 4 for manufacturing, and X = 5 for interdisciplinary topics) and YY will be course number. In addition to the focus placed on original research, graduate students will be provided with unique opportunities for professional development through engaging in complementary education and training in areas outside their fields of research as discussed in sections 4.1.1 to 4.1.3 and 4.2.

Each graduate student at the Department of Mechanical Engineering at York University should identify an academic supervisor(s) (a faculty member from the Department of Mechanical Engineering) from the starting date of his/her enrolment in the program. All students are required to plan and conduct their course - and research-related activities under the direct guidance of their supervisors as discussed in the following sections.

4.1.1. Master of Applied Science (M. A. Sc.) Degree Requirements

Students enrolled at this level will pursue a Master of Applied Science (M.A.Sc.) degree in the Department of Mechanical Engineering at York University. Students are expected to complete the M.A.Sc. in Mechanical Engineering in two years. All requirements for a Master's degree must be fulfilled within 12 terms (4 years) of registration as a full-time or part-time Master's student, in accordance with Faculty of Graduate Studies Registration Policies, including the requirement of continuous registration.

Students are required to complete a minimum of four graduate credit courses (12 credits). Out of these, at least two courses need to be from the core Mechanical Engineering department course offerings (see Section 4.2) and one can be a Directed Study (MECH 8000) or credit course from outside the Mechanical Engineering Department (from other departments in the Lassonde School of Engineering (LSE), outside LSE at York University (YU)). These courses should be selected in consultation with and upon approval of the student's supervisor and the Graduate Program Director (GPD). There will be one complementary education and training course to be chosen out of the current courses available (see Section 4.1.3), typically to be taken after completion of the first year of the program. In addition, every registered graduate student needs to complete two non-credit courses, viz., Engineering Ethics and Graduate Seminar series (see Appendices A and B). To accommodate quick adoption of new graduate core courses from new hires in mechanical engineering, a place holder, MECH 7000, will be used to float "Special Topics in Mechanical Engineering". The course requirements for M.A.Sc. students are summarized in the table below:

Courses	Requirements
Core Mechanical Engineering Courses – MECH 6101, MECH 6102, MECH 6103, MECH 6201, MECH 6202, MECH 6301, MECH 6401, MECH 6402, MECH 6501, MECH 7000	At least 2 courses
Directed Studies (MECH 8000) or Courses outside Mechanical Engineering Department	No more than one course
Complementary Education and Training Course – ENG 6001, ENG 6002, ENTR 6xxx, EDUC 5414	At least 1 course
Engineering Ethics – ENG 6000	Compulsory non-credit course
Graduate Seminar Series – MECH 6000	Compulsory non-credit course

Master's students are required to get involved in research activities immediately upon registration in the Mechanical Engineering program and under the general direction of their supervisors. They need to be registered for non-credit Master's Thesis course (see Section 4.2). They are required to submit a Progress Report (see Appendix D) to their supervisory committee in compliance with the general requirements of the Faculty of Graduate Studies. The Progress Report will document courses taken, teaching assistant duties, knowledge dissemination through publications and presentation, and supervisory committee's direct feedback on the overall performance of the graduate student. If the performance of the student in research is deemed unsatisfactory by the supervisory committee, he/she may be asked to withdraw from the program immediately. If recommended to continue, students are obliged to conduct and conclude their research and to submit a written thesis to their supervisory committee at the end of their degree period. The thesis should clearly demonstrate the candidate's ability to conduct independent research and creative activities with guidance, resulting in contributions to the body of knowledge in the area of investigation. The research undertaken and the thesis should be defended by the student in an oral examination session, according to the Faculty of Graduate Studies Standards and Procedures, details of which are provided in Appendix C. The examination committee members will be selected and the defense session will be conducted based on regulations set by the Faculty of Graduate Studies at York University.

4.1.2. Doctoral Degree Requirements

The Mechanical Engineering graduate program's degree completion requirements will be as per the current FGS regulations and requirements. A supervisory committee, recommended by the appropriate graduate program director and approved by the Dean, Faculty of Graduate Studies, must be formed no later than the end of the fourth term of study. Students will not be able to register in the fifth term of study unless a supervisory committee has been approved. This committee will consist of student's supervisor and at least two other faculty members from the Faculty of Graduate Studies at York University, one of whom has to be from the Department of Mechanical Engineering.

Students, who already have M.A.Sc., or equivalent Masters' degrees, are required to complete a minimum 4 graduate credit courses. Out of these, at least 2 courses need to be from the core Mechanical Engineering department course offerings (see Section 4.2) and one can be a Directed Study (MECH 8000) or credit course from outside Mechanical Engineering Department (from other departments in Lassonde School of Engineering (LSE), outside LSE at York University (YU)). These courses should be selected in consultation with and upon approval of the student's supervisor and the GPD. There will be one complementary education and training course to be chosen out of the current courses available (see Section 4.1.3), typically to be taken after completion of the first year of the program. To accommodate quick adoption of new graduate core courses from new hires in mechanical engineering, a place holder, MECH 7000, will be used to float "Special Topics in Mechanical Engineering". The course requirements for Ph.D. students are summarized in the table below:

Courses	Requirements
Core Mechanical Engineering Courses – MECH 6101, MECH 6102, MECH 6103, MECH 6201, MECH 6202, MECH 6301, MECH 6401, MECH 6402, MECH 6501,	At least 2 courses (Note: At least 4 courses if students do not have Master's degree in Mechanical Engineering)

MECH 7000	
Directed Studies (MECH 8000) or Courses outside Mechanical Engineering Department	No more than one course
Complementary Education and Training Course – ENG 6001, ENG 6002, ENTR 6xxx, EDUC 5414	At least 1 course
Engineering Ethics – ENG 6000	Compulsory non-credit course
Graduate Seminar Series – MECH 6000	Compulsory non-credit course

For students who are admitted directly into the Ph.D. program in Mechanical Engineering after completion of their undergraduate degree, would require to take a minimum of 6 courses, out of which 4 courses need to be from the core Mechanical Engineering department course offering (see Section 4.2), one can be a Directed Study or course from outside Mechanical Engineering Department (from other departments in Lassonde School of Engineering (LSE), outside LSE at York University (YU)) and one course has to be the one of the compulsory complementary education and training courses (see Section 4.1.3), typically to be taken after completion of the first year of the program.

Every registered PhD graduate student needs to complete 2 non-credit courses, viz., Engineering Ethics and Graduate Seminar series (see Appendices A and B). For students who have already received their M.A.Sc. from the mechanical engineering department, would not require to take ENG 6000. Other course requirements remain the same. In addition, within 12 months of the program, each Ph.D. student would require to pass the Ph.D. comprehensive examination (see Appendix C). Students who are unable to meet the academic and research requirements for Ph.D. degree, will have the option to be transferred to M.A.Sc. or M.Eng. degrees with appropriate course credits, as recommended by a committee comprised of the Chair of Mechanical Engineering, Graduate Program Director, and Associate Dean Research & Graduate Studies, LSE or his/her representative.

PhD students will also commence their research activities upon registration in the program and plan them in consultation with their supervisor at the start of their studies. They need to be registered for the non-credit Ph.D. Thesis course (see Section 4.2). Ph.D. students are required to conduct research independently through defining, planning and solving of scientific problems to lead and advance knowledge in their field of specialization. Research outcomes should lead to creativity and competence at an international level and have the significance and standard level that can be disseminated in the form of scientific publications. Ph.D. student's research progress is examined annually by meeting with the supervisory committee in which the student is required to submit Progress Report (see Appendix D). The Progress Report will document courses taken, teaching assistant duties, knowledge dissemination through publications and presentation, and supervisor's direct feedback on the overall performance of the graduate student. If the annual performance of the student in research is deemed unsatisfactory by the supervisory committee, he/she may be asked to withdraw from the program immediately, even after successful completion of the Ph.D. comprehensive examination. If recommended to continue, students are obliged to conduct and conclude their research and to submit a written thesis to their supervisory committee at the end of their degree period. The thesis should clearly demonstrate candidate's ability to conduct independent research and creative activities with guidance, resulting in contributions to the body of knowledge in the area of investigation. The research undertaken and the thesis should be defended by the student in an oral examination session, details of which are provided in Appendix C. The examination committee members will be selected and the defense session will be conducted based on regulations set by the Faculty of Graduate Studies at York University.

4.1.3. Complementary Education and Training

The proposed graduate program at the Department of Mechanical Engineering at York University is unique because it will engage graduate students in important complementary education and training in areas such as teaching/mentoring, engineering pedagogy, technology transfer, entrepreneurship and commercialization, legal aspects and governance, communications, as well as ethical, societal and safety obligations. This is possible due to the strong interactions with the Schulich School of Business and the Osgoode Law School at York University, which also translated during the graduate program development exercise. This will result in diversification of knowledge and experience beyond the immediate research field as well as acquisition of qualities and transferable skills required for employment and professional development by the students.

