University of Ontario
INSTITUTE OF TECHNOLOGY

Master of Applied Science and Master of Engineering

in Automotive Engineering

Submission to the Ontario Council on Graduate Studies June 2006

Appraisal Brief

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

Brief for the Appraisal of the MASc and MEng Programs in Automotive Engineering

Submitted to the
Ontario Council on Graduate Studies
June 27, 2006

VOLUME I: The Program

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1 INTRODUCTION

1.1 Brief listing of programs

The University of Ontario Institute of Technology (UOIT) proposes to offer master's programs leading to a Master of Applied Science (MASc) or Master of Engineering (MEng) in Automotive Engineering. The MEng program will have two options: (i) MEng-Project with of a combination of courses and a project and (ii) MEng-Course, which consists only of courses. These graduate programs are new programs offered at UOIT. The programs are planned to start in January, 2008, or as soon as practical after all necessary approvals are obtained, by the Faculty of Engineering and Applied Science and its affiliated School of Energy Systems and Nuclear Science.

1.2 Background

The automotive sector has vital importance to the economies of Ontario and Canada. One in seven Canadians depends on the automotive sector for employment. The automotive industry is Canada's largest manufacturing sector. It represents about 12 percent of manufacturing GDP and 25 percent of manufacturing trade. It employs about 171 thousand people in automotive assembly and component manufacturing, plus about another 333 thousand in distribution and aftermarket sales and service. It has grown significantly over the past few decades, from industry shipments of $37.8 billion in vehicles and $14.7 billion in parts in 1993, to $69.3 billion in vehicles and $31.4 billion in parts in 2003. Automotive manufacturing is mainly clustered in southern Ontario, with seven of the world's largest vehicle manufacturers operating 14 plants in Ontario. These include giant multinationals, such as Ontario-based Magna International, Dana Corporation and Delphi Automotive, as well as dynamic home-grown companies like the Woodbridge Group, Wescast Industries and Linamar. Ontario is the largest auto-making province or state in North America (see Fig. 1.1; source: http://strategis.ic.gc.ca).

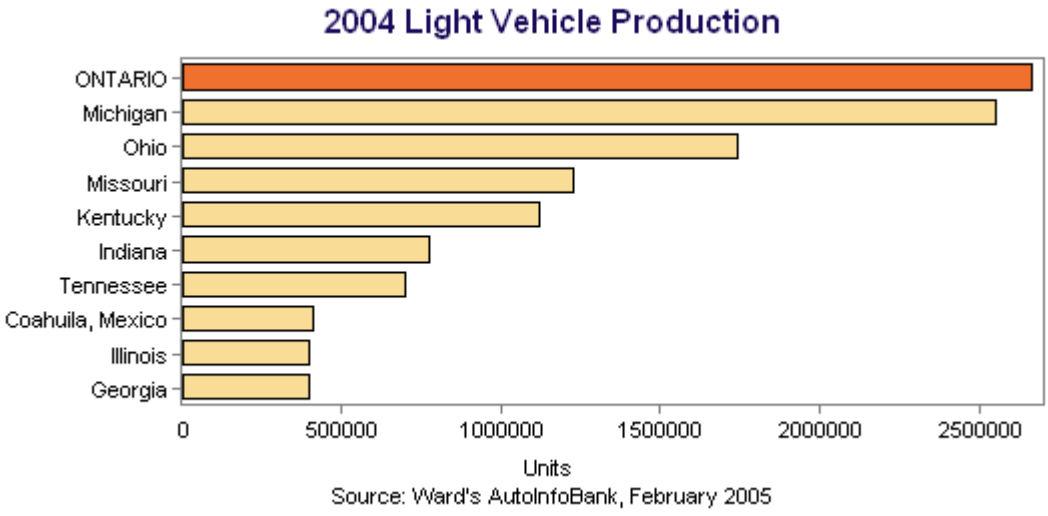

Figure 1-1: 2004 Light Vehicle Production in North America

It is well known that Ontario's automotive industry is experiencing challenges with global

competition. In 2001, Canada ranked fifth in global vehicle production, but it has slipped to eighth place in 2004. Automakers are facing severe competition overseas with lower labor costs. Also, rising commodity and energy costs are reducing profits. This includes rising costs of iron ore, steel and other raw materials, as well as energy costs related to manufacturing operations.

Ontario's future prosperity depends heavily on economic growth in its automotive sector. This will require training of future engineers to foster automotive innovation and commercialization of advanced new technologies. At Ontario's newest university, UOIT (University of Ontario Institute of Technology), the undergraduate Automotive Engineering program provides students with the knowledge and skills required for engineering in all areas of the automotive sector and related industries. The program is the only undergraduate program in Automotive Engineering in Canada. At the post-graduate level, there are currently no Automotive Engineering programs in Canada. However, there is a great need for such programs that train students at a Master's degree level. Training of future graduate students in Automotive Engineering is critical to provide a competitive advantage for Ontario's automakers. These graduate students would provide the advanced skills needed to lead Ontario's automakers to future success.

UOIT accepted its first undergraduate engineering students in the fall of 2003. Undergraduate engineering degrees at UOIT are offered by both the Faculty of Engineering and Applied Science and its affiliated School of Energy Systems and Nuclear Science. The Faculty of Engineering and Applied Science first offered an undergraduate program in Manufacturing Engineering in the fall of 2003. In the fall of 2004, the Faculty of Engineering and Applied Science added an undergraduate program in Mechanical Engineering with three options: (i) Mechanical Engineering Comprehensive, (ii) Energy Engineering and (iii) Mechatronics Engineering. In the fall of 2005, the Faculty of Engineering and Applied Science added undergraduate programs in Automotive, Electrical, and Software Engineering. The School of Energy Systems and Nuclear Science, which is affiliated with the Faculty of Engineering and Applied Science, first offered an undergraduate program in Nuclear Engineering in the fall of 2003.

UOIT offered its first master's program (Master of Information Technology Security) in September 2005. In the Faculty of Engineering and Applied Science, graduate programs leading to the degrees of Master of Applied Science (MASc) and Master of Engineering (MEng) were approved to commence by the Ontario Council on Graduate Studies (OCGS) in January, 2006. A Master of Science (MSc) in Modelling and Computational Science was also recently approved to commence by OCGS. With the rapid growth of UOIT's engineering programs, the Faculty of Engineering and Applied Science is ready and able to expand graduate programs by offering MASc and MEng programs in Automotive Engineering in January, 2008. Doctoral programs are also planned, but after the master's programs are up and running. Table 1-1 summarizes the details of UOIT's graduate programs.

Table 1-1 – UOIT Graduate Programs

Graduate Program	**Status**
Master of Information Technology Security	Launched in September, 2005
MASc and MEng in Mechanical Engineering	Expected to begin in September, 2006
MSc in Modelling and Computational Science	Expected to begin in January, 2007
MASc and MEng in Electrical and Computer Engineering	Planned to begin in September, 2007
MASc and MEng in Automotive Engineering	Proposed to begin in January, 2008

1.2.1 Other programs

As of the fall of 2005, there were 15 universities in Ontario offering graduate programs in engineering (see Table 1-2).

Table 1-2 – Graduate Engineering Programs in Ontario as of 2005

University	Programs	Degrees
Brock University	Geological Engineering	MSc
Carleton University	Civil Engineering[1]	MASc/MEng/PhD
	Electrical Engineering[1]	MASc/MEng/PhD
	Environmental Engineering[1]	MASc/MEng/PhD
	Geological Engineering[1]	MSc/PhD
	Mechanical & Aerospace Engineering[1]	MASc/MEng/PhD
	Software Engineering ConGESE[2]	MEng
	Telecommunications Technology Management	MEng
University of Guelph	Engineering	MEng/MSc/PhD
Lakehead University	Environmental Engineering	MSc
	Control Engineering	MSc
	Geological Engineering	MSc
Laurentian University	Mineral Resources Engineering	MASc/MEng
	Geological Engineering	MSc/PhD
McMaster University	Chemical Engineering	MASc/MEng/PhD
	Civil Engineering	MASc/MEng/PhD
	Design & Manufacturing[3]	MEng
	Electrical & Computer Engineering	MASc/MEng/PhD
	Engineering Physics	MEng/PhD
	Geological Engineering	MSc/PhD
	Materials Science & Engineering	MASc/MSc/PhD
	Mechanical Engineering	MASc/MEng/PhD
	Software Engineering	MASc/MEng/PhD
University of Ontario Institute of Technology	Mechanical Engineering	MASc/MEng
University of Ottawa	Chemical Engineering	MASc/MEng/PhD
	Civil Engineering[1]	MASc/MEng/PhD
	Electrical Engineering[1]	MASc/MEng/PhD
	Engineering Management	MEng
	Environmental Engineering[1]	MASc/MEng/PhD
	Geological Engineering[1]	MSc/PhD
	Mechanical & Aerospace Engineering[1]	MASc/MEng/PhD
	Software Engineering ConGESE[2]	MEng

Queen's University	Chemical Engineering	MEng/MSc/PhD
	Civil Engineering	MEng/MSc/MSc(Eng)/PhD
	Design & Manufacturing[3]	MEng
	Electrical & Computer Engineering	MEng/MSc/MSc(Eng)/PhD
	Geoengineering[4]	MSc/MScE/PhD
	Materials & Metallurgical Engineering	MEng/MSc/MSc(Eng)/PhD
	Mechanical Engineering	MEng/MSc/MSc(Eng)/PhD
	Mining Engineering	MEng/MSc/MSc(Eng)/PhD
Royal Military College of Canada	Chemistry & Chemical Engineering	MSc/MEng/PhD
	Civil Engineering	MEng/PhD
	Defence Engineering & Management	MDEM
	Electrical & Computer Engineering	MEng/PhD
	Mechanical Engineering	MASc/MEng/PhD
Ryerson University	Chemical Engineering	MASc/MEng
	Civil Engineering	MASc/MEng/PhD
	Electrical & Computer Engineering	MASc/MEng/PhD
	Elect. & Comp. Eng. – Computer Networks	MASc/MEng
	Environmental Applied Science & Management	MASc
	Mechanical Engineering	MASc/MEng/PhD
University of Toronto	Aerospace Science & Engineering	MASc/MEng/PhD
	Biomedical Engineering	MASc/PhD
	Chemical Engineering & Applied Chemistry	MASc/MEng/PhD
	Civil Engineering	MASc/MEng/PhD
	Clinical Biomedical Engineering	MHSc
	Design & Manufacturing[3]	MEngDM
	Electrical & Computer Engineering	MASc/MEng/PhD
	Engineering & Management	BASc/MBA
	Environmental Engineering[5]	MASc/MEng/PhD
	Environmental Studies[5]	MASc/MEng/PhD
	Geological Engineering	MASc/MSc/PhD
	Integrated Manufacturing[5]	MEng
	Knowledge Media Design[5]	MASc/PhD
	Materials Science & Engineering	MASc/MEng/PhD
	Mechanical & Industrial Engineering	MASc/MEng/PhD
	Software Engineering ConGESE[2]	MEng
	Telecommunications	MEng
	Wood Engineering[5]	MASc
University of Waterloo	Chemical Engineering	MASc/PhD
	Civil Engineering	MASc/MEng/PhD
	Design & Manufacturing[3]	MEng
	Electrical & Computer Engineering	MASc/MEng/PhD
	Geological Engineering	MSc/PhD
	Management of Technology	MASc
	Management Sciences	MASc/MMSc/PhD
	Mechanical Engineering	MASc/MEng/PhD
	Software Engineering ConGESE[2]	MASc
	Systems Design Engineering	MASc/MEng/PhD

University of Western Ontario	Biomedical Engineering	MESc/PhD
	Design & Manufacturing[3]	MEng
	Geological Engineering	MSc/PhD
	Engineering Science	MESc/MEng/PhD
University of Windsor	Civil Engineering	MASc/MEng/PhD
	Electrical Engineering	MASc/MEng/PhD
	Engineering Materials	MASc/MEng/PhD
	Environmental Engineering	MASc/MEng/PhD
	Geological Engineering	MSc/PhD
	Industrial Engineering	MASc/MEng
	Manufacturing Systems	PhD
	Mechanical Engineering	MASc/MEng/PhD

Sources: Advanced Design and Manufacturing Institute (ADMI), Canadian Council of Professional Engineers (CCPE), Consortium for Graduate Education in Software Engineering (ConGESE), and Ontario Council on Graduate Studies (OCGS).

[1] *Joint program between Carleton University and the University of Ottawa (Ottawa-Carleton Institute for Electrical and Computer Engineering (OCIECE))*

[2] *ConGESE: Consortium for Graduate Education in Software Engineering – Joint program between Carleton University, University of Ottawa, Queen's University, University of Toronto, University of Waterloo, University of Western Ontario, and York University. Note that only schools that offer ConGESE master's degrees through engineering departments are noted in the table.*

[3] *ADMI: Advanced Design and Manufacturing Institute - Joint program between McMaster University, Queen's University, University of Toronto, University of Waterloo, and University of Western Ontario.*

[4] *Joint program between Queen's University and Royal Military College of Canada.*

[5] *Collaborative program between two or more graduate units at the University of Toronto.*

It can be observed in Table 1-2 that Automotive Engineering graduate programs are not offered by any universities in Ontario. Unlike most auto-making countries in the world, Canada does not have graduate programs in Automotive Engineering. Several universities in Ontario offer graduate degrees in Mechanical Engineering and other programs related to automotive systems (such as Electrical Engineering), but not specifically Automotive Engineering.

In the United States, many universities offer graduate programs in Automotive Engineering. For example, at Lawrence Technological University in Southfield, Michigan, an MAE degree in Automotive Engineering is offered. The main faculty research areas focus on advanced composite materials, carbon and glass fiber sheets and development of drive shafts using composite materials. Recent figures indicate that there are currently about 245 graduate students enrolled in the MAE program, including part-time students. Students have both core and elective courses in the program. Electrical engineering students take (i) Introduction to Thermal Systems and (ii) Introduction to Mechanical Systems. Mechanical engineering students take (i) Circuits and Electronics and (ii) Electrical Machines and Controls. Additional examples of graduate programs around the world are listed in Appendix A.

Figure 1-2 shows the cities that offer engineering graduate programs in Southern Ontario. Kingston, Toronto, and Ottawa have two universities offering graduate programs. Figure 1-1 shows alls cities in Ontario that offer engineering graduate programs, except Lakehead University in Thunder Bay.

Figure 1-2: Cities Offering Graduate Engineering Programs in Southern Ontario (Large Circles) and the Location of the University of Ontario Institute of Technology in Oshawa
Source: Yahoo! Maps (http://maps.yahoo.com/)

1.2.2 Graduate program demand

Due to recent events in the United States, there has been a shift in international graduate student enrolments from the United States to Canada. Also, a large proportion of new immigrants to Canada have settled in the Greater Toronto Area (GTA) and they wish to upgrade their skills with graduate degrees for employment opportunities in the automotive sector. These two trends will contribute to strong demand for graduate student spaces in Automotive Engineering at UOIT.

Both federal and provincial government policies are also encouraging demand for graduate programs in Automotive Engineering. A report in 2002 by Industry Canada[1] has outlined many goals and targets, including:

> **GOALS - ADDRESSING THE KNOWLEDGE PERFORMANCE CHALLENGE**
> • Vastly increase public and private investments in knowledge infrastructure to improve Canada's R&D performance.
>
> **TARGETS**
> • By 2010, rank among the top five countries in the world in terms of R&D performance.
> • By 2010, at least double the Government of Canada's current investments in R&D.

1 Source: Industry Canada, 2002, *Achieving Excellence: Investing in People, Knowledge and Opportunity*.

GOALS - ADDRESSING THE SKILLS CHALLENGE
• Develop the most skilled and talented labour force in the world.

TARGETS
• Through to 2010, increase the admission of master's and PhD students at Canadian universities by an average of 5 percent per year.
• By 2004, significantly improve Canada's performance in the recruitment of foreign talent, including foreign students, by means of both permanent immigrant and temporary foreign worker programs.
• Over the next five years, increase the number of adults pursuing learning opportunities by 1 million.

GOALS - ADDRESSING THE INNOVATION ENVIRONMENT CHALLENGE
• Governments at all levels work together to stimulate the creation of more clusters of innovation at the community level.
• Federal, provincial/territorial and municipal governments cooperate and supplement their current efforts to unleash the full innovation potential of communities across Canada, guided by community-based assessments of local strengths, weaknesses and opportunities.

TARGETS
• By 2010, develop at least 10 internationally recognized technology clusters.
• By 2010, significantly improve the innovation performance of communities across Canada.

The proposed graduate programs in Automotive Engineering at UOIT would help to meet the above goals and targets.

In 2003, the Council of Ontario Universities (COU) formed a Task Force on Future Requirements for Graduate Education in Ontario. The Task Force determined that the Government of Ontario should establish a 10-year goal of doubling graduate enrolment in Ontario's universities to meet the demand for increased graduates[2]. The programs proposed by UOIT and the location of the university make it an advantageous choice for developing Automotive Engineering graduate school capacity in Ontario.

Figure 1-3 shows the location of graduate engineering programs in the GTA and neighbouring cities. The figure shows that there are no engineering graduate schools in the eastern half of the GTA, or in any neighbouring cities east of the GTA. All of the graduate schools in the region are located in the centre of the GTA or in neighbouring cities west of the GTA. The location of UOIT makes it an excellent choice for increasing engineering graduate school capacity to the eastern half of the GTA and neighbouring cities. In addition to having a strategic location based on the population of the GTA, the location of UOIT is also ideal for taking advantage of many automotive companies in the eastern half of the GTA, including General Motors of Canada, Lear Corporation and others.

2 Source: COU Task Force on Future Requirements for Graduate Education in Ontario, 2003, *Advancing Ontario's Future Through Advanced Degrees.*

Figure 1-3: Universities Offering Graduate Engineering Programs within the Greater Toronto Area (GTA) and Neighbouring Cities and the Location of the University of Ontario Institute of Technology
Source: Yahoo! Maps (http://maps.yahoo.com/)

1.3 Mission

The mission of the Faculty of Engineering and Applied Science is to contribute to society through excellence in education, scholarship, and service. It will provide for our graduate students a rigorous education and endeavour to instil in them the attitudes, values, and vision that will prepare them for a lifetime of continued learning and leadership in their chosen careers. The Faculty engages in scholarship of discovery, application, and integration.

1.4 Program objectives

There are four objectives common to the Automotive Engineering graduate programs:

- Depth. To provide students with a detailed understanding for the practice and advanced study of advanced technologies related to automotive systems. This includes scientific principles, analysis techniques, and design methodologies.

- Breadth. To provide students with the broad and advanced education necessary for productive careers in the public or private sectors, as well as academia.

- Professionalism. To develop skills necessary for clear communication and responsible teamwork, and to inspire professional attitudes and ethics, so that students are prepared for modern work environments and lifelong learning.

- Learning Environment. To provide an environment that will enable students to pursue their

goals through innovative graduate programs, which are rigorous, challenging, and supportive.

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

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

1.5 Method used for self-study and preparation of this brief

This appraisal was prepared by an Automotive Graduate Committee in the Faculty of Engineering and Applied Science, in consultation with practicing engineers in the automotive sector. Many faculty members have contributed material to this brief. The appraisal has received thorough reviews by the Curriculum Committee and the Faculty Council of the Faculty of Engineering and Applied Science and School of Energy Systems and Nuclear Science, as well as by the Dean of Graduate Studies, the Curriculum and Program Review Committee, and the Academic Council of UOIT.

1.6 Fields in the programs

There are no declared fields in this program.

1.7 Review concerns expressed in previous appraisal and actions taken

This is an application for a new program, so this section is not applicable.

1.8 Special matters and innovative features

The University of Ontario Institute of Technology provides each of its students access to a Mobile Learning Environment. Every graduate student at UOIT will have wireless access to library resources, email, and the internet, in addition to other online services.

Students enrolled in the programs will have access to state-of-the-art facilities that are unique to Canada and particularly beneficial to conducting automotive research. These include the Automotive Centre of Excellence (ACE) and the Integrated Manufacturing Centre (IMC). The ACE and IMC will provide an opportunity for graduate students in the program to conduct innovative research in automotive systems.

ACE will be a state-of-the-art automotive R&D facility at UOIT. It will provide graduate students access to world-class automotive testing and research facilities that will be unique to Canada.

The IMC is a fully automated, industrial-grade, flexible manufacturing facility capable of fabricating

and assembling automotive products from raw materials, with limited human intervention. The IMC provides a facility to conduct research in advanced manufacturing related to the automotive industry. Additional details regarding ACE and IMC will be provided in Section 3.2.

2 THE FACULTY

2.1 List of faculty by field

Table 2-1 lists the faculty members involved in the graduate program and identifies their research field, gender, home unit, and supervisory privileges. Currently, there are 19 core faculty members involved in the graduate programs. This includes 3 Category-1 core faculty, 10 Category-3 core faculty and 8 Category-6.

Faculty Name and Rank	M/F	Home Unit [2]	Supervisory Privileges	Fields[3]
Category [1]				
Ebrahim Esmailzadeh – Full Professor	M	FEAS	Full	**X**
Yuping He – Assistant Professor	M	FEAS	Full	**X**
Subhash Rakheja - Full Professor (CRC nominee)	M	FEAS	Full	**X**
Greg Rohrauer – Assistant Professor	M	FEAS	Full	**X**
Category [3]				
Peter Berg – Assistant Professor	M	FS	Full	**X**
Ibrahim Dincer – Full Professor	M	FEAS	Full	**X**
Kamiel Gabriel – Full Professor	M	FEAS	Full	**X**
Greg Naterer – Full Professor	M	FEAS	Full	**X**
Scott Nokleby – Assistant Professor	M	FEAS	Full	**X**
Remon Pop-Iliev – Associate Professor	M	FEAS	Full	**X**
Ghaus Rizvi – Assistant Professor	M	FEAS	Full	**X**
Marc Rosen – Full Professor	M	FEAS	Full	**X**
Dan Zhang – Associate Professor	M	FEAS	Full	**X**
Category [6]				
Michael Bennett – Full Professor	M	FBIT/FEAS	Full	**X**
Ali Grami – Associate Professor	M	FBIT/FEAS	Full	**X**
Ramiro Liscano – Associate Professor	M	FEAS	Full	**X**
Lixuan Lu – Assistant Professor	F	FEAS/SESNS	Full	**X**
Richard Marceau – Full Professor	M	FEAS	Full	**X**
Clemens Martin – Assistant Professor	M	FBIT/FEAS	Full	**X**
Jing Ren – Assistant Professor	F	FEAS	Full	**X**
Shahram Shahbazpanahi – Assistant Professor	M	FEAS	Full	**X**

Miguel Vargas Martin – Assistant Professor	M	FBIT/FEAS	Full	**X**

[1] Category 1: tenured or tenure-track core faculty members whose graduate involvement is exclusively in the graduate program under review. For this purpose the master's and doctoral streams of a program are considered as a single program. Membership in the graduate program, not the home unit, is the defining issue.
Category 2: non-tenure-track core faculty members whose graduate involvement is exclusively in the graduate program under review.
Category 3: tenured or tenure-track core faculty members who are involved in teaching and/or supervision in other graduate program(s) in addition to being a core member of the graduate program under review.
Category 4: non-tenure track core faculty members who are involved in teaching and/or supervision in other graduate program(s) in addition to being a core member of the graduate program under review.
Category 5: other core faculty: this category may include emeritus professors with supervisory privileges and persons appointed from government laboratories or industry as adjunct professors. Please explain who would fall into this category at your institution.
Category 6: non-core faculty who participate in the teaching of graduate courses.

[2] FEAS: Faculty of Engineering and Applied Science
SESNS: School of Energy Systems and Nuclear Engineering
FBIT: Faculty of Business and Information Technology
FS: Faculty of Science

[3] There are no declared fields in the programs.

It should be noted that UOIT is a new university and it began to offer undergraduate programs in Automotive Engineering in the fall 2005 semester. The first undergraduate class will graduate in the spring of 2009. UOIT recognizes that it is imperative for the Faculty of Engineering and Applied Science to increase the number of faculty members in this program rapidly over the next few years, to fully meet CEAB requirements in terms of faculty to student ratios. CEAB is the Canadian Engineering Accreditation Board, which was established by the Candian Council of Professional Engineers (CCPE) in 1965 to accredit undergraduate engineering programs.

Table 2-2 shows the Faculty's plan for new faculty hires up to 2010. Faculty members will be hired at all levels, to ensure a successful balance between full professors, associate professors, and assistant professors across different fields of interests. With graduate programs in Automotive Engineering in place, it is anticipated that more senior faculty can be hired. It is expected that faculty members having expertise in all main areas of Automotive Engineering will be hired over the next 5 years, including vehicle dynamics, powertrains, NVH (noise, vibration and harshness), vehicle aerodynamics, materials and automotive electronics.

Table 2-2: Planned Faculty Hiring in Automotive Engineering (2006 to 2010)

Year	*Number of faculty hires*
2006-2007	3
2007-2008	6
2008-2009	4
2009-2010	4

Also, UOIT plans to support adjunct professorships to well-qualified external academics and professionals with industrial links. They would contribute to the graduate programs, in terms of

student supervision and teaching of graduate courses. It is also expected that members of other Faculties at UOIT will participate in the proposed programs as they evolve.

2.2 External operating research funding

Table 2-3 shows the external research funding secured by faculty members since 1998. The funding represents confirmed funding and it will likely increase over time, as faculty members successfully secure additional funding. Since the first professors started at UOIT in 2003, the funding in Table 2-3 for the years 1998 to 2002 represents funding secured by UOIT faculty, while at other institutions.

Table 2-3: Operating Research Funding by Source and Year

	Source			
Year[1]	**Granting Councils [2]**	**Other Peer Adjudicated [3]**	**Contracts**	**Others [4]**
1998	$20,947	$153,584	$24,148	$81,366
1999	$20,947	$111,633	$44,000	$84,041
2000	$53,947	$116,179	$2,360	$2,675
2001	$101,407	$61,375	$33,750	$0
2002	$68,000	$124,360	$33,750	$0
2003	$58,000	$150,505	$61,250	$128,210
2004	$145,870	$57,975	$105,050	$283,210
2005	$112,870	$0	$105,050	$150,000
2006[5]	$572,994	$218,191	$0	$120,000
Totals	$1,154,982	$993,802	$409,358	$849,502

[1] *Calendar year.*
[2] *NSERC.*
[3] *Canadian International Development Agency; Canadian Space Agency; Environment Canada; Natural Resources Canada; MITACS, PREA, Ontario Ministry of Community and Social Services, Business and Technology Integration Branch; Alberta Innovation Fund; International Federation for the Promotion of Mechanism and Machine Science (IFToMM), King Fahd University of Petroleum and Minerals (KFUPM); Auto 21; CDEN; MMO; Sharif University of Technology; Government of Brunei; Government of Iran.*
[4] *University start-up grants and other miscellaneous research funding.*
[5] *Confirmed to date. Note that all new faculty member have applied for NSERC Discovery Grants. In addition, faculty members have applied for NSERC Research Tools and Instruments Grants, CFI New Innovations Fund and ORF (Research Excellence) Grants.*

Faculty members are actively applying for funding from the Natural Sciences and Engineering Research Council (NSERC) of Canada, the Canadian Foundation for Innovation (CFI), AUTO21, Materials and Manufacturing Ontario (MMO), ORF (Ontario Research Fund; Research Excellence Program) and others. In addition, faculty members are active in securing research funding through industry contracts. As the number of faculty increases rapidly over the next few years, it is fully expected that the funding levels in Table 2-3 will increase substantially.

2.3 Graduate supervision

Table 2-4 shows the completed and current numbers of thesis supervisions by faculty member. The table shows that there is a good balance of senior professors, who have successfully graduated students, and new professors, who have not yet graduated students. Faculty members are also active in co-supervising students with professors at other institutions within Ontario and Canada. Several faculty members have adjunct appointments at other universities. Table 2-5 outlines these adjunct appointments.

Table 2-4: Completed and Current Numbers of Thesis Supervisions by Faculty Member

	Completed			Current		
Member	**Master's**	**PhD**	**PDF**	**Master's**	**PhD**	**PDF**
Category 1						
Ebrahim Esmailzadeh	31	8	7	4	4	3
Yuping He	0	0	0	1	0	0
Subhash Rakheja	35	15	9	5	10	2
Greg Rohrauer	0	0	0	4	0	0
Category 3						
Peter Berg	0	0	0	0	1	1
Ibrahim Dincer	9	7	12	4	7	4
Ebrahim Esmailzadeh	31	8	7	4	4	3
Kamiel Gabriel	16	1	7	3	1	1
Greg Naterer	5	6	2	1	3	0
Scott Nokleby	0	0	0	2	0	0
Remon Pop-Iliev	4	0	0	0	1	0
Ghaus Rizvi	3	0	0	0	2	1
Marc Rosen	10	1	2	4	0	2
Dan Zhang	2	0	0	0	0	0
Category 6						
Michael Bennett	27	2	0	0	0	0
Ali Grami	0	0	0	0	0	0
Ramiro Liscano	8	0	0	6	1	0
Lixuan Lu	0	0	0	0	0	0

Richard Marceau	13	4	0	0	0	0
Clemens Martin	11	0	0	1	0	0
Jing Ren	0	0	0	0	0	0
Shahram Shahbazpanahi	2	2	0	0	0	0
Miguel Vargas Martin	0	0	0	1	0	0

Table 2-5: Adjunct Appointments

Member	University – Department
Category 1	
Ebrahim Esmailzadeh	Concordia University – Department of Mechanical and Industrial Engineering Sharif University of Technology, Iran – Department of Mechanical Engineering University of Toronto – Department of Mechanical and Industrial Engineering
Yuping He	
Subhash Rakheja	
Greg Rohrauer	
Category 3	
Peter Berg	University of Waterloo – Department of Mechanical Engineering
Ibrahim Dincer	Carleton University – Department of Mechanical Engineering University of Toronto – Department of Mechanical and Industrial Engineering University of Waterloo – Department of Mechanical Engineering
Kamiel Gabriel	
Greg Naterer	University of Toronto – Department of Mechanical and Industrial Engineering University of Manitoba – Dept. of Mechanical and Manufacturing Engineering
Scott Nokleby	University of Victoria – Department of Mechanical Engineering
Remon Pop-Iliev	
Ghaus Rizvi	
Marc Rosen	Ryerson University – Department of Mechanical and Industrial Engineering University of Western Ontario – Department of Mechanical Engineering
Dan Zhang	University of Saskatchewan – Department of Mechanical Engineering
Category 6	
Michael Bennett	University of Western Ontario
Ali Grami	
Ramiro Liscano	University of Ottawa – School of Information Technology and Engineering Dalhousie University – Faculty of Computer Science
Lixuan Lu	

Richard Marceau	
Clemens Martin	
Jing Ren	
Shahram Shahbazpanahi	McMaster Unviersity
Miguel Vargas Martin	Universidad Autonoma de Aguascalientes, Mexico – Department of Electronic Systems

2.4 Current teaching assignments

Table 2-6 shows the planned teaching loads for the 2006/2007, academic year, while Table 2-7 shows the teaching assignments for the previous 2005/2006 academic year. Note that UOIT had its first undergraduate students in the 2003/2004 academic year. After graduate programs begin in the Faculty of Engineering and Applied Science, a normal teaching load will consist of three to four semester-length courses per year.

Table 2-6: Teaching Assignments for 2006/2007 at UOIT

Faculty Member	Rank	Undergraduate[1]	Graduate	Comments
Category 1				
Ebrahim Esmailzadeh	Professor	ENGR 3350U (3/1/1) ENGR 3210U (3/2/1)	ENGR 5240G	
Yuping He	Assistant Professor	ENGR 3270U (3/1/1) ENGR 2860U (3/2/1)		
Subhash Rakheja	Professor			Tier 1 Canada Research Chair (nominee, pending)
Greg Rohrauer	Assistant Professor	ENGR 2310U (3/2/0) (2 sections) ENGR 3220U (3/2/1)		
Category 3				
Peter Berg	Assistant Professor	PHY1010U (3/3/2) PHY2030U (3/3/2)		
Ibrahim Dincer	Professor	ENGR 2320U (3/1/1)	ENGR 5100G	Programs Director, Faculty of Engineering and Applied Science
Kamiel Gabriel	Professor			Associate Provost, Research, UOIT
Greg Naterer	Professor	ENGR 3930U (3/2/1)	ENGR 5140G	Director of Research, Graduate Studies and Development, FEAS
Scott Nokleby	Assistant Professor	ENGR 4280U (3/2/1) ENGR 3390U (3/1/1) (2 sections)	ENGR 5260G	
Remon Pop-Iliev	Associate Professor	ENGR 3200U (3/1.5/1.5) ENGR 3030U (4/2/0) ENGR 3395U (3/0/2)	ENGR 5011G	NSERC-GM Chair in Innovative Design Engineering, UOIT

Ghaus Rizvi	Assistant Professor	ENGR 2220U (3/0/0) (2 sections) ENGR 4045U (3/0/1)		
Marc Rosen	Professor			Dean, Faculty of Engineering and Applied Science
Dan Zhang	Associate Professor	ENGR 2420U (3/1/1) (2 sections)		
Category 6				
Michael Bennett	Professor			
Ali Grami	Associate Professor	ENGR 1400 (3/0/0)		
Ramiro Liscano	Associate Professor	ENGR 2710 (3/3/2) ENGR 1200 (3/3/2) ENGR 2720U (3/0/2)		
Lixuan Lu	Assistant Professor	ENGR 4015U (3/0/1) ENGR 2450U (3/3/2)		
Richard Marceau	Professor			Provost, UOIT
Clemens Martin	Assistant Professor	ENGR 1200 (3/0/2)	MITS 5200G MITS 5300G	
Jing Ren	Assistant Professor			hired in 2006
Shahram Shahbazpanahi	Assistant Professor	ENGR 2200U (3/3/2) ENGR 2790U (3/2/0) (2 sections)		
Miguel Vargas Martin	Assistant Professor	BUSI 1830 (3/0/3) INFR 1010 (3/0/3) INFR 2820 (3/3/3) ENGR 1200 (3/0/2)	MITS 5500G	

[1] *The numbers in the brackets after the course number refer to weekly Lecture/Laboratory/Tutorial hours, respectively.*

Table 2-7: Teaching Assignments for 2005/2006 at UOIT

Faculty Member	Rank	Undergraduate[1]	Graduate	Comments
Category 1				
Ebrahim Esmailzadeh	Professor	ENGR 2020 (4/0/2) ENGR 2420 (3/1/1)		
Yuping He	Assistant Professor			hired in 2006
Subhash Rakheja	Professor			Tier 1Canada Research Chair (nominee, pending)
Greg Rohrauer	Assistant Professor			Academic Leader, Automotive Centre of Excellence
Category 3				

Peter Berg	Assistant Professor	PHY1010U (3/3/2) PHY2030U (3/3/2)		Faculty of Science
Ibrahim Dincer	Professor	ENGR 2320U (3/1/1) ENGR 2860U (3/1/1) (2 Sections)		Programs Director, Faculty of Engineering and Applied Science
Kamiel Gabriel	Professor			Associate Provost, Research, UOIT
Greg Naterer	Professor	ENGR 2640U (3/1/1)		Director of Research, Graduate Studies and Development, FEAS
Scott Nokleby	Assistant Professor	ENGR 3200U (3/1.5/1.5) ENGR 3270U (3/1/1) ENGR 3390U (3/1/1)		
Remon Pop-Iliev	Associate Professor	ENGR 2310U (3/2/0) ENGR 3030U (4/2/0) ENGR 3300U (3/0/1)		NSERC-GM Chair in Innovative Design Engineering, UOIT
Ghaus Rizvi	Assistant Professor	ENGR 2220U (3/0/0) ENGR 2420U (3/1/1) ENGR 3190U (3/1.5/0)		
Marc Rosen	Professor			Dean, Faculty of Engineering and Applied Science
Dan Zhang	Associate Professor	ENGR 2220U (3/0/0) ENGR 2420U (3/1/1) ENGR 3350U (3/1/1)		
Category 6				
Michael Bennett	Professor	SE312 (3/2) SE313 (3/2)		University of Western Ontario
Ali Grami	Associate Professor	BUSI 1500 (3/0/0) BUSI 1900 (3/0/1) ENGR 1400 (3/0/0)	MITS 5200G (co-teaching)	
Ramiro Liscano	Associate Professor	ENGR 1200 (3/3/2)		hired in 2006
Lixuan Lu	Assistant Professor	ENGR 3200U (3/1.5/1.5) ENGR 3460U (3/1.5/1.5)		
Richard Marceau	Professor			Provost, UOIT
Clemens Martin	Assistant Professor	ENGR 1200 (3/0/2)	MITS 5200G (co-teaching) MITS 5300G	
S. Shahbazpanahi	Assistant Professor			hired in 2005
M. Vargas Martin	Assistant Professor	BUSI 1830 (3/0/3) INFR 1010 (3/0/3)	MITS 5500G (3/0/0)	

[1] *The numbers in the brackets after the course number refer to weekly Lecture/Laboratory/Tutorial hours, respectively.*

2.5 Commitment of faculty members from other graduate programs and/or other institutions

Professors Martin, Grami and Vargias Martin hold a cross appointment between the Faculty of Engineering and Applied Science and the Faculty of Business and Information Technology. He

teaches graduate courses in both faculties. This includes courses in the MASc and MEng programs in Electrical and Computer Engineering (Faculty of Engineering and Applied Science), as well as graduate courses in the Faculty of Business and Information Technology's Master of Information Technology program. As a cross appointed faculty member, he will divide his time accordingly between the two faculties. Professor Lu is cross appointed between the School of Energy Systems and Nuclear Science, and the Faculty of Engineering and Applied Science.

Professor Berg in the Faculty of Science is involved in graduate programs within the Faculty of Science, in addition to his involvement in the proposed graduate program in the Faculty of Engineering and Applied Science. As UOIT expands, it is expected that additional faculty members from the Faculty of Science with automotive related expertise will have involvement in the proposed graduate programs.

3 PHYSICAL AND FINANCIAL RESOURCES

3.1 Library resources

The goal of the University of Ontario Institute of Technology library is to enrich the teaching, research and learning environment of the University by providing exceptional library and information services and facilities to support all academic programs.

A new, state-of-the-art library for the University of Ontario Institute of Technology was recently completed in the fall of 2004. Designed by internationally renowned Diamond and Schmitt Architects Inc., the 73,000-square-foot library serves students, faculty, and staff. The four-storey, $20.7-million library houses individual and collaborative learning spaces, research workstations, electronic classrooms, a round pavilion with a reading room and periodicals collection, and other facilities. It offers a variety of learning spaces to suit individual learning styles and user needs. Its design also allows for future enlargement, up to double the original size.

The University's Mobile Learning environment provides students with access to library resources using their wireless laptop anytime, from anywhere. Students can work individually or collaboratively anywhere in the building. Digital resources and complementary print collections are provided for students in both a physical and virtual environment. Librarians are available to provide students with the skills to navigate effectively through the information environment.

In addition to interlibrary loans, students will also have access to the resources available at the largest academic library in Canada, the University of Toronto Libraries, through a partnership program. To keep faculty and students informed of the library's continued growth and to provide easy access to resources, the UOIT Library staff have been developing and updating its website (www.uoit.ca/library) on an ongoing basis.

3.2 Automotive Centre of Excellence (ACE)

In 2005, General Motors of Canada (GMCL) announced a $2.5 billion investment in GM's Canadian operations. This represents the largest and most comprehensive automotive investment in Canadian history. Together with the Ontario and Federal Governments, this "Beacon Project" aims to strengthen automotive engineering, R&D and manufacturing capabilities in Canada. GM Canada will make major investments in new vehicle and advanced engine technologies at its operations in Oshawa, St. Catharines and Ingersoll, Ontario. It will also proceed with major

investments in flexible manufacturing systems at its Oshawa Car Assembly Plant. These investments will enable the Oshawa plant to adapt quickly to customer and vehicle market changes. They will enable production of a multitude of vehicle models and platforms on the same assembly line.

As part of the Beacon Project, an Automotive Centre of Excellence (ACE) will be created at UOIT. Launched with support from GMCL and the Province of Ontario, ACE will link participating automotive companies, suppliers, automotive engineers, universities, colleges, researchers and students in a new building equipped with state-of-the-art automotive design, engineering and research facilities. ACE will anchor a new Canadian Automotive Innovation Network, which will be comprised of selected universities in Ontario, Quebec and British Columbia, led by GM's Canadian Engineering Centre in Oshawa. GM Canada will invest in the Innovation Network to enhance the competitiveness of the Canadian automotive industry through leading edge R&D. This will include investments in new research projects, Design and Research Chairs at Canadian universities and in-kind donations of computer-based design tools by GM and partners.

The Centre will be owned and operated by UOIT. It will provide approximately 90,000 (gross) ft^2, which translates to approximately 45,000 (net) ft^2. It will be located in a new building at UOIT. ACE will comprise two main functional divisions: (i) Core Research Facility (CRF) containing a state-of-the-art climatic wind tunnel and (ii) other equipment designed to respond to automotive manufacturing issues, as well as enable research and involvement of graduate students in industry-based projects. The Integrated Research and Training Facilities (IRTF) will provide educational, lab, research, and project space for use by UOIT faculty, students and colleagues from other institutions. Also, it will serve collaborations with the automotive industry and suppliers, including graduate student research projects. The Centre will be connected to UOIT engineering labs, and it will share university services in the performance of its mandate.

The Automotive Centre of Excellence will prepare the Automotive Engineering graduate students to take the automotive industry to a new level of competitiveness and future success. It will stimulate the development of new advanced technologies focused on future-based applications for the automotive industry in Canada. The $58 million grant provided by the Government of Ontario as part of its Ontario Automotive Investment Strategy program supports the ACE project costs for CRF and IRTF. ACE will be provide the following exceptional opportunities for Automotive Engineering graduate students at UOIT:

- a multi-faceted centre with world-class experimental facilities to conduct automotive related research;
- a way to share learning, best practices, pedagogical tools, and curriculum development with the goals of enhancing graduate studies and research opportunities in Automotive Engineering;
- an exposure for students to the commercial applications of research;
- an opportunity for graduate students to work and learn alongside top professionals in the automotive industry;
- a stimulating environment for research collaboration among university and industry-based researchers, ranging from the exploration of 'what if' research ideas and their implications, to the pursuit of new product design, development, and commercialization;
- a path to developing the leaders who will shape Canada's automotive industry future.

The Core Research Facility will comprise a net 15,000 ft^2 specifically for Beacon Project infrastructure, including the following facilities:

- Climatic Wind Tunnel (CWT)
- CWT Control Room, Data Room and Soak Area
- Environmental Chamber and Four-Post Shaker
- Chassis Dynamometer
- Four Post Test Cell HVAC Plant
- NVH Noise and Vibration Test Cell
- General Hoist Bay Work Areas
- Drive Aisle
- Engine Test Cells
- Vehicle Concept Lab and Bay Areas
- Optical Microscopy and Electron Microscopy
- Polishing and Etching Lab
- Ancillary facilities, support shop and office areas
- Areas for on-site physical modifications to vehicles and systems
- Computer and software tools
- Miscellaneous test and IT equipment
- Facility arrangements to ensure security between the various industrial users

The Integrated Research and Training Facilities (IRTF) will comprise an additional 30,000 ft^2 net space, which will span three floors for research, education and training space within ACE. Space will be allocated in accordance with the following three levels of activity.

1) A dedicated UOIT space will function as university (rather than rental) space, including offices for faculty members, graduate students and other researchers.
2) Collaborative research laboratory space will be made available for automotive research projects, including graduate student projects, contract research and space leased to industry for access to ACE research equipment and facilities.
3) For industry-sponsored research space, automotive partners and suppliers will have access to additional ACE space on a contractual basis to conduct research projects relevant to their needs. Faculty members and graduate students may also contribute to this industry work.

Thus, IRTF provide educational, research, and project space for use by UOIT faculty and graduate students, as well as colleagues from other institutions, the automotive industry and suppliers. It will be results-focused and designed to support UOIT automotive research and education, as well as attracting revenue-generating research projects on a continuous basis. ACE will work closely with automotive partners to help close the innovation gap faced by the automotive industry in developing advanced technologies, through leading-edge research and training of a new generation of automotive engineering graduate students.

Through ACE, GMCL will be able to expand research and development activities, through unique facilities not currently available in Canada or elsewhere. These R&D efforts will have direct applications to current automotive industry needs. ACE will bring GMCL advanced product engineers to UOIT. It will also foster project opportunities for faculty members and graduate students to have access to the GMCL Canadian Engineering Centre virtual simulation and physical test facilities. ACE will provide extraordinary opportunities for cross-fertilization of research innovations, by bringing together personnel from industry and universities to study industry's most pressing needs. As these partnerships grow over time, suppliers will be attracted to the learning,

knowledge and advanced developments conducted at ACE. They will be encouraged to further invest and participate in the growing source of intellectual capital and graduate student talent for their own local engineering and commercialization efforts. This new collaborative spirit of ACE will contribute to a new generation of Automotive Engineering graduate students, which will be uniquely prepared to contribute to future success of Canada's automotive industry.

3.3 Other laboratory facilities

In addition to ACE, students in the Automotive Engineering MASc and MEng programs will have access to the following other equipment and common facilities.

- Integrated Manufacturing Centre (IMC; 925 m^2 – Shared)
- Active Vibration Control Laboratory – UA1540 (65 m^2 – Shared)
- Advanced Materials Engineering Laboratory – UA1440 (70 m^2 – Shared)
- Advanced Energy Systems Research (AESR) Laboratory – UA1620 (55 m^2)
- Centre for Engineering Design, Automation, and Robotics (CEDAR) – UA1460 (65 m^2 – Shared)
- Thermal Engineering and Microfluidics Laboratory – UA1520 (60 m^2)
- Intelligent Robotics and Manufacturing Laboratory – UA1460 (65 m^2 – Shared)
- Laboratory for Applied Research on Design and Engineering of Composite Materials – UA1440 (70 m^2 – Shared)
- Mechatronic and Robotic Systems Laboratory – UA1460 (65 m^2 – Shared)
- Nuclear Engineering Laboratory – UA4150 (78 m^2)
- Radiation Engineering Laboratory – UAB408 (45 m^2)
- SHARCNET – UA4280 (70 m^2)
- Two-Phase Flow Laboratory – UA1420 (78 m^2)

Integrated Manufacturing Centre (IMC): The IMC is a 925 m^2, fully automated, industrial-grade, flexible manufacturing facility capable of fabricating and assembling a wide range of products from raw materials, with limited human intervention. The IMC provides a facility to conduct research in advanced manufacturing for automotive applications. The main components of the IMC are divided into two main areas: (i) manufacturing zone and (ii) assembly zone.

Manufacturing Zone:

- Inverted, Rail-Mounted, 6-Axis Robot
- Parts Washer
- CNC Electrical Discharge Machine (EDM)
- CNC Milling Machine
- CNC Lathe
- Injection Moulding Machine
- CNC Coordinate Measuring Machine (CMM)
- 3-D Printer

Assembly Zone:

- Automatic Storage and Retrieval System (ASRS)
- Conveyor System
- Eight 6-Axis Robots (Two with Welding Capabilities)

Active Vibration Control Laboratory: This lab is primary used for research into the areas of adaptive, active and passive vibration control, and dynamic modeling and vibrations of nonlinear machines and flexible structures. The experimental work is aimed to verify the vibration suppression of time-varying and parametrically excited dynamic structures through adapting a two-tier alternative: a) system identification to determine the deviations in the structural parameters, and b) a semi-active optimal re-tuning of the absorber elements. In order to show the vibration suppression improvement, the system is initially excited by a simple harmonic excitation. After changing the frequency of excitation, the effectiveness of the re-tuning procedure is obtained. Additional research will study performance of servo-valve controlled pneumatic isolators. Feedback and feed-forward signals using displacement and velocity transducers (LVDT) will be fed to the control systems to excite the spool valve and adjust the air trapped in a pneumatic system. The aim is to have zero level motion for a spring mass subjected to a harmonically excited base support. These studies will have relevance to vibration suppression in automotive related projects.

Advanced Energy Systems Research (AESR) Laboratory: Advanced energy systems, including fuel cells, have importance in automotive related research. The lab will conduct research with analysis, design, modeling, performance improvement, and economic and environmental considerations of advanced energy systems. The main objective is to develop more efficient, cost-effective, environmentally benign and more sustainable systems of energy supply. Some current research projects are listed below.

- Energy and exergy analysis of PEM and SO fuel cells
- Transport phenomena in PEM and SO fuel cells
- Life cycle assessment of fuel cell vehicles
- Hybrid energy systems for hydrogen production
- Energy and exergy analysis of energy storage systems
- Hybrid energy systems for snow melting and freeze protection of highways and bridges
- Performance assessment of integrated energy systems

Advanced Materials Engineering Laboratory: The Advanced Materials Engineering Laboratory conducts leading research on plastic composites, polymer bonding and other topics. Studies are conducted to improve mechanical properties of plastic parts produced by rapid prototyping systems, with the ultimate goal of manufacturing functional parts instead of just 3-D models. The parts are produced by fusing particles or filaments of plastics, at elevated temperatures, which are formed layer by layer to build a 3-D part. The research investigates bond formation due to sintering and diffusion phenomena in polymers. It also develops predictive models for new materials and compositions to be evaluated expeditiously with minimum experimentation.

The Laboratory also conducts research on wood plastic composites. Wood is one of the most versatile of natural materials with many desirable properties. Therefore, its widespread usage as a building material is placing strain on the world's forest resources. The research involves development and production of Wood Plastic Composites (WPC) with improved properties, with goals of enabling these composites to replace wood in many applications, thereby helping to reduce deforestation rates. Current WPC materials have certain inferior properties, which are not suitable for many wood replacement applications. Current research focuses on improving the properties of WPC by using stronger reinforcing fibres, in conjunction with a fine cellular structure. In this way, the new composite not only looks and feels like real wood, but it will have mechanical properties similar to it too. The WPC will be produced with an extrusion processing system capable

of using both chemical and physical blowing agents. Other research interests in the Lboratory are development of production processes and characterization of new composites, nano-materials, bio-based materials, and foamed materials. These advanced materials are envisioned to have promising potential for various automotive applications.

Centre for Engineering Design, Automation, and Robotics (CEDAR): This Centre consists of a reconfigurable manipulator system, mobile-manipulator system, and a machine vision system. The facilities are used to conduct research into robotics, mechatronics, and manufacturing. The CEDAR facilities will also be used in conjunction with the IMC to increase the IMC's ability to conduct research into flexible manufacturing, including applications to automotive manufacturing. CEDAR currently has one affiliated laboratory: the Mechatronic and Robotic Systems Laboratory.

Thermal Engineering and Microfluidics Laboratory: This laboratory studies heat transfer related to automotive and other industrial applications. This includes heat transfer in manufacturing and materials solidification problems, such as extrusion, welding, casting and injection molding. Experimental studies of convective heat transfer with phase change are performed in a closed test cell. Thermocouples and interferometric/pulsed laser measurements provide new temperature and velocity data involving convective irreversibilities within the fluid. Also, predictive design tools are developed with CFD (Computational Fluid Dynamics). The research infrastructure includes test cells for forced and free convection, computer workstations, microchannel experiments, fluid and heat transfer instrumentation (including laser based measurements) and temperature control systems.

Additional research includes micro-scale heat transfer, with applications to automotive waste heat recovery to generate electricity using micro-devices and MEMS (microelectrmechanical systems). Advanced miniaturization involving microfluidic systems has considerable potential in the development of ultra small power sources (micro heat engines), sensors, waste heat recovery, fluid control and advanced insulation materials. For example, micro heat engines could enhance battery performance by recovering lost heat in automotive systems. Also, micro-devices have promising potential for drag reduction in vehicle aerodynamics. This laboratory investigates embedded microchannels, micro-engines or micro-tabs within a surface to delay boundary layer separation or reduce wall friction. It is known that micro-scale heat and fluid flow become appreciably different from large-scale systems, due to surface, electromagnetic and thermocapillary effects. Experimental and theoretical studies of these effects are conducted. In the micro heat engine experiments, a suspended droplet within a microchannel is developed with a thermal bridge to provide a cyclic heat source to the microchannel. The experiment includes sensors responsive to a pressure change within the microchannel to induce a voltage drop.

Intelligent Robotics and Manufacturing Laboratory: The Intelligent Robotics and Manufacturing Laboratory within the Centre for Engineering Design, Automation, and Robotics (CEDAR) at UOIT has two core research directions: (i) Reconfigurable Manufacturing and (ii) Distributed Control. The two core research areas of the lab focus on developing complementary new technologies for flexible manufacturing systems, including applications to automotive manufacturing. The objectives of the Distributed Control research are to develop new Internet/Web based distributed intelligent systems to monitor, manage and control production systems. The newly developed systems will allow manufacturers to re-organize production and process plans dynamically within a shop floor or within a group of shop floors. The objectives of the Reconfigurable Manufacturing research are to develop new production systems that can be reconfigured to optimize utilization of resources. Three themes within the Reconfigurable Manufacturing research are the design of new modular

reconfigurable machine systems (Reconfigurable Parallel Kinematic Machines), virtual reconfigurable manufacturing systems and modular reconfigurable control. The Laboratory will conduct studies relevant to manufacturing processes and robotics relevant to automotive systems.

Laboratory for Applied Research on Design and Engineering of Composite Materials: Cellular and reinforced polymeric and metallic composite materials offer a balance of properties unavailable from other material types. These materials have importance in automotive applications, as they can satisfy the following conflicting requirements of materials: (i) minimum material usage, due to high material costs and weight constraints, and (ii) the need for safe and predictable performance within severe service environments. This research laboratory, led by Dr. Remon Pop-Iliev, focuses on addressing these conflicting requirements. It studies the design and development of novel composite materials capable of satisfying demanding combined mechanical, chemical, thermal and environmental factors. Also, it develops innovative processing strategies for their fabrication. This includes research on material selection development, materials qualification and evaluation, materials processing, product design and manufacturing. It also involves product evaluation, life prediction failure analysis, and disposal recycle reuse analysis.

Mechatronic and Robotic Systems Laboratory: The Mechatronic and Robotic Systems Laboratory conducts research into advanced robotic and mechatronic systems, which have relevance and applications to automotive systems. The laboratory is led by Dr. Scott Nokleby and it is affiliated with UOIT's Centre for Engineering, Design, Automation, and Robotics (CEDAR). The lab conducts research into the kinematics and control of complex systems, such as joint-redundant manipulators, mobile-manipulator systems, and redundantly-actuated parallel manipulators. Redundant manipulators and mobile-manipulator systems offer numerous advantages over traditional non-redundant systems. Effective utilization of the redundancy inherent in systems is instrumented in the systems for practical feasibility in real-world applications. Research is conducted in conjunction with facilities of CEDAR.

SHARCNET: See Section 3.4.

Two Phase Flow Laboratory: Two-phase flows occur in automotive air conditioning systems. The Two Phase Flow Laboratory at UOIT contains a two-phase experimental facility, which is used to study the behaviour of two-phase flows under different orientations and flow conditions. It is a fully automated, closed loop system with vertical upward and vertical downward observation sections, heated test sections, and a 180 degree bend. The facility permits studies of heat transfer, film thickness, void fraction, pressure drop, and phase distribution properties of two-phase flows. An HSV-1000 high speed video camera capable of recording at 500 or 1000 frames per second in colour or black & white is used to record flow regimes and their transitions. Additional equipment planned for the laboratory includes: circumferentially and volumetrically heated channels; concentric heated piping; condensers and heat exchangers; manifolds; low-flow meters; pressure and differential transducers; void-fraction meters; thermocouples; and other instruments. The equipment will be used to conduct research on natural circulation phenomena under single-phase and two-phase flow conditions in pipes and interconnected piping, manifolds, and heat exchangers. These studies will have significance to improved performance of automotive air conditioning systems.

Additional Facilities: Construction of a 3,835 m^2 Engineering Laboratory Building on the UOIT campus will be completed in the Fall of 2006. Upon completion, graduate students will have access to the following shared laboratories:

- Combustion/HVAC Laboratory
- Component Design Laboratory
- Computer Aided Design (CAD) Laboratory
- Control Systems Laboratory
- Electronics Laboratory
- Emerging Energy Laboratory
- Fluid Mechanics/Heat Transfer Laboratories
- Manufacturing Laboratory with CNC and Plastics Processing Equipment
- Mechatronics Laboratory
- Microprocessors/Digital Systems Laboratory
- Solid Mechanics Laboratory

Future Research Laboratories and Facilities: As the Faculty of Engineering and Applied Science and the School of Energy Systems and Nuclear Science expand, additional research labs will be added. Future labs and facilities relevant to the Automotive Engineering graduate programs are shown in the following list.

- Controls Laboratory
- Materials Laboratory
- Micro-Electrical-Mechanical Systems (MEMS) and Nano-Engineering Laboratory
- Thermodynamics Laboratory

The Faculty of Engineering and Applied Science plans to also launch graduate programs (MASc and MEng) in Electrical and Computer Engineering. These programs will compliment Automotive Engineering graduate programs, including the following additional future research labs and facilities.

- Digital Signal Processing (DSP) Laboratory
- Digital Systems Laboratory
- Electronics Laboratory
- Power Systems Laboratory
- Software Laboratory
- Wireless Communications Laboratory

3.4 Computer facilities

Individual supervisors will provide computer facilities, including appropriate computer systems and software packages, for their MASc and MEng-Project students. These facilties will enable them to carry out their research, for their computational, modeling and simulation needs, as well as to enable them access to the internet, email and library resources (such as online journals and conference proceedings). Also, graduate students will have the option to subscribe to UOIT's laptop program. UOIT's laptop program provides students with a current model IBM laptop that is equipped with a suite of program specific software. UOIT has additional shared computer facilities of several hundred PCs available to all students in the Learning Commons and library.

UOIT is a member of the Shared Hierarchical Academic Research Computing Network

(SHARCNET). SHARCNET[3] is a High Performance Computing (HPC) institute involving 11 academic institutions in southern Ontario. The purpose of SHARCNET is to provide computational facilities for leading-edge research in high performance computing. Automotive Engineering graduate students will have access to this facility for their research.

Also, UOIT has joined the program of Partners for the Advancement of Collaborative Engineering Education4 (PACE). PACE is a program between General Motors of Canada, Sun Microsystems, and UGS, which provides state-of-the-art hardware and software for universities with engineering programs. The value of the PACE contribution to UOIT will be $35 million. Both MASc and MEng graduate students will have full access to the PACE hardware and software for their automotive related studies.

3.5 Space

The Faculty of Engineering and Applied Science and the School of Energy Systems and Nuclear Science are located in UOIT's Engineering and Science Building. This is a new building that features office space for faculty and graduate students, in addition to research lab space. The current total research space allocated to Engineering is 1,496 m^2. An additional 273 m^2 has been allocated for faculty and graduate student offices.

Faculty members have private offices with telephone lines. Graduate students will have access to shared office facilities and/or research labs. All offices and research spaces are wired for access to UOIT's network.

Office space totalling 62 m^2 is currently allocated exclusively to graduate students. The amount of space allocated to graduate students will increase as additional graduate programs come online. Graduate students will also have office space within the research laboratory of their respective supervisors. Faculty office space averages 13 m^2 and faculty research space averages ~25 m^2.

3.6 Financial support of graduate students

Every MASc student offered admission to a graduate program in the Faculty of Engineering and Applied Science and its affiliate School of Energy Systems and Nuclear Science at the University of Ontario Institute of Technology should be able to complete their program regardless of their financial status.

It is expected that the average support for MASc students will be approximately $16,000 per year with funding coming from a variety of sources, including the following sources.

- UOIT Scholarships/Bursaries[5] – ten Engineering Research Excellence Awards of $7,500 per year and five Engineering Research Awards of $5,000 per year will be available. These two sets of awards will be merit based. Another $41,000 in funding per year will be distributed on a needs basis in the form of bursaries. The amounts for both scholarships and bursaries will be distributed over a two-year period to eligible students.

3 Source: SHARCNET web site: http://www.sharcnet.ca/

4 Source: PACE web site: http://www.pacepartners.org/

5 The amounts listed are based on a financial analysis of the proposed programs. Exact amounts of the proposed awards may change, depending on University policies and market demands.

- External Awards – These include NSERC postgraduate awards and provincial awards.

- Teaching Assistantships – MASc students will be eligible to earn up to approximately $8,000 per year through teaching assistantships.

- Research Assistantships – Additional support from individual supervisors will be available to students.

- Work-Study and Other Forms of Employment-Based Learning will be available.

- Provincial Loan Programs are also available.

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

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

The University and its student support services shall make financial counselling available to students. Also, the Office of Graduate Programs, with the assistance of Student Services, will issue an annual report on Student Financial Support to include the following items:
- levels of student financial need;
- student financial assistance provided, broken down by category and source (external/Faculty) of assistance; and
- the debt levels carried by students upon graduation.

This report shall be submitted for information to the Academic Council of UOIT.

4 PROGRAM REGULATIONS AND COURSES

4.1 Intellectual development and educational experience of the student

Graduates of the Automotive Engineering graduate programs shall be able to:

- Demonstrate knowledge and understanding of essential facts, concepts, principles, and theories relating to their graduate programs.
- Recognize and be guided by the social, professional, and ethical issues pertaining to advanced education and research.
- Learn to effectively use advanced tools for research.
- Apply the principles of effective data management, information organization, and information-retrieval skills to data of various types.
- Be prepared to pursue specific and well-concentrated research topics in depth.
- Critically evaluate advanced information and knowledge and their implementation.
- Identify problems and opportunities for system analysis, design, improvement, and optimization of automotive systems.
- Understand, explain, and solve problems using quantitative and qualitative methods.
- Have a solid understanding of contemporary issues, as well as professional and ethical

responsibility.
- Have an appreciation of the need and ability to further their education through lifelong learning.
- Know how to design and conduct experiments, analyze and interpret experimental data and results from computational simulations.
- Demonstrate effective oral and written communication skills.
- Have a demonstrated competence in their graduate program areas.