Additionally, students' appreciation of and commitment to implementation of professional and ethical standards as well as sustainable practices related to research and professional activities will be fostered in the proposed graduate program. The critical component towards the design of our proposed graduate program is that we are ensuring every graduate student have necessary complementary skill sets by making graduate students to take one of the complementary education and training courses (for course listing see Section 4.2), based on their interest in engineering education, business, legal aspects, etc., as a compulsory requirement towards completion of their degree requirements.

4.2 Provide a list of courses that will be offered in support of the program. The list of courses must indicate the unit responsible for offering the course (including cross-lists and integrations, as appropriate), the course number, the credit value, the short course description, and whether or not it is an existing or new course. For existing courses, the frequency of offering should be noted. For new courses, full course proposals are required and should be included in the proposal as an appendix. (The list of courses may be organized to reflect the manner in which the courses count towards the program requirements, as appropriate; e.g. required versus optional; required from a list of specified courses; specific to certain concentrations, streams or fields within the program, etc.)

All courses starting with MECH will be offered by the Department of Mechanical Engineering. These are termed as core courses and compulsory graduate courses (see Section 4.1.2 and 4.1.2). The courses with other designations for the first four letters, the prefix describes the unit responsible as per standard. Out of these courses, we have also identified the courses that are classified as complementary education and training courses (see Section 4.1.3). For description of all courses, the credit values as well as prerequisite and co-requisites, see Appendix A.

Core Mechanical Engineering Graduate Courses (for credit):

Course No.	Course Title
MECH 6101	Microfluidics and Nanofluidics
MECH 6102	Interfacial Phenomena
MECH 6103	Convective Heat Transfer
MECH 6201	Advanced Continuum Mechanics
MECH 6202	Advanced Dynamics
MECH 6301	The Finite Element Method in Engineering Analysis
MECH 6401	Design and Fabrication of Polymer Composites and Nanocomposites
MECH 6402	Smart and Multifunctional Materials
MECH 6501	Advanced Engineering Mathematics
MECH 7000	Special Topics in Mechanical Engineering

Compulsory Graduate Courses (not for credit):

Course No.	Course Title
ENG 6000	Engineering Ethics
MECH 6000	Graduate Seminar Series
MECH 9001	M.A.Sc. Thesis
MECH 9002	Ph.D. Thesis

Complementary Education and Training Courses (for credit):

Course No.	Course Title
ENG 6001	Legal Aspects and Governance in Engineering
ENG 6002	The Arts and Sciences of Scholarly Writing
ENTR 6xxx	Entrepreneurship and Technology Ventures
EDUC 5414	Teaching and Learning in post-secondary education

4.3 For undergraduate programs, comment on the anticipated class sizes. For graduate programs, comment on how the course offerings will ensure that each graduate student in the program will take a minimum of two-thirds of the course requirements from among graduate level courses.

The proposed graduate program, as described in Sections 4.1.1, 4.1.2 and 4.1.3, only allows graduate level courses or integrated courses (if available; maximum one integrated course) to be taken as part of their degree requirements. However, if recommended by the supervisory committee, a graduate student may need to take undergraduate courses, which will not be credited towards the graduate degree requirements for M.A.Sc. and Ph.D. degrees in Mechanical Engineering.

4.4 As an appendix, provide a copy of the program requirements as they will appear in the Undergraduate Calendar or Graduate Calendar, as appropriate.

The program requirements are provided in Appendix F. See Appendices A, B, C, and D for all the required courses and other activities that students must complete to graduate.

5. Program Structure, Learning Outcomes & Assessment

The intent of this section is to provide reviewers with an understanding of the knowledge, methodologies, and skills students will have acquired by the time they complete the program (i.e. the program learning outcomes), including the appropriateness of the program learning outcomes and how they will be supported and demonstrated. With that in mind, and with explicit reference to the relevant degree level expectations, it would be useful to focus on what students in the program will know and/or be able to do by the end of a defined period of time and how that knowledge, methodology and/or skill will be supported and demonstrated.

5.1 Provide a detailed description of the program learning outcomes and indicate how the program learning outcomes are appropriate and align with the relevant degree level expectations.

Ontario Universities Council on Quality Assurance provides approval for the existing and new graduate programs in Ontario based on the use of Graduate Degree Level Expectations (GDLEs) that are developed by the Ontario Council on Graduate Studies (OCGS). Accordingly, graduates with M.A.Sc. and PhD degrees are expected to demonstrate the general DLEs listed below but at appropriate competency levels.

- 1- Depth and Breadth of Knowledge
- 2- Research and Scholarship
- 3- Level of Application of Knowledge
- 4- Professional Capacity / Autonomy
- 5- Level of Communication Skills
- 6- Awareness of Limits of Knowledge

The proposed graduate program in Mechanical Engineering at York University encompasses a wide variety of theoretical, applied and complementary studies and activities with program-level learning outcomes that are designed for training of students with the abovementioned GDLEs. These learning outcomes (Tables 5.1.1 for M.A.Sc. and 5.1.2 for PhD graduates) have been developed by the existing faculty members of the department who are experts in various core and interdisciplinary areas of Mechanical Engineering. Graduated students from this program will acquire theoretical knowledge in fundamental (e.g. solid and fluid mechanics, dynamics and control, mechanical design and thermofluids) and applied (e.g. microsystems, advanced materials and biomechanics, energy) areas of Mechanical Engineering, learn how to conduct independent and creative research and to disseminate/communicate scientific results in their specialized fields, diversify their expertise and experiences beyond their immediate research fields by being introduced to complementary studies in business, law and education, and commit to implementation of professional and ethical standards in their future

endeavors. In Tables 5.1.1 and 5.1.2, it is clearly shown how the design of the program, which is based on the guidelines provided by the Ontario Council of Academic Vice-Presidents, captures the University Graduate Degree Level Expectations for M.A.Sc. and PhD students.

Table 5.1.1 Mechanical Engineering M.A.Sc. Graduate Program Learning Outcomes

Degree Level Expectation	Program Learning Outcome <i>By the end of this program, the graduated M.A.Sc. students will be able to:</i>	Program Activities that Fulfill Learning Outcome
1- Depth and Breadth of Knowledge	<ul style="list-style-type: none"> - Critically assess a complex problem with opposing and conflicting positions - Systematically review, analyze, assimilate and interpret a body of scientific literature and innovations in discipline area - Ability to apply mathematics, science and engineering principles 	MECH 6101 to 6501 MECH 6000 MECH 9001
2- Research and Scholarship	<ul style="list-style-type: none"> - Evaluate techniques of research and inquiry - Apply appropriate techniques of research and inquiry to create and interpret knowledge in the discipline - Critique current research and scholarship in the area of professional competence - Analyze complex issues and judgments in the field using established principles and techniques - Design a method of inquiry to explore a research question in the field 	MECH 6000 MECH 9001
3- Level of Application of Knowledge	<ul style="list-style-type: none"> - Critically assess complex problems from the stakeholders viewpoint - Extrapolate limitations of experimental method and propose revised methodology for future research - Apply and validate innovations and discoveries in the lab or real world settings in more efficient and effective ways - Ability to identify, formulate and solve engineering problems 	MECH 6000 MECH 9001
4- Professional Capacity / Autonomy	<ul style="list-style-type: none"> - Create design solutions that take ethical, social, environmental, legal and regulatory influences into account - Predict potential economic, societal, environmental, health, and/or safety risks and benefits of performing a particular engineering task and propose alternative designs to mitigate risks - Integrate professional, social, and environmental considerations into decision analyses - Design research projects that take ethical, social, environmental, legal and regulatory influences into account - Comply with relevant laws, regulations, intellectual property guidelines and contractual obligations and follow best practices in conceptualizing research design projects - Develop concise and coherent reports/academic papers and design documents that reflect critical analysis and synthesis of research 	MECH 9001 ENG 6000 ENG 6001 ENG 6002 ENTR 6xxx EDUC 5414
5- Level of Communication Skills	<ul style="list-style-type: none"> - Construct a credible argument and design appropriate formats to convey position - Critically evaluate reports, design documents and academic papers and present findings to justify one's position - Present material in a coherent and organized form, using an appropriate combination of media, to a variety of audiences 	MECH 9001 ENG 6002 MECH 6000 MECH 6101 to 6501
6- Awareness of Limits of Knowledge	<ul style="list-style-type: none"> - Justify the strength and limitations of identified research solutions and propose questions and methods for future research 	MECH 9001