4.2 Program regulations

4.2.1 Part-time studies

To facilitate access to all potential students, part-time studies will be permitted. This is especially true to allow engineers in industry to have access to the MEng program. The MASc program has a minimum residence requirement, where the student must be enrolled full-time and he/she must attend the University of Ontario Institute of Technology. For the MASc program, students must spend a minimum of one year of full-time study in residence at UOIT.

4.2.2 Admission

The minimum admission requirements for the Automotive Engineering MASc and MEng programs is completion of an undergraduate engineering degree from an accredited engineering program at a Canadian university, or its equivalent, with a minimum of a B (75%) average in the last two years, although a B+ is preferred for MASc applicants. Students having undergraduate degrees in mechanical engineering, electrical engineering, or other fields of engineering or science are expected to apply to the Automotive Engineering graduate programs. The multi-disciplinary nature of automotive systems, ranging from manufacturing and powertrains to electrical power / control systems and others, are believed to support high demand and strong enrolment in the new graduate programs.

Applicants must possess maturity and self-motivation. Since close technical contact with a faculty member is an essential part of graduate education in engineering, MASc students must find a professor, who specializes in the applicant's desired area of research and is willing to act as a supervisor, prior to being accepted into the program. MEng students that pursue the MEng-Project option must find a professor who is willing to act as a project supervisor. In the event the MEng student cannot find a project supervisor, the student must transfer into the MEng-Course option.

4.2.3 Degree requirements

The MASc degree involves a thesis, whereas the MEng program has two options. The MEng-Project consists of both courses and a project, while the MEng-Course consists only of courses. Courses offered in the MASc and MEng programs are listed in section 4.4. They are sub-divided into an automotive core area (53xxG) and specific concentration areas of energy and thermofluids (51xxG), mechatronics and manufacturing (52xxG), communications and signal processing (56xxG), software (57xxG) and electronics and control systems (58xxG, 59xxG).

For the MASc program, a student must complete five courses for a total of 15 credits and a thesis worth 15 credits. The course ENGR 5300G (Automotive Engineering) is a required course for all

automotive engineering graduate students. It gives an advanced overview of the automobile as an integrated system. Students having adequate background in automotive engineering with an equivalent undergraduate course may receive an exemption (subject to the approval of both the student's supervisor and the Graduate Program Director), thereby allowing ENGR 5300G to be replaced with another course in the set of 53xxG courses.

Students must also select at least two additional courses from the group of ENGR 53xxG courses (focusing on automotive engineering), plus remaining electives from the series of 50xxG, 51xxG, 52xxG, 56xxG, 57xxG, 58xxG and 59xxG courses. In addition to these five graduate courses, the student must successfully complete ENGR 5003G – Seminar. MASc students must spend a minimum of one year of full-time study in residence at the University of Ontario Institute of Technology. The maximum time for completion of a MASc degree is three years, or six years for students who switch to part-time status, measured from the date the student entered the program. No financial support will be available from the Faculty after two years.

For the MEng-Project option, a student must complete seven courses for a total of 21 credits and a project worth 9 credits. This includes the required course (5300G), at least three other courses from the 53xxG group and remaining courses from the electives. For the MEng-Course option, a student must complete 10 courses, worth a total of 30 credits. In this option, the student requires 5300G, plus at least three other courses from the 53xxG group and the remaining elective courses. The maximum time for completion of a MEng degree is four years measured from the date the student entered the program.

MASc and MEng-Project students may take one senior year engineering or applied science (i.e., a course with the prefix ENGR) undergraduate course in lieu of a graduate level elective course, provided they have not already taken a similar course during their undergraduate degree and the course is approved by both the student's supervisor and the Faculty Graduate Programs Director.

4.2.4 Progress reports

After completing the first year of their program and in each year thereafter, MASc students must complete a progress report that outlines accomplishments in the previous year and objectives for the following year. This progress report must be submitted to the student's supervisory committee (see Section 4.2.6). Permission to continue in the program will be based on a satisfactory report, as determined by the student's supervisory committee.

4.2.5 Thesis evaluation procedures

Within six months after starting a MASc program, a supervisory committee for the student must be formed. The supervisory committee for a MASc student will consist of the student's supervisor or supervisors plus two faculty members from UOIT.

The supervisory committee is chaired by a member of the committee, other than the student's supervisor. The supervisory committee is responsible for monitoring and evaluating the student's progress throughout their program.

All MASc students must successfully defend their thesis in front of an examination committee. The examination committee for a MASc student will be comprised of the student's supervisory committee plus an external examiner, who may or may not be a faculty member of UOIT. All

external examiners must be approved by the Dean of Graduate Studies.

4.2.6 Language requirements

All applicants are required to give evidence of their oral and written proficiency in English. This requirement can be satisfied with one of the following criteria:

i) The student's first language is English;

ii) The student has studied full-time for at least three years (or equivalent in part-time studies) in a secondary school or university where the language of instruction and examination was English; or

iii) The student has achieved the required proficiency on one of the recognized tests in English language, which is acceptable to the University of Ontario Institute of Technology (see below).

Recommended Scores - English Language Proficiency Tests
(higher scores may be required)

TOEFL (computer based): 220
TOEFL (paper based): 560
IELTS: 7
MELAB: 85

4.2.7 Distance delivery

The programs will not be delivered in a distance delivery manner at the present time. In the future, it is expected that distance delivery of parts of the programs, where the subject matter permits, will be used.

4.3 Part-time studies

Part-time studies are primarily offered for the MEng program. To facilitate engineers from industry taking the MEng program, graduate courses are planned to be offered in the late afternoon or early evening.

The MASc program has a minimum residence requirement where the student must be enrolled full-time and he/she must attend the University of Ontario Institute of Technology. For the MASc program, students must spend a minimum of one year of full-time study in residence at UOIT.

4.4 Total graduate courses listed and level

The following list shows all courses relevant to the Automotive Engineering graduate programs. MASc and MEng-Project students may take one ENGR 4xxxU level undergraduate course, in lieu of a graduate level course, provided they have not already taken a similar course during their undergraduate degree and the course is approved by both the student's supervisor and the Faculty Graduate Programs Director. MEng-Course students may take up to two ENGR 4xxxU level undergraduate courses, in lieu of up to two graduate level courses, again, provided they have not taken similar courses during their undergraduate degree and the courses are approved by the Faculty Graduate Programs Director. Students will be allowed to take graduate courses offered by

other faculties, provided they are approved by the Faculty Graduate Programs Director.

- ENGR 5001G - MASc Thesis
- ENGR 5002G - MEng Project
- ENGR 5003G - Seminar
- ENGR 5004G - Directed Studies
- ENGR 5005G - Special Topics
- ENGR 5010G - Advanced Optimization
- ENGR 5011G - Advanced Engineering Design
- ENGR 5012G - Advanced and Smart Materials

Concentration Area - Energy and Thermofluids:

- ENGR 5100G - Advanced Energy Systems
- ENGR 5101G - Thermal Energy Storage
- ENGR 5102G - Fuel Cells and Hydrogen Systems
- ENGR 5120G - Advanced Fluid Mechanics
- ENGR 5121G - Advanced Turbo Machinery
- ENGR 5122G - Computational Fluid Dynamics
- ENGR 5140G - Advanced Heat Transfer
- ENGR 5141G - Heat Exchanger Design and Analysis
- ENGR 5160G - Advanced Thermodynamics
- ENGR 5161G - HVAC and Refrigeration Systems Design and Analysis

Concentration Area - Mechatronics and Manufacturing:

- ENGR 5221G - Computer-Integrated Manufacturing
- ENGR 5222G - Polymers and Composite Processing
- ENGR 5223G - Advanced Manufacturing Processes and Methodologies
- ENGR 5240G - Advanced Dynamics
- ENGR 5241G - Advanced Mechanics of Materials
- ENGR 5242G - Advanced Vibrations
- ENGR 5260G - Advanced Robotics and Automation
- ENGR 5261G - Advanced Mechatronics: MEMS and Nanotechnology
- ENGR 5263G - Advanced Control

Core Area of Automotive Systems:

- ENGR 5300G - Automotive Engineering
- ENGR 5310G - Automotive System Dynamics
- ENGR 5320G - Automotive Aerodynamics
- ENGR 5330G - Automotive Powertrains
- ENGR 5340G - Automotive Noise, Vibrations and Harshness
- ENGR 5350G - Automotive Materials and Manufacturing
- ENGR 5360G - Automotive Software and Electronics

Concentration Area – Communications and Signal Processing:

- ENGR 5610G - Stochastic Processes
- ENGR 5620G - Digital Communications
- ENGR 5630G - Statistical Signal Processing

- ENGR 5640G - Advanced Wireless Communications
- ENGR 5650G - Adaptive Systems and Applications
- ENGR 5670G - Cryptography and Secure Communications

Concentration Area - Software:

- ENGR 5720G - Real-Time and Embedded Computing
- ENGR 5730G - Algorithms and Data Structures
- ENGR 5750G - Software Quality Management
- ENGR 5760G - Software Metrics

Concentration Area – Electronics and Control Systems:

- ENGR 5850G - Analog Integrated Circuit Design
- ENGR 5860G - Digital Integrated Circuit Design
- ENGR 5910G - Embedded Real-Time Control Systems
- ENGR 5920G - Analysis and Control of Nonlinear Systems
- ENGR 5930G - Adaptive Control
- ENGR 5940G - Intelligent Control Systems
- ENGR 5970G – Power Electronics

The core area of automotive systems (ENGR 53xxG) focuses on courses specifically aimed at engineering systems for automobiles, unlike the other concentration areas that have general applications to other mechanical, electrical and non-automotive systems. For example, ENGR 5310G (Automotive System Dynamics) covers systems and components unique to automobiles, while ENGR 5240G (Advanced Dynamics) and ENGR 5263G (Advanced Control) cover more general topics such as variational mechanics and Hamilton's equations, which are applied to non-automotive systems. Another example is ENGR 5320G (Automotive Aerodynamics). It differs considerably from ENGR 5120G (Advanced Fluid Mechanics), which covers advanced theory of fluid mechanics, boundary layers and turbulence, whereas ENGR 5320G focuses on drag correlations and aerodynamics specifically for automobiles. It also differs from ENGR 5122G (Computational Fluid Dynamics), which focuses on algorithm and software development, rather than automotive simulations. Similar explanations can be given for ENGR 5340G (Automotive Noise, Vibrations and Harshness) and ENGR 5242G (Advanced Vibrations), as well as ENGR 5350G (Automotive Materials and Manufacturing) and similar courses offered in the concentration area of mechatronics and manufacturing (ENGR 5012G, ENGR 5221G, ENGR 5222G and ENGR 5223G). In these examples, the ENGR 53xxG set of courses is specifically focused on automotive systems, whereas the ENGR 50xxG, 51xxG and 52xxG courses have more generalized applicability and non-automotive applications.

In addition to the required courses from the ENGR 53xxG set of courses (described in section 4.2.3), it will be beneficial for students to take some of the remaining electives from the same concentration area. For example, after completing ENGR 5310G (Automotive System Dynamics), it could in some instances be beneficial for students to take follow-up courses of ENGR 5240G and/or ENGR 5263G, which cover other advanced topics of dynamics and control. These courses also give greater depth of understanding that would be useful for subsequent research. Courses have been grouped into several areas of concentration. However, it is not required that all electives are completed from a single concentration area, as it is also valuable for students to receive breadth of knowledge at the graduate level.

4.5 Graduate course descriptions

Detailed course decriptions in the Automotive Engineering graduate programs are listed on the following pages.

Course Title: ENGR 5001G – MASc Thesis
Year and Semester: N/A
• **Course Description and Content Outline:** The thesis is the major component of the MASc program and is carried out under the direction of the student's supervisor. The thesis may involve an investigation which is fundamental in nature, or may be applied, incorporating creative design. Through the thesis, candidates are expected to give evidence of competence in research and a sound understanding of the area of specialization involved. • **Delivery Mode and Teaching Method(s):** N/A • **Student Evaluation:** The student is required to write a research thesis. Upon completion, the student must defend the thesis in front of an examination committee comprised of his or her supervisory committee plus an external examiner. • **Resources to be purchased by students:** None • **Textbook requirements:** None • **Learning Outcomes.** Students who successfully complete the MASc thesis have reliably demonstrated the ability to: Outcome 1: understand and explain the essential facts, concepts, principles, and theories relating to their research topic. Outcome 2: learn to effectively use advanced tools for research. Outcome 3: apply the principles of effective data management, information organization, and information-retrieval skills to data of various types. Outcome 4: critically evaluate advanced information and knowledge and their implementation. Outcome 5: understand, explain, and solve problems using quantitative and qualitative methods. Outcome 6: know how to design and conduct experiments, analyze and interpret experimental data, and/or computational results. Outcome 7: effectively write a large research document.
Information About Course Designer/Developer: Course designed by faculty eligible to teach this course: S. Nokleby, PhD, PEng, Faculty of Engineering and Applied Science
Identify faculty to teach the course and/or statement "faculty to be hired": All Faculty Members
If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A
Faculty qualifications required to teach/supervise the course: PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.
Classroom requirements: None
Equipment requirements: Dependent on the Topic

Course Title: ENGR 5002G – MEng Project
Year and Semester: N/A
• **Course Description and Content Outline:** The MEng Project provides students with the opportunity, under the supervision of a faculty member, to integrate and synthesize knowledge gained throughout their program of study. The chosen topic will be dependent on the area of specialization of the student. • **Delivery Mode and Teaching Method(s):** N/A • **Student Evaluation:** Students are required to write a report and give a presentation on their completed project. Upon completion, the student must defend the project in front of an examination committee. • **Resources to be purchased by students:** None • **Textbook requirements:** None • **Learning Outcomes.** Students who successfully complete the MEng project have reliably demonstrated the ability to: Outcome 1: understand and explain the essential facts, concepts, principles, and theories relating to their research topic. Outcome 2: identify problems and opportunities for system analysis, design, improvement, and optimization Outcome 3: understand, explain, and solve problems using quantitative and qualitative methods. Outcome 4: write large technical reports.
Information About Course Designer/Developer: Course designed by faculty eligible to teach this course: S. Nokleby, PhD, PEng, Faculty of Engineering and Applied Science
Identify faculty to teach the course and/or statement "faculty to be hired": All Faculty Members
If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A
Faculty qualifications required to teach/supervise the course: PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.
Classroom requirements: None
Equipment requirements: Dependent on the Topic

Course Title: ENGR 5003G – Seminar
Year and Semester: N/A
• **Course Description and Content Outline:** Participation in a program of seminars by internal and external speakers on current research topics. All MASc students will be required to give a seminar on their thesis research during the second year of their program. • **Delivery Mode and Teaching Method(s):** Mandatory attendance in a series of seminars by internal and external speakers. • **Student Evaluation:** Pass/Fail • **Resources to be purchased by students:** None • **Textbook requirements:** None • **Learning Outcomes.** Students who successfully complete the course have reliably demonstrated the ability to: Outcome 1: recognize and be guided by the social, professional, and ethical issues involved in advanced education and research. Outcome 2: have an understanding of contemporary issues as well as professional and ethical responsibility. Outcome 3: have the appreciation of the need and ability to further their education through lifelong learning. Outcome 4: effectively communicate ideas via a research seminar.
Information About Course Designer/Developer: Course designed by faculty eligible to teach this course: S. Nokleby, PhD, PEng, Faculty of Engineering and Applied Science
Identify faculty to teach the course and/or statement "faculty to be hired": N/A
If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A
Faculty qualifications required to teach/supervise the course: N/A
Classroom requirements: Seminars will require the use of a classroom/meeting with VRC, DVD, data projectors, and internet access.
Equipment requirements: None

Course Title: ENGR 5004G – Directed Studies
Year and Semester: N/A
• **Course Description and Content Outline:** Faculty permission may be given for supervised research projects, individual study, or directed readings. Students wishing to pursue a course of directed studies must, with a faculty member who is willing to supervise such a course, formulate a proposal accurately describing the course content, the intended method and extent of supervision, and the method by which work will be evaluated. This course may only be taken once. • **Delivery Mode and Teaching Method(s):** Dependent on the Topic • **Student Evaluation:** Dependent on the Topic • **Resources to be purchased by students:** Dependent on the Topic • **Textbook requirements:** Dependent on the Topic • **Learning Outcomes:** Dependent on the Topic
Information About Course Designer/Developer: Course designed by faculty eligible to teach this course: S. Nokleby, PhD, PEng, Faculty of Engineering and Applied Science
Identify faculty to teach the course and/or statement "faculty to be hired": All Faculty Members
If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A
Faculty qualifications required to teach/supervise the course: PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.
Classroom requirements: None
Equipment requirements: Dependent on the Topic

Course Title: ENGR 5005G – Special Topics
Year and Semester: N/A
• **Course Description and Content Outline:** Presents material in an emerging field or one not covered in regular offerings. May be taken more than once, provided the subject matter is substantially different. • **Delivery Mode and Teaching Method(s):** Dependent on the Topic • **Student Evaluation:** Dependent on the Topic • **Resources to be purchased by students:** Dependent on the Topic • **Textbook requirements:** Dependent on the Topic • **Learning Outcomes:** Dependent on the Topic
Information About Course Designer/Developer: Course designed by faculty eligible to teach this course: S. Nokleby, PhD, PEng, Faculty of Engineering and Applied Science
Identify faculty to teach the course and/or statement "faculty to be hired": All Faculty Members
If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A
Faculty qualifications required to teach/supervise the course: PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.
Classroom requirements: Dependent on the Topic
Equipment requirements: Dependent on the Topic

Course Title: ENGR 5010G – Advanced Optimization

Year and Semester: N/A

- **Course Description and Content Outline:** The objective of this course is to understand the principles of optimization and its application to engineering problems. Topics covered include: the steepest descent and Newton methods for unconstrained optimization; golden section, quadratic, cubic and inexact line searches; conjugate and quasi-Newton methods; the Fletcher-Reeves algorithm; fundamentals of constrained optimization theory; simplex methods for linear programming; modern interior-point methods; active-set methods and primal-dual interior-point methods for quadratic and convex programming; semidefinite programming algorithms; sequential quadratic programming and interior-point methods for nonconvex optimization. In addition, implementation issues and current software packages/algorithms for optimization will be covered. Global optimization, including genetic algorithms and simulated annealing, will be introduced.
- **Delivery Mode and Teaching Method(s):** This one-term course will be delivered using 3 hours of lectures per week.
- **Student Evaluation:** The principal form of assessment will be two major research projects, one counting for 30% and the other counting for 50% of the course mark. Assignments will count for the remaining 20%. The exact weighting of the various components will be presented to the students in the first week of lectures.
- **Resources to be purchased by students:** N/A
- **Textbook requirements (sample):**
  Antoniou, A. and Lu, W.-S., (In-Press), *Optimization: Methods, Algorithms, and Applications*, Kluwer Academic.
- **Learning Outcomes.** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome 1: formulate and solve unconstrained and constrained optimization problems.
  Outcome 2: understand how the major unconstrained, constrained, and global optimization techniques work.
  Outcome 3: use optimization as a tool for solving engineering design problems.

Information About Course Designer/Developer:
Course designed by faculty eligible to teach this course: S. Nokleby, PhD, PEng, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
S. Nokleby, D. Zhang and S. Shahbazpanahi

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: Software requirements include MATLAB with both the Optimization Toolbox and the Genetic Algorithm and Direct Search Toolbox.

Course Title: ENGR 5011G – Advanced Engineering Design

Year and Semester: N/A

- **Course Description and Content Outline:** This course covers the basics of design philosophy, methodology, principles, and theory as a foundation for surveying current research areas in the product development process. A brief introduction to concurrent design and life cycle design is followed by addressing the application of the design process to problem solving. The relationship between creativity and the design process is explored by using tools for solving engineering system design and synthesis problems. Computer, mathematical, and/or physical modeling of the problem and solution, the axiomatic design approach, Taguchi robust design, design of experiments, and prototyping are strongly emphasized topics.
  - **Content outline by topic:**
  1. Introduction to Concurrent Design
  2. Introduction to Life Cycle Design. Design for X
  3. Axiomatic Design. The independence axiom. The information axiom. Design Matrix. Design hierarchy. Mapping from functional to physical to process domains.
  4. Functional Decomposition
  5. Modeling
  6. Taguchi Robust Design
  7. Design of Experiments
  8. Prototyping
  9. Analysis of Engineering Experiments
- **Delivery Mode and Teaching Method(s):** Classroom presentation, laboratories, and tutorials. Guest lectures by engineers from industry on selected topics. Lectures: 3 hours/week and Tutorials/Laboratory: 2 hours/week
- **Student Evaluation:** Teamwork and communication skills are strongly encouraged and developed through group assignments. Students will be actively involved in hands-on design and execution of original individual and group projects under faculty supervision. Student project teams will prepare a demanding final group project involving both analytical techniques and some computational techniques that will be supported with a detailed report and an oral presentation.
- **Resources to be purchased by students:** To be Determined by Professor
- **Textbook requirements:** None.
- **References:**
  Suh, N. P., 1990, *The Principles of Design*, Oxford Series on Advanced Manufacturing.
- **Learning Outcomes.** At the conclusion of the semester the student should be able to:
  Outcome 1: synthesise solutions to open-ended design problems
  Outcome 2: demonstrate the ability to define the problem, review current research, generate multiple solutions to a defined problem, analyze possible solutions, and develop the best possible solution to the defined problem.
  Outcome 3: demonstrate the ability to model the problem, generate a computer model of the problem / solution or create a physical model of the solution.
  Outcome 4: develop criteria for testing, analyze how well the model fits the defined solution, optimize the solution, document the solution, demonstrate the ability of the design to meet the original problem statement, develop a technical presentation of the solution.
  Outcome 5: identify the principles of good teamwork and effective communication and demonstrate those skills during a series of interactive exercises.

Information About Course Designer/Developer: Course designed by faculty eligible to teach this course: R. Pop-Iliev, PhD, PEng, Faculty of Engineering and Applied Science
Identify faculty to teach the course and/or statement "faculty to be hired": R. Pop-Iliev
If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A
Faculty qualifications required to teach/supervise the course: PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.
Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.
Equipment requirements: Stationary desktop PC units (or laptops) having a specific suite of software installed and wireless internet access will be preferred.

Course Title: ENGR 5012G – Advanced and Smart Materials

Year and Semester: N/A

- **Course Description and Content Outline:** The core material will consist of: basic features of physical transducer behavior, mathematical constitutive models and material properties, characterization methods and experimental data, sensor and actuator devices, translation of material behavior to device behaviour, solid state devices, non-solid state devices (motors and pumps), mesoscale and MEMS devices, adaptive structures. However, due to the rapid evolutions in the field, the syllabus will be dynamic to respond to the new developments in materials and their applications. The topics will be continually reviewed and monitored for currency. Some of the topics from the following list will be also be included, covering fundamental principles, mechanisms and applications: a) Piezoelectric materials, b) 'Negative' materials, c) Conductive polymers, d) Advanced composites, e) Shape-memory materials, f) Magneto-rheological fluids, and g) Intelligent textiles.
- **Delivery Mode and Teaching Method(s):** This one-term course will be delivered using 3 hours of lectures per week.
- **Student Evaluation:** Reports 35%, presentations 35% exam 30%
- **Resources to be purchased by students:** N/A
- **Textbook requirements:** None
- **Learning Outcomes.** On successful completion of course, the students will have demonstrated the ability to:
  Outcome 1: understand the issues relating to a range of advanced and smart materials, and the fundamental principles and mechanisms responsible for their characteristic behaviours.
  Outcome 2: discuss the role and critical importance of the underlying mechanisms responsible for advanced and smart behaviour.
  Outcome 3: critically assess a given scenario and produce a scientific report that is effective in terms of content and structure.
  Outcome 4: select and use materials based upon the properties and characteristics of materials and their influences on the design of solutions to technological challenges.
  Outcome 5: undertake case studies into the area of advanced and smart materials and identify and retrieve relevant information from various sources with minimal assistance.

Information About Course Designer/Developer:
Course designed by faculty eligible to teach this course: G. Rizvi, PhD, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
R. Pop-Iliev and G. Rizvi

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: None

Course Title: ENGR 5100G – Advanced Energy Systems

Year and Semester: N/A

- **Course Description and Content Outline:** Advanced power and refrigeration cycles. Advanced gas turbine systems. Combustion systems and applications. Energy storage. Nuclear reactor technology. Fuel cells. Solar power. Wind power. Hydro power. Co- and tri-generation. Geothermal district heating systems. Energy and exergy analysis of advanced energy systems.
  - **Content outline by topic:**
    - Advanced power and refrigeration cycles.
    - Advanced gas turbine systems.
    - Combustion systems and applications.
    - Energy storage.
    - Nuclear reactor technology.
    - Fuel cells.
    - Solar power, Wind power, Hydro power.
    - Co- and tri-generation.
    - Geothermal district heating systems.
    - Energy and exergy analysis of advanced energy systems.
- **Delivery Mode and Teaching Method(s):** This one-term course will be delivered using 3 hours of lectures per week.
- **Student Evaluation:** Mid-term exam (20%), project and presentation (25%), weekly homework assignments (15%), and final exam (40%).
- **Resources to be purchased by students:** None
- **Textbook requirements:**
  Kharchenko, N. V., 1999, *Advanced Energy Systems*, New York, NY.
- **Learning Outcomes.** This course is designed to give graduates in Engineering theoretical and practical background on how to design, analyze, rate and evaluate advanced energy systems, particularly for practical applications and provide them with the necessary practical solution methodologies and tools.

Information About Course Designer/Developer:
Course designed by faculty eligible to teach this course: I. Dincer, PhD, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
I. Dincer and M. Rosen

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? Course materials and details will be available on WebCT. Numerical and analytical methods will be used.

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: Engineering Equation Solver (EES) and MATLAB will be provided to the students.

Course Title: ENGR 5101G – Thermal Energy Storage

Year and Semester: N/A

- **Course Description and Content Outline:** General Introductory Aspects for Thermal Engineering. Energy Storage Systems. Thermal Energy Storage Methods. Thermal Energy Storage and Environmental Impact. Energy Storage and Energy Savings. Solar Energy and Thermal Energy Storage. Heat Transfer and Stratification in Sensible Heat Storage Systems. Latent Heat Storage Systems. Heat Storage with Phase Change. Thermodynamic Optimization of Thermal Energy Storage Systems. Energy and Exergy Analyses of Thermal Energy Storage Systems. Thermal Energy Storage Case Studies.
  - **Content outline by topic:**
    - General Introductory Aspects for Thermal Engineering.
    - Energy Storage Systems. Thermal Energy Storage Methods.
    - Thermal Energy Storage and Environmental Impact.
    - Energy Storage and Energy Savings.
    - Solar Energy and Thermal Energy Storage.
    - Heat Transfer and Stratification in Sensible Heat Storage Systems.
    - Latent Heat Storage Systems. Heat Transfer with Phase Change.
    - Thermodynamic Optimization of Thermal Energy Storage Systems.
    - Energy and Exergy Analyses of Thermal Energy Storage Systems.
    - Thermal Energy Storage Case Studies.
- **Delivery Mode and Teaching Method(s):** This one-term course will be delivered using 3 hours of lectures per week.
- **Student Evaluation:** Mid-term exam (20%), project and presentation (25%), weekly homework assignments (15%), and final exam (40%).
- **Resources to be purchased by students:** None
- **Textbook requirements:** Dincer, I. and Rosen, M. A., 2002, *Thermal Energy Storage Systems and Applications*, Wiley: New York, NY.
- **Learning Outcomes.** This course is designed to give graduates in Engineering theoretical and practical background on thermal energy storage systems and applications and provide them with the solution methodologies and tools for practical thermal energy storage systems design, analysis and performance evaluation.

Information About Course Designer/Developer:
Course designed by faculty eligible to teach this course: I. Dincer, PhD, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
I. Dincer and M. Rosen

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? Course materials and details will be available on WebCT. Numerical and analytical methods will be used.

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: Engineering Equation Solver (EES).

Course Title: ENGR 5102G – Fuel Cells and Hydrogen Systems

Year and Semester: N/A

- **Course Description and Content Outline:** Introduction to hydrogen and hydrogen fuel cells. Efficiency and open circuit voltage. Operational fuel cell voltages. Proton exchange membrane fuel cells. Alkaline electrolyte fuel cells. Direct methanol fuel cells. Medium and high-temperature fuel cells. Fuelling fuel cells. Components of fuel cell power systems. Delivering fuel cell power. Analysis of Fuel cell systems. Fuel cell calculations. Tests.
  - **Content outline by topic:**
    - Introduction to hydrogen and hydrogen fuel cells.
    - Efficiency and open circuit voltage. Operational fuel cell voltages.
    - Proton exchange membrane fuel cells.
    - Alkaline electrolyte fuel cells. Direct methanol fuel cells.
    - Medium and high-temperature fuel cells. Fuelling fuel cells.
    - Components of fuel cell power systems, system design.
    - Delivering fuel cell power. Analysis of Fuel cell systems.
    - Fuel cell modeling and calculations. Tests and industry standards.
    - Reliability, durability, and engineering challenges.
- **Delivery Mode and Teaching Method(s):** This one-term course will be delivered using 3 hours of lectures per week.
- **Student Evaluation:** Mid-term exam (20%), project and presentation (25%), weekly homework assignments (15%), and final exam (40%).
- **Resources to be purchased by students:** None
- **Textbook requirements:** Larminie, J. and Dicks, A., 2003, *Fuel Cell Systems Explained – 2nd Edition*, Wiley: New York, NY.
- **Learning Outcomes.** Upon completion of this course, students should be able to:
  Outcome 1: apply fundamentals of electrochemistry, thermodynamics, fluid dynamics, and heat and mass transfer, to examine various issues of interest to mechanical engineers including electrode flooding (water management), temperature, and species distribution.
  Outcome 2: articulate the basic fundamentals of electrochemistry in terms of electrode processes, electrochemical potential, thermodynamics and kinetics of electrode reactions applicable to electrochemical systems.
  Outcome 3: describe, explain, and model the various types of electrochemical overpotential occurring within the electrochemical system including ohmic, concentration, and activation overpotentials.
  Outcome 4: describe, explain, and model the effects of mass transfer in electrochemical systems by migration, diffusion, and convection.
  Outcome 5: describe and use Nernst equation to model cell EMF as a function of product and reactant activities.
  Outcome 6: understand the meaning, use, and experimental derivation of the Tafel slope for determination of the transfer coefficient and the exchange current density.
  Outcome 7: understand the concepts and fundamentals behind basic experimental electrochemical methods used to determine various key parameters including, mass and ionic transport coefficients, exchange current density, and internal resistances.
  Outcome 8: Identify the main components, advantages, and limitations of gas-fed PEM, direct inject PEM, molten carbonate, alkaline, phosphoric acid, and SO fuel cell systems.
  Outcome 9: visualize current, temperature and species distributions in an operating fuel cell under various operating conditions.
  Outcome 10: apply basic software tools to the analysis of experimental data and

mathematical models.
Information About Course Designer/Developer: Course designed by faculty eligible to teach this course: I. Dincer, PhD, Faculty of Engineering and Applied Science
Identify faculty to teach the course and/or statement "faculty to be hired": P. Berg, I. Dincer, and M. Rosen
If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? Course materials and details will be available on WebCT. Numerical and analytical methods will be used.
Faculty qualifications required to teach/supervise the course: PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.
Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.
Equipment requirements: Engineering Equation Solver (EES) and MATLAB will be provided to the students.