Table 5.1.2 Mechanical Engineering PhD Graduate Program Learning Outcomes

Degree Level Expectation	Program Learning Outcome <i>By the end of this program, the graduated PhD student will be able to:</i>	Program Activities to Fulfill Learning Outcome
1- Depth and Breadth of Knowledge	<ul style="list-style-type: none"> - Critically assess a complex problem with opposing and conflicting positions - Systematically review, analyze, assimilate and interpret a body of scientific literature and innovations in a number of fields outside ones area of research but pertinent to the research being undertaken - Identify gaps in the literature and opportunities for new research to address shortcomings in the field - Ability to apply mathematics, science and engineering principles 	MECH 6101 to 6501 MECH 6000 MECH 9002
2- Research and Scholarship	<ul style="list-style-type: none"> - Identify novel and significant open research questions - Design research projects to investigate a research question which addresses a gap in the field/discipline - Define and defend a research method and analyses that will achieve the research goals - Revise research design and methodology to account for limitations of the original design - Speculate how the proposed research will address a gap in the field - Speculate how applications of findings would impact the broader body of knowledge and disciplines - Strategize how to address unforeseen outcomes of research by developing a new method of research in the field - Formulate possible modes of solving a research question and decide upon appropriate method by comparing and contrasting complex issues in a specialized field - Critically analyze ideas and data presented at conferences by others and participate in a peer review process 	MECH 6000 MECH 9002
3- Level of Application of Knowledge	<ul style="list-style-type: none"> - implement research experimentation independently without supervision - Conduct independent research appreciating limitations of one's knowledge and seeking support and advice when warranted - Identify and design new tools to assist with experimentation - Ability to identify, formulate and solve engineering problems 	MECH 9002
4- Professional Capacity / Autonomy	<ul style="list-style-type: none"> - Accept responsibility for one's research - Evaluate multidimensional appropriateness of possible courses of action in research experimentation and make autonomous decisions in ways to move forward - Evaluate individual progress towards meeting program requirements and timelines - Before engaging in academic debate evaluate literature to remain up-to-date on findings in the field - Evaluate how ethical, social, environmental, legal and regulatory influences may affect the discipline of one's research differently than other fields of research - Evaluate how non-compliance with relevant laws, regulations, intellectual property guidelines and contractual obligations may create risks in managing one's research - Analyze the critical debates within ones field and more broadly within related fields and predict/identify possible implications of one's research outcomes 	MECH 9002 ENG 6000 ENG 6001 ENG 6002 ENTR 6xxx EDUC 5414
5- Level of Communication Skills	<ul style="list-style-type: none"> - Present material in a coherent and organized form in a public setting, using an appropriate combination of media, to a variety of audiences - Listen carefully and gather feedback and opinions - Debate one's research position in an open forum - Present research findings or proposal of design at an academic conference 	MECH 9002 ENG 6002 MECH 6000 MECH 6101 to 6501
6- Awareness of Limits of Knowledge	<ul style="list-style-type: none"> - Explain how research findings affect multidisciplinary lines between various research fields and disciplines - Identify how assumptions of one's research may be understood differently within different disciplines 	MECH 9002

5.2 Address how the program curriculum and structure supports achievement of the program learning outcomes. For research-focused graduate programs, comment on the nature and suitability of the major research requirement(s) for degree completion.

The program curriculum, as discussed in section 4, is designed to advance students’ knowledge and professional skills in fundamental and applied areas of Mechanical Engineering beyond undergraduate level, and also to provide them with opportunities for professional development through engaging in complementary education and training in areas such as law, business, ethics, technical writing, and communication. The program is research-focused but also takes advantage of course-based activities to reinforce research and professional development. The curriculum, as outlined below and shown in Table 5.2.1, directs each and every student to get engaged in cutting-edge research projects led by the Mechanical Engineering faculty members from the commencement of their graduate studies at York University. This is done by assigning every graduate student to one or more Mechanical Engineering faculty member(s) as supervisor(s) from the beginning of their studies and having them conducting an independent research project immediately after joining the program. These faculty members who have extensive expertise in their research areas supervise the graduate students throughout their studies and form supervisory committees that will monitor student performance as they progress through the program.

Performance assessment is achieved through a number of different approaches, such as annual meetings, submission of Student Activity Reports, oral presentations, comprehensive examinations (Ph.D. students only) and many opportunities for face-to-face communications to ensure that all master and doctoral students receive appropriate training to achieve desired learning outcomes. To reinforce research, students’ level of knowledge in topics related to their fields of scientific investigation and beyond will be strengthened by a combination of coursework requirements in the program.

From a minimum total of four required credit courses, M.A.Sc. and PhD students must select two core ME courses to broaden their knowledge in a wider area of fundamental and applied ME. They must also take one Directed Study or credit course from outside ME department that can be highly tailored towards their research needs, and another one from a set of complementary courses (section 4.1.3) to provide them with unique professional development training and skills in areas such as business, law and education. Beyond the abovementioned activities, all graduate students (master and doctoral) will also participate in two non-credit courses, i.e. engineering ethics and graduate seminars, and are expected to disseminate scholarly research results by preparation of scientific articles and attendance at prestigious scientific conferences and workshops at an internationally-recognized level.

In Table 5.2.1, we provide concrete examples of how the program curriculum and structure supports attainment of the program learning outcomes and hence the GDLEs:

Table 5.2.1 Program components aligned with GDLEs

Degree Level Expectation	Program components supporting achievement of the learning outcomes and the DLES	
	M.A.Sc.	Ph.D.
1- Depth and Breadth of Knowledge	<ul style="list-style-type: none"> - Taking 2 core courses in Mechanical Engineering that widens knowledge beyond immediate field of study - Taking one Directed Studies or credit course from outside ME department that is tailored to immediate research requirements - Taking one complementary credited course to broaden knowledge and improve professional skills - Taking part in Graduate Seminars to get acquainted with other students’ and faculty members’ research programs 	
	Acquiring in-depth knowledge in particular research areas through conducting, writing and defending Master’s theses	Acquiring and generating in-depth knowledge in particular research areas through conducting, writing and defending PhD dissertations
2- Research and Scholarship	<ul style="list-style-type: none"> - Appropriate choice of novel research topics in consultation with supervisors - Dissemination of research results by scholarly publications and presentations at conferences and workshops - Graduate Seminar series that provides opportunities for the students to evaluate current research and perform literature review pertaining to their research topic. 	

Degree Level Expectation	Program components supporting achievement of the learning outcomes and the DLES	
	M.A.Sc.	Ph.D.
	- Core courses in Mechanical Engineering provide state-of-art knowledge in the given area.	
	Successful completion of M.A.Sc. thesis	Successful completion of Ph.D. dissertation
3- Level of Application of Knowledge	Conducting independent research and creative activities with guidance that results in contributions to the body of existing knowledge of their chosen fields	Conducting research independently through defining, planning and solving of scientific problems to lead and advance knowledge in the field of specialization. Research outcomes lead to creativity and competence at an international level
4- Professional Capacity / Autonomy	- Core courses will involve activities to obtain professional skills and experiences in conducting independent and group projects - Every student has to successfully complete the Engineering Ethics course. - Every student has to successfully complete a complementary education and training course in one of the following area: a) Legal Aspects and Governance in Engineering b) The Arts and Science of Scholarly Writing c) Entrepreneurship and Technology Ventures or d) Teaching and Learning in Post-Secondary Education - Students get advice and guidance from supervisors throughout their studies, when preparing presentations for graduate seminars or conferences, and when writing scientific papers, to commit to implementation of professional and ethical standards as well as sustainable practices related to research and professional activities - Students submit Activity Reports annually to supervisory committees for review and approval. The supervisor committee plays a key role in evaluating the students' progress on an annual basis, and supporting and advising the student moving forward.	
	- M.A.Sc. students will learn to become independent researchers and to make decisions with guidance to advance their research when encountered complex obstacles	- Ph.D. researchers will take responsibility and devise creative solutions after identifying complex problems
5- Level of Communication Skills	- Students have to take the Graduate Seminar course and present research results and future plans in written (Student Activity Report) and oral formats annually. - Graduate courses involve projects that will be presented to the class and course directors in the form of reports and presentations. <i>Optional:</i> - Students are expected to attend conferences and workshops and to present their work to academic and industrial audience of a wide variety of technical background - Students have the choice of taking ENG 6002 The Arts and Sciences of Scholarly Writing as part of one of the courses under complementary education and training. - Graduate students will act as Teaching Assistants of undergraduate courses and deliver occasional lectures, laboratory tutorials and demonstrations to undergraduate students	
	- Students submit M.A.Sc. theses	- Students submit PhD dissertations
6- Awareness of Limits of Knowledge	- Every graduate student has to complete the Master's thesis or PhD dissertation which will describe the critical component about their research contributions, limitations and future scope of expanding the research topic.	

5.3 Address how the methods and criteria for assessing student achievement are appropriate and effective relative to the program learning outcomes and Degree Level Expectations.

Graduate students' performance and progress at Mechanical Engineering department will be assessed continuously by a variety of methods and criteria in both their coursework and research-related activities. These methods and criteria will ascertain that the program learning outcomes are achieved and the GDLEs are met. The particular assessment tools and methods that are used to evaluate the program structural components (discussed in section 5.2) and their relations to the program learning outcomes (discussed in section 5.1) and GDLEs for M.A.Sc. and Ph.D. degrees are listed in Tables 5.3.1 and 5.3.2, respectively.

Table 5.3.1 Student assessment methods and criteria and their alignment with GDLEs of M.A.Sc. program

Degree Level Expectation	Program Learning Outcomes	Student Assessment Methods and Criteria
<p>1- Depth and Breadth of Knowledge</p>	<ul style="list-style-type: none"> ▪ Critically assess a complex problem with opposing and conflicting positions ▪ Systematically review, analyze, assimilate and interpret a body of scientific literature and innovations in discipline area 	<p>Every M.A.Sc. student must:</p> <ul style="list-style-type: none"> ▪ successfully defend his/her thesis in an examination session following guidelines specified by the Faculty of Graduate Studies at York University. This involves submission of written thesis and completion of an oral defense. Details provided in Appendix C. ▪ obtain a minimum grade of B- to successfully pass any of the required courses according to the degree requirements. These courses will involve a combination of oral and written examinations, term projects, assignments, case studies, field visits, technical reports and/or presentations. Course details provided in Appendix E. ▪ submit a Student Activity Report and deliver a 15 min presentation at the graduate seminar event and attend at least 80% of the presentations to receive a pass grade. The report and the presentation are assessed by referee faculty members based on a provided rubric (see Appendix B for detailed information)
<p>2- Research and Scholarship</p>	<ul style="list-style-type: none"> ▪ Evaluate techniques of research and inquiry ▪ Apply appropriate techniques of research and inquiry to create and interpret knowledge in the discipline ▪ Critique current research and scholarship in the area of professional competence ▪ Analyze complex issues and judgments in the field using established principles and techniques ▪ Design a method of inquiry to explore a research question in the field 	<ul style="list-style-type: none"> ▪ Research progress is mainly assessed by the supervisors in a variety of methods such as weekly, biweekly and/or monthly group and one-on-one meetings, progress reports and annual meetings with supervisory committees involving submission of Activity Reports and delivery of oral presentations ▪ The M.A.Sc. theses will be evaluated by a committee with domain knowledge expertise and one graduate faculty member at arm's length from the dissertation, usually from outside the ME department. ▪ Students must successfully defend their thesis in Oral Examinations which also will be assessed by the examination committee following FGS guidelines ▪ Every student has to successfully complete the Graduate Seminar Series course.
<p>3- Level of Application of Knowledge</p>	<ul style="list-style-type: none"> ▪ Critically assess complex problems from the stakeholders viewpoint ▪ Extrapolate limitations of experimental method and propose revised methodology for future research ▪ Apply and validate innovations and discoveries in the lab or real world settings in more efficient and effective ways 	<ul style="list-style-type: none"> ▪ Publication of innovative research results in peer-reviewed journals and attendance at prestigious internationally-known conferences can be considered for evaluation of students' performance in advancing the level of knowledge in their fields, as recorded in Student Activity Report (Appendix D). ▪ Level of application of knowledge is assessed by the supervisor and also by the committee members during yearly meetings, with consideration of the student performance in his/her coursework

Degree Level Expectation	Program Learning Outcomes	Student Assessment Methods and Criteria
<p>4- Professional Capacity / Autonomy</p>	<ul style="list-style-type: none"> ▪ Evaluate accountability lines within ethical code structure and legal requirements and design research methods that incorporate appropriate ethical and legal requirements ▪ Evaluate industry standards to guide professional practice and incorporate these requirements into one's research ▪ Create design solutions that take ethical, social, environmental, legal and regulatory influences into account ▪ Predict potential economic, societal, environmental, health, and/or safety risks and benefits of performing a particular engineering task and propose alternative designs to mitigate risks ▪ Integrate professional, social, and environmental considerations into decision analyses ▪ Design research projects that take ethical, social, environmental, legal and regulatory influences into account ▪ Comply with relevant laws, regulations, intellectual property guidelines and contractual obligations and follow best practices in conceptualizing research design projects, which is more emphasized for students who take ENG6001 ▪ Develop concise and coherent reports/academic papers and design documents that reflect critical analysis and synthesis of research 	<ul style="list-style-type: none"> ▪ Students must receive a pass grade on a mandatory Engineering Ethics course and one complementary education and training course. Assessment for the complimentary education and training course will be done by traditional midterm and final examinations, case studies, assignments, oral presentations and in-class participation and discussions ▪ Project components in each course will carry a certain percentage of the final grades and will be assessed by the course directors. Students are expected to submit written reports and articles as well as to deliver in-class presentation and demonstrations on these projects ▪ Teaching assistants (if applicable) will be evaluated by undergraduate students during the course evaluation process that is conducted by York University. ME department will provide the results of these evaluations to the TA graduate students
<p>5- Level of Communication Skills</p>	<ul style="list-style-type: none"> ▪ Construct a credible argument and design appropriate formats to convey position ▪ Critically evaluate reports, design documents and academic papers and present findings to justify one's position ▪ Present material in a coherent and organized form, using an appropriate combination of media, to a variety of audiences 	<ul style="list-style-type: none"> ▪ Presentation skills will be evaluated during the graduate seminar event by two faculty members as session referees, and fellow graduate students. Evaluations will be used to determine a grade for this course and for selection of the best presenter ▪ Students' Activity Reports will be assessed by supervisors and committee members on a yearly basis. ▪ These will be evaluated by examination committees following instructions provided by FGS
<p>6- Awareness of Limits of Knowledge</p>	<ul style="list-style-type: none"> ▪ Justify the strength and limitations of identified research solutions and propose questions and methods for future research 	<ul style="list-style-type: none"> ▪ Students are expected to include a section in their theses to discuss the limitations and future directions of the conducted research.

Table 5.3.2 Student assessment methods and criteria and their alignment with GDLEs of Ph.D. program

Degree Level Expectation	Program Learning Outcomes	Student Assessment Methods and Criteria
1- Depth and Breadth of Knowledge	<ul style="list-style-type: none"> ▪ Critically assess a complex problem with opposing and conflicting positions ▪ Systematically review, analyze, assimilate and interpret a body of scientific literature and innovations in a number of fields outside ones area of research but pertinent to the research being undertaken ▪ Identify gaps in the literature and opportunities for new research to address shortcomings in the field 	<p>Every Ph.D. student must:</p> <ul style="list-style-type: none"> ▪ pass the Ph.D. comprehensive examination within 12 months of the program (see Appendix C). ▪ successfully defend his/her dissertation in an examination session following guidelines provided by the Faculty of Graduate Studies at York University. This involves submission of written dissertation and completion of an oral defense. ▪ obtain a minimum grade of B- to successfully pass any of the required courses. These courses will involve a combination of oral and written examinations, term projects, assignments, case studies, field visits, technical reports and/or presentations ▪ submit a Student Activity Report and deliver a 15 min presentation at the graduate seminar event and attend at least 80% of the presentations to receive a pass grade. The report and the presentation are assessed by referee faculty members based on a provided rubric. See appendix B for details.
2- Research and Scholarship	<ul style="list-style-type: none"> ▪ Identify novel and significant open research questions ▪ Design research projects to investigate a research question which addresses a gap in the field/discipline ▪ Define and defend a research method and analyses that will achieve the research goals ▪ Revise research design and methodology to account for limitations of the original design ▪ Speculate how the proposed research will address a gap in the field ▪ Speculate how applications of findings would impact the broader body of knowledge and disciplines ▪ Strategize how to address unforeseen outcomes of research by developing a new method of research in the field ▪ Formulate possible modes of solving a research question and decide upon appropriate method by comparing and contrasting complex issues in a specialized field ▪ Critically analyze ideas and data presented at conferences by others and participate in a peer review process 	<ul style="list-style-type: none"> ▪ Research progress is mainly assessed by the supervisors in a variety of methods such as weekly, biweekly and/or monthly group and one-on-one meetings, progress reports and annual meetings with supervisory committees involving submission of Activity Reports and delivery of oral presentations ▪ The Ph.D. dissertations will be evaluated by a committee with domain knowledge expertise and one graduate faculty member at arm's length from the dissertation, usually from outside the ME department. ▪ Students must successfully defend their dissertation in Oral Examinations which also will be assessed by the examination committee following FGS guidelines ▪ Every student has to successfully complete the Graduate Seminar Series course
3- Level of Application of Knowledge	<ul style="list-style-type: none"> ▪ implement research experimentation independently without supervision ▪ Conduct independent research appreciating limitations of one's knowledge and seeking support and advice when warranted ▪ Identify and design new tools to assist with experimentation 	<ul style="list-style-type: none"> ▪ Publication of innovative research results in peer-reviewed journals and attendance at prestigious internationally-known conferences can be considered for evaluation of students' performance in advancing the level of knowledge in their fields as recorded in Student Activity Report (Appendix D). ▪ In addition to assessments stated for M.A.Sc. students, each PhD student is required to pass the Ph.D. comprehensive examination within 12 months of the program (see Appendix C). Candidate must propose and successfully defend a research proposal that leads and advances knowledge in the field of specialization