Course Title: ENGR 5120G – Advanced Fluid Mechanics

Year and Semester: N/A

- **Course Description and Content Outline:** Derivation of three-dimensional conservation equations of mass, momentum and energy for compressible viscous fluids. General properties of Navier-Stokes equations. Examples of exact solutions of the Navier-Stokes equations. Approximate solutions for creeping motions. Laminar boundary layer equations and methods of solution: derivation of boundary layer equations, boundary layer separation, general properties of boundary layer equations; Von Karman momentum-integral equations; finite-difference solutions. Stability of laminar flows: theory of small disturbances; Orr-Summerfield equation, transition. Introduction to turbulence. Applications.
  - **Content outline by topic:**
    - Derivation of three-dimensional conservation equations of mass, momentum and energy for compressible viscous fluids.
    - General properties of Navier-Stokes equations.
    - Examples of exact solutions of the Navier-Stokes equations.
    - Approximate solutions for creeping motions.
    - Laminar boundary layer equations and methods of solution: derivation of boundary layer equations, boundary layer separation, general properties of boundary layer equations; Von Karman momentum-integral equations; finite-difference solutions.
    - Stability of laminar flows: theory of small disturbances; Orr-Summerfield equation, transition.
    - Introduction to turbulence. Applications.
- **Delivery Mode and Teaching Method(s):** This one-term course will be delivered using 3 hours of lectures per week.
- **Student Evaluation:** Mid-term exam (20%), project and presentation (25%), weekly homework assignments (15%), and final exam (40%). A term project will be assigned to develop and use numerical techniques to solve the governing equations.
- **Resources to be purchased by students:** None
- **Textbook requirements:**
  Schlichting, H., 1989, *Boundary Layer Theory – 8th Edition*, McGraw-Hill: New York, NY.
  White, F. M., 1991, *Viscous Fluid Flow*, McGraw-Hill, New York, NY.
- **Learning Outcomes.** This course is designed to give graduates in Engineering insight into the phenomena of viscous fluid flow, to enable them to derive the governing equations for practical cases, and to show how the boundary layer theory can make flows involving fluids of small viscosity amenable to successful theoretical analyses.

Information About Course Designer/Developer:
Course designed by faculty eligible to teach this course: I. Dincer, PhD, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
K. Gabriel and G. Naterer

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? Course materials and details will be available on WebCT. Computer-based simulations will be conducted.

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty

members will normally be registered Professional Engineers.
Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.
Equipment requirements: Simulation software.

Course Title: ENGR 5121G – Advanced Turbo Machinery

Year and Semester: N/A

- **Course Description and Content Outline:** Basic Thermodynamics and Fluid Mechanics equations and definitions of efficiencies in turbomachines. Two-dimensional cascades (cascade analysis, performance of cascades and cascade correlations). Axial flow turbines. Radial flow turbines. Axial flow compressors. Centrifugal compressors and fans. Applications of turbomachinery to engineering problems. Design, analysis and performance analyses of turbomachines. Transport phenomena aspects. Software use and tests.
  - **Content outline by topic:**
    - Basic Thermodynamics and Fluid Mechanics equations and definitions of efficiencies in turbomachines.
    - Two-dimensional cascades (cascade analysis, performance of cascades and cascade correlations).
    - Axial flow turbines, radial flow turbines, axial flow compressors.
    - Centrifugal compressors and fans.
    - Applications of turbomachinery to engineering problems.
    - Design, analysis and performance analyses of turbomachines.
    - Transport phenomena aspects.
    - Software use and tests.
- **Delivery Mode and Teaching Method(s):** This one-term course will be delivered using 3 hours of lectures per week.
- **Student Evaluation:** Mid-term exam (20%), project and presentation (25%), weekly homework assignments (15%), and final exam (40%).
- **Resources to be purchased by students:** None
- **Textbook requirements:**
  Wilson, G. and Korakianitis, T., 2002, *The Design of High-Efficiency Turbomachinery and Gas Turbines – 2nd Edition*, Pearson: New York, NY.
- **Learning Outcomes.** It is aimed to teach students the principles used in analyzing/designing compressors and turbines. Students will be expected to design a gas turbine to meet specific mission requirements. Upon completion of the course, students will be able to understand the design systems and techniques used in the aeropropulsion and gas turbine industries.

Information About Course Designer/Developer:
Course designed by faculty eligible to teach this course: I. Dincer, PhD, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
M. Rosen

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? Course materials and details will be available on WebCT. Numerical and analytical methods will be used.

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: Engineering Equation Solver (EES) and MATLAB will be provided to the students.

Course Title: ENGR 5122G – Computational Fluid Dynamics

Year and Semester: N/A

- **Course Description and Content Outline:** Introduction to CFD modelling and mesh generation software. Basic equations of fluid flow and commonly used approximations. Turbulence modelling (one and two equation models, and higher order models). Iterative solution methods and convergence criteria. Practical analysis of turbulent pipe flow / mixing elbow and turbomachinery blade problems. Software use and tests.
  - **Content outline by topic:**
    - Introduction to CFD modelling and mesh generation software.
    - Basic equations of fluid flow and commonly used approximations.
    - Turbulence modelling (one and two equation models, higher order models).
    - Iterative solution methods and convergence criteria.
    - Practical analysis of turbulent pipe flow / mixing elbow and turbomachinery blade problems.
    - Software use and tests.
- **Delivery Mode and Teaching Method(s):** This one-term course will be delivered using 3 hours of lectures per week.
- **Student Evaluation:** Mid-term exam (20%), project and presentation (25%), weekly homework assignments (15%), and final exam (40%).
- **Resources to be purchased by students:** None
- **Textbook requirements: (i)** Chung, T. J., 2002, *Computational Fluid Dynamics*, Cambridge University Press: (ii) Oxford, UK. Ferziger, J. H., and Peric, M., 2003, *Computational Methods for Fluid Dynamics*, Springer: New York, NY.
- **Learning Outcomes.** The aim of this course is to develop practical skills in Computational Fluid Dynamics and the use of FLUENT, the most widely used commercial CFD code available. Students are expected to apply these skills to relevant Engineering applications and gain an appreciation of the limitations and advantages of CFD modelling. On completion of the course a successful student should be able to: (i) Set up a numerical model (including mesh generation) using FLUENT. (ii) Identify and define the correct boundary conditions and most appropriate turbulence model. (iii) Interpret the results and validate them using experimental and theoretical data.

Information About Course Designer/Developer:
Course designed by faculty eligible to teach this course: I. Dincer, PhD, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
P. Gulshani and G. Naterer

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? Course materials and details will be available on WebCT. Numerical and analytical methods will be used.

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: Special CFD software (e.g., FLUENT) will be provided to the students.

Course Title: ENGR 5140G – Advanced Heat Transfer

Year and Semester: N/A

- **Course Description and Content Outline:** Introduction and conservation equations. Conservation equations and gas kinetics. Unidirectional Steady Conduction.Multidirectional Steady Conduction. Time-Dependent Conduction. External Forced Convection. Internal Forced Convection. Natural Convection. Convection with Change of Phase. Heat Exchangers. Radiation. Mass Transfer Principles.
  - **Content outline by topic:**
    - Introduction and conservation equations.
    - Conservation equations and gas kinetics.
    - Unidirectional Steady Conduction. Multidirectional Steady Conduction.
    - Time-Dependent Conduction.
    - External Forced Convection. Internal Forced Convection.Natural Convection.
    - Convection with Change of Phase.
    - Radiation.
    - Mass Transfer Principles.
- **Delivery Mode and Teaching Method(s):** This one-term course will be delivered using 3 hours of lectures per week.
- **Student Evaluation:** Mid-term exam (20%), project and presentation (25%), weekly homework assignments (15%), and final exam (40%).
- **Resources to be purchased by students:** None
- **Textbook requirements:**
  Bejan, A., 1998, *Heat Transfer – 2nd Edition*, Wiley: New York, NY.
  Bejan, A. and Kraus, A. D., 2003, *Heat Transfer Handbook*, Wiley: New York, NY.
- **Learning Outcomes.** This course is designed to give graduates in Engineering insights and theory into the phenomena of advanced heat transfer topics in conduction, convection and radiation, phase change heat transfer and mass transfer and provide them with the background to solve advanced heat transfer problems both analytically and numerically.

Information About Course Designer/Developer:
Course designed by faculty eligible to teach this course: I. Dincer, PhD, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
I. Dincer, K. Gabriel, P. Gulshani, G. Naterer, and M. Rosen

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? Course materials and details will be available on WebCT. Numerical and analytical methods will be used.

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: Engineering Equation Solver (EES) will be provided to the students.

Course Title: ENGR 5141G – Heat Exchanger Design and Analysis

Year and Semester: N/A

- **Course Description and Content Outline:** Basic mechanisms of heat transfer, such as conduction, convection, boiling, condensation and radiation. Classification of heat exchangers according to flow. Heat exchanger analysis using LMTD, 2–NTUc–R–P–F and ε-NTU methods. Selection criteria of heat exchangers. Thermal-hydraulic and mechanical design of shell-and-tube heat exchangers. Design and analysis of double-pipe heat exchangers. Design and performance evaluation of finned-tube heat exchangers. Energy and exergy analyses of heat exchangers. Performance evaluation of plate-fin heat exchangers. Design considerations in boilers and condensers. Fouling growth models and its impact on heat exchanger performance and life-cycle analysis. Flow-induced vibration. Software Use/Tests.
  - **Content outline by topic:**
    - Basic mechanisms of heat transfer, such as conduction, convection, boiling, condensation and radiation.
    - Classification of heat exchangers according to flow.
    - Heat exchanger analysis using LMTD, 2–NTUc–R–P–F and -NTU methods.
    - Selection criteria of heat exchangers.
    - Thermal-hydraulic and mechanical design of shell-and-tube heat exchangers.
    - Design and analysis of double-pipe heat exchangers.
    - Design and performance evaluation of finned-tube heat exchangers.
    - Energy and exergy analyses of heat exchangers.
    - Performance evaluation of plate-fin heat exchangers.
    - Design considerations in boilers and condensers.
    - Fouling growth models and its impact on heat exchanger performance and life-cycle analysis.
    - Flow-induced vibration.
    - Software Use/Tests.
- **Delivery Mode and Teaching Method(s):** This one-term course will be delivered using 3 hours of lectures per week.
- **Student Evaluation:** Mid-term exam (20%), project and presentation (25%), weekly homework assignments (15%), and final exam (40%).
- **Resources to be purchased by students:** None
- **Textbook requirements:**
  Hewitt, G. F., 2002, *Heat Exchanger Design Handbook*, Begell House: New York, NY.
- **Learning Outcomes.** This course is designed to give graduates in Engineering theoretical and practical background on how to design, analyze, rate and evaluate heat exchangers, particularly for thermal applications and provide them with the solution methodologies and tools for practical applications.

Information About Course Designer/Developer:
Course designed by faculty eligible to teach this course: I. Dincer, PhD, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
I. Dincer, K. Gabriel, G. Naterer, and M. Rosen

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-

line? Course materials and details will be available on WebCT. Numerical and analytical methods will be used.
Faculty qualifications required to teach/supervise the course: PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.
Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.
Equipment requirements: Engineering Equation Solver (EES) and MATLAB will be provided to the students.

Course Title: ENGR 5160G – Advanced Thermodynamics

Year and Semester: N/A

- **Course Description and Content Outline:** Axiomatic representation of fundamentals of classical thermodynamics. First law of thermodynamics. Equilibrium. Euler and Gibbs-Duhem relations. Second law of thermodynamics. Entropy production. Exergy and Irreversibility. Energy and exergy analysis of advanced power and refrigeration cycles. Legendre transformations and Extremum principle. Maxwell relations and thermodynamics derivatives. Stability. Phase transformations. Nernst postulate. Chemical reactions and equilibrium. Case study problems.
  - **Content outline by topic:**
    - Axiomatic representation of fundamentals of classical thermodynamics.
    - First law of thermodynamics.
    - Equilibrium.
    - Euler and Gibbs-Duhem relations.
    - Second law of thermodynamics.
    - Entropy production.
    - Exergy and irreversibility.
    - Energy and exergy analysis of advanced power and refrigeration cycles.
    - Legendre transformations and extremum principle.
    - Maxwell relations and thermodynamics derivatives.
    - Stability. Phase transformations.
    - Nernst postulate.
    - Chemical reactions and equilibrium.
    - Case study problems.
- **Delivery Mode and Teaching Method(s):** This one-term course will be delivered using 3 hours of lectures per week.
- **Student Evaluation:** Mid-term exam (20%), project and presentation (25%), weekly homework assignments (15%), and final exam (40%).
- **Resources to be purchased by students:** None
- **Textbook requirements:**
  Bejan, A., 1997, *Advanced Engineering Thermodynamics – 2nd Edition*, Wiley: New York, NY.
  Winterbone, D. E., 1997, *Advanced Thermodynamics for Engineers*, Elsevier: London, UK.
  Wark, K., 1994, *Advanced Thermodynamics for Engineers*, McGraw-Hill: New York, NY.
- **Learning Outcomes.** This course is designed to give graduate students in engineering selected advanced subjects in thermodynamics. The students are also expected to learn the main laws and concepts of thermodynamics and apply these over the whole range of conventional and new systems and technologies covered by engineering thermodynamics.

Information About Course Designer/Developer:
Course designed by faculty eligible to teach this course: I. Dincer, PhD, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
I. Dincer, G. Naterer, and M. Rosen

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? Course materials and details will be available on WebCT.

Faculty qualifications required to teach/supervise the course: PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.
Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.
Equipment requirements: None

Course Title: ENGR 5161G – HVAC and Refrigeration Systems Design and Analysis

Year and Semester: N/A

- **Course Description and Content Outline:** Basic Concepts. Elements of Heat Transfer for Buildings. Thermodynamic Processes in Buildings. Energy use and Environmental Impact. Human Thermal Comfort and Indoor Air Quality. Fluid Mechanics in Building Systems. Solar Radiation. Heating and Cooling Loads. Annual Energy Consumption. Heat Transfer Equipment. Cooling Equipment. Thermal Energy Storage. Software Use/Tests.
  - **Content outline by topic:**
    - Basic Concepts
    - Elements of Heat Transfer for Buildings
    - Thermodynamic Processes in Buildings
    - Energy use and Environmental Impact
    - Human Thermal Comfort and Indoor Air Quality
    - Fluid Mechanics in Building Systems
    - Solar Radiation, Heating and Cooling Loads
    - Annual Energy Consumption
    - Heat Transfer Equipment, Cooling Equipment
    - Thermal Energy Storage. Software Use/Tests.
- **Delivery Mode and Teaching Method(s):** This one-term course will be delivered using 3 hours of lectures per week.
- **Student Evaluation:** Mid-term exam (20%), project and presentation (25%), weekly homework assignments (15%), and final exam (40%).
- **Resources to be purchased by students:** None
- **Textbook requirements:**
  Dincer, I., 2003, *Refrigeration Systems and Applications*, Wiley, New York, NY.
  Kreider, J., Rabl, A., 2002, *Heating and Cooling of Buildings*, McGraw-Hill, New York, NY.
  ASHRAE, 1999, *Handbook of Fundamentals*, Atlanta, GA.
- **Learning Outcomes.** This course is designed to give graduates in Engineering theoretical and practical background on HVAC and refrigeration systems, particularly for building applications and provide them with the solution methodologies and tools for practical HVAC and refrigeration systems design, analysis and performance evaluation.

Information About Course Designer/Developer: Course designed by faculty eligible to teach this course: I. Dincer, PhD, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
I. Dincer and M. Rosen

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? Course materials and details will be available on WebCT. Numerical and analytical methods will be used.

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: Engineering Equation Solver (EES) will be provided to the students. The second software will be provided with the book.

Course Title: ENGR 5221G – Computer-Integrated Manufacturing

Year and Semester: N/A

- **Course Description and Content Outline:** This course is about Computer-Integrated Manufacturing (CIM) with a particular focus on automated manufacturing process planning. It provides advanced instruction in design and implementation of integrated CAD/CAM, robotics, and flexible manufacturing systems. It also provides emphasis on concurrent engineering principles, manufacturing process engineering, computer-aided process planning, NC programming, and CAD/CAM integration. The course provides experience with CAD/CAM software and NC machines.
  - **Content outline by topic:**
    1. Computer evolution
       - Computer architecture
       - Boolean algebra
       - Logic design
    2. Concurrent engineering principles
    3. Analysis of product definition processes
    4. Manufacturing process engineering
    5. Communication in manufacturing environments
    6. Technological and organizational requisites for CIM
    7. Manufacturing requirements planning
    8. CAD/CAM integration
       - NC programming
    9. Just-in-time manufacturing
    10. Future directions for factory automation
- **Delivery Mode and Teaching Method(s):** Classroom presentation, laboratories, and tutorials. Guest lectures by engineers from industry on selected topics. Lectures: 3 hours/week and Tutorials/Laboratory: 2 hours/week.
- **Student Evaluation:** Students will be actively involved in hands-on design and execution of original individual and group projects under faculty supervision. Student project teams will prepare a demanding final group project involving a detailed report and an oral presentation.
- **Resources to be purchased by students:** To be Determined by Professor
- **Textbook requirements:**
  None
- **Learning Outcomes.** At the conclusion of the semester the student should be able to:
  Outcome 1: explain the issues relating to automation in a manufacturing setup and the abilities and limitation of computerized systems in dealing with them.
  Outcome 2: explain the function of software commonly used in manufacturing and demonstrate their ability to use that software to design a flexible manufacturing process.
  Outcome 3: access and use a variety of resources (human, equipment, tools, plans, vendors and materials) to plan and complete CIM projects according to process and time requirements.
  Outcome 4: analyze and execute a flexible manufacturing process, identify problems in the process, and redesign the process for improvement during a simulated manufacturing line.
  Outcome 5: to demonstrate proficiency in these skills through a variety of shop projects and in a final exercise that uses a combination of these skills.

Information About Course Designer/Developer:

Course designed by faculty eligible to teach this course: R. Pop-Iliev, PhD, PEng, Faculty of Engineering and Applied Science and G. Rizvi, PhD, Faculty of Engineering and Applied Science
Identify faculty to teach the course and/or statement "faculty to be hired": R. Pop-Iliev and G. Rizvi
If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A
Faculty qualifications required to teach/supervise the course: PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.
Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.
Equipment requirements: Stationary desktop PC units (or laptops) having a specific suite of software installed and wireless internet access will be preferred.

Course Title: ENGR 5222G – Polymers and Composite Processing
Year and Semester: N/A
• **Course Description and Content Outline:** Polymer structure-property relations, linear and nonlinear viscoelasticity, dynamic mechanical analysis, time temperature superposition, creep and stress relaxation, mechanical models for prediction of polymer deformation, rubber elasticity, experimental methods for viscosity-temperature-shear rate measurements, application to melts, filled systems and suspensions. Processes for polymers; injection, extrusion, thermoforming, blow molding, rotational molding, compression and transfer molding, calendaring and post-manufacturing operations. Fibre types and properties, fibre forms, polymeric matrix and interfaces, typical composite properties. Processes for long fibre/thermoset composites, pre-pregging, resin transfer moulding, filament winding, pultrusion, autoclave cure. • **Delivery Mode and Teaching Method(s):** one-term course, 3 hours of lectures per week • **Student Evaluation:** Assignments 15%, Midterm 35% Final 50% • **Resources to be purchased by students:** N/A • **Textbook requirements:** None • **Learning Outcomes.** On successful completion of course, the students will Outcome 1: relate the significance of polymer structures to their physical, mechanical and thermal properties. Outcome 2: use linear and nonlinear viscoelasticity, dynamic mechanical analysis, time temperature superposition and creep and stress relaxation principles to predict polymer behaviour due to applications of stress and strain. Outcome 3: mechanical models for prediction of polymer deformation and rubber elasticity. Outcome 4: explain experimental methods for measuring viscosity-temperature-shear rate. Outcome 5: describe the basic processes for polymers; i.e. injection, extrusion, thermoforming, blow molding, rotational molding, compression and transfer molding, calendaring and post-manufacturing operations. Outcome 6: assess and recommend fibre types and properties, fibre forms, polymeric matrix and interfaces, typical composite properties for applications. Outcome 7: describe the processes for long fibre/thermoset composites, pre-pregging, resin transfer moulding, filament winding, pultrusion, autoclave cure.
Information About Course Designer/Developer: Course designed by faculty eligible to teach this course: G. Rizvi, PhD, Faculty of Engineering and Applied Science
Identify faculty to teach the course and/or statement "faculty to be hired": R. Pop-Ileiv and G. Rizvi
If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A
Faculty qualifications required to teach/supervise the course: PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.
Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.
Equipment requirements: None

Course Title: ENGR 5223G – Advanced Manufacturing Processes and Methodologies

Year and Semester: N/A

- **Course Description and Content Outline:** This course is about implementing advanced manufacturing processes and methodologies into production operations as the strategy for achieving reductions in inventory costs, faster manufacturing turnaround times, fewer faulty products, and using less floor space for production. It addresses the next generation manufacturing and production techniques that take advantage of the opportunities offered by selective use of new materials and emerging technologies for high efficient machining, coating, forming, assembly operations, etc. Virtual manufacturing methodologies and multi-objective optimization in terms of design, performance, safety, cost, and environment as well as advanced manufacturing methodologies such as lean manufacturing are also addressed.
  - **Content outline by topic:**
    1. Overview of emerging materials and technologies: Ceramics and intermetallics for high temperature, Advanced aluminium, magnesium and cast iron alloys, Aluminium and polyurethane foams for crash energy absorption, Powder metallurgy, Metal and ceramic matrix composites
    2. Machining: High speed and dry, Materials and coatings for high efficiency tools, Machining centers
    3. Forming: Sheet metals and plastics, Low investment metal forming, Innovative casting, Rapid prototyping and tooling
    4. Assembly: Laser welding of steels, Laser welding of thermoplastics, Laser processes monitoring, Adhesive and mechanical joining
    5. Surface treatments and coatings: Laser treatments, Eco-compatible and sustainable, Wear prevention coatings
    6. Virtual manufacturing: Metal forming and machining (e.g., sheet metal stamping, advanced forming technologies such as double-sheet hydroforming, high speed, and dry machining), Plastic molding, Casting and forging (e.g., semi-solid casting and local forging)
    7. Lean Manufacturing
    8. Kanban: Demand driven, pull-based flow manufacturing, Demand Flow Technology (DFT)
    9. Relationship between Lean manufacturing and Six Sigma
- **Delivery Mode and Teaching Method(s):** Classroom presentation, laboratories, and tutorials. Guest lectures by engineers from industry on selected topics. Lectures: 3 hours/week and Tutorials/Laboratory: 2 hours/week
- **Student Evaluation:** Teamwork and communication skills are encouraged and developed through group assignments. Students will be actively involved in hands-on execution of original individual and group assignments under faculty supervision. Student project teams will prepare a final group project involving a detailed report and oral presentation.
- **Resources to be purchased by students:** To be Determined by Professor
  Textbook requirements: None

- **Learning Outcomes.** At the conclusion of the semester the student should be able to:
  Outcome 1: master the main concepts of the major advanced manufacturing processes and display competence in a range of advanced manufacturing methodologies.
  Outcome 2: apply a broad-based knowledge of the various areas of advanced manufacturing processes to both simulated and real world manufacturing processes.
  Outcome 3: apply advanced improvement methodologies and techniques to both

simulated and real world manufacturing processes.
Outcome 4: to critically evaluate and communicate both orally and in writing primary literature articles in the area of advanced manufacturing processes and methodologies. Outcome 5: identify the principles of good teamwork and effective communication in an manufacturing environment and demonstrate those skills during interactive exercises.
Information About Course Designer/Developer: Course designed by faculty eligible to teach this course: R. Pop-Iliev, PhD, PEng, Faculty of Engineering and Applied Science
Identify faculty to teach the course and/or statement "faculty to be hired": R. Pop-Iliev and G. Rizvi
If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A
Faculty qualifications required to teach/supervise the course: PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.
Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.
Equipment requirements: Stationary desktop PC units (or laptops) having a specific suite of software installed and wireless internet access will be preferred.

Course Title: ENGR 5240G Advanced Dynamics

Year and Semester: N/A

- **Course Description and Content Outline:** This course builds upon the knowledge students have gained in a first dynamics course to cover more advanced dynamical systems. Topics covered will include: 3-D kinematics and kinetics of particles and systems of particles using Newton's method; equations of motion in normal and tangential, cylindrical, and spherical coordinates; two body central force motion with applications in orbital dynamics, and particle on a rotating earth. 3-D kinematics and kinetics of rigid bodies, Euler angles, single and multiple rotating reference frames, Coriolis acceleration, inertial reference frames, equations of translational motion, angular momentum, rotational motion, body axes and rotation relative to a coordinate system, Euler's and modified Euler's equations of motion with applications in dynamics of gyroscopes, robots, and vehicles. Variational mechanics, constraints, generalized coordinates, principles of virtual work, D'Alembert, and Hamilton's principle, concept of Hamiltonian, Hamilton's canonical equations. Lagrange's equation for system of particles and rigid bodies, generalized force and moment, calculus of variations, concepts of Lagrangian and Lagrange multiplier, Lagrange's equations for holonomic and non-holonomic systems, stability analysis of autonomous and non-autonomous dynamical systems. Numerical solutions of dynamic systems, explicit methods include finite difference and Rung-Kutta, and implicit methods are Houbolt, Wilson-theta, Park stuffy stable, and Newark-beta.
- **Delivery Mode and Teaching Method(s):** one-term course, 3 hours of lectures per week
- **Student Evaluation:** The principal form of assessment will be a final exam worth 50% of the course mark and one research project worth 20% of the course mark. Assignments will count for 10% and a mid-term exam will count for the remaining 20%. The exact weighting of various components will be presented to the students in the first week of the lectures.
- **Resources to be purchased by students:** None
- **Textbook requirements (sample):** Ginsberg, J. H., 1995, Advanced Engineering Dynamics – 2nd Edition, Cambridge University Press: New York, NY.
- **Learning Outcomes.** Students who successfully complete the course will
  Outcome 1: model and analyze systems of rigid bodies in three dimensions.
  Outcome 2: use Lagrange's equations to solve complex dynamical problems.
  Outcome 3: understand the applications of Hamiltonian and Hamilton's canonical.
  Outcome 4: determine the stability of 3-D motions of many dynamical systems.
  Outcome 5: apply numerical methods to obtain solutions of dynamical systems.

Information About Course Designer/Developer: Course designed by faculty eligible to teach this course: E. Esmailzadeh, Ph.D., Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
E. Esmailzadeh, S. Nokleby, and D. Zhang

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: To Be Determined by Professor

Course Title: ENGR 5241G – Advanced Mechanics of Materials

Year and Semester: N/A

- **Course Description and Content Outline:** This course builds upon the knowledge students have gained in the first solid mechanics course to cover more advanced mechanics of materials. Topics covered will include: The general state of stress and strain in three dimensions; formulation of general equilibrium equations; compatibility conditions; constitutive relationships; elasto-plastic relationships; Airy stress function; analytical solutions of special problems including thick-walled cylinders, rotating disks, bucking of columns, stress concentration, and curved beams; energy methods in elasticity; torsion problem; bending of beams; contact stresses; analysis of flat plates; creep and relaxation; introduction to fracture mechanics; fatigue and failure theories.
- **Delivery Mode and Teaching Method(s):** This one-term course will be delivered using 3 hours of lectures per week.
- **Student Evaluation:** The principal form of assessment will be a final exam worth 50% of the course mark and one research project worth 20% of the course mark. Assignments will count for 10% and a mid-term exam will count for the remaining 20%. The weighting of the various components will be presented to the students in the first week of lectures.
- **Resources to be purchased by students:** None
- **Textbook requirements (sample):** Boresi, A. P. and Schmidt, R. J., 2003, *Advanced Mechanics of Materials – 6th Edition*, John Wiley & Sons, Inc.
- **Learning Outcomes.** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome 1: understand and apply transformation of stress and strains in three dimensions and failure theories for isotropic materials.
  Outcome 2: apply energy methods to determine the values of load and deflection of indeterminate structures.
  Outcome 3: design flexible structures based on the principles of fracture mechanics and predict the critical load and crack length.
  Outcome 4: estimate fatigue life of the structures subjected to cyclic loadings.
  Outcome 5: understand and apply the principles of shear and torsion of beams, shafts, and thin-walled structures.
  Outcome 6: analyze the stress distribution in curved beams, rotating disks, thick-walled cylinders, and flat plates.

Information About Course Designer/Developer:
Course designed by faculty eligible to teach this course: E. Esmailzadeh, PhD, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
E. Esmailzadeh and D. Zhang

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: To Be Determined by Professor

Course Title: ENGR 5242G - Advanced Vibrations
Year and Semester: N/A
• **Course Description and Content Outline:** This course builds upon the knowledge students have gained in a first vibration course to cover more advanced vibrating systems. Topics covered will include: Lagrange's equations of motion, generalized coordinates and force, virtual work, linearization of equations for small oscillations, multi-degree of freedom linear systems, mass matrix, flexibility and stiffness matrix, natural frequencies and mode shapes, orthogonality of the mode shapes, modal matrix and decoupling procedure, harmonic force, and series solution for arbitrary excitation. Linear continuous systems, free vibration of strings, rods and shafts, lateral vibration of Euler-Bernoulli beams, effect of rotary inertia and shear on the vibration of beams, orthogonality of the mode shapes, harmonic excitation of beams, mode summation method in the case of arbitrary excitation. Approximate methods for free vibration analysis: Rayleigh, Dunkerly, Rayleigh-Ritz, Holzer, Myklestud, and matrix iteration methods. Vibration of plates, free vibration analysis using analytical methods, Rayleigh and Rayleigh-Ritz methods, harmonic excitation, and Galerkin's method in forced vibration analysis of plates. • **Delivery Mode and Teaching Method(s):** This one-term course will be delivered using 3 hours of lectures per week. • **Student Evaluation:** The principal form of assessment will be a final exam worth 50% of the course mark and one research project worth 20% of the course mark. Assignments will count for 10% and a mid-term exam will count for the remaining 20%. The exact weighting of the various components will be presented to the students in the first week of the lectures. • **Resources to be purchased by students:** None • **Textbook requirements (sample):** Ginsberg, J. H., 2001, *Mechanical and Structural Vibrations: Theory and Applications*, John Wiley & Sons: Toronto, ON. • **Learning Outcomes.** Students who successfully complete the course have reliably demonstrated the ability to: Outcome 1: model and analyze discrete vibrating systems. Outcome 2: obtain the transient and steady-state response of m-DOF systems. Outcome 3: obtain the eigenvalues and eigenvectors using different techniques. Outcome 4: model and analyze continuous systems. Outcome 5: solve partial differential equations for flexible structures.
Information About Course Designer/Developer: Course designed by faculty eligible to teach this course: E. Esmailzadeh, Ph.D., Faculty of Engineering and Applied Science
Identify faculty to teach the course and/or statement "faculty to be hired": E. Esmailzadeh and D. Zhang
If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A
Faculty qualifications required to teach/supervise the course: PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.
Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.
Equipment requirements: To Be Determined by Professor

Course Title: ENGR 5260G – Advanced Robotics and Automation

Year and Semester: N/A

- **Course Description and Content Outline:** This course builds upon the knowledge students have gained in a first robotics course to cover more advanced kinematics topics and their application to more complex robotic systems such as redundant manipulators and parallel mechanisms. Topics covered will include: point, direction, line, and screw motion descriptions; homogeneous transformations; line and screw coordinates; quaternion representations; inverse displacement solutions by analytic, root finding, hybrid, and numerical methods; appropriate frames of reference; screw systems and transforms; local and globally optimum solutions of redundant rates; overdetermined and near degenerate solutions; singularity analysis; and parallel manipulator kinematics. Prerequisite: Robotics and Automation (ENGR 4280U) or equivalent.
- **Delivery Mode and Teaching Method(s):** This one-term course will be delivered using 3 hours of lectures per week.
- **Student Evaluation:** The principal form of assessment will be a final exam worth 50% of the course mark and one research project worth 30% of the course mark. Assignments will count for the remaining 20%. The exact weighting of the various components will be presented to the students in the first week of lectures.
- **Resources to be purchased by students:** N/A
- **Textbook requirements (sample):**
  Davidson, J. K. and Hunt, K. H., 2004, *Robots and Screw Theory: Applications of Kinematics and Statics to Robotics*, Oxford University, Press: Toronto.
  Angeles, J., 2002, *Fundamentals of Robotic Mechanical Systems: Theory, Methods, and Algorithms – Second Edition*, Springer, New York, New York.
  Tsai, L.-W., 1999, Robot Analysis: *The Mechanics of Parallel and Serial Manipulators*, John Wiley & Sons, Inc.: Toronto.
- **Learning Outcomes.** Students who successfully complete the course will
  Outcome 1: understand advanced serial manipulator kinematics and its applications.
  Outcome 2: understand parallel manipulator kinematics and its applications.
  Outcome 3: apply advanced kinematic geometry methods, such as screw theory, to various problems in robotics.

Information About Course Designer/Developer:
Course designed by faculty eligible to teach this course: S. Nokleby, PhD, PEng, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
S. Nokleby and D. Zhang

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: Robot manipulators available in UOIT's Integrated Manufacturing Centre. Software requirements include MATLAB and MAPLE.

Course Title: ENGR 5261G – Advanced Mechatronics: MEMS and Nanotechnology

Year and Semester: N/A

Course Description and Content Outline: This course is designed to be an introduction to MEMS (micro-electro-mechanical systems) and nanotechnology and their applications. Topics covered will include: introduction to MEMS and nanotechnology; working principles of MEMS and nanotechnology; design and fabrication of MEMS and nano-systems; microfabrication and micromachining; materials for MEMS and nanotechnology; and applications of MEMS and nanotechnology.

- **Delivery Mode and Teaching Method(s):** This one-term course will be delivered using 3 hours of lectures per week.
- **Student Evaluation:** The principal form of assessment will be a final exam worth 50% of the course mark and one research project worth 30% of the course mark. Assignments will count for the remaining 20%. The exact weighting of the various components will be presented to the students in the first week of lectures.
- **Resources to be purchased by students:** To Be Determined by Professor
- **Textbook requirements (sample):**
  Senturia, S. D., 2001, Microsystem Design, Kluwer Academic Publishers.
- **Learning Outcomes.** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome 1: understand the basic principles of how MEMS and nano-systems work.
  Outcome 2: design and analyze MEMS and nano-systems.
  Outcome 3: understand the processes for fabricating MEMS and nano-systems.
  Outcome 4: understand applications of MEMS and nanotechnology.

Information About Course Designer/Developer:
Course designed by faculty eligible to teach this course: D. Zhang, PhD, PEng, Faculty of Engineering and Applied Science and S. Nokleby, PhD, PEng, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
S. Nokleby, D. Zhang, and Faculty to be Hired

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: To Be Determined by Professor

Course Title: ENGR 5262G – Manipulator and Mechanism Design

Year and Semester: N/A

- **Course Description and Content Outline:** This course is designed to teach students the necessary skills to design or synthesize mechanisms and manipulators to perform desired tasks. Topics covered will include: synthesis of mechanisms for function generation, path generation, and rigid body guidance; graphical, analytical, and optimization based methods of synthesis; mechanism cognates, Chebychev spacing, Burmister curves; manipulator joint layout synthesis for spatial positioning and orientation; conditions of singularity and uncertainty; and solution of nonlinear problems of kinematics involved in mechanism synthesis using compatibility equations, 1/2 angle substitutions, and dialytic elimination.
- **Delivery Mode and Teaching Method(s):** This one-term course will be delivered using 3 hours of lectures per week.
- **Student Evaluation:** The principal form of assessment will be a final exam worth 50% of the course mark and one research project worth 30% of the course mark. Assignments will count for the remaining 20%. The exact weighting of the various components will be presented to the students in the first week of lectures.
- **Resources to be purchased by students:** N/A
- **Textbook requirements (sample):**
  McCarthy, J. M., 2000, *Geometric Design of Linkages*, Springer: New York.
- **Learning Outcomes.** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome 1: design mechanisms for function generation, path generation, and rigid body guidance using graphical, analytical, and optimization based methods.
  Outcome 2: design manipulator joint layouts for specified tasks.
  Outcome 3: solve nonlinear problems in kinematics using compatibility equations, 1/2 angle substitutions, and dialytic elimination.

Information About Course Designer/Developer:
Course designed by faculty eligible to teach this course: S. Nokleby, PhD, PEng, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
S. Nokleby and D. Zhang

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: Software requirements include MATLAB, Working Model, and MSC.visualNastran 4D.

Course Title: ENGR 5263G – Advanced Control

Year and Semester: N/A

- **Course Description and Content Outline:** This course builds upon the knowledge students have gained in a first control course to cover more materials in advanced control systems. Topics covered will include: a. State variables and state space models: Relations between state space models and the transfer-function models (controllable and observable canonical forms, and diagonal form), Jordan form, solutions of linear state equations, transition matrix. b. Controllability and observability: Definition and criteria, state feedback and output feedback, pole assignment via state feedback, design of servo-controlled systems. c. State estimation and observer: Observer state-variable feedback control. d. Multi-input multi-output (MIMO) systems: Pole assignment via state feedback. e. Introduction to nonlinear systems: Describing functions for kinds of nonlinear systems (on/off, dry friction, dead zone, saturation, and hystersis), phase plane trajectories, concept of limit cycle. f. Stability analysis: Lyapunov function, and Lyapunov stability criterion. g. Introduction to optimal control: Linear quadratic regulator (LQR), Riccati equation, properties of LQR systems. h. Sampled data systems: Pulse transfer function, zero and first order hold systems, stability and root locus in the z-plane, transformations, Routh Hurwitz stability criterion in the z-plane, system compensation in the z-plane using root locus, and generalized PID controllers.
- **Delivery Mode and Teaching Method(s):** one-term course, 3 hours of lectures per week
- **Student Evaluation:** The principal form of assessment will be a final exam worth 50% of the course mark and one research project worth 20% of the course mark. Assignments will count for 10% and a mid-term exam will count for 20%. The exact weighting of the various components will be presented to the students in the first week of the lectures.
- **Resources to be purchased by students:** N/A
- **Textbook requirements (sample):**
  Ogata, K., 2002, *Modern Control Engineering – 4th Edition*, Prentice Hall: New Jersey.
- **Learning Outcomes.** Students who successfully complete the course will
  Outcome 1: model and analyze the state space descriptions of dynamical systems.
  Outcome 2: apply the concepts of controllability and observability of control systems.
  Outcome 3: utilize pole placement in state feedback control for SISO and MIMO systems.
  Outcome 4: design observer state feedback control.
  Outcome 5: gain knowledge about nonlinear control systems, limit cycle, and instabilities.

Information About Course Designer/Developer:
Course designed by faculty eligible to teach this course: E. Esmailzadeh, Ph.D., Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
E. Esmailzadeh, S. Nokleby, and D. Zhang

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: None

Course Title: ENGR 5300G – Automotive Engineering

Year and Semester: N/A

Course Description and Content Outline: Components of the automobile. Engineering factors in all components and sub-system areas of automobile design. Vehicle characteristics and dynamic interactions. Systems modeling approach and mathematical models for ride, vibration, handling control and powertrains of automobiles. Tire mechanics, including construction, rolling resistances, traction/braking properties, cornering and aligning properties and measurement methods. Vehicle mobility, motion performance of the vehicle, characterization of resistances, propulsion system and tractive efforts. Brake system design, braking performance, brake distribution. Steady state handling. Measurement methods. Suspension system design considerations. Design and performance of an automobile from a systems point of view. External factors such as markets, financing, and sales.

Delivery Mode and Teaching Method(s): This one-term course will be delivered using 3 hours of lectures per week.

- **Student Evaluation:** The principal form of assessment will be a final exam worth 50% of the course mark and one project worth 30% of the course mark. Assignments will count for the remaining 20%. The exact weighting of the various components will be presented to the students in the first week of lectures.
- **Resources to be purchased by students:** N/A
- **Textbook requirements (sample):** (i) R. Bosch, *Automotive Handbook*, 6th Edition, John Wiley & Sons, 2004, (i) J. Fenton, *Handbook of Automotive Body and Systems Design*, John Wiley & Sons, 2005
- **Learning Outcomes.** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome 1: analyze overall design of an automobile as an integrated system;
  Outcome 2: address technical issues in the design of automotive components and sub-systems, ranging from diagnosis, engines and mechatronics to automotive braking;
  Outcome 3: conduct theoretical, numerical and experimental analysis of automotive systems;
  Outcome 4: gain detailed knowledge necessary to comprehend journal publications and other archival literature relevant to advanced design of automotive systems;
  Outcome 5: gain knowledge on performance assessment methodologies and interpretations of standards.

Information About Course Designer/Developer:
Course designed by G. F. Naterer, PhD, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
S. Rakheja, G. Rohrauer

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: N/A

Course Title: ENGR 5310G Automotive System Dynamics

Year and Semester: N/A

Course Description and Content Outline: Introduction to transport systems related to vehicle dynamics behaviour. Pneumatic tire mechanics – ride, cornering and aligning properties. Transient and steady-state directional dynamics and handling analyses of road vehicles. Directional response and stability analysis in small and large perturbation maneuvers; roll dynamics and rollover; braking performance analyses; directional responses to simultaneous steering and braking inputs; performance measures. Characterization of road roughness; ride vibration analyses; assessment of ride comfort. Measurement methods and data analyses techniques. Vehicle-driver interactions – analysis of the closed loop vehicle-driver system. Introduction to typical control strategies for vehicle dynamic control.

Delivery Mode and Teaching Method(s): This one-term course will be delivered using 3 hours of lectures per week. The teaching will be carried out through a combination of classroom-based theory sessions and computer simulation workshops.

- **Student Evaluation:** The principal form of assessment will be a final exam worth 50% of the course mark and one project worth 30% of the course mark. Assignments will count for the remaining 20%. The exact weighting of the various components will be presented to the students in the first week of lectures.
- **Resources to be purchased by students:** N/A
- **Textbook requirements (sample):** *Vehicle Dynamics and Control,* by Rajesh Rajamani, Springer, 2006. (ISBN: 0-387-26396-9)
- **Learning Outcomes.** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome 1: well understand vehicle dynamics and control systems.
  Outcome 2: generate typical vehicle dynamic models and control system models and perform dynamic simulations.
  Outcome 3: evaluate vehicle dynamic performance based on numerical simulation results.

Information About Course Designer/Developer:
Course designed by faculty eligible to teach this course: Yuping He, Ph.D., Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
Y. He, S. Rakheja, E. Esmailzadeh, P. Berg

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: Multibody dynamics software packages (e.g. ADAMS) and control system modeling tools (e.g. MATLAB/Simulink).

Course Title: ENGR 5320G – Automotive Aerodynamics

Year and Semester: N/A

Course Description and Content Outline: Formulation of fluid mechanics and aerodynamics for automotive design. Inviscid and viscous flow. Wind tunnels and their applications to external aerodynamics. Aerodynamic drag coefficient and its effect on vehicle performance. Experimental methods, drag force measurements and wind tunnel instrumentation. Computational aerodynamics. Comparisons between experimental results and numerical results. Aerodynamic design for drag reduction. Aerodynamics of engine cooling. Fluid structure interactions. Aerodynamic noise.

Delivery Mode and Teaching Method(s): This one-term course will be delivered using 3 hours of lectures per week.

- **Student Evaluation:** The principal form of assessment will be a final exam worth 50% of the course mark and one project worth 30% of the course mark. Assignments will count for the remaining 20%. The exact weighting of the various components will be presented to the students in the first week of lectures.
- **Resources to be purchased by students:** N/A
- **Textbook requirements (sample):** V. Sumantran, G. Sovran, Vehicle Aerodynamics, SAE Publishers, Warrendale, PA, 1996
- **Learning Outcomes.** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome 1: understand methods of automotive aerodynamics for reducing drag, reducing wind noise, and preventing undesired lift forces at high speeds;
  Outcome 2: gain detailed understanding of wind-tunnel testing, computational simulations, thermal analysis, and acoustics.
  Outcome 3: develop innovative methods of improving vehicle aerodynamics, such as integrating the wheel and lights to have a small streamlined surface, which does not have sharp edges crossing the wind stream above the windshield. Also, aerodynamic improvement of engine cooling involves air that enters/exits the engine bay, reaccelerates through a nozzle and exits through the floor.
  Outcome 4: develop methods of computer modelling and wind tunnel testing. Related technologies include tunnels equipped with a rolling road (movable floor for the working section), which prevents a boundary layer forming on the floor of the working section.
  Outcome 5: gain detailed knowledge necessary to comprehend journal publications and other archival literature relevant to automotive aerodynamics.

Information About Course Designer/Developer: Course designed by G. F. Naterer, PhD, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
G. F. Naterer

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: N/A

Course Title: ENGR 5330G – Automotive Powertrains

Year and Semester: N/A

Course Description and Content Outline: Design of automotive power transmission systems. Loads on the vehicle. Evaluation of various engine and vehicle drive ratios on acceleration performance and fuel economy. Manual transmission and automatic transmission. Combustion in CI and SI engines. Selection of combustion chamber type and shape, intake and exhaust systems. Differences between engine types. Cylinder number, configuration, size and material selection. Selection of mixture preparation, firing order. Mechanism of combustion. Fuel and additive characteristics. Fuel metering and ignition systems. Exhaust emissions and control systems. Heat transfer, friction and lubrication systems. Air pollution. Exhaust systems. Effects of emission on air quality. Sources of auto emission.

Delivery Mode and Teaching Method(s): This one-term course will be delivered using 3 hours of lectures per week.

- **Student Evaluation:** The principal form of assessment will be a final exam worth 50% of the course mark and one project worth 30% of the course mark. Assignments will count for the remaining 20%. The exact weighting of the various components will be presented to the students in the first week of lectures.
- **Resources to be purchased by students:** N/A
- **Textbook requirements (sample):** Automotive Powertrains, John Wiley & Sons, New York, 1996 (ISBN 1-86058-020-3)
- **Learning Outcomes.** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome 1: conduct detailed analysis and design of automotive engines, sub-systems and componetns;
  Outcome 2: gain understanding of next-generation engine technologies, including alternative fuels, hybrid vehicles, fuel cells and hydrogen systems.
  Outcome 3: conduct theoretical, numerical and experimental analysis of automotive engines and powertrains;
  Outcome 4: gain detailed knowledge necessary to comprehend journal publications and other archival literature relevant to automotive powertrains.

Information About Course Designer/Developer:
Course designed by G. F. Naterer, PhD, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
G. Rohrauer

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: N/A

Course Title: ENGR 5340G Automotive Noise, Vibrations and Harshness

Year and Semester: N/A

Course Description and Content Outline: Evaluating the vibration and acoustic characteristics of automotive systems and components. Human comfort and annoyance guidelines and standards. Sound, hearing and physiological effects of noise and vibration. Modeling and experiment methods. Modal analysis and digital signal processing. Noise sources such as gears, bearings, rotating imbalance, gas flow, combustion, impact. Source-path-receiver identification. Sound transmission, air-borne and structure-borne noise. Structural-acoustic interactions. Noise and vibration passive/active control.

Delivery Mode and Teaching Method(s): This one-term course will be delivered using 3 hours of lectures per week.

- **Student Evaluation:** The principal form of assessment will be a final exam worth 50% of the course mark and one project worth 30% of the course mark. Assignments will count for the remaining 20%. The exact weighting of the various components will be presented to the students in the first week of lectures.
- **Resources to be purchased by students:** N/A
- **Textbook requirements (sample):** 1) *Vehicle Refinement* (*Controlling Noise and Vibration in Road Vehicles)*, by Matthew Harrison, Elsevier, 2004. 2) *Introduction to Modern Vehicle Design*, by Bertrand D Hsu, SAE, 2002. 3) *Modal Analysis*, by Zhi-Fang Fu and Jimin He, Elsevier, 2001. 4) *Theory of Vibration with Applications,* by W.T. Thomson, Prentice-Hall, 1981.
- **Learning Outcomes.** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome 1: understand the fundamental theory in the areas of vibration and acoustics.
  Outcome 2: evaluate the effects of vibration and acoustic on vehicle systems or components and identify popular approaches for reducing the vibration and acoustic.
  Outcome 3: gain knowledge on human perception to noise, vibration, guidelines and assessment methods;
  Outcome 4: apply popular computational methods for automotive NVH applications.

Information About Course Designer/Developer:
Course designed by faculty eligible to teach this course: Yuping He, Ph.D., Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
Y. He, S. Rakheja, E. Esmailzadeh

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: N/A

Course Title: ENGR 5350G – Automotive Materials and Manufacturing

Year and Semester: N/A

Course Description and Content Outline: Materials in the automotive industry. Selection of materials and shapes. Materials processing and design. Interaction of materials. Performance of materials in service. Examples of new materials. Role of environmental regulations and societal pressures on the selection of alternate materials. Manufacturing processes, including casting, forging, forming, machining and molding for the automotive industry. Quality control and techniques, process selection and methods. Manufacturing considerations for various lightweight automotive structural materials. Stiffness, fatigue, vibrations, dent resistance and crush resistance. Methods of producing lightweight automotive structures are discussed. Design for manufacturing, assembly, disassembly and recycling.

Delivery Mode and Teaching Method(s): This one-term course will be delivered using 3 hours of lectures per week.

- **Student Evaluation:** The principal form of assessment will be a final exam worth 50% of the course mark and one project worth 30% of the course mark. Assignments will count for the remaining 20%. The exact weighting of the various components will be presented to the students in the first week of lectures.
- **Resources to be purchased by students:** N/A
- **Textbook requirements (sample):** Automotive Manufacturing, John Wiley & Sons, New York, 1997 (ISBN 1-86058-113-7)
- **Learning Outcomes.** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome 1: understand the advanced technologies, theory and engineering systems used for automotive manufacturing;
  Outcome 2: identify characteristics, properties and processing of materials used in automotive components and susb-systems;
  Outcome 3: gain detailed knowledge of computational tools and experimental methods for testing of automotive materials;
  Outcome 5: acquire knowledge needed to comprehend journal publications and other archival literature relevant to advanced technologies in automotive materials and manufacturing.

Information About Course Designer/Developer:
Course designed by G. F. Naterer, PhD, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
G. Rizvi

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: N/A

Course Title: ENGR 5360G – Automotive Software and Electronics

Year and Semester: N/A

Course Description and Content Outline: Automotive design software tools, including FEA, CFD, Unigraphics and other packages. Software development and integration for design and manufacturing of automobiles. Electrical systems in automobiles, including power supplies, junction transistors, sensors and rectifiers. Signal amplifiers, gain-bandwidth limitations and circuit models. Motor drive control, inverters, actuators, PWM controllers, active filters, signal conditioners, power electronics and regulators. Battery chargers and solar cells. Automotive applications and case studies.

Delivery Mode and Teaching Method(s): This one-term course will be delivered using 3 hours of lectures per week.

- **Student Evaluation:** The principal form of assessment will be a final exam worth 50% of the course mark and one project worth 30% of the course mark. Assignments will count for the remaining 20%. The exact weighting of the various components will be presented to the students in the first week of lectures.
- **Resources to be purchased by students:** N/A
- **Textbook requirements (sample):** R. Bosch, *Automotive Electrics and Automotive Electronics*, John Wiley & Sons, New York, 2004 (ISBN 1-86058-436-5)
- **Learning Outcomes.** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome 1: have detailed understanding of electronics with applications to automotive systems, including microelectronics, sensors and control systems;
  Outcome 2: design of automotive electrical systems, including effects of electromagnetic compatibility and interference suppresion;
  Outcome 3: analysis of alternators, batteries, starter motors and lighting systems;
  Outcome 4: understand sensor technologies for speed, rpm, acceleration, temperature, vibrations and force sensors;
  Outcome 5: design and operation of automotive software packages;
  Outcome 6: understand data processing, software and data transfer between automotive electronic systems;
  Outcome 7: gain detailed knowledge necessary to comprehend journal publications and other archival literature relevant to automotive software and electronics.

Information About Course Designer/Developer:
Course designed by G. F. Naterer, PhD, Faculty of Engineering and Applied Science

Identify faculty to teach the course and/or statement "faculty to be hired":
Faculty to be hired

If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line? N/A

Faculty qualifications required to teach/supervise the course:
PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Classroom requirements: Standard computer enabled UOIT classroom equipped with VRC, DVD, data projectors, and internet access.

Equipment requirements: N/A

Course Title: ENGR 5610G – Stochastic Processes

- **Course Description and Content Outline:** Review of probability theory including, random variables, probability distribution and density functions, characteristic functions, convergence of random sequences, and laws of large numbers. Random processes, stationarity and ergodicity, correlation and power spectral density, cross-spectral densities, response of linear systems to stochastic input, innovation and factorization, Fourier and K-L expansion, mean square estimation, Markov chains and processes, queuing theory. Applications in communications and signal processing, emphasis on problem solving using probabilistic approaches.
- **Delivery Mode and Teaching Method:** 3 hours of class lectures per week.
- **Student Evaluation:** assignments: 10%, mid-term test: 20%, research project: 20%, and final exam: 50%.
- **Textbook requirements:** A. Papoulis and S.U. Pillai, *Probability, Random Variables and Stochastic Processes*, McGraw-Hill, 2003, ISBN 0-07-366011-6
- **Learning Outcomes:** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome-1: know the fundamentals of probability Theory and random variables.
  Outcome-2: understand the meaning and importance of the laws of large numbers.
  Outcome-3: distinguish between strict-sense and wide-sense stationary random processes
  Outcome-4: analyze systems with stochastic inputs.
  Outcome-5: obtain the correlation functions of practically important stochastic processes and analyze it.
  Outcome-6: derive power spectral density for stationary signals.
  Outcome-7: expand the stochastic process.
  Outcome-8: factorize stochastic processes and whiten them.
  Outcome-9: grasp the importance of Markov process and basic renewal processes.
  Outcome-10: analyze birth-death processes.
  Outcome-11: appreciate and benefit from applying their knowledge on stochastic processes to the applications in Communications and Signal Processing.

Information About Course Designer/Developer:
Course designed by Shahram Shahbazpanahi, PhD, Faculty of Engineering and Applied Science

- **Identify faculty to teach the course and/or statement "faculty to be hired":**
  S. Shahbazpanahi, A. Grami

- **Faculty qualifications required to teach/supervise the course:**
  PhD degree in Electrical Engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Course Title: ENGR 5620G – Digital Communications

- **Course Description and Content Outline:** Optimum receiver principles: AWGN, geometric representation of signals, maximum likelihood criterion and optimum decision regions, correlation receivers and matched filters, probability of error and union bound; digital bandpass modulation (ASK, FSK, PSK, QAM, CPFSK, CPM), baseband systems (PAM, PRS), performance comparisons: bit error rate, bandwidth, power, complexity; fundamental limits in information theory: entropy and the source coding theorem; channel capacity and the channel coding theorem; information capacity theorem and design trade-offs
- **Delivery Mode and Teaching Method:** 3 hours of class lectures per week.
- **Student Evaluation:** assignments: 20%, mid-term test: 30%, and final exam: 50%.
- **Textbook requirements:** J.G. Proakis, *Digital Communications*, McGraw-Hill, 2001, ISBN 0-07-232111-3.
- **Learning Outcomes:** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome-1: understand Gram-Schmidt orthogonalization procedure.
  Outcome-2: categorize classes of noise and characterize Additive White Noise Gaussian Noise and its impact on performance.
  Outcome-3: analyze coherent detection of signals in noise.
  Outcome-4: grasp the fundamentals of optimum receivers.
  Outcome-5: derive probability of error and assess bit error rate and symbol error rate.
  Outcome-6: find spectra for various modulation schemes and line codes.
  Outcome-7: identify trade-offs for coherent and non-coherent detection schemes.
  Outcome-8: know theoretical aspects design trade-offs for all M-PSK and M-QAM systems in use.
  Outcome-9: appreciate Shannon's theorems, their limits, roles, benefits, and design trade-offs.
  Outcome-10: obtain insights into rate distortion theory and its applications.

- **Information About Course Designer/Developer:**
  Course designed by Ali Grami, PhD, Faculty of Engineering and Applied Science and Faculty of Business and Information Technology.

- **Identify faculty to teach the course and/or statement "faculty to be hired":**
  A. Grami, S. Shahbazpanahi.

- **Faculty qualifications required to teach/supervise the course:**
  PhD degree in Electrical Engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Course Title: ENGR 5630G – Statistical Signal Processing

- **Course Description and Content Outline:** Detection Theory: fundamentals of detection theory, Neyman-Pearson theorem, receiver operating characteristics, minimum probability of error, Bayes risk, binary multiple hypothesis testing, minimum Bayes risk detector, Maximum Likelihood detector, Chernoff bound, detection of deterministic and random signals. Estimation Theory: mathematics of estimation theory, minimum variance unbiased estimation, Cramer-Rao lower bund, linear models, general minimum variance unbiased estimation, best linear unbiased estimators, Maximum Likelihood estimation.
- **Delivery Mode and Teaching Method:** 3 hours of class lectures per week.
- **Student Evaluation:** mid-term test: 20%, research project: 40%, and final exam: 40%.
- **Textbook requirements:** H.L. Van Trees, *Detection, Estimation, and Modulation Theory, Part I*, John Wiley, 2004, ISBN 0-471-09517-6.
- **Learning Outcomes:** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome-1: know the fundamentals of detection and estimation.
  Outcome-2: characterize the operation of a detector.
  Outcome-3: understand the concepts of consistency and bias in estimation.
  Outcome-4: decide which criteria to use to estimate or to detect a parameter.
  Outcome-5: derive performance bounds for estimation or a detection problem.
  Outcome-6: analyze the performance of different estimation or detection techniques by comparing the performance of the estimator or detector with the corresponding bounds.
  Outcome-7: appreciate the Maximum Likelihood approach in detection and estimation.
  Outcome-8: apply the theory of estimation and detection to communication systems.
  Outcome-9: grasp the basic idea of linear estimators.
  Outcome-10: apply the theory of estimation to spectral analysis and array processing.
- **Information About Course Designer/Developer:** Course designed by S. Shahbazpanahi, PhD, Faculty of Engineering and Applied Science
- **Identify faculty to teach the course and/or statement "faculty to be hired":**
  S. Shahbazpanahi, A. Grami
- **Faculty qualifications required to teach/supervise the course:**
  PhD degree in Electrical Engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Course Title: ENGR 5640G – Advanced Wireless Communications

- **Course Description and Content Outline:** Wireless communications systems, technologies, and standards; propagation environments (indoor/outdoor, fixed/mobile, cordless/wireless, voice/data/video/multimedia, radio/infra-red/optical, terrestrial/satellite); spread spectrum techniques; multiple access schemes (TDMA, OFDM, MC-CDMA), duplexing methods and diversity techniques; mobile cellular systems: frequency reuse, cell splitting, cellular traffic, call processing, hand-off, roaming, location determination; radio link analysis; multipath fading and fading models; wireless security and protocols, ad hoc mobile and sensor networks; link design aspects for emerging techniques (UWB, RFID)
- **Delivery Mode and Teaching Method:** 3 hours of class lectures per week.
- **Student Evaluation:** assignments: 10%, mid-term test: 20%, research project: 20%, and final exam: 50%.
- **Textbook requirements:** S.G. Glisic, *Advanced Wireless Communications*, Wiley, 2004, ISBN 0-470-86776-0.
- **Learning Outcomes:** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome-1: know the fundamentals of IEEE wireless standards (WLAN, WPAN, WMAN).
  Outcome-2: describe the principles of operations of cellular mobile systems (IS-95, I-136, GSM, 3G-WCDMA).
  Outcome-3: assess diversity techniques (time, space, polarization, frequency, angle, multipath).
  Outcome-4: characterize various fading channels and appreciate various fading models and parameters.
  Outcome-5: know how equalization and synchronization methods are employed in wireless environments.
  Outcome-6: analyze Orthogonal Frequency Division Multiplexing and Multi-Carrier CDMA.
  Outcome-7: carry out network modeling, analysis, and simulation.
  Outcome-8: research major issues in mobile ad hoc and sensor networks and provide potential solutions.
  Outcome-9: conduct thorough link budgets for emerging wireless systems.
  Outcome-10: grasp the basics of space-time coding and their benefits and applications.

- **Information About Course Designer/Developer:**
  Course designed by A. Grami, PhD, Faculty of Engineering and Applied Science and Faculty of Business and Information Technology.

- **Identify faculty to teach the course and/or statement "faculty to be hired":**
  A. Grami, S. Shahbazpanahi.