Degree Level Expectation	Program Learning Outcomes	Student Assessment Methods and Criteria
4- Professional Capacity / Autonomy	<ul style="list-style-type: none"> ▪ Accept responsibility for one's research ▪ Evaluate multidimensional appropriateness of possible courses of action in research experimentation and make autonomous decisions in ways to move forward ▪ Evaluate individual progress towards meeting program requirements and timelines ▪ Before engaging in academic debate evaluate literature to remain up-to-date on findings in the field ▪ Evaluate how ethical, social, environmental, legal and regulatory influences may affect the discipline of one's research differently than other fields of research ▪ Evaluate how non-compliance with relevant laws, regulations, intellectual property guidelines and contractual obligations may create risks in managing one's research, which is more emphasized for students who take ENG6001 ▪ Analyze the critical debates within ones field and more broadly within related fields and predict/identify possible implications of one's research outcomes 	<ul style="list-style-type: none"> ▪ Students must receive a pass grade on a mandatory Engineering Ethics course and one complementary education and training course. For the complementary education and training course, assessment will be done by traditional midterm and final examinations, case studies, assignments, oral presentations and in-class participation and discussions ▪ Project components in each course will carry a certain percentage of the final grades and will be assessed by the course directors. Students are expected to submit written reports and articles as well as to deliver in-class presentation and demonstrations on these projects ▪ Teaching assistants (if applicable) will be evaluated by undergraduate students during the course evaluation process that is conducted by York University. ME department will provide the results of these evaluations to the TA graduate students
5- Level of Communication Skills	<ul style="list-style-type: none"> ▪ Present material in a coherent and organized form in a public setting, using an appropriate combination of media, to a variety of audiences ▪ Listen carefully and gather feedback and opinions ▪ Debate one's research position in an open forum ▪ Present research findings or proposal of design at an academic conference 	<ul style="list-style-type: none"> ▪ Presentation skills will be evaluated during the graduate seminar event by two faculty members as session referees, and fellow graduate students. Evaluations will be used to receive a passing grade for this course and for selection of the best presenter ▪ Students' Activity Reports will be assessed by supervisors and committee members on a yearly basis. ▪ Dissertations will be evaluated by examination committees following instructions provided by FGS
6- Awareness of Limits of Knowledge	<ul style="list-style-type: none"> ▪ Explain how research findings affect multidisciplinary lines between various research fields and disciplines ▪ Identify how assumptions of one's research may be understood differently within different disciplines 	<ul style="list-style-type: none"> ▪ Ph.D. students will have to identify scientific gaps in their field of specialization and propose innovative, creative and independent research during their comprehensive examination that will be assessed by the committee members ▪ Students are expected to include a section in their theses/dissertations to discuss the limitations and future directions of the conducted research

5.4 For graduate programs, indicate the normal full-time program length (i.e. the length of time in terms in which full-time students are expected to complete the program) including a description of how students' time-to-completion will be supported and managed to ensure that the program requirements can be reasonably completed within the proposed time period. Indicate if the program will be available on a part-time basis, and, if applicable, explain how students' time-to-completion will be supported and managed to ensure that the program requirements can be reasonably completed on a part-time basis.

The graduate program in Mechanical Engineering will offer two graduate degrees – M.A.Sc. and Ph.D.

For M.A.Sc., the expected degree completion time is 6 terms (2 years) on a full-time enrolment basis. For Ph.D., the expected degree completion time is 12 terms (4 years) on a full-time enrolment basis.

The time-to-completion is supported by an effective supervisory committee and also the requirement of providing Annual Progress Report by each registered graduate student to the supervisory committee as regulated by FGS. In addition, the Mechanical Engineering Graduate Program Director will oversee all students progress and activities (such as completion of required graduate courses, students participation in graduate seminars, etc.) to ensure that master and doctoral students fulfill the overall FGS institutional requirements and the mechanical engineering graduate program requirements.

5.5 Describe the proposed mode(s) of delivery, including how it/they are appropriate to and effective in supporting the program learning outcomes.

Since the modes of delivery and the associated learning outcomes differ from course to course, students will be exposed to a blend of the items indicated in table 5.5.1 in each course.

Table 5.5.1 Mechanical Engineering Graduate Courses Proposed Modes of Delivery

Program Activities	Mode(s) of delivery	Relevance to the program learning outcomes Under the proposed delivery methods students will be able to:
MECH 6101 to 6501 MECH 6000	<ul style="list-style-type: none"> - Delivery in regular lecture rooms using active learning strategies - Case Studies and Problem-Based Learning - Group/team projects - Presentations, discussions and self-learning activities - Computational and/or experimental laboratory components - Annual research seminar (MECH 6000) 	<ul style="list-style-type: none"> - Critically assess a complex problem with opposing and conflicting positions - Systematically review, analyze, assimilate and interpret a body of scientific literature and innovations in discipline area - Construct a credible argument and design appropriate formats to convey position - Critically evaluate reports, design documents and academic papers and present findings to justify one's position - Present material in a coherent and organized form, using an appropriate combination of media, to a variety of audiences - Present material in a coherent and organized form, using an appropriate combination of media, to a variety of audiences
ENG 6000 ENG 6001 ENG 6002 ENTR 6xxx EDUC 5414	<ul style="list-style-type: none"> - Delivery in regular lecture rooms using active learning strategies - Case Studies and Problem-Based Learning - Group/team projects - Presentations, discussions and self-learning activities 	<ul style="list-style-type: none"> - Evaluate accountability lines within ethical code structure and legal requirements and design research methods that incorporate appropriate ethical and legal requirements - Evaluate industry standards to guide professional practice and incorporate these requirements into one's research - Create design solutions that take ethical, social, environmental, legal and regulatory influences into account - Predict potential economic, societal, environmental, health, and/or safety risks and benefits of performing a particular engineering task and propose alternative designs to mitigate risks - Integrate professional, social, and environmental considerations into decision analyses - Design research projects that take ethical, social, environmental, legal and regulatory influences into account - Comply with relevant laws, regulations, intellectual property guidelines and contractual obligations and follow best practices in conceptualizing research design projects - Develop concise and coherent reports/academic papers and design documents that reflect critical analysis and synthesis of research

Table 5.5.2 Mechanical Engineering Graduate Thesis and Dissertation Modes of Delivery

Program Activities	Mode(s) of delivery	Relevance to the program learning outcomes Under the proposed delivery methods students will be able to:
MECH 9001	<ul style="list-style-type: none"> - Supervision and mentorship by individual faculty members - Annual student progress report - Thesis exam committee meeting 	<ul style="list-style-type: none"> - Critically assess a complex problem with opposing and conflicting positions - Systematically review, analyze, assimilate and interpret a body of scientific literature and innovations in discipline area - Evaluate techniques of research and inquiry - Apply appropriate techniques of research and inquiry to create and interpret knowledge in the discipline - Critique current research and scholarship in the area of professional competence - Analyze complex issues and judgments in the field using established principles and techniques - Design a method of inquiry to explore a research question in the field - Critically assess complex problems from the stakeholders viewpoint - Extrapolate limitations of experimental method and propose revised methodology for future research - Apply and validate innovations and discoveries in the lab or real world settings in more efficient and effective ways - Construct a credible argument and design appropriate formats to convey position - Critically evaluate reports, design documents and academic papers and present findings to justify one's position - Present material in a coherent and organized form, using an appropriate combination of media, to a variety of audiences - Justify the strength and limitations of identified research solutions and propose questions and methods for future research

Program Activities	Mode(s) of delivery	Relevance to the program learning outcomes Under the proposed delivery methods students will be able to:
MECH 9002	<ul style="list-style-type: none"> - Supervision and mentorship by individual faculty members - Doctoral comprehensive examination - Annual student progress reports - Annual committee meetings - Doctoral dissertation exam committee meeting 	<ul style="list-style-type: none"> - Critically assess a complex problem with opposing and conflicting positions - Systematically review, analyze, assimilate and interpret a body of scientific literature and innovations in a number of fields outside ones area of research but pertinent to the research being undertaken - Identify gaps in the literature and opportunities for new research to address shortcomings in the field - Identify novel and significant open research questions - Design research projects to investigate a research question which addresses a gap in the field/discipline - Define and defend a research method and analyses that will achieve the research goals - Revise research design and methodology to account for limitations of the original design - Speculate how the proposed research will address a gap in the field - Speculate how applications of findings would impact the broader body of knowledge and disciplines - Strategize how to address unforeseen outcomes of research by developing a new method of research in the field - Formulate possible modes of solving a research question and decide upon appropriate method by comparing and contrasting complex issues in a specialized field - Critically analyze ideas and data presented at conferences by others and participate in a peer review process - implement research experimentation independently without supervision - Conduct independent research appreciating limitations of one's knowledge and seeking support and advice when warranted - Identify and design new tools to assist with experimentation - Accept responsibility for one's research - Evaluate multidimensional appropriateness of possible courses of action in research experimentation and make autonomous decisions in ways to move forward - Evaluate individual progress towards meeting program requirements and timelines - Present material in a coherent and organized form in a public setting, using an appropriate combination of media, to a variety of audiences - Listen carefully and gather feedback and opinions - Debate one's research position in an open forum - Present research findings or proposal of design at an academic conference - Explain how research findings affect multidisciplinary lines between various research fields and disciplines - Identify how assumptions of one's research may be understood differently within different disciplines

6. Admission Requirements

6.1 Describe the program admission requirements, including how these requirements are appropriately aligned with the program learning outcomes.