- **Faculty qualifications required to teach/supervise the course:**
  PhD degree in Electrical Engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Course Title: ENGR 5650G – Adaptive Systems and Applications

- **Course Description and Content Outline:** This course covers algorithms, filter structures, and applications in adaptive systems. Basic information-processing operations and recursive algorithms are discussed. Also, distinct methods for deriving recursive algorithms for the operation of adaptive filters are identified. Lastly, applications of adaptive filters, mainly to digital communication systems, are explored in details.
- **Content Outline by Topic:**
  - Linear filtering problem and their types
  - Recursive algorithms and their parameters
  - Methods for deriving algorithms
  - Applications of adaptive filters to communications
- **Delivery Mode and Teaching Method:** 3 hours of lectures per week.
- **Student Evaluation:** Mid-term exam: 20%, research project and presentation: 40%, assignments: 20%, and final exam: 20%.
- **Textbook requirements:** S. Haykin, *Adaptive Filter Theory*, Pearson Education, 2001, ISBN 0130901261.
- **Learning Outcomes:** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome 1: model filtering, smoothing, and prediction problems.
  Outcome 2: analyze algorithms based on various performance measures, such as rate of convergence, mis-adjustment, robustness, computational requirements, structure, and numerical properties.
  Outcome 3: understand methods for deriving recursive algorithms, namely Wiener filter theory, Kalman filter theory, and least squares.
  Outcome 4: assess performance of transversal and lattice structures in adaptive systems.
  Outcome 5: apply adaptive filters to communications, namely to system identification, adaptive equalization, spectrum estimation, noise and echo cancellation, adaptive beam forming, and carrier and symbol synchronization.
  Outcome 6: carry out numerical analysis and computer simulations for various adaptive systems and a variety of scenarios.

- **Information about Course Designer/Developer:**
  Course designed by A. Grami, PhD, Faculty of Engineering and Applied Science and Faculty of Business and Information Technology

- **Identify faculty to teach the course and/or statement "faculty to be hired":**
  S. Shahbazpanahi, A. Grami

- **Faculty qualifications required to teach/supervise the course:**
  PhD degree in electrical engineering, and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Course Title: ENGR 5670G – Cryptography and Secure Communications

- **Course Description and Content Outline:** This course covers diverse topics on cryptography and security including classical encryption, symmetric and public-key cryptography, key management, message authentication, digital signatures, denial-of-service (DoS), distributed DoS, malicious software, and intrusion detection systems.
- **Content Outline by Topic:**
  - o Introduction to security and cryptography
  - o Classical cryptography and block ciphers and Data Encryption Standard
  - o Advanced Encryption Standard
  - o Confidentiality using symmetric encryption
  - o Public-key cryptography and RSA, and key management
  - o Message authentication and hash functions and authentication applications
  - o Web security, malicious software & denial-of-service attacks
  - o Firewalls & intrusion detection systems
- **Delivery Mode and Teaching Method:** 3 hours of lectures per week.
- **Student Evaluation:** mid-term test: 20%, research project and presentation: 30%, assignments: 25%, and final exam: 25%.
- **Textbook requirements:** W. Stallings. *Cryptography and Network Security: Principles and Practices (4th edition)*. Prentice Hall, 2006. ISBN: 0131873164.
- **Learning Outcomes:** Students who successfully complete the course have reliably demonstrated the ability to:
  - Outcome 1: apply fundamentals of security, and symmetric and public-key cryptography, including block ciphers, RSA, key management, hash functions, detection of and reaction to mal-code attacks, mitigation of denial-of-service attacks, and network disruptions.
  - Outcome 2: articulate the basic fundamentals of number theory applied to cryptography in order to provide confidentiality, integrity and availability in information systems.
  - Outcome 3: assess the security of information systems based on the quality of cryptographic algorithms and protocols, authentication systems, firewalls, and intrusion detection systems.
  - Outcome 4: design secure information systems using symmetric and public-key cryptography applied to Web services and transactions.
  - Outcome 5: determine the suitability of a security system based on its cryptographic strengths and vulnerabilities, and the value and significance of the protected information.
  - Outcome 6: evaluate the security of commercial applications by understanding the fundamentals of their underlying cryptographic algorithms.

- **Information about Course Designer/Developer:**
  Course designed by M. Vargas Martin, PhD, Faculty of Engineering and Applied Science and Faculty of Business and Information Technology

- **Identify faculty to teach the course and/or statement "faculty to be hired":**
  M. Vargas Martin, R. Liscano

- **Faculty qualifications required to teach/supervise the course:**
  PhD degree in engineering/computer science, & relevant experience in teaching & research. Faculty members will normally be registered Professional Engineers.

Course Title: ENGR 5720G – Real-Time and Embedded Computing

- **Course Description and Content Outline:** The term ``real-time'' can be used to describe any information processing activity or system which has to respond to externally generated input stimuli within a finite and specified period. A key feature of all these applications is the role of the computer as an information processing component within a larger engineering system. For this reason, such applications have become known as ``embedded computer systems''. The course provides the opportunities to the students to learn various fundamental issues as well as practical developments in the area of real-time embedded systems.
- **Content outline by topic:**
  - o Issues and concepts: definition of real-time, temporal and event determinism, architecture review and interfacing, Interrupts, traps and events, response times and latency, real-time clocks
  - o Operating systems: structure of an RTOS, nucleus, servers, schedulers and dispatchers, Synchronization and communication: priority and distribution queues, device drivers
  - o Languages in real-time: concurrency Issues, real-time programming in high-level languages, e.g. C, Java, C#
- **Delivery Mode and Teaching Method:** 3 hours of lectures per week.
- **Student Evaluation:** Mid-term exam: 20%, research project: 30%, assignments: 15%, and final exam: 25%, paper review: 10%.
- **Textbook requirements:** Jane Liu, *Real-time Systems*, Prentice Hall; ISBN: 0130996513; 2000; Douglass B P, *Real Time UML: Advances in the UML for Real-time Systems*, ISBN 0321160762, Addison-Wesley (2004).
- **Learning Outcomes:** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome 1: embedded systems tools and techniques.
  Outcome 2: aspects of high level languages appropriate to embedded systems.
  Outcome 3: features of real-time schedulers, kernels and operating systems.
  Outcome 4: alternative real-time strategies not based on operating systems.
  Outcome 5: applications that are subject to critical timing constraints.
  Outcome 6: design and implementation of simple real-time systems based on real-time OS kernels.
  Outcome 7: work on projects related but not limited to data acquisition and embedded controlling systems, embedded system software development, scheduling analysis, and hardware/software co-design.

- **Information About Course Designer/Developer:**
  Course designed by R. Liscano, PhD, Faculty of Engineering and Applied Science

- **Identify faculty to teach the course and/or statement "faculty to be hired":**
  R. Liscano, C. Martin

- **Faculty qualifications required to teach/supervise the course:**
  PhD degree in Engineering or Computer Science with relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Course Title: ENGR5730G – Algorithms and Data Structures

- **Course Description and Content Outline:** This course studies the mathematical foundations of algorithms and data structures, covering sorting and searching algorithms, stacks, queues, lists, trees, hash tables, search trees, binomial heaps, minimum spanning trees, shortest paths, the theory of NP-completeness, and approximation algorithms.
- **Content Outline by Topic:**
  - o Functions, summations, recurrences, set theory, counting
  - o The heap sort algorithm and the quick sort algorithm
  - o Lower bounds for sorting
  - o Stacks and queues
  - o Linked lists, trees
  - o Hash tables and functions
  - o Insertion and deletion in binary search trees
  - o Message authentication and hash functions
  - o Binomial trees and breadth-first and depth-first search, minimum spanning trees
  - o Dijkstra's algorithm and the Bellman-Ford algorithm
  - o Theory of NP-completeness proofs and problems
  - o Approximation algorithms to NP problems
- **Delivery Mode and Teaching Method:** 3 hours of lectures per week
- **Student Evaluation:** mid-term exam: 20%, research project and presentation: 25%, homework assignments: 15%, and final exam: 40%.
- **Textbook requirements:** T.H. Cormen, *et al. Introduction to Algorithms (2nd ed.)*. MIT Press, McGraw-Hill, New York, USA, 2006.
- **Learning Outcomes:** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome 1: apply the fundamentals of algorithms analysis and design, and data structures.
  Outcome 2: articulate the fundamentals of sorting and searching algorithms for data structures.
  Outcome 3: analyze problems from the perspective of computational efficiency.
  Outcome 4: design solutions that involve efficient algorithms to perform fundamental computation tasks that operate on appropriate and efficient data structures.
  Outcome 4: analyze the algorithmic complexity of problems and be able to design approximation algorithms for NP problems.

- **Information About Course Designer/Developer:**
  Course designed by M. Vargas Martin, PhD, Faculty of Engineering and Applied Science and Faculty of Business and Information Technology

- **Identify faculty to teach the course and/or statement "faculty to be hired":**
  M. Vargas Martin, R. Liscano

- **Faculty qualifications required to teach/supervise the course:**
  PhD degree in electrical/software engineering or computer science, and relevant experience in teaching & research. Faculty members will normally be registered Professional Engineers.

Course Title: ENGR 5750G – Software Quality Management

- **Course Description and Content Outline**: An intensive investigation into software quality engineering issues, including testing techniques, defect detection and prevention, reliability engineering, examination of maintenance issues and configuration management. Software evolution issues, including planning for evolution, round out the course. Students will do a major team project examining issues in defect reduction. The course will have a strong industrial flavour.
- **Content outline by topic:**
  - o Introduction to software quality engineering
  - o Software Quality Standards
  - o Testing: concepts, issues and techniques
  - o Life cycle testing
  - o Coverage and usage testing
  - o Software quality metrics
  - o Defect reduction, defect classification
  - o Software inspection
  - o Developing a software quality plan
  - o Safety and quality Issues
  - o Software reliability engineering
  - o Software evolution
  - o Maintenance issues
- **Delivery Mode and Teaching Method:** 3 hours of lectures per week.
- **Student Evaluation:** Mid-term exam: 10%, research project and presentation: 20%, assignments: 30%, and final exam: 40%.
- **Textbook requirements:** J. Tien, *Software Quality Engineering,* John Wiley 2005
- **Learning Outcomes:** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome 1: understand the importance of good quality in software.
  Outcome 2: explain and use the basic Quality Life Cycle.
  Outcome 3: use the 7 basic tools of quality control.
  Outcome 4: write a software quality management plan.
  Outcome 5: use software quality metrics.
  Outcome 6: implement defect reduction programs.
  Outcome 7: manage safety-software issues.
  Outcome 8: plan for the evolution of software.
  Outcome 9: manage software maintenance.
  Outcome 10: analysis case studies in software quality.

- **Information About Course Designer/Developer:**
  Course designed by J.M. Bennett, PhD, Faculty of Engineering and Applied Science

- **Identify faculty to teach the course and/or statement "faculty to be hired":**
  J.M. Bennett, R. Liscano, C. Martin

- **Faculty qualifications required to teach/supervise the course:**
  PhD degree in engineering/computer science & relevant experience in teaching & research. Faculty members may be registered Professional Engineers.

Course Title: ENGR 5760G – Software Metrics

- **Course Description and Content Outline**: Analysis of software metrics. Introduction to the techniques of measurement. Syntax and semantics of software metrics. Planning a metrics program. Using metrics for prediction (quality, project time estimations). Case studies.
- **Content outline by topic:**
  - Fundamentals of Measurement and Experimentation.
  - Visualizing Metrics
  - Software Metrics
  - Estimation Metrics
  - Process Control with Software Metrics
  - Project Control with Software Metrics
  - Implementing and Managing a Metrics Program
  - Case Studies
- **Delivery Mode and Teaching Method:** 3 hours of lectures per week.
- **Student Evaluation:** Mid-term exam: 10%, research project and presentation: 20%, homework assignments: 30%, and final exam: 40%.
- **Textbook requirements:** *Software Metrics, 2nd ed.* Fenton, N.E. & Pfleeger, S.L.
- **Learning Outcomes.** Students who successfully complete the course have reliably demonstrated the ability to
  Outcome 1: measure in an engineering way.
  Outcome 2: use the Goal-Question-Metric paradigm.
  Outcome 3: capture meaningful metrics.
  Outcome 4: display the reduced data in a meaningful way.
  Outcome 5: apply control theory to software metrics.
  Outcome 6: handle metrics related to product and process, internally and externally.
  Outcome 7: plan and execute a measurement program.
  Outcome 8: predict the outcome of software activities using appropriate metrics.
  Outcome 9: control and predict software project management.
  Outcome 10: analyze case studies.

- **Information About Course Designer/Developer:**
  Course designed by J.M. Bennett, PhD, Faculty of Engineering and Applied Science

- **Identify faculty to teach the course and/or statement "faculty to be hired":**
  J.M. Bennett, C. Martins, R. Liscano

- **Faculty qualifications required to teach/supervise the course:**
  PhD degree in engineering and relevant experience in teaching and research.
  Faculty members will normally be registered Professional Engineers.

Course Title: ENGR 5850G – Analog Integrated Circuit Design

- **Course Description and Content Outline:** This course covers modeling of IC devices, current sources and mirrors, gain stages, level shifters, analysis and design of BJT and MOS operational amplifiers, current-feedback amplifiers, wideband amplifiers and comparators. Frequency response of amplifiers, feedback techniques, analysis and design, stability and compensation of amplifiers, high slew-rate topologies, noise in IC circuits, fully differential circuits, analog multipliers and modulators, CAD tools for circuit design and testing.
- **Content Outline by Topic:**
  - o Operational amplifiers modeling, applications and topologies
  - o CAD simulation tools, IC fabrication technology and device models
  - o Gain stages, current sources and active loads
  - o Frequency response: single-stage frequency response; multistage frequency response; frequency/time response relationship
  - o Feedback: gain sensitivity; effect on distortion; feedback configurations; effect of loading
  - o Frequency response and stability of feedback amplifiers
  - o Noise in integrated circuits: noise sources; noise models; circuit noise calculations; equivalent input noise generators; noise bandwidth; noise figure and noise temperature.
  - o Translinear and current-mode circuits
  - o Analog multipliers: Gilbert multiplier; multiplier specifications; multiplier applications
- **Delivery Mode and Teaching Method:** 3 hours of lectures per week.
- **Student Evaluation:** mid-term exam: 20%, research project and presentation: 20%, homework assignments: 20%, and final exam: 40%.
- **Textbook requirements:** P.R. Gray, P.J. Hurst, S.H. Lewis, R.G. Meyer, J., *Analysis and Design of Analog Integrated Circuits*, Wiley & Sons, 2001, ISBN 0-471-32168-0, 4th Ed.
- **Learning Outcomes:** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome 1: analyze and design transistor-based op amp filter and oscillator topologies.
  Outcome 2: analyze and design multi-device gain stages in bipolar and MOS technologies.
  Outcome 3: analyze and design bandgap reference circuits.
  Outcome 4: analyze the frequency response of transistor-based amplifier topologies.
  Outcome 5: analyze and design feedback circuits & establish stability in feedback amplifiers.
  Outcome 6: analyze the noise performance of analog circuits.
  Outcome 7: analyze and design translinear circuits.
  Outcome 8: design an analog circuit of the students choosing to meet desired specifications.
- **Information about Course Designer/Developer:**
  Course designed by A. Grami PhD, Faculty of Engineering and Applied Science and Faculty of Business and Information Technology
- **Identify faculty to teach the course and/or statement "faculty to be hired":**
  To be hired
- **Faculty qualifications required to teach/supervise the course:**
  PhD degree in electrical engineering, and relevant experience in teaching & research.
  Faculty members will normally be registered Professional Engineers.

Course Title: ENGR 5860G – Digital Integrated Circuit Design

- **Course Description and Content Outline:** This course covers the analysis and design of digital integrated circuits. Students are instructed in methods and the use of computer-aided design tools for the design and testing of large-scale integrated digital circuits.
- **Content Outline by Topic:**
  - o CMOS devices and manufacturing
  - o Integrated circuit inter-connect
  - o CMOS combinational and sequential logic design
  - o CMOS design implementation and timing
  - o Static and dynamic characteristics
  - o DC and transient modeling
  - o CMOS datapath and control subsystems
  - o CMOS memory subsystems
  - o CMOS testing
- **Delivery Mode and Teaching Method:** 3 hours of lectures per week.
- **Student Evaluation:** mid-term exam: 20%, research project and presentation: 20%, homework assignments: 20%, and final exam: 40%.
- **Textbook requirements:** Rabaey, Chandrakasan & Nikolic, *Digital Integrated Circuits: Design*, Prentice Hall, 2003., ISBN 01309009963
- **Learning Outcomes:** Students who successfully complete the course have reliably demonstrated the ability to:
  - Outcome 1: apply in depth understanding of CMOS inverter, CMOS combinational and CMOS sequential circuits.
  - Outcome 2: study and design the arithmetic building blocks, memory and array structures.
  - Outcome 3: explore and explain about the effect of interconnect on the performance of the circuits.
  - Outcome 4: consider the timing issues in high speed digital circuits and implement methods to overcome the issues.
  - Outcome 5: understand and apply the concepts of design methodologies and VLSI implementations.
  - Outcome 6: use CAD tools to design and verify typical digital circuits.

- **Information about Course Designer/Developer:**
  Course designed by A. Grami PhD, Faculty of Engineering and Applied Science and Faculty of Business and Information Technology

- **Identify faculty to teach the course and/or statement "faculty to be hired":**
  To be hired

- **Faculty qualifications required to teach/supervise the course:**
  PhD degree in electrical engineering, and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Course Title: ENGR 5910G – Embedded Real-Time Control Systems

- **Course Description and Content Outline:** This course focuses on the design and implementation techniques for embedded real-time control systems. It covers embedded system design, instruction sets for microprocessor architecture, I/O, interrupts, hardware and software of embedded systems, program design and analysis, practical issues, multi-tasking operating systems, scheduling and system design techniques.
- **Content outline by topic:**
  - o Embedded system design process
  - o Instruction sets for microprocessor architecture
  - o Mechanisms for input, output, and interrupts
  - o Basic hardware and software platforms and Embedded computing
  - o Program design and analysis
  - o Practical issues related to computer based control systems
  - o Multi-tasking operating systems for embedded applications
  - o Priority scheduling and System design techniques
- **Delivery Mode and Teaching Method:** 3 hours of lectures per week.
- **Student Evaluation:** mid-term exam: 20%, research project and presentation: 25%, homework assignments: 15%, and final exam: 40%.
- **Textbook requirements:** Wittenmark, K.J. 2000, *Principles of Embedded Computing System Design,* Wayne Wolf, Morgan Kaufmann Publishers. ISBN 1-55860-541-X
- **Learning Outcomes:** Students who successfully complete the course have reliably demonstrated the ability to:
  - Outcome 1: articulate the characteristics of embedded and real-time systems in terms of functionality, time constraints, power consumption, cost and development environment.
  - Outcome 2: become familiar with the design process in real-time applications; use UML modeling language to design real-time applications.
  - Outcome 3: describe architecture features of ARM RISC processor and SHARC processor; understand the difference between the two processors; and use instruction sets of these processors to accomplish simple operations.
  - Outcome 4: understand major challenges in embedded computing system design.
  - Outcome 5: get familiar with practical issues related to computer based control systems: PID tuning, anti-aliasing filters, integrator saturation and windup, switch de-bouncing, selection of sampling rates.
  - Outcome 6: write simple programs with multi-tasking operating systems.
  - Outcome 7: design, build and integrate hardware and software for simple real-time embedded applications.
  - Outcome 8: use industry-grade tools & development environment for embedded applications.
- **Information About Course Designer/Developer:**
  Course designed by J. Ren, PhD, Faculty of Engineering & Applied Science and L. Lu, PhD, School of Energy Systems & Nuclear Science and Faculty of Engineering & Applied Science
- **Identify faculty to teach the course and/or statement "faculty to be hired":**
  J. Ren, L. Lu
- **Faculty qualifications required to teach/supervise the course:**
  PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Course Title: ENGR 5920G – Analysis and Control of Nonlinear Systems

- **Course Description and Content Outline:** Introduction to nonlinear systems, phase plane analysis, stability determination by Lyapunov direct method, advanced stability theory, existence of Lyapunov functions, describing function analysis, nonlinear control system design by feedback linearization, sliding control, variable structure control, adaptive control of linear and nonlinear systems, control of multi-output systems, control of multi-input multi-output systems.
- **Content outline by topic:**
  - o Introduction to nonlinear systems
  - o Planar systems and their phase space
  - o Lyapunov stability theory
  - o Input-output stability
  - o Absolute stability
  - o Passivity
  - o Perturbed systems
  - o Feedback linearization
  - o Sliding mode control
  - o Back-stepping control
  - o Lyapunov based adaptive control
  - o Nonlinear observers
- **Delivery Mode and Teaching Method:** 3 hours of lectures per week.
- **Student Evaluation:** mid-term exam: 20%, research project and presentation: 25%, homework assignments: 15%, and final exam: 40%.
- **Textbook requirements:** Khailil, H.K. *Nonlinear Systems – 3rd Edition*. Prentice Hall, 2002.
- **Learning Outcomes:** Students who successfully complete the course have reliably demonstrated the ability to:
  - Outcome 1: get familiar with the basic fundamentals of nonlinear phenomena: multiple equilibria, limit cycles, complex dynamics, bifurcations.
  - Outcome 2: identify second order nonlinear systems: phase plane techniques, limit cycles-Poincare-Bendixson theory, index theory.
  - Outcome 3: understand Input-output analysis and stability: small gain theorem, passivity, describing functions.
  - Outcome 4: understand Lyapunov stability theory: basic stability and instability theorems, LaSalle's theorem, indirect method of Lyapunov.
  - Outcome 5: linearize a system by state feedback: input-output and full state linearization, zero dynamics, inversion, tracking, stabilization.
  - Outcome 6: apply basic software tools to the analysis of nonlinear systems.

- **Information About Course Designer/Developer:**
  Course designed by L. Lu, PhD, School of Energy Systems and Nuclear Science and Faculty of Engineering and Applied Science

- **Identify faculty to teach the course and/or statement "faculty to be hired":**
  L. Lu and E. Esmailzadeh

- **Faculty qualifications required to teach/supervise the course:**
  PhD degree in engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

Course Title: ENGR 5930G – Adaptive Control

- **Course Description and Content Outline:** This is a course on the general principles of adaptive control and learning. This course will cover real-time parameter estimation, deterministic self-turning regulators, stochastic & predictive self-tuning regulators, model reference adaptive systems, gain-scheduling, properties of adaptive systems, robust adaptive control schemes, adaptive control of nonlinear systems, practical issues and implementation.
- **Content outline by topic:**
  - Real-time parameter estimation
  - Deterministic self-turning regulators
  - Stochastic & predictive self-tuning regulators
  - Model reference adaptive systems
  - Gain-scheduling
  - Properties of adaptive systems
  - Robust adaptive control schemes
  - Adaptive control of nonlinear systems
  - Practical issues and implementation
- **Delivery Mode and Teaching Method:** 3 hours of lectures per week.
- **Student Evaluation:** mid-term exam: 20%, research project and presentation: 25%, homework assignments: 15%, and final exam: 40%.
- **Textbook requirements:** K. J. Astrom and B. Wittenmark, *Adaptive Control*, 2nd , Addison-Wesley, 1995
- **Learning Outcomes.** Students who successfully complete the course have reliably demonstrated the ability to

  Outcome 1: understand the fundamental concepts of adaptive control and learning.
  Outcome 2: understand and apply the concepts of convergence, stability, and robustness to analyze control systems.
  Outcome 3: estimate parameters and learn models from empirical data.
  Outcome 4: understand and analyze the behavior of adaptive control schemes such as model reference.
  adaptive control and self tuning regulators.
  Outcome 5: articulate perturbation and averaging theory.
  Outcome 6: use advanced stability theory to analyze adaptation schemes.
  Outcome 7: design of gain-scheduling controllers.
  Outcome 8: be familiar with practical issues in implementation of adaptive controllers.

- **Information About Course Designer/Developer:**
  Course designed by J. Ren, PhD, Faculty of Engineering & Applied Science

- **Identify faculty to teach the course and/or statement "faculty to be hired":**
  J. Ren, L. Lu

- **Faculty qualifications required to teach/supervise the course:**
  PhD degree in engineering and relevant experience in teaching and research.
  Faculty members will normally be registered Professional Engineers.

Course Title: ENGR 5940G – Intelligent Control Systems

- **Course Description and Content Outline:** With the advance of increasingly faster computing hardware and cheaper memory chips, computational intelligence, also known as a part of "soft computation", is becoming more and more important in control engineering. This course will equip the student with the essential knowledge and useful resources to solve some of the systems control problems not easily solved using conventional control methods. This course will cover: fundamentals of fuzzy set theory, structures of fuzzy logic controllers, structures of neural networks, learning algorithms, genetic algorithms.
- **Content outline by topic:**
  - o General characteristics of intelligent control systems.
  - o Fundamentals of fuzzy set theory.
  - o Application of fuzzy logic in control.
  - o Basic and complex structures of fuzzy logic controllers.
  - o Automated design and self-organization of fuzzy controllers.
  - o Basic structures of neural nets.
  - o Static and dynamic neural nets.
  - o Learning algorithms.
  - o Application of neural nets in modeling, identification and control of systems.
  - o Optimization by using genetic algorithms.
  - o Examples of intelligent control systems in industry.
- **Delivery Mode and Teaching Method:** One-term 3 hours of lectures per week.
- **Student Evaluation:** mid-term exam: 20%, research project and presentation: 25%, homework assignments: 15%, and final exam: 40%.
- **Textbook requirements:** C.T.Lin, C.S.G.Lee (1996): *Neural Fuzzy systems - A Neuro-Fuzzy Synergysm to Intelligent Systems*, Prentice Hall, New York.
- **Learning Outcomes:** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome 1: understand fundamental concepts of fuzzy logic (FL), neural network (NN) and genetic algorithm (GA).
  Outcome 2: use NN/FL to model the complex static/dynamic systems.
  Outcome 3: use NN/FL as a tool to construct the complex nonlinear controller to better control the complex dynamics systems.
  Outcome 4: use GA to solve global optimization problem.
  Outcome 5. gain hands-on experience on MATLAB toolboxes for NN and FL to solve practical control design problems.
  Outcome 6: get familiar with the Internet resources on computational intelligent related to control engineering.

- **Information About Course Designer/Developer:**
  Course designed by J. Ren, PhD, Faculty of Engineering & Applied Science

- **Identify faculty to teach the course and/or statement "faculty to be hired":**
  J. Ren

- **Faculty qualifications required to teach/supervise the course:**
  PhD degree in electrical engineering and relevant experience in teaching & research.
  Faculty members will normally be registered Professional Engineers.

Course Title: ENGR 5970G – Power Electronics

- **Course Description and Content Outline:** This course covers fundamentals of lossless switching techniques: zero-voltage switching, zero-current switching; resonant converters: series, parallel and series-parallel topologies; soft-switching converters: natural and auxiliary commutation converter topologies control techniques: variable frequency phase-shift and hybrid control; applications to single-phase three-phase and multi-level converters; line- and force-commutated converters; high power ac/dc and dc/ac converter structures and switching techniques; principles of HVDC and HVAC systems.
- **Delivery Mode and Teaching Method:** 3 hours of class lectures per week.
- **Student Evaluation:** assignments: 25%, mid-term test: 25% and final exam: 50%.
  Textbook requirements: R.W. Erickson, D. Maksimovic, *Fundamentals of Power Electronics*, Springer, 2001, ISBN: 0792372700
- **Learning Outcomes:** Students who successfully complete the course have reliably demonstrated the ability to:
  Outcome-1: derive averaged equivalent circuit models of converters operating in steady state
  Outcome-2: apply Middlebrook's Extra Element Theorem to the input filter design and the resonant inverter design.
  Outcome-3: understand the dynamics of discontinuous conduction mode converters and current-mode control.
  Outcome-4: present the basic magnetics theory necessary for informed design of magnetic components in switching power converters.
  Outcome-5: model various classes of converters and identify their technical requirements, applications and characteristics.
  Outcome-6: appreciate engineering design process and the need for design-oriented analysis.
  Outcome-7: develop design techniques for practical applications.
  Outcome-8: carry out computer simulation of power electronics systems.
- **Information About Course Designer/Developer:**
  Course designed by A. Grami, Ph.D., Faculty of Engineering and Applied Science and Faculty of Business and Information Technology.
- **Identify faculty to teach the course and/or statement "faculty to be hired":**
  R. Marceau, additional faculty to be hired
- **Faculty qualifications required to teach/supervise the course:**
  Ph.D. degree in Electrical Engineering and relevant experience in teaching and research. Faculty members will normally be registered Professional Engineers.

4.6 Collateral and supporting departments

The School of Energy Systems and Nuclear Science, which is affiliated with the Faculty of Engineering and Applied Science, is an important component of this program. Also, the Faculty of Business and Information Technology, and the Faculty of Science at the University of Ontario Institute of Technology are supporting the proposed programs, in part by providing faculty members who contribute their expertise and time to the proposed programs, as well as sharing resources where mutually beneficial.

5 OUTCOMES

5.1 Enrolment and graduations

This is an application for a new program, so this section is not applicable.

5.2 Employment

Employment records of the graduates from the program will be maintained on an ongoing basis.

5.3 Publications

Publication records of the graduates from the program will be maintained on an ongoing basis.

5.4 Projected graduate intake and enrolments

Table 5-1 shows the projected graduate student enrolment (both full-time and part-time students) over the next seven years. As additional faculty are hired over the next few years, the planned enrolment in the program is expected to increase.

Table 5-1 Projected Intake and Enrolments for MASc and MEng Programs

YEAR	FULL-TIME				PART-TIME				TOTAL ENROLMENT	
	Intake		Enrolments		Intake		Enrolments			
	MASc	MEng	MASc	MEng	MASc	MEng	MASc	MEng	MASc	MEng
2007	5-10	5-10	5-10	5-10	1-3	5-10	1-3	5-10	6-13	10-20
2008	10-15	5-10	15-25	10-20	1-3	5-10	2-6	10-20	17-31	20-40
2009	10-15	5-10	20-30	10-20	1-3	5-10	3-9	10-20	23-39	20-40
2010	10-20	10-15	20-35	10-25	1-3	5-10	3-9	10-20	23-44	20-45
2011	10-20	10-15	20-40	10-30	1-3	5-10	3-9	10-20	23-49	20-50
2012	10-20	10-15	20-40	10-30	1-3	5-10	3-9	10-20	23-49	20-50

2013	10-20	10-15	20-40	10-30	1-3	5-10	3-9	10-20	23-49	20-50

In the spring of 2007, the first class of students will graduate from UOIT's undergraduate programs in Manufacturing Engineering and Nuclear Engineering, followed by the first Mechanical Engineering and Energy Engineering graduates in 2008, and the first Automotive Engineering graduates in 2009. As more students successfully complete their undergraduate degrees at UOIT, it is expected that the enrolments in the Automotive Engineering master's programs will rise, as some of these students pursue post-graduate degrees.

APPENDIX A: Survey of Worldwide Graduate Programs in Automotive Engineering

Many graduate programs in automotive engineering are offered in the United States. For example, the University of Michigan offers an MEng degree in Automotive Engineering. Recent figures indicate that the number of enrolled graduate students is 33 full-time students (7 women) and 38 part-time students (7 women), including 14 international students. The MEng degree requires 30 credit hours of course work (or 10 courses). In addition to a mandatory course (Automotive Engineering), students have courses from required areas of powertrains and vehicle dynamics, plus additional elective courses. There is an Automotive Engineering Seminar and Project, which is graded.

At the University of Michigan, Dearborn, an MSE degree in Automotive Systems Engineering is offered. Recent figures have approximately 20 full-time students and 65 part-time students enrolled in the program. Students take 4 courses from a core area, plus courses in a concentration area (such as automotive manufacturing or materials). Capstone projects are team-oriented and they emphasize the interdisciplinary nature of the program. A capstone project or thesis is conducted over a period of two semesters. Also, a thesis is submitted by each individual student.

Kettering University in Flint, Michigan, offers an MSEng in Automotive Systems Engineering. The key faculty research areas include computational fluid dynamics (CFD), emission materials science, plasma, fuel cells and engine combustion. Recent figures indicate that there are about 44 students enrolled in the program, plus 8 international students. The curriculum requires ten four-credit courses for completion of the MSEng degree. This includes MATH 601 (Advanced Engineering Mathematics) and 4 core courses from a group of 6 courses. Also, 4 additional elective courses from a group of 10 courses are required. A thesis or 600-level elective course is also required.

A graduate program in automotive engineering at Clemson University (Clemson, South Carolina) emphasizes product development and vehicle systems integration. The program begins in the Fall of 2006. It will be located in a dedicated state-of-the-art facility. Current plans call for four senior, world-class chaired faculty members in automotive engineering: systems integration, design and development, electronic systems, and manufacturing (hired). In addition, six tenure-track faculty members, closely associated with senior faculty members will be hired.

Outside North America, most auto-making countries have graduate programs in Automotive Engineering. An MSc programme in Automotive Systems Engineering at Loughborough University, UK, is aimed at engineers working in the automotive industry, to extend and deepen their skills and understanding of automotive systems. The MSc comprises 180 modular credits, made up from six modules valued at 15 credits each, plus a Master's Project valued at 90 credits. From the group of six taught modules, two modules are compulsory and four more electives are chosen from a list of available options. The course is also attended by graduate engineers working in the automotive industry. It runs as a series of intensive week-long modules conducted at an on-site University conference centre. The compulsory modules are (1) Vehicle Functional Performance and (2) Vehicle Systems Analysis. The elective modules (select four) are (1) Vehicle NVH, (2) Electronic Systems Integration, (3) Powertrain Engineering, (4) Vehicle Platform Engineering, (5) Engine Performance Advanced Technologies, (6) Design Integrated Manufacture, (7) Systems Safety and Reliability Engineering and (8) Manufacturing Systems.

Cranfield University in Bedfordshire, UK, offers an MSc degree in Automotive Product Engineering. The program requirements include a course, individual project and 30 hours of industrial lectures, which provide an overview of a wide range of aspects of automotive industry practices. The course runs from early October of one year to mid-September of the next year. It contains a range of subject materials, including vehicle dynamics, design, powertrains, controls and management. Entry to the program requires an undergraduate degree in Engineering, Physics or Mathematics. Various other universities in the UK offer graduate studies in Automotive Engineering. For example, Coventry University in the UK offers the degree of MSc in Automotive Engineering Design, as well as an MSc degree in Automotive and Automotive Component Manufacture.

Esslington University of Applied Science in Germany offers an MSc degree in Automotive Engineering. The first semester provides foundation courses in Automotive Engineering. The modules of the first semester are (i) Principles of Intelligent Design, (ii) Modern Manufacturing, (iii) Advanced Electronic Systems and (iv) Advanced Propulsion Technology. Besides technical subjects, these modules also cover management and engineering issues, including the subjects of quality management, project management and global engineering.

At the end of the first semester, the students decide on their area of specialization (Design / Manufacturing or Mechatronics) and they complete a project in this field. Elective courses are taken in the second semester. For students pursuing a Major in Design/Manufacturing, this module consists of lectures combined with exercises organized individually or in groups in the subjects of Design, Integrity of Structures, Material Technology, Production Systems, Operation Management, Quality Assurance and Maintenance. For a Major in Mechatronics, this module consists of lectures combined with exercises organized individually or in groups in the subjects Multi Body Systems, Powertrain Management, Mechatronic Systems, Sensors and Measurement Technology and Computer Simulation. Project 2 is carried out in small groups usually in one of the university laboratories or in industry. Project work has crucial importance in the MSc curriculum. Companies require that engineers are experienced in teamwork, have skills and flexibility regarding more than one technical area, have social competence and the fluent command of at least one second language. In the third semester, students will work on their Master´s Thesis. In their final thesis, Master's candidates demonstrate the full extent of their scientific and practical engineering knowledge of a specific subject. The Master´s thesis has a duration of six months and it is performed preferably in industry.

The MA program in Automotive Engineering at Bogazici University, Turkey, covers a range of automotive engineering courses. This includes inner workings of the automobile engine to external aspects such as vehicle aerodynamics, properties of materials used in automobiles and transportation analysis. Practical applications of the theory of mechanics, dynamics, combustion, aerodynamics and heat transfer are also covered. For the completion of the program, students are required to take 30 credits of coursework consisting of 10 courses and a research project (2 credits). The research project is selected jointly by the student, faculty member and a representative from an industrial partner. There are no required courses. Students can typically finish the program in 3 or 4 semesters.

South Korea has several universities offering graduate programs in automotive engineering. For example, Keimyung University in Taegu offers a Master's Degree in Automotive Engineering. Another example, Kyung Hee University, Seoul, South Korea, which also offers a Master's Degree in Automotive Engineering. In Australia, the Royal Melbourne Institute of Technology offers a

Master's degree in Automotive Engineering, as part of a University International Partnership for the collaborative development and training of automotive engineering students.

Appendix B

General Policies and Procedures for Graduate Studies

at the

University of Ontario Institute of Technology

June 1, 2006

Preamble:

As a young and dynamic institution, the University of Ontario Institute of Technology (UOIT) continues to develop policies and procedures for matters related to graduate studies. The new policies in this paper are based on the best practices of leading institutions across Canada, while recognizing UOIT's unique mission, principles and dynamics.

The main purpose of this document is to consolidate proposed new graduate studies policies with existing ones, thus creating a comprehensive set of conventions for all UOIT students, faculty members and staff pursuing graduate-level study, teaching or administration.

To clarify any information in these policies, please contact the Dean of Graduate Studies. The General Policies and Procedures for Graduate Studies will be reviewed no later than fall 2010.

The following current UOIT policies and guidelines also apply to graduate studies:

- Student Conduct;
- Protection of Privacy and Access to Information;
- Research Guidelines;
- Intellectual Property; and
- Use of Turnitin.com's Plagiarism Detection System.

List of Policies

1. Administration of Graduate Studies
- 1.1 Dean of Graduate Studies
  - 1.1.1 Responsibilities
- 1.2 Graduate Program Directors
  - 1.2.1 Appointment
  - 1.2.2 Responsibilities

2. Graduate Faculty Appointments
- 2.1 Categories of Graduate Teaching and Supervision Privileges

3. Program Format

4. Student Supervision
- 4.1 Faculty Advisor Appointment
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- 4.4 Research Supervisor Responsibilities
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5. Supervisory Committee
- 5.1 Appointment
- 5.2 Composition
- 5.3 Responsibilities
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6. Thesis, Project or Major Paper
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- 6.2 Use of Copyright Material in Student Work
- 6.3 Oral Examination
  - 6.3.1 Examining Committee
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  - 6.3.5 Outcomes of Completion of the Oral Examination
- 6.4 Project or Major Paper Evaluation
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7. Submission of Student Work

8. Intellectual Property
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- 15.5 Academic Appeals

1. Administration of Graduate Studies

1.1 Dean of Graduate Studies

The role of the Dean of Graduate Studies is central to all major academic and administrative graduate study activities.

1.1.1 Responsibilities

The responsibilities of the Dean of Graduate Studies include:

- providing leadership, strategic planning and vision, particularly in the growth and development of graduate programs and activities;
- administering all regulations relating to graduate studies;
- chairing the Graduate Studies Committee of Academic Council;
- representing graduate studies at Academic Council; and
- representing the university's graduate studies to internal and external individuals and groups.

1.2 Graduate Program Directors

Each program will have a Graduate Program Director. This role is of critical importance to ensuring the success of the program and its students.

Graduate Program Directors should have a strong interest in students and their success, thoroughly understand UOIT's policies and procedures for graduate studies, and be available on a regular basis to assist students seeking advice on issues related to their studies.

The Graduate Program Director is accountable to the Dean of the Faculty and, with respect to graduate activities, to the Dean of Graduate Studies.

1.2.1 Appointment

The Graduate Program Director is appointed by the Dean of the home Faculty, in consultation with the Dean of Graduate Studies. The duration of the appointment may be two or three years at the discretion of the home Faculty Dean with opportunity for re-appointment.

1.2.2 Responsibilities

Each Graduate Program Director has a formal role and responsibilities relating to the Graduate Studies Committee of Academic Council, including nominations, Supervisory Committees, student awards and similar matters.

The main duties of the Graduate Program Director are to:

1. ensure that all graduate studies policies and procedures are administered fairly and correctly and are communicated to students in their program;
2. chair the Academic Committee for the program and make recommendations to the Dean of Graduate Studies regarding the admission of applicants;
3. approve a program of studies for each student and provide advice regarding changes to a student's status or program;
4. appoint a faculty advisor or research supervisor for each student;
5. where applicable, work with the student and research supervisor to form a Supervisory Committee and appoint a committee Chair;
6. recommend external examiners to the Dean of Graduate Studies;

7. consider requests from students to defer an examination;
8. consider for approval changes to a student's grade;
9. liaise regularly with the Dean of Graduate Studies and, as needed, with the Registrar;
10. maintain student records and forward to the appropriate UOIT office(s), as required;
11. provide advice, as needed, to units and bodies such as the Graduate Studies Committee of Academic Council;
12. help ensure that graduate students have the necessary resources, facilities and support;
13. co-ordinate financial assistance (including assistantships and fellowships) for graduate students;
14. help monitor the progress of graduate students;
15. provide input and assistance as requested for the creation and review of graduate programs;
16. mediate as needed in conflicts or disputes between a graduate student and his or her research supervisor; and
17. co-ordinate graduate student recruitment activities for the program.

2. Graduate Faculty Appointments

Faculty members who are eligible to participate in the supervision of graduate students and teach graduate courses must have an academic appointment at UOIT. This may be a core or definite-term appointment, or that of an Adjunct Professor or Professor *Emeritus/Emerita*. Individuals wishing to teach at the graduate level are nominated by the Dean of the Faculty through which the program is delivered. Once approved by the Dean, the nomination is forwarded to the Graduate Studies Committee of Academic Council for final approval.

All faculty members who are currently involved in any aspect of graduate education, including acting as a research supervisor and/or member of a Supervisory Committee and who are listed in the Ontario Council of Graduate Studies (OCGS) briefs, automatically become eligible to teach graduate courses and supervise graduate students. The category of membership will be determined by the criteria set out in section 2.1.

Membership is effective from the date of introduction of a graduate program until the program is scheduled for a periodic appraisal by OCGS. At this point—and every seven years thereafter—all faculty members will be re-evaluated for graduate teaching and supervision privileges. In effect, the normal renewal of graduate teaching and supervision privileges will be synchronous with OCGS periodic program appraisal.

The updated faculty list will be printed annually in the paper and electronic versions of the graduate section of the *Calendar*. It is the responsibility of the Graduate Program Director to keep an up-to-date list of eligible faculty members who participate in a graduate program.

2.1 Categories of Graduate Teaching and Supervision Privileges

Graduate studies at UOIT offers three categories of eligibility: Graduate Faculty, Probationary Faculty and Special Faculty.

Graduate Faculty are UOIT faculty members who are authorized to participate in all aspects of a graduate program on a regular and sustained basis. These privileges are renewable every seven years at the time of the OCGS periodic appraisal of the graduate program in which the

faculty member participates. Graduate Faculty are authorized to perform a variety of activities including: serving as a research supervisor or co-supervisor or as a member of a student Supervisory Committee, participating in an Examining Committee, teaching graduate-level courses, acting as a faculty advisor, and mentoring and advising graduate students in all aspects of their program. Graduate Faculty have a research program that includes externally refereed publication as well as previous experience in graduate teaching and/or supervision.

Probationary Graduate Faculty status is accorded to new faculty members at UOIT who are authorized to participate in graduate education immediately upon commencement of duties at UOIT. Faculty with graduate supervisory or teaching experience and a research program that includes externally refereed publication may be accorded Probationary Graduate Faculty or Graduate Faculty status on appointment. Normally, Probationary Graduate Faculty privileges are granted for two-year periods. Probationary Graduate Faculty have the same responsibilities as Graduate Faculty, but cannot act as a student's sole research supervisor. In graduate programs involving theses, projects or major papers, a faculty member may apply for Graduate Faculty status after successful committee participation in the completion of at least one master's thesis or acting as a co-supervisor for a project or major paper, as well as the publication of at least one refereed article. In graduate programs involving only coursework, a faculty member may apply for Graduate Faculty status after successfully teaching courses in the graduate program and publishing at least one refereed article.

Exceptions to this regulation will be considered by the Graduate Studies Committee of Academic Council on a case-by-case basis. Probationary Graduate Faculty status can be withdrawn at any time by the Graduate Studies Committee of Academic Council.

Special Graduate Faculty status is intended for non-core faculty members who have temporary appointments at UOIT (in certain cases where qualifications warrant) and who provide a limited graduate educational activity for a limited time (i.e. two to three years). Faculty members in this category may be appointed to serve on a Supervisory Committee and/or as external examiners. They may also be allowed to teach graduate courses for a limited time and participate on an Examining Committee. Permission for such appointments must be obtained from the Dean of the host Faculty with a memo to the Dean of Graduate Studies and an up-to-date curriculum vitae.

In no case may a non-core faculty member or Adjunct Professor serve as the sole research supervisor of a graduate student. Individuals with special graduate teaching and supervision privileges may assist with the direction of a graduate student's research, following approval by the Dean, through appointment as a co-supervisor. In this case, however, one of the co-supervisors must be a member of the Graduate Faculty for that graduate program.

3. Program Format

Some master's programs require students to write a thesis, while other programs require a project, major paper or other work. The thesis, project or major paper is a central part of the student's program and helps fulfill one of UOIT's mandates: to promote the generation of knowledge through scholarly research of the highest quality.

In some UOIT programs, students may choose between one or more formats such as a thesis, project or a course work option. The program format and options are specified in the program

description in the graduate section of the *Calendar* and in other program information.

A graduate thesis is an original work that is overseen by a research supervisor and a Supervisory Committee. Theses are worth at least nine credits and involve an oral examination that includes an assessment by an external examiner. A project or major paper is an original work that is supervised by a research supervisor and includes a second reader. Projects and major papers are worth at least six credits and do not require an oral examination or an external examiner.

4. Student Supervision

Each master's student will have a faculty advisor or research supervisor to provide guidance throughout the program. In programs that do not require a thesis, project or major paper, the student will be guided by a faculty advisor throughout the program.

A student registered in a program that requires a thesis, project or major paper may initially have a faculty advisor, but will be assigned a research supervisor when the student begins his or her research. In some cases a student may have co-supervisors, with the terms established through an agreement for co-supervision and made clear at the outset to all involved.

4.1 Faculty Advisor Appointment

The Graduate Program Director is responsible for assigning faculty advisors.

4.2 Faculty Advisor Responsibilities

The faculty advisor will be a member of the student's home Faculty. The main responsibilities of the faculty advisor are to:

1. consult with the student, recommend a program of study, and submit it to the Graduate Program Director for approval;
2. help the student choose an appropriate area of research, if applicable;
3. ensure that the student understands all degree requirements and regulations, as well as applicable policies;
4. be knowledgeable about, and inform the student of, key deadlines and related information;
5. be reasonably available to the student to discuss the program of study, as well as any academic concerns;
6. if requested, advise the student on academic or personal student services or resources; and
7. monitor the student's academic progress.

4.3 Research Supervisor Appointment

The relationship between the student and the research supervisor is most important to the student's successful completion of a graduate degree. The Graduate Program Director will seek input from the student before assigning a research supervisor.

All research supervisory appointments must be approved in the first instance by the Dean of the primary Faculty in which the student is registered. Except in extraordinary circumstances, approved on an individual basis by the Dean of Graduate Studies, research supervisors must be members of the UOIT core faculty. Associate members and Adjunct Professors may serve as co-supervisors with the approval of the Dean of the Faculty.

Before approving the appointment of a research supervisor, the Dean should give careful consideration to the faculty member's research activities, supervisory experience and training, previous performance in graduate student supervision, the number of graduate students already being supervised, any imminence of leave (i.e. research, maternity or administrative) or retirement, and any other relevant factors.

Since continuity of supervision is important in all graduate work, a change of research supervisor may be made only for strong reasons and after extensive consultation with all involved. A request for a change may come from the student, the research supervisor, the Graduate Program Director or the Dean. It should normally be sent, in writing, to the Graduate Program Director accompanied by the reasons for the proposed change. If the home Faculty Dean concurs with the request, the recommendation for change should be sent to the Dean of Graduate Studies for final approval.

4.4 Research Supervisor Responsibilities
Specific responsibilities of the research supervisor include:

1. being sufficiently familiar with the field of research to provide guidance and/or be willing to gain that familiarity before agreeing to act as a research supervisor;
2. being accessible to the student for consultation and discussion of the student's academic progress and research;
3. helping the student select and plan a suitable, timely and manageable research topic;
4. co-operating with the student and Graduate Program Director to establish a Supervisory Committee to convene meetings, normally at least once annually, to evaluate the student's progress;
5. responding in a timely, consistent and thorough manner to written work submitted by the student, with constructive and well-informed suggestions for improvement and continuation;
6. providing a research environment that is safe, healthy, tolerant and free from harassment, discrimination and conflict;
7. within the norms appropriate to the discipline, providing financial support and/or helping the student obtain financial support from all reasonable sources;
8. when there is conflicting advice, or when there are different expectations on the part of co-supervisors or members of a student's Supervisory Committee, endeavouring to achieve consensus and resolve differences in the best interests of all involved;
9. acknowledging appropriately the contributions of the student in presentations and published material, in many cases via joint authorship;
10. being sensitive to cultural factors which may influence the individual student's learning and research behaviour and experience; and
11. making arrangements for continuity of the student's supervision before beginning an extended leave of absence.

4.5 Student Responsibilities
Student responsibilities include:

1. making a commitment and showing substantial effort, initiative and dedication to gain the background knowledge and skills needed to pursue the research project successfully;
2. working with their research supervisor to develop a plan and a timetable for completion

of all stages of the research project, and working assiduously to adhere to a schedule and to meet appropriate deadlines;
3. meeting regularly with their research supervisor and reporting fully and regularly on progress and results;
4. keeping their Graduate Program Director fully informed regarding any matter relevant to their status in the program and seeking advice from their research supervisor, as appropriate;
5. meeting agreed-upon performance standards and deadlines of funding organizations to the extent possible when financing has been provided by UOIT or a funding agency, or through a contract or grant; and
6. adhering to the standards of research ethics, health and safety, and respecting the requirements of academic integrity, honesty and professionalism (this includes, but is not limited to, acknowledging and crediting any source of ideas, assistance, materials and/or data provided by others).

4.6 Student-Research Supervisor Conflicts
It is the responsibility of UOIT and its Faculties to ensure that all graduate students receive appropriate and fair supervision. Due to the nature of the relationship between the student and research supervisor, conflicts may arise. In such instances, the first step must be to attempt to resolve the conflict informally between the student and research supervisor. It is the responsibility of the Graduate Program Director to act as a mediator.

A student who believes the conflict has not been resolved should contact the Dean of the student's home faculty. If the conflict persists, the student may pursue appropriate resolution through the Dean of Graduate Studies.

5. Supervisory Committee

Each graduate student in a program that requires a thesis will have a Supervisory Committee. Early formation of a Supervisory Committee, along with regular meetings and formal meeting records, will help ensure higher completion rates.

5.1 Appointment
The Supervisory Committee will be appointed by the Graduate Program Director, after consultation with the research supervisor and the student. The appointment will be made once the research supervisor is satisfied that the student has made adequate progress in the chosen research area.

5.2 Composition
Normally, each Supervisory Committee consists of the student's research supervisor and at least one other UOIT faculty member. The Chair, who may be someone other than the student's research supervisor, will be appointed by the Graduate Program Director of the student's home Faculty.

5.3 Responsibilities
The Supervisory Committee's main responsibilities are to:

1. advise the student and help define the course of study;
2. assess and approve the student's research proposal;
3. provide support to the student and research supervisor by broadening and deepening

the range of expertise and experience available;
4. be reasonably accessible to the student to discuss and suggest other sources of information;
5. offer comments when requested on written work submitted by the student;
6. review the student's progress toward successful completion of the thesis with scheduled meetings at least once per year;
7. provide constructive feedback and provocative discussion of the student's program of study, thereby exposing the student to a wider range of expertise and ideas than can be provided by the research supervisor alone;
8. report progress to the Graduate Program Director and recommend continuation in the program based on satisfactory performance (in the case of reports of unsatisfactory progress, the student may be required to withdraw from the graduate program); and
9. recommend to the Graduate Program Director and the Dean of Graduate Studies whether a thesis should move to oral examination (this stage must be completed no less than three months prior to the date set for examination).

5.4 Chair's Responsibilities
The main responsibilities of the Chair of the Supervisory Committee are to:

- convene and run Supervisory Committee meetings;
- keep the Graduate Program Director informed of the student's progress;
- recommend potential External Examiners to the Dean of Graduate Studies; and
- forward a copy of the student's thesis to members of the Examining Committee at least four weeks before the oral examination.

6. Thesis, Project or Major Paper

Many master's programs require students to write a thesis or major paper, or produce a project. All written work must be in English and in correct, concise and scholarly language.

6.1 Permission to Begin
Permission to begin the thesis is given by the student's Supervisory Committee when there is general agreement that sufficient research has been done. If the student's program requires a project or major paper, the student's research supervisor will authorize the student to begin the project or major paper.

Students should seek guidance from their research supervisor regarding the use of a style manual appropriate to the academic discipline in which they are working, as well as other available guides to assist in effective writing. Also, students are expected to be aware of and observe copyright requirements, and follow other standards as outlined in the UOIT policies on Research Ethics (http://www.uoit.ca/EN/main2/11246/13525/14057/14152/research_ethics.html) and Research Involving Animals (http://www.uoit.ca/EN/main2/11246/13525/14057/14152/research_guidelines.html).

6.2 Use of Copyright Material in Student Work
When preparing a thesis, major paper or other program work, students may include some copyright material, typically in the form of excerpts from books or articles, charts, diagrams or similar previously published materials. It is the student's responsibility to acknowledge properly

any copyright materials used, strictly following the citation guidelines and rules of their Faculty and/or program.

As well, students who use extensive selections of copyright work may need to seek advance written permission from the author, and must append the letter to their work. Students should contact the copyright holder well in advance of their deadline, as obtaining permission to use copyright materials may take considerable time. In addition, students may be required to pay a fee to obtain such permission. Questions regarding the use of copyright materials should be discussed with the faculty advisor or research supervisor, as appropriate.

Students may be required to submit their work to Turnitin.com. Further information can be obtained from UOIT's policy on the Use of Turnitin.com's Plagiarism Detection System (http://www.uoit.ca/EN/main2/11246/13525/14057/14152/turnitin_policy.html).

6.3 Oral Examination
Master's candidates whose programs require a thesis will be required to defend their work orally in front of an Examining Committee. Students are expected to follow the advice of their research supervisor and their Supervisory Committee in establishing when their work is ready for examination. In exceptional circumstances students may request that the Dean of Graduate Studies arrange for an examination of the thesis or other work without the support of the research supervisor and Supervisory Committee.

It is the student's responsibility to ensure that all materials are prepared and assembled appropriately. Students should consult their research supervisor for specific regulations on the preparation and presentation of materials.

6.3.1 Examining Committee
The Examining Committee evaluates the academic merit of each student who defends a thesis and decides whether the student has satisfactorily passed the oral examination.

The Examining Committee consists of all members of the Supervisory Committee plus one external examiner (section 6.3.2). The committee is chaired by the Graduate Program Director or designate.

6.3.2 External Examiner
An external examiner is typically a faculty member outside the student's program. The external examiner can not be an Associate or Adjunct member of the student's home Faculty, nor have had any direct or indirect supervision of the student's thesis. This person will have considerable direct knowledge in the field of study of the subject matter.

Conflicts of interest must be avoided when recommending the names of external examiners to the Dean of Graduate Studies. External examiners must not be teaching or supervising family members or relatives of the student, must not be closely linked in a personal or research capacity, nor shall they have shared financial interests with either the student or the research supervisor. Should the student's thesis contain chapters or sections of previously published works, the external examiner shall not have been involved in the review or editing of this material in any capacity.

When an external examiner from outside the university is recommended, a curriculum vitae and written rationale for the choice must be provided to the Dean of Graduate Studies.

The external examiner is appointed by the Dean of Graduate Studies, upon recommendation of the Chair of the Supervisory Committee.

6.3.3 Approval for Oral Examination
Before an oral examination can be held, the Supervisory Committee must approve the thesis for examination (no more than one negative vote and/or abstention). The work must be submitted at least four weeks prior to the proposed oral examination.

The Examining Committee will meet at least one week prior to the scheduled date of examination and will determine if the work in its form and content is ready to be examined. If the work is deemed not ready for defense, the Examining Committee must provide to the candidate and the Dean of Graduate Studies in writing its reasoning for disagreement within 72 working hours. In this instance, the oral examination shall be postponed for a period of time not exceeding one year from the scheduled date.

6.3.4 Examination Procedure
Once the work has been deemed ready for examination, the Chair of the Examining Committee shall make all necessary arrangements for sending the thesis to the external examiner, setting the examination date, and preparing the relevant documents needed at the time of the examination.

If a member of the Examining Committee finds that he or she is unable to attend the oral examination, the Graduate Program Director should secure a suitable replacement. Should a suitable replacement not be found, the member is asked to submit his or her questions or concerns, to be read by the Examining Committee Chair at the defense. In extraordinary circumstances, the examination will be rescheduled if one or more members of the Examining Committee are unable to attend.

The oral examination consists of a short presentation (15-20 minutes) by the candidate summarizing the main findings of the work. The presentation is an open event that can be attended by all interested parties at the discretion of the Chair, but visitors may not remain for the rest of the proceedings.

Once the presentation has concluded, the student answers questions from members of the Examining Committee, including the committee Chair. Questions must be related to the work done by the student for the thesis and be based on knowledge directly related to the material.

When the question period is over, the student is asked to leave the room and members of the Examining Committee will determine the outcome of the oral examination. The Examining Committee Chair is a non-voting member, unless the Chair’s vote is needed to break a tie.

6.3.5 Outcomes of Completion of the Oral Examination
The Examining Committee will render one of the following four decisions:

1. acceptable without change;
2. acceptable with minor change;
3. acceptable with major change; or

4. not acceptable.

1. Acceptable Without Change
A grade of pass is given if there is acceptance of the student's work with no required revisions by the committee as a whole.

2. Acceptable with minor change
A grade of pass is given if there is acceptance of the student's work with minor revisions to be completed within four weeks; revisions must not alter or drastically change the content of the thesis.

3. Acceptable with major change
A thesis which is not acceptable as a pass but not deemed a fail is referred for major revision. A thesis cannot be referred for a major revision and a second oral examination more than once; no further defense is permitted. In order to qualify for a decision of major revision, the work must meet one of the following requirements:

a) the committee agrees that the work requires considerable change in order to be deemed a pass; or
b) there is a majority vote in favour of major revision.

In the case of a major revision, the Examining Committee will reconvene within six months to continue the examination including the revisions. The revised thesis will be distributed within four to six weeks prior to the meeting to all members of the committee for review and assessment.

4. Not Acceptable
A thesis is deemed failed if:

a) there is a majority vote to fail it; or
b) the thesis is deemed unacceptable after major revisions.

Detailed reasons for failure must be submitted by the Chair of the Examining Committee to the Dean of Graduate Studies, the Graduate Program Director, and the candidate within two weeks.

6.4 Project or Major Paper Evaluation
The research supervisor or co-supervisors, and at least one other reader appointed by the Graduate Program Director from among the Graduate Faculty, Probationary Graduate Faculty, or Special Graduate Faculty for that program, shall submit a grade for the project or major paper. All grades must be accompanied by a report that outlines the reasons for the grade.

Each of the submitted grades will be one of the following.

1. acceptable without change;
2. acceptable with minor change;
3. acceptable with major change; or
4. not acceptable.

In cases where all the submitted grades are acceptable without change, a grade of pass will be given.

In cases where at least one grade is “acceptable with minor change” and there are no “acceptable with major change” or “not acceptable” grades, the research supervisor will ensure that the student’s work is revised to respond to the recommended minor changes. Normally, these revisions must be completed within four weeks. Revisions must not alter or drastically change the content of the project or major paper. Upon the satisfactory completion of the revisions, a grade of pass will be submitted for the student.

In cases where at least one grade is “acceptable with major change” and there are no “not acceptable” grades, the research supervisor will ensure that the student’s work is revised to respond to the recommended changes. These revisions must be completed within six months. After these revisions are complete the student’s project or major paper will be circulated a second time for evaluation by the research supervisor or co-supervisor and at least one other reader appointed by the Graduate Program Director. Any grade of “acceptable with major change” or “not acceptable” from the second reading will result in a grade of fail. Any evaluations of “acceptable without change” or “acceptable with minor change” will be processed accordingly and the student will be given a grade of pass.

In cases where there are at least two “not acceptable” grades, the student will be given a grade of fail.

In cases where there is only one “not acceptable” grade, the Graduate Program Director will meet within two weeks with the research supervisor and the student. The Graduate Program Director has two options after this consultation:

1. The Graduate Program Director sends the project or major paper to another reader within four weeks. The project or major paper may incorporate only minor revisions. If the new reader determines that the project or major paper is either “acceptable without change,” “acceptable with minor change” or “acceptable with major change,” the assessment of the student’s work will continue with the appropriate level of response as outlined above for the evaluation that requires the greatest revision. If the new reader assigns a grade of “not acceptable,” the student will have then received a second “not acceptable” and will be given a grade of fail.

or

2. The Graduate Program Director follows the procedures associated with “acceptable with major revision.”

6.5 Thesis, Project or Major Paper Notation

Upon acceptance of the student’s thesis, project or major paper, the title of the work and date of approval will be recorded on the transcript.