The minimum admission requirements to the Master’s program in the Department of Mechanical Engineering are those of the current admission requirements as described by FGS:

- B for the Master’s program in the final year of undergraduate study.

The minimum admission requirements to the Ph.D. program in the Department of Mechanical Engineering are those of the current admission requirements as described by FGS:

- B for entry into the Ph.D. program in each of the previous two years of graduate studies; and

Applicants must be a graduate from relevant Engineering programs (e.g., Mechanical Engineering, Material Engineering, Electrical Engineering) or Sciences programs (e.g., Physics, Chemistry, Biology).

For applicants who have not completed four full years of studies at the secondary-school level or university level in a country where English is a primary language or where English is the primary language of instruction,

they must demonstrate their language proficiency in English. Accepted tests include TOEFL, IELTS, YELT and others. Detailed scores can be found here: http://futurestudents.yorku.ca/requirements/language_tests.

The research activities in the Mechanical Engineering graduate program as described in Section 4 draw from and rely heavily on understanding of concepts and skills in Engineering Sciences, Mathematics, Physics, Biology and/or Chemistry. Furthermore, with the objectives of the proposed graduate to develop students' skills and experiences in complementary areas, including teaching and mentoring as well as communications, English language skills are important. Taken all together, admission requirements for the program are appropriately aligned with the program learning outcomes.

6.2 Explain any alternative requirements, if any, for admission into an undergraduate, graduate or second-entry program, such as minimum grade point average, additional languages or portfolios, along with how the program recognizes prior work or learning experience.

Not applicable.

7. Resources

7.1 Comment on the areas of strength and expertise of the faculty who will actively participate in delivering the program, focusing on its current status, as well as any plans in place to provide the resources necessary to implement and/or sustain the program.

The Department of Mechanical Engineering at York University was established in 2013 as one of the major building blocks of the Lassonde School of Engineering (LSE). Since January 2013, seven faculty members (two Professors, two Associate Professors and three Assistant Professors) have been hired as stipulated in the LSE planning document to establish the required foundations to deliver the undergraduate and graduate programs in Mechanical Engineering. Also, we have cross-appointed a faculty member from Earth and Space Science Engineering (in Professor rank) into the Mechanical Engineering program to augment further the graduate teaching and learning for the department. The hiring of an Alternative Stream (Lecturer) faculty member is currently taking place and a request to hire two more faculty members has been approved by the office of the dean for the year 2015. The hiring process at the Department of Mechanical Engineering will continue on a rolling basis over the next seven years in order to reach a full faculty capacity of 23 faculty members by 2021.

The undergraduate Mechanical Engineering program at the Lassonde School of Engineering was approved by the Ontario Universities Council on Quality Assurance in August 2013 and the first cohort of students were admitted in September 2014. The demand for the undergraduate program on the first year has been tremendously astonishing with more than a thousand applicants for 55 vacant positions. Historically, graduate and undergraduate programs have been tightly interconnected and complementary to one another in both research and teaching aspects. For instance, graduate students can play an important role in assisting course directors for delivering undergraduate lab tutorials and lectures, and undergraduate students with interest in research can participate in summer research positions and work with graduate students and faculty members. Accordingly, the proposed graduate program in Mechanical Engineering at LSE is essentially needed at this stage and will have its focus on both research and teaching components of education.

The current faculty members of the department have been provided with generous start-up funds from LSE to establish their research laboratories and to recruit outstanding graduate students. These faculty members have been provided with office and laboratory spaces at the Life Sciences Building and access to its state-of-the-art infrastructure. They have expertise in the core and emerging areas of Mechanical Engineering (e.g. thermo-fluids, fluid mechanics, design, solid mechanics, materials and manufacturing, microfluidics and thermo-photonics). They have established six research laboratories in the Department of Mechanical Engineering since January 2013, namely the Surface Engineering and Instrumentation Laboratory (Dr. A. Amirfazli), Innovative Design Engineering and Analysis Laboratory (Dr. A. Czekanski, NSERC Design Chair in Engineering), Micro and Nano-Scale Transport Laboratory (Dr. S. Mitra), Multifunctional Materials, Micro- and Nano-Structuring Laboratory (Dr. S. N. Leung), Advanced Centre for Microfluidics Technology and Engineering

(Dr. P. Rezai), and Hybrid Biomedical Optics Laboratory (Dr. N. Tabatabaei). Also, through cross-appointment, Materials and Structure Laboratory (Dr. G. Zhu) is also available.

As a partial requirement towards the completion of graduate studies in Mechanical Engineering department M.A.Sc. and Ph.D. students should pass a certain number of graduate-level courses (Section 4) and also contribute to the delivery of undergraduate courses as teaching assistants to the course directors. This further intensifies the requirement of establishing a graduate program at the Department of Mechanical Engineering since the first class of undergraduate students will tentatively enter the department in September 2015. The current six faculty members will be able to plan and deliver the undergraduate program in the academic year of 2014-2015. With the newly hired faculty members in consequent years, it will be assured that the teaching and administration demands of the undergraduate program will be satisfied while the students entering their higher academic years and new students get admitted into the program. Each faculty member is also expected to teach at least one graduate-level course (Section 4.2 and Appendix A) so that graduate students coursework can be fully supported at the department level. At this stage, courses in polymer composites and nano-composites, micro and nano-fluidics, continuum mechanics, FEM, interfacial phenomena, engineering mathematics, dynamics, waves and optics as well as heat transfer are being developed and proposed to the Faculty of Graduate Studies at York University.

The hiring plan for the next year at the department is to recruit four more faculty members in the areas of solid mechanics, control and measurement, energy and heat transfer. Office and laboratory spaces are allocated to them in the new building, the Bergeron Centre for Engineering Excellence that is currently under construction on York University's Keele campus (see Sections 7.3 and 7.4). This will prepare the department to launch cutting edge research programs in established and emerging areas of Mechanical Engineering. The Alternate Stream faculty member that will be hired by early 2015 will aim to spearhead the experiential learning component of the curriculum, execute the communication education across curriculum strategy, and lead and inform the professional (regular) stream faculty in teaching methods that are stipulated in the Lassonde School of Engineering philosophy (e.g. using technology for out-of-class learning).

In addition to attracting professional faculty members to the department, we will also establish strategic partnerships with the Schulich School of Business, Osgoode Hall Law School and Teaching Commons at York University to deliver complementary graduate-level courses and training to the graduate students that will make them unique and competent (i.e. "Renaissance Engineers") in the job market and the academic world as discussed in Section 4.2.

7.2 Comment on the anticipated role of retired faculty and contract instructors in the delivery of the program, as appropriate.

Not applicable.

7.3 As appropriate identify major laboratory facilities/equipment that will be available for use by undergraduate and/or graduate students and to support faculty research, recent acquisitions, and commitments/plans (if any) for the next five years.

The current faculty members (i.e., two Professors, two Associate Professors, and three Assistant Professors) of the Department of Mechanical Engineering have established their research laboratories at the Life Sciences Building, located in the Keele campus of York University. These research laboratories, outlined in Section 7.1, are equipped with a wide range of state-of-the-art infrastructure. These include sample and material fabrication facilities (e.g., batch foaming system, compression molding system, lab-scale thermoforming system, plasma oxidizer, sonicator, thermal bath, wet chemical stations), as well as characterization equipment (e.g., fluorescent microscope, high speed digital cameras, spray characterization equipment, thermal conductivity analyzers, wettability measurement equipment). With the continuous hiring of new faculty members over the next few years and the expansion of the current research laboratories, it is expected that the list of major laboratory facilities available for use by graduate students and to support faculty research will continue to expand rapidly.

Faculty members and their research teams also have access to leading-edge technologies for advanced imaging and analysis in other faculties at York University. For instance, advanced imaging facilities include an

environmental scanning electron microscope, a spinning disk confocal system, a confocal microscope, a multiphoton imaging system. Specialized analytical facilities include a high resolution mass spectrometer, a 700 MHz nuclear magnetic resonance spectrometer, fluorescence activated flow cytometer, scanning ion-selective electrode technique and scanning vibrating electrode technique. Environmental testing facilities include thermal vacuum chamber, vacuum oven, shake/vibration table, rotating air bearing table. Furthermore, faculty research is also supported by full technical service facilities, including an electronic shop, a machine shop, a student machine shop, and a glassblowing shop, and two science stores.

High performance computing facilities are available for faculty research through SHARCNET, which is a consortium of 18 Canadian academic institutions who share a network of high performance computers to enable world-class research. A suite of software tools under the four categories of the CAD, Data Acquisition and Analysis, Simulation, and Office and Teamwork Productivity has been identified and will be installed in the laboratories as needed; this will be supported by an IT team within the Lassonde School of Engineering. For examples, a number of engineering software for CAD (e.g., Creo, SolidWorks), data acquisition (e.g., Labview), simulation (e.g., MATLAB), multiphysics analysis (e.g., ANSYS) are either currently available or will be purchased for faculty research.

In addition to the aforementioned facilities, a brand new 167,500 sq. ft. engineering complex, the Bergeron Centre for Engineering Excellence will be ready in the fall of 2015. At that time Mechanical Engineering faculty members and students will have their various specialized facilities (e.g. laboratories, a machine shop, and a workshop) to support their research in addition to the laboratories of their academic supervisors. In particular, the building will be housing the following facilities: Thermofluid lab, Fluid Mechanics and Hydraulics lab, Heat Transfer and Engine lab, Metrology lab, Advanced Manufacturing lab, Materials and Structural Testing lab, a Class 10,000 Cleanroom (116.55 m² area), Prototyping workshop, six group work rooms, Computer labs, and student projects area. There are 15 faculty offices at 11.32 m² per office with a total space of 170 m²; meeting room, storage, coffee/lunch with a space of 55m²; graduate student open office space of 320 m²; computational rooms with a space of 112 m². There will be 4 lab spaces with wet benches (each space around 50 m²); 3 lab spaces with dry benches (each space around 47 m²); and a fully functional machine shop to support in-house research activities with floor space of 660 m². A list of existing and future equipment for each of the laboratories has been prepared and submitted to the facilities manager for the Lassonde School of Engineering. He has been working with the building group to ascertain fitting requirements and services for the equipment to operate will be in place and equipment will be purchased and installed.

[7.4 As appropriate, provide information on the office, laboratory and general research space available that will be available for faculty, undergraduate and/or graduate students; the availability of common rooms for faculty and graduate students; administrative space; as well as any commitments/plans \(if any\) for the next five years.](#)

Currently, the Department of Mechanical Engineering encompasses in its capacity the fourth floor of the recently built Life Science Building (approximately 25,000 sqft). It includes office and research spaces for faculty members and more than half of its available area is dedicated to graduate research laboratories in addition to nearly 100 graduate student desk spaces in an open concept environment. .

The construction and preparation of the Bergeron Centre for Engineering Excellence will be completed and ready for use in 2015. In addition to the currently available Life Science Building, the new building will have all the required space and infrastructure for the projected teaching, research and experimental activities in the Department of Mechanical Engineering. The entire fourth floor will be dedicated to the mechanical engineering faculty and graduate research laboratories, while the first floor will support both undergraduate and graduate student activities, research projects including prototype workshop, mechanical and machine shops, six group work rooms and ten open space zones/project areas, as well as small student projects sections. Technical support staff will have office spaces next to the laboratories or workshop regions for better and more efficient support and integration with student activities. These facilities will offer superior support and supervision for all mechanical engineering students. Furthermore, the new building will have a number of meeting and project discussion zones to facilitate out-of-class learning; this is augmented by the special design of the building architecture that has envisioned various “social learning spaces” where students can interact amongst themselves or with faculty/staff members.

7.5 As appropriate, comment on academic supports and services, including information technology, that directly contribute to the academic quality of the program proposed.

The Department of Mechanical Engineering will require support and services in five major categories in order to successfully deliver the proposed graduate program. These categories are listed below and the plans to fulfill the requirements are discussed. A faculty member at the department who will be appointed as the Graduate Program Director will be responsible for administration of these activities. As such, he/she should be provided with appropriate teaching relief as per terms of York University's Collective Agreement.

1- *Information Technology (IT)*: Support for IT at the department will be mainly provided from the Faculty level as per our current agreement in-place with LSE. A number of major software tools for CAD (e.g. Creo, SolidWorks), Data Acquisition (e.g. LabVIEW), Simulation (e.g. MATLAB) and Office and Teamwork Productivity have already been identified by the current faculty members and the required number of licenses have been communicated with IT staff in LSE. Any specialized software (used by only a single research group) is expected to be purchased and maintained by individual faculty members at the department.

2- *Technical support*: The department is in need of two technical support staffs, i.e. a Mechanical Engineering and an Electrical Engineering Technologist. The Mechanical Engineering Technologist will be partially responsible for helping faculty members and their graduate students to setup their laboratories, equipment and major experimental setups while also running the machine shop and fabrication facilities and maintaining the undergraduate laboratories at the Department of Mechanical Engineering. The hiring of the Mechanical Engineering Technologist has already been completed. The Electrical Engineering Technologist will assist the faculty members and graduate students with their software and computer hardware inquiries while also making sure that all the undergraduate-level computer labs are operated flawlessly.

3- *Office support*: The Faculty of Graduate Studies at York University is fully staffed and will oversee the process of graduate student recruitment and admission. In terms of support staff for delivery of the graduate program in Mechanical Engineering, many roles in terms of supporting student clubs, student engagement, experiential education, financial support, academic honesty, mentorship, and advising will be provided and supported by the Student Welcome and Support Centre, with currently 7 full-time administrative positions supporting these areas. Additionally, the Lassonde Dean's Office provides administrative oversight and support for communications, recruitment and admissions, as well as research administrative support through an additional 5 full-time administrative positions. The Department of Mechanical Engineering is also supported by a full-time administrative assistant, with plans to hire a full-time graduate program assistant, as faculty and student complement warrant full-time support.

4- *Resources*: One of the key elements for a successful graduate program is to allow the faculty members and the graduate students to have access to the most recent scientific contents and research activities within their areas of specialty. York University is well advanced in this aspect. Mechanical Engineering students have access to a host of core textbooks at the Steacie Science and Engineering Library. The library also provides students with access to database resources, such as Knovel, Web of Science and Engineering Village where students can actively search for research and development advancements in many different disciplines of Mechanical Engineering. The Engineering Librarians have also been very supportive in providing faculty members with access to journal articles that York University had not subscribed to in the past.

5- *Research Facilities*: There are a number of key pieces of equipment and facilities that are needed commonly by the majority of faculty members in the Department of Mechanical Engineering and their graduate students for the purpose of conducting research. For instance, for the analysis of materials and surfaces down to a microstructural level, many research disciplines from metal forming to micro-engineering will require access to state-of-the-art material testing facilities, microscopy facilities (optical, fluorescent, scanning electron microscopy and transmission electron microscopy), imaging (e.g. cameras) and image processing tools (e.g. MATLAB). Micro- and nano-fabrication equipment is also among the same category of commonly-used facilities in Mechanical Engineering. Accordingly, the Bergeron Centre for Engineering Excellence that is going to house our department in the Fall of 2015 will be equipped with facilities such as a "Class 10,000" cleanroom, machine shop labs and equipment, microscopy and imaging instruments, and custom-designed laboratories that will facilitate research and innovation in various fields of Mechanical Engineering, the details of which are already provided in Section 7.3.

7.6 For graduate programs, indicate financial support that will be provided to master’s and/or PhD students, including how this support will be sufficient to ensure adequate quality and numbers of students. Comment on how supervisory loads will be distributed, as appropriate. Special attention should be paid to supervisory capacity for new PhD programs.

The proposed graduate program in Mechanical Engineering will commit to promote excellence in research and teaching for graduate students. Master’s and/or Ph.D. students can expect annual financial support, comprising a package of Scholarships and/or Research, Teaching, and Financial Assistantships, valid for up to two years and four years, respectively. Table 7.6.1 summarizes the breakdown of the financial support to the four categories of graduate students (i.e., domestic M.A.Sc. students, international M.A.Sc. students, domestic Ph.D. students, and international PhD student) as of 2014-2015 Academic Year as well as the net amounts of financial support to them after the deduction of their tuition fees.

Table 7.6.1. Annual financial support to Master’s and Ph.D. students in the proposed graduate program

Source	M.A.Sc. Domestic	M.A.Sc. International	Ph.D. Domestic	Ph.D. International
LSE RA	\$5,500	\$14,000	\$6,000	\$14,000
TA	\$7,000	\$7,000	\$7,000	\$7,000
Supervisor RA	\$8,500	\$14,000	\$10,000	\$16,000
Gross amount	\$21,000	\$35,000	\$23,000	\$37,000
Tuition fees	\$5,500	\$19,500	\$5,500	\$19,500
Net amount	\$15,500	\$15,500	\$17,500	\$17,500

The aforementioned funding support to Master’s and Ph.D. students will be comparable or better than other graduate programs in Ontario (e.g., the University of Toronto’s graduate program for Mechanical Engineering guarantees a minimum of \$15,000/year for living expenses, plus tuition and fees). Therefore, the competitive funding packages, together with our state-of-the-art research and laboratory facilities/equipment, will ensure the proposed graduate program to attract adequate quality and numbers of students.

In addition, all graduate students are encouraged to apply for external government awards and other awards tenable at York University. Some examples of high-profile external scholarships are:

- Ontario Graduate Scholarships (OGS);
- Ontario Trillium Scholarship (OTS);
- Canada Graduate Scholarships (CGS);
- The Canadian Institutes of Health Research (CIHR);
- Natural Sciences and Engineering Research Council of Canada (NSERC); and
- Vanier Canada Graduate Scholarships (Vanier CGS).

The supervisory loads of Master’s and Ph.D. students will initially be shared among the currently appointed faculty members, comprising two Full Professors, two Associate Professors, and three Assistant Professors. It is expected that each faculty member will supervise an average of two Master’s students and one Ph.D. student initially upon kick-off of the proposed graduate program, and this number is expected to ramp up gradually. Together with the continuous hiring of new faculty members per year for the next few years (i.e., up to 23 faculty members by year 2021), sufficient supervisory capacity will be available to support the supervision of adequate number of high quality graduate students in the proposed graduate program in Mechanical Engineering.

Table 1 – Listing of Faculty

For graduate programs: Identify all full-time faculty, retired faculty, adjuncts and contract instructors who will be appointed to and who will actively participate in delivering the program, as follows:

Faculty Name & Rank	Home Unit	Primary Graduate Program (yes/no)	Area(s) of Specialization or Field(s)		
			Area/Field 1	Area/Field 2	Area/Field 3
Full Members (Note: does not apply to master's-only programs)					
Alidad Amirfazli, Professor	Mechanical Engineering	YES	Thermofluids	Surface Engineering	Surface Thermodynamics
Alex Czekanski, Associate Professor	Mechanical Engineering	YES	Computational Mechanics	Finite Element Analysis	Experimental Mechanics
Siu N. (Sunny) Leung, Assistant Professor	Mechanical Engineering	YES	Advanced manufacturing	Multifunctional and smart materials	Sustainable energy
Andrew Maxwell Associate Professor	Mechanical Engineering	YES	Technology entrepreneurship and new venture	Technology commercialization	New product development
Sushanta Mitra, Professor	Mechanical Engineering	YES	Microfluidics	Porous Media	Bio-systems
Pouya Rezai, Assistant Professor	Mechanical Engineering	YES	Microfluidics	Point-of-Care Diagnostics and Detection	Organisms-on-a-Chip
Nima Tabatabaei, Assistant Professor	Mechanical Engineering	YES	Biomedical Optics	Thermo-Photonics	Diffusion-Wave Fields
George Zhu Professor	Earth & Space Science Engineering	YES	Dynamics	Solid Mechanics	Robotics and Control
Associate Members					
Members Emeriti					
Adjunct Members					
Jacob Abkarian	Mechanical Engineering	YES	Control system	Robotics	Technology commercialization
Roderick Guthrie	Mechanical Engineering	YES	System design	Fluid dynamics	Metallurgical processes
Yadollah Maham	Mechanical Engineering	YES	Thermodynamics	Thermal systems	Chemical processes
Instructor Members					

Full Members hold a tenure-track/tenured position at York University. They are eligible for the full range of teaching, examination and supervisory activities, including principal supervision doctoral dissertations.

Associate Members hold a tenure-track/tenured or contractually limited position at York University. They may be eligible for the full range of teaching, examination and supervisory activities, excluding principal supervision doctoral dissertations. They may serve as a co-supervisor of doctoral dissertations on the condition that the other co-supervisor is a full member of the graduate program.

Members Emeriti may be eligible to act as co-supervisor of doctoral dissertations and as the principal or as a co-supervisor of master's theses; may serve on supervisory and examining committees, and; may teach graduate course courses (including supervision of Major Research Papers/Projects).

Adjunct Members hold academic or professional positions external to York University, but whose academic and/or professional expertise is relevant to the graduate program in question. Adjunct members may be eligible to serve on supervisory committees but normally may not act as principal supervisor or co-supervisor of doctoral dissertations or master's theses. Adjunct members may be eligible to serve on examining committees but may not act as the Chair or Dean's representative.

Instructor Members are eligible to teach a specific graduate course or courses, based on program need and the members' academic and/or professional expertise. The appointment is coincident with the terms over which the graduate course(s) is/are taught.

Primary Graduate Program: An individual may be appointed to more than one graduate program, in which event they shall designate one of the programs as their primary graduate program. Although this designation is intended to signify an individual's principal, but not exclusive, commitment in relation to graduate supervision, teaching and service, a faculty member may shift their principal commitments over the course of their career.

Table 2 – Graduate Supervision

For graduate programs: Identify the supervisorships of master's major research papers/projects (MRP), master's theses, doctoral dissertations, and post-doctoral students (PDF) by each faculty member who will be appointed to the proposed program completed within the past eight years and currently in progress.

Faculty Member	Completed (within past eight years)				In Progress			
	MRP	Thesis	Dissertation	PDF	MRP	Thesis	Dissertation	PDF
Full Members								
Alidad Amirfazli	9	9	6	1	1	3	1	2
Alex Czekanski						1		
Siu N. (Sunny) Leung						2	1	1
Sushanta Mitra		25	7	5		2	3	1
Pouya Rezai						4	1	
Nima Tabatabaei						1	2	
Andrew Maxwell								
George Zhu	2	4	1	6		3	5	2
Associate Members								
Members Emeriti								
Adjunct Members								
Jacob Abkarian								
Roderick Guthrie	1		2		2		3	4
Yadollah Maham								

Table 3 – Research Funding Received by Faculty

For graduate programs: Identify the research funding received for each of the past eight years by members who will be appointed to the proposed program. This table is intended to show the amount of funding available to support faculty research and potentially available to support students' work, either through the provision of stipends or materials for the conduct of the research. For this reason, grants for travel and publication awarded to faculty should not be included in this table. Major equipment grants, which provide important resources for the work of faculty and students, may be listed separately.

Year	Source			
	Tri-Council	Other Peer Adjudicated	Contracts	Institutional
2014	645,000	242,500		400,000
2013	1,558,393	28,750		50,000
2012	1,969,123	100,000		
2011	972,423			
2010	241,400	301,652		
2009	155,000	342,400		
2008	171,400	50,000		
2007	233,316	95,000		

8. Enrolment Projections

8.1 Indicate the anticipated implementation date (i.e. year and term of initial in-take), and provide details regarding the anticipated yearly in-take and projected steady-state enrolment target, including when steady-state will be achieved.

The program start date is September 2015 with an intake of 21 students. The program intake will increase to 48 by 2019. The program will reach the steady state at the beginning of academic year 2019/20 when most of the hiring of all Mechanical Engineering department faculty members will be completed. The projections for the number of students enrolled in the program are based on the assumption that each faculty member in the Mechanical Engineering department will be supervising/co-supervising a minimum of 3-4 graduate students, with at least 1 Ph.D. student being supervised by the faculty member.

Table 8.1.1 MASc annual intake and FTE (heads) targets in Mechanical Engineering

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023
Annual Intake	11	15	16	18	18	20	20	21	23
FTE	11	23	28	31	33	34	37	40	42
Attrition	0	3	3	3	3	4	4	4	4

Table 8.1.2 PhD annual intake and FTE (heads) targets in Mechanical Engineering

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023
Annual Intake	10	13	15	16	16	16	16	16	16
FTE	10	22	37	31	31	34	36	37	37
Attrition	0	1	1	1	2	2	2	3	3
Extended Degree Completion	0	0	0	0	3	4	4	4	5

9. Support Statements

Support statements are required from:

- relevant Dean(s)/Principal, with respect to the adequacy of existing human (administrative and faculty), physical and financial resources necessary to support the program, as well as the commitment to any plans for new/additional resources necessary to implement and/or sustain the program
- Vice-President Academic and Provost, with respect to the adequacy of existing human (administrative and faculty), physical and financial resources necessary to support the program, as well as the commitment to any plans for new/additional resources necessary to implement and/or sustain the program
- University Librarian confirming the adequacy of library holdings and support
- University Registrar confirming the implementation schedule and any administrative arrangements
- relevant Faculties/units/programs confirming consultation on/support for the proposed program, as appropriate
- professional associations, government agencies or policy bodies with respect to the need/demand for the proposed program, as appropriate

New Program Proposals: Curricula Vitae of the Faculty

For new graduate programs, the Program Brief must include up-to-date CVs for all faculty members who will be appointed to the proposed program, as well as a copy of the program-specific appointment criteria. The program-specific appointment criteria must be developed in accordance with the Policy on Appointments to the Faculty of Graduate Studies. CVs must be submitted in a standardized format relevant to the proposed program, such as that used by one of the Tri-Councils (CIHR, NSERC, SSHRC) or the current OCGS format. The program proponents should agree upon the format prior to sending out a call to faculty members.

Although they are part of the Program Brief, CVs should be submitted *as an independent document*. Within this document, the CVs should be compiled in alphabetical order, with a table of contents. Where appropriate, a program may have separate sections for faculty members who hold full-time (including CLAs) positions at York, retirees, and adjunct appointments. The program-specific appointment criteria should be included in the document as an appendix.

An electronic or soft copy of the CV document in the format describe above should be submitted to the Office of the Vice Provost Academic at the same time as the proposal and external reviewer nominations. At the same time, a copy of the CV document should be submitted to the Office of Dean, Faculty of Graduate Studies, along with any other documentation necessary with respect to the formal appointment to the Faculty of Graduate Studies of those individuals who will participate in the offering of the proposed program.