7. Submission of Student Work

Once a student’s thesis, project or major paper has been approved, the student must submit the work formally. The following procedures and conditions apply:

1. one bound copy and one electronic copy of the original thesis, project or major paper become UOIT property;

2. the student grants UOIT a royalty-free, non-exclusive licence to make copies of the work for academic purposes at UOIT, and upon request from other universities or bona fide institutions;

3. the international copyright symbol (©) is displayed prominently on the title page of the thesis (or displayed with similar prominence on other types of work);

4. the site licence, signed by the student at the start of the program, takes effect; the site licence permits the UOIT library to circulate as part of its collection and/or copy the work for academic purposes only (the university's copyright notice is placed on all copies made under the authority of the licence);

5. while the site licence excludes the sale of authorized copies for profit, UOIT may recover duplication costs through a fee;

6. every copy made available under the licence clearly states that the copy is being made available in this form with full consent of the copyright owner and only for the purposes of private study or research; and

7. UOIT may submit the work to the National Library of Canada, which is permitted to reproduce and lend copies for educational or research use only.

8. Intellectual Property

Intellectual property (IP) comprises original work which often takes various forms such as research data, books, journal papers, theses, projects, photographs, computer programs, websites, equipment, devices, or audio recordings.

8.1 Students and Ownership of Intellectual Property

Students, as well as faculty members and researchers, may create intellectual property. This may be done individually or in collaboration with one or more students, the student's research supervisor or faculty advisor, or other faculty members.

UOIT's Intellectual Property policy generally states that creators own their work. As a result, student rights are treated as equivalent to those of all other academic personnel, including faculty members. When a student works collaboratively with other students, the student's research supervisor, or other UOIT faculty members or researchers, credit for the work is generally shared among the research collaborators. To be considered for joint authorship, all collaborators must:

- have made a significant contribution to the concept, design, collection, analysis or interpretation of the data; and
- have helped write and revise the draft publication for intellectual content.

In addition, as the Student Contributors section of UOIT's Research Guidelines states:

> "A student should be granted due prominence on the list of co-authors for any multiple-authored article or report that is based primarily on the student's own work, according to the commonly accepted practice in the field."

8.2 Students and Ownership of Externally Funded Research

While jointly created intellectual property (IP) is owned jointly, other ownership rules may apply when a student participates in a project that is funded by externally sponsored contracts or grants. In such cases, the sponsoring organization or any contractual agreement with UOIT may determine ownership and control of IP.

Students should discuss with their research supervisor or faculty advisor whether any such conditions apply to the student's work. Nevertheless, an external organization or agency may not delay completion of a student's thesis, project or major paper. Only in special circumstances may an outside organization or agency be permitted to temporarily delay public dissemination of such student work.

If the work has commercial value, the student, in conjunction with other co-creators of the work, may wish to apply for a patent or other IP protection. Upon request, UOIT will assess the commercial value of the work and may agree to pay for these costs and manage the IP commercialization process on behalf of the creators. In all cases, commercialization activities require authorization from the Associate Provost, Research to confirm that obligations to UOIT and any research sponsors have been met and will continue to be satisfied.

9. New Graduate Programs and Review of Existing Programs

When developing new graduate programs or reviewing existing ones, UOIT will follow the policies and procedures of the Ontario Council on Graduate Studies (OCGS). OCGS policies and procedures can be found at http://ocgs.cou.on.ca/.

10. Admission Policies and Regulations

10.1 Application Procedure

Applications for admission to graduate studies programs are normally submitted online at http://www.uoit.ca/. Where paper applications are required, they shall be submitted to:

Registrar's Office
UA2071
University of Ontario Institute of Technology
2000 Simcoe St. North
Oshawa, Ontario L1H 7K4

10.2 Application Deadline Dates

Prospective students should consult the university academic schedule and/or program information for application deadlines relating to specific programs.

10.3 Admissions

To be eligible for admission to any graduate degree program at UOIT, applicants must normally meet the following requirements:

a) Hold a four-year honours degree or equivalent from a recognized institution in the area of graduate study or a closely related subject.

b) Have an overall academic standing of at least a B (GPA = 3.0 on a 4.0/4.3 scale), with a minimum B in the last two full-time years (four semesters) of undergraduate work or equivalent.
c) Provide a minimum of two letters of reference from persons having direct knowledge of the applicant's academic competence. Some Faculties may require three letters. Academic references are preferred; however professional references will be accepted. Letters of reference should come from individuals under whom the applicant has worked closely or studied.
d) Provide proof of English proficiency if the first language is not English (see current policy on English proficiency in the graduate section of the *Calendar*).
e) Submit one official copy of each previous undergraduate and graduate transcript directly from the granting institute. It is the student's responsibility to provide a certified English translation of the transcript if the original is in another language.
f) If required, submit a brief description of the courses listed on the official transcripts or provide a copy of the relevant calendar where they are listed.

The aforementioned requirements are the minimum required for entry into graduate studies at UOIT. Some Faculties may have additional requirements for entry into a specific program.

10.3.1 Offers of Admission
All offers of admission are based on the recommendation of the Graduate Committee of the graduate program in question.

10.3.2 Refusal of Admission
Due to enrolment limitations and additional requirements in some programs, meeting the minimum requirements does not guarantee admission to the program. UOIT may, at its sole discretion, refuse admission to an applicant even if the above minimum admission criteria have been met.

10.3.3 Appeal of Admission Decisions
Individuals may appeal their admission decision in writing within 10 working days to the Registrar's office. There may be a charge assessed for such appeals. Admission appeals are directed to the Dean of Graduate Studies who will refer the appeal to the Graduate Studies Committee of Academic Council.

10.3.4 Letters of Permission (students from other universities)
Students completing graduate programs at other Ontario universities may register under the Ontario Visiting Graduate Student Plan (see section 13.8). Students completing graduate programs from universities outside of Ontario may apply to complete individual courses on a Letter of Permission (LOP) from their home university. Such students shall be admitted to UOIT as non-degree students.

LOP students will still be required to complete the UOIT Application for Admission form, as well as submit a letter from the Dean of Graduate Studies at the student's home university to the Office of Graduate Studies at UOIT, outlining the expectations of work to be completed while at UOIT.

10.4 Description of Graduate Students

Regular student: Applicants meeting the minimum admission requirements are considered for admission as a regular student.

Probationary student: Applicants who do not meet the minimum admissions requirements may be considered for admission to a probationary year. Applicants must be approved by the Graduate Program Director who will prescribe a program of studies to meet the admission requirements for a master's program. During this time, the student will be admitted as a non-degree student until the qualifications outlined have been met and the student can be moved into regular student status.

Special student: Applicants who are non-degree-seeking students may apply to take graduate-level courses for professional upgrading or personal interest. Applicants will apply through the Registrar's office and successful students must receive Faculty consent prior to registering for the course.

11. Student Status

11.1 Classification of Graduate Students

Full-time*:* Graduate students are considered full time if they meet the following criteria:

a) pursue their studies as a full-time occupation;
b) formally identify themselves as full-time students on all documentation;
c) maintain regular contact with their faculty advisor or research supervisor, if applicable, and be geographically available and visit the campus regularly; and
d) if employed by UOIT, work no more than 10 hours per week per term for which they are registered as a full-time student.

Part-time*:* Graduate students who do not meet the above criteria are deemed part-time students. Part-time students may have course load restrictions. Students should consult the individual Faculty with regard to the availability of part-time studies within their program.

11.2 Absences from Studies

Graduate students are expected to be uninterruptedly registered in their designated program of study in order to support the timely completion of their degree. However, the university recognizes that under certain circumstances a student may need to absent themselves from regular study while maintaining their relationship with UOIT. Such circumstances must have sufficient cause and an official leave of absence must be requested through the Office of Graduate Studies and approved by the Dean of Graduate Studies.

Acceptable circumstances include:

a) exceptional circumstances: medical, extraordinary demands of employment, compassionate circumstances;
b) maternity leave: available to students during or following a pregnancy; and
c) parental leave: available to students who face extraordinary demands in parental responsibilities, or whose duties require that they be absent from their studies for a period of time.

12. Financial Aid

UOIT endeavours to help support graduate students in their programs by offering teaching assistantships, research assistantships, scholarships and bursaries. The Office of Graduate Studies and individual Graduate Program Directors have the most up-to-date information on external and internal awards and other financial support.

13. Registration Policies and Regulations

13.1 Session Dates

Graduate students normally register for three academic semesters per year: fall (September to December), winter (January to April) and summer (May to August).

13.2 Registration

Students must be registered in all terms commencing with the term specified in their letter of acceptance and continuing until graduation. Failure to register in all terms will result in withdrawal from the program. If a student does not register within one term of acceptance, readmission to the program is required. All courses in the student's program must be approved by the Graduate Program Director.

Students will be automatically registered in a graduate continuance course until graduation, withdrawal or program termination. Students must actively register for all other program courses.

13.3 Changes in Course Registration

Students may add courses with the approval of the Graduate Program Director within the first two weeks of lectures in any given semester. Students may drop courses without academic penalty within the first 75 per cent of the semester, with the approval of the Graduate Program Director. Students should see the academic timetable for specific add and drop deadlines. Financial deadlines may differ from these dates.

13.4 Residency Requirement

At least half of a graduate student's courses must be from the UOIT course offerings in order to meet the residency requirements for graduation.

13.5 Program Changes

Changes to a graduate student's program must be approved by the Graduate Program Director.

13.6 Provision for Waiver of Regulations

Waivers of course prerequisites/co-requisites may be granted by the Graduate Program Director. Waivers of Faculty, degree or general regulations may be granted by the Dean of Graduate Studies.

13.7 Transfer Credits

All course credit transfers into graduate programs require the approval of the Graduate Program Director of the Faculty delivering the equivalent course. Transfer courses may not have been used to satisfy other degree requirements. Graduate transfer courses will not be

considered for transfer if they were completed more than eight years prior to admission or if the grade received if the course is below B- (70%).

13.8 Visiting Students
The Ontario Visiting Graduate Student Plan (OVGSP) permits a graduate student to take courses at other Ontario universities while remaining a registered student at his or her home institution. UOIT students must complete the OVGSP form (available from their Faculty) and provide an outline of the course, desired term, and the reasoning for requesting such permission. The course must be a requirement of the student's program and must be formally approved by the Graduate Program Director as well as the student's faculty advisor or research supervisor before submission to the Registrar's office. Students from other universities wishing to register for graduate-level courses at UOIT should contact the Office of Graduate Studies at their home institution for more information regarding the process.

UOIT students wishing to take courses at institutions outside Ontario may do so on a letter of permission. Such a course must be approved in advance by the student's Graduate Program Director, in consultation with the student's faculty advisor or research supervisor, as applicable. A letter of permission ensures that the courses to be taken at the host institution will be recognized for credit at UOIT and are applicable to the student's program of study. This allows the student to attend the host institution without formal admission. If the student is in clear academic standing (section 14.11) and has the necessary prerequisite courses, the student shall complete a Letter of Permission Request form and submit the course outline(s) to the Registrar's office. Students are responsible for having copies of the final transcript from the host institution forwarded to the UOIT Registrar's office for award of transfer credit. The minimum mark a student must achieve to have the course transferred is B- (70%).

UOIT students must apply for a letter of permission before taking a course elsewhere. Failure to do so could result in revocation of admission.

13.9 Repeating Courses
Students who fail one required course may be permitted to continue their program with permission of their Graduate Program Director. Students who do not successfully complete the second attempt at the course, or who fail more than one course, will be required to withdraw immediately from their program of study.

13.10 Deferral of Course Examinations
Students whose religious obligations conflict with a scheduled final examination will be permitted to write a deferred examination. Such students are required to give three weeks' notice to their Graduate Program Director and to document the religious obligations involved.

Graduate Program Directors may grant deferred examinations on medical or compassionate grounds where sufficient documentation exists. A request for deferral on medical or compassionate grounds, along with supporting documentation, must be provided to the Graduate Program Director within four days after the scheduled writing of the examination.

A Graduate Program Director may also grant a deferred examination to a student who is scheduled to write three examinations in a 24-hour period. In this case, the exam in the middle of the three is normally the one that will be considered for deferral. Scheduling is conducted in such a way as to minimize the instance of consecutive examinations for students.

If a technical difficulty prevents the writing of a computer-based examination, the Graduate Program Director may arrange for a deferred examination for all students in the class. Such an examination will be scheduled no later than the end of the first week of classes in the following semester.

13.11 Supplemental Examinations
In some circumstances students may be allowed to write one supplemental examination. The mark from a supplemental examination may replace or otherwise augment a mark previously obtained in an examination in the same course. Students should contact their Graduate Program Director for regulations concerning supplemental examinations.

13.12 Grading Scheme

Grade	**Percentage**	**Grade Points**	**Description**
A+	90-100	4.3	**Very Good to Excellent**— Student demonstrated mastery of the course material
A	85-89	4.0	
A-	80-84	3.7	
B+	77-79	3.3	**Acceptable to Good**— Student demonstrated adequate knowledge of course material
B	73-76	3.0	
B-	70-72	2.7	
F	0-69	0	**Inadequate**— Student did not perform to academic expectations

13.13 Minimum Average
In order to continue in a prescribed program of study at the graduate level, a student must maintain a minimum B- average overall.

13.14 Grade Changes
After grades have been officially approved and released, any grade changes must be submitted in writing to the Registrar. Grade changes may result from the submission of course work, the writing of a deferred examination, clerical errors, or an approved examination reread. All grade changes must be approved by the course instructor and the Graduate Program Director or designate.

If a student's grade is not available when final grades are approved at the end of the term because of special circumstances, a special designation will be temporarily added to the student's record. If a deferred examination has been granted, a grade of DEF will be assigned. If a portion of the work required for the course is incomplete, a grade of INC may be recorded. These grades may satisfy prerequisites for further courses on a temporary basis, but not beyond the end of the subsequent term after which these grades revert to "F."

Graduate continuance courses will be assigned a grade of CO (continuance) and will not be included in grade point average calculations.

13.15 Grade Appeals

Students may, with sufficient academic grounds, request that a final grade in a course be appealed (which will comprise only the review of specific pieces of tangible but not oral work). Grounds not related to academic merit are not relevant for grade appeals.

Students are normally expected to contact the course director first to discuss the grade received and to request that their tangible work be reviewed. Students should be aware that a request for a grade appeal may result in the original grade being raised, lowered or confirmed. The deadline for submitting grade appeals is three weeks after the release of final grade reports in any term.

If the condition of sufficient academic grounds has been met, the student shall lodge a request with the Registrar's office, which will contact the Graduate Program Director and collect any fees incurred for the appeal. Students must specify the rationale for their appeal by making clear the component of the final grade upon which they seek appeal. The Graduate Program Director will be responsible for ensuring that the work is reappraised by an appropriate faculty member, ensuring anonymity of both the student and the reappraiser, and for communicating the result of the appeal (including the reappraiser's comments) and the route of appeal to the student and the course director. The reappraiser will be given the nature of the assignment and the rationale for the original grade. It is expected that every effort will be made to render the decision within 30 days of the reviewer having received the work.

In the event that a student is still not satisfied with the final grade, or the course director is not available to review the work, a student may submit, in writing, a formal request for a grade appeal to the Graduate Studies Committee of Academic Council. Such appeals can only be considered on the grounds of procedural irregularity. Appeals must be submitted within 15 working days of notification of the decision. Appeals shall be heard by a panel of a minimum of three committee members, as determined by the Dean of Graduate Studies, including at least one student and at least two faculty members. The appeal hearing shall be chaired by the Dean of Graduate Studies or designate, who shall be counted as a panel member.

At the discretion of the relevant faculty committee, the student and/or the faculty member may be invited to meet with the panel to present their case(s) orally. The panel's decision will be taken in camera and it is expected that parties will be informed of the decision in writing within 20 working days of the filing of the appeal.

13.16 Conferral of Degrees

Students expecting to graduate in any given term are required to contact the Registrar's office to complete the necessary forms. All applications must be received no later than January 15 for June graduation.

Degrees will be conferred at the time of Academic Council approval and notation of the degree awarded will be entered on the student's record. All students who are awarded a degree are eligible to attend the session of Convocation that immediately follows the date of conferral.

14. Degree Requirements

All candidates pursuing a master's degree shall enroll in an advanced course of study approved by the Graduate Program Director where the graduate student is registered. Each student must meet the program requirements laid out by the host Faculty, while maintaining the required average to qualify to graduate in a timely manner.

14.1 Time Limits

The minimum time allowed for full-time students to complete all requirements for a master's program is one year, and the maximum time is three years from the time of initial registration as a full-time student. Students registering on a part-time basis have a maximum of five years to complete the degree. Terms for which a student is granted a leave of absence shall not be included in these time limits.

Students needing to exceed the normal allotted time for completion of their program must formally request an extension to their program. Extension requests are to be made after the normal program length to the Dean of Graduate Studies.

Students who do not complete degree requirements within the allotted time and have not been granted an extension may be required to withdraw from the program. Under exceptional circumstances and on the recommendation of the Chair of the Supervisory Committee, a student who did not complete the degree requirements within the allotted time may be readmitted for one semester only to complete those requirements. Final approval for readmission must be granted by the Dean of Graduate Studies.

15. Academic Conduct

15.1 Code of Academic Conduct

Faculty members and students share an important responsibility to maintain the integrity of the teaching and learning relationship. This relationship is characterized by honesty, fairness, and mutual respect for the aims and principles of the pursuit of education. Academic misconduct impedes the activities of the university community, and is punishable by appropriate disciplinary action.

UOIT and its members have the responsibility of providing an environment which does not facilitate the inadvertent commission of academic misconduct. Students and faculty should be made aware of the actions which constitute academic misconduct, the procedures for launching and resolving complaints, and the penalties for commission of acts of misconduct.

15.1.1 Academic Misconduct: Offences

Academic misconduct includes, but is not limited to:

- unreasonable infringement on the freedom of other members of the academic community (i.e. disrupting classes or examinations, or harassing, intimidating or threatening others);
- violation of safety regulations in a laboratory or other setting;

- cheating on examinations, assignments, reports or other work used to evaluate student performance (cheating includes copying from another student's work or allowing one's own work to be copied, submitting another person's work as one's own, fabrication of data, consultation with an unauthorized person during an examination, and use of unauthorized aids);
- impersonating another student or allowing oneself to be impersonated for purposes of taking examinations, or carrying out laboratory or other assignments;
- plagiarism, which is the act of presenting the ideas, words, or other intellectual property of another as one's own (the use of other people's work must be properly acknowledged and referenced in all written material);
- obtaining by improper means examination papers, tests or similar materials, or the use or distribution of such materials to others;
- falsifying academic records, including tests and examinations, or submitting false credentials for the purpose of gaining admission to a program or course, or for any other purpose;
- misrepresentation of facts, whether written or oral, which may have an effect on academic evaluation; this includes making fraudulent health claims, obtaining medical or other certificates under false pretenses, or altering certificates for the purposes of misrepresentation;
- submission of work when a major portion has been previously submitted or is being submitted for another course, without the express permission of all instructors involved; and
- professional unsuitability, such as behaviour inconsistent with the norms and expectations of the profession.

15.2 Procedure for Resolution
With respect to all accusations of academic misconduct, students are presumed innocent until the contrary has been established. Decisions regarding the commission of academic misconduct are based on the balance of probabilities. A record of all allegations of misconduct, along with details of the resolution, will be entered into the central academic records kept by the Registrar's office.

Faculty, staff, or students who have reason to believe that an academic offence has been committed should report the matter promptly to the appropriate Dean. A written report of the alleged offence shall be prepared, together with any relevant evidence.

The Dean must decide promptly whether an attempt is to be made to resolve the matter informally; otherwise, the Dean shall follow the procedures for formal resolution. In either case, a student will not be permitted to withdraw from the course in which the offence was alleged to have been committed until the matter is resolved and penalty imposed, if applicable.

15.2.1 Informal Resolution
The Dean must inform the student of the accusation of academic misconduct. The student will have five working days in which to respond to these allegations. If the alleged offender responds with an admission of guilt and agrees to the terms of a resolution as set out by the Dean, the matter will be considered closed. The terms of the resolution shall be detailed in writing and signed by the Dean and the student in question. A copy of this document will be sent to the Dean of Graduate Studies.

Informal resolution may not result in the expunging of grades, the revoking of degrees, or in the student being suspended or expelled.

15.2.2 Formal Resolution
When an attempt at informal resolution fails or is deemed inappropriate, the Dean must inform the student in writing of the charge, the possible penalties, and a copy of the pertinent policy statement. The student will be given five working days to prepare a response. The Dean will then meet with the student to hear the response. Both the Dean and the student are entitled to be accompanied by up to two advisors at this meeting, provided 48 hours' advanced notice is given of the identity of the advisors.

The Dean shall then conduct a thorough investigation of the allegations and response, to be concluded within 10 further working days, and notify the parties of the decision in writing. A copy of the decision will be provided to the Dean of Graduate Studies and, on a need to-know basis, to administrative units (i.e. the Graduate Program Director, other Faculties, the Registrar).

15.3 Penalties
If a student is deemed to have committed academic misconduct, one or more of the disciplinary penalties in the following list may be imposed. The severity of the penalty will be determined by the nature of the offence and the student's past record of conduct. Students found guilty of successive acts of misconduct will receive increasingly severe penalties.

The disciplinary penalties are:

- Resubmission of the piece of academic work in respect of which the misconduct was committed, for evaluation.
- A written reprimand, warning the student that the behaviour was unacceptable and that further misconduct will lead to additional penalties. A copy of the reprimand will be placed in the student's file, but no notation will appear on the academic record.
- Submission of a failing grade in an examination, test, assignment or course.
- Disciplinary probation for the remainder of the student's registration in his current program of study. A note to this effect will be placed in the student's file, but no notation will appear on the academic record. Any further offence will lead to a more severe penalty.
- Expunging of grades or revoking of degrees.
- Restraining orders or monetary restitution where appropriate in the case of threats, harassment, or damage to property.
- Suspension from attendance in a course, program, Faculty or UOIT itself, for a period not exceeding three years as deemed appropriate. While suspended, a student may not register, and loses the right to attend lectures, write examinations, and receive payment from UOIT sources. Courses taken elsewhere during the period of suspension are not eligible for transfer credit. Notice of suspension will be placed in the student's file and will appear on the student's academic record. The conditions of suspension will specify the length of time such notice will remain on the student's academic record.
- Permanent expulsion from UOIT. A note to this effect will be placed in the student's file and will remain on his academic record.
- Such other penalty as deemed appropriate.

15.4 Termination of Student Enrolment
UOIT may terminate a student's enrolment in a graduate program on any of the following grounds:

- failure to achieve the required grades to continue as outlined in the degree regulations;
- failure to achieve the required grade on a comprehensive exam or project;
- failure to successfully complete a thesis, project or major paper;
- failure to register in any semester;
- failure to report, in advance, courses being taken at another institution;
- lack of progress toward completion of the program;
- recommendation of termination from the Supervisory Committee;
- failure to meet the conditions of admission;
- academic misconduct;
- professional unsuitability as defined by the program; or
- research misconduct and/or noncompliance with UOIT's research ethics guidelines or policies.

15.5 Academic Appeals
All decisions of the university relating to academic conduct or program termination may be appealed to the Graduate Studies Committee of Academic Council. The student will be given 10 working days to gather new evidence and to submit a letter of appeal to the Dean of Graduate Studies. Under normal circumstances, disciplinary penalties will not be imposed before an appeal is decided; however, official transcripts will not be issued during this period. Formal registration may be revoked where warranted. In the case of suspected professional unsuitability, a student may be withdrawn from classes, practica, work placements or other program-related activities pending resolution of the case.

A student may apply to the Dean of Graduate Studies for continued attendance in classes and related activities while the appeal is being heard. In order for such a request to be granted, the Dean of Graduate Studies must be satisfied that there would be no detrimental effect of such continued attendance. If the appeal is granted, formal registration will be reinstated.

15.5.1 Graduate Academic Appeals Procedures

1. Appeals shall be heard by a panel of a minimum of three committee members, as determined by the Dean of Graduate Studies, including at least one student and at least two faculty members.
2. The appeal hearing shall be chaired by the Dean of Graduate Studies or designate, who shall be counted as one of the panel members.
3. Decisions with respect to the final disposition of an appeal will be carried by a simple majority of panel members hearing the appeal.
4. An appellant must have completed any prior levels of appeal open to him or her before filing a Notice of Appeal with the committee.
5. An appeal to the committee shall be commenced by filing a Notice of Appeal in the required form no later than 4 p.m. on the 10th working day after the date of the decision which is being appealed.
6. The chair may refuse to give a hearing to an appeal on the grounds that it is not within the jurisdiction of the committee.

7. The panel of the committee hearing an appeal may dismiss an appeal by unanimous decision after considering the written submissions notwithstanding a request for an oral hearing on the grounds that there is no real case for an appeal (i.e. the appeal is frivolous or vexatious and without merit).
8. In the Notice of Appeal, the appellant shall elect whether an oral hearing is requested. If no election is made, the appeal shall be determined in writing.
9. Where an appeal is to be determined in writing:
    i. As soon as reasonably practicable the panel shall provide a copy of the Notice of Appeal to the responding Faculty;
    ii. The responding Faculty has 10 working days to deliver to the panel a written response to the Notice of Appeal, attaching any documents relevant to the decision under appeal. A copy of the written response and attached documents shall be mailed to the appellant; and
    iii. The appellant shall have 10 working days from the mailing date of the responding Faculty's response to provide any final written response. A copy of this shall be mailed to the Faculty.
10. Where the appeal is to be determined by oral hearing:
    a. Upon receipt of the Notice of Appeal, the panel, in consultation with the appellant and the responding Faculty, will schedule a date for the oral hearing;
    b. No less than 10 working days prior to the hearing, the appellant shall deliver to the panel (three copies) and the responding Faculty (one copy) of:
        i. Any written submissions to be relied upon at the hearing;
        ii. Copies of all documents to be referred to at the hearing; and
        iii. A list of persons attending as witnesses and a brief summary of each witness's intended evidence.
    c. No less than five working days prior to the hearing, the responding Faculty shall deliver to the panel (three copies) and
    the appellant (one copy) of its material listed at paragraph 10.1(b), (i) to (iii), above.
11. Where the appeal is to be determined in writing, the members of the panel may convene in person or via teleconference.
12. For an oral hearing, the following procedures shall apply:
    i. At the commencement of the hearing, the chair shall identify the parties and the members of the panel;
    ii. The appellant or a representative shall briefly describe the case to be presented, and provide factual support for the case through documentary evidence and testimony of the appellant and any witnesses, if relevant;
    iii. The responding Faculty or a representative shall briefly reply to the appellant's case and provide facts in opposition to the case through documentary evidence and the testimony of witnesses, if relevant;
    iv. Panel members may ask questions at the conclusion of each person's statement or testimony, or at the conclusion of the appellant's or responding Faculty's case;
    v. Normally, neither the appellant nor the responding Faculty may ask questions of the other's witnesses. Where facts important to the decision of the appeal are in dispute, however, either party may ask permission and, if appropriate, the panel may grant permission for the cross-examination of some or all witnesses;

vi. Following the presentation of the appellant's and the responding Faculty's cases, the appellant and the responding Faculty may each make brief closing statements to summarize the main points of their respective positions;
vii. Following the foregoing steps, the parties will withdraw and the panel will move in camera for its deliberations;
viii. The decision of the panel will be in writing and shall include the names of the panel and all who appeared, a brief summary of the issues on the appeal, the panel decision and reasons in support of the decision.

13. The time limits specified under these procedures may be extended by the chair at the request of the appellant or responding Faculty, if reasonable grounds are shown for the extension.

APPENDIX C: Library

LIBRARY SUBMISSION TO ONTARIO COUNCIL OF GRADUATE STUDIES (OCGS) FOR: THE MASTER OF APPLIED SCIENCE AND MASTER OF ENGINEERING PROGRAMS IN AUTOMOTIVE ENGINEERING
University of Ontario Institute of Technology (UOIT)

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Introduction

With respect to the University of Ontario Institute of Technology's Master of Applied Science and Master of Engineering in Automotive Engineering as offered by the Faculty of Engineering and Applied Science and its affiliated School of Energy Systems and Nuclear Science, the following document discusses the Library in relation to the collection; the accessibility of resources and services; and research support, staffing, and partnerships. The collection is defined as including both the traditional paper book or periodical, and the more nontraditional – but increasingly common - electronic index, book or journal database. Librarian recommended web sites are also a unique part of the collection in that they direct students and staff to valid academic sources. A subscription to the Data Liberation Initiative (DLI), a detailed comprehensive series of data sets offered through Statistics Canada, was recently acquired in response to expanded research initiatives at UOIT. Similarly, D-Space, an institutional repository system that captures, stores, indexes and preserves digital research material is also being launched by the UOIT Library. Accessibility addresses the physical presence of the Library, onsite reference assistance, the Library web page www.uoit.ca/library as a 24/7 portal, and interlibrary loan and document delivery. Research support, staffing, and partnerships emphasize the Library's role in teaching students, liaising with faculty, and connecting with government and corporate agencies.

Collections

It is understood that the Library's acquisition plan must be based on evolving pedagogical needs as determined by the academic schools. In close liaison with the Deans and Professors, subject specialist Librarians will define collection development strategies for the ongoing curriculum-based purchase of resources as well as for the evaluation and review of existing material. Given the two streams of the Automotive Engineering program, it is realized that both research-oriented and applied resources are required:

> The main objective of the MASc program is to prepare students for a career as an R & D engineer…[or to prepare them to] continue their education and pursue a PhD degree…The main objective of the MEng program is to provide the opportunity for engineers in industry to upgrade and expand their skills. Graduates of the program will apply their education to various advanced technologies in the automotive sector or other industries (OCGS Appraisal Brief, August 31, 2006).

Books

The Library offers a small but comprehensive collection. At present, there are approximately 73,000 volumes on the shelves. In August 2004, the Library took possession of its new building (described below) and this additional space will allow for the relatively quick expansion of the collection to 160,000 texts. Currently, there are approximately 8,500 volumes focusing on pure and applied science topics many of which relate directly to the Automotive Engineering masters program. For example, books on materials, thermodynamics, engineering design, robotics and automation, digital communications, and noise, vibrations and harshness are already available. Please note that in the Fall of 2005, the Faculty of Engineering and Applied Science launched undergraduate programs in Automotive, Electrical, and Software Engineering. The Library obviously had to be prepared for these students and Faculty. Although this is only the third year that UOIT has offered courses, with the Library understandably being in a significant growth phase, this Masters program is particularly well placed in terms of resources. From its onset, UOIT has been building its reputation on science- based programming in mathematics, physics, chemistry and biology; Library collection development has echoed this.

More specialized and academically focused books are being bought in preparation for year four of UOIT's operation and for postgraduate programs. This includes texts that address the drafting of research proposals, grant writing, public speaking and presentation techniques, technical communications including abstracting, and university teaching. The Library's goal is to increase its holdings by 2,000 to 3,000 volumes per year for several successive years with a current projected cost of $400,000. to $450,000. per annum. Books are selected primarily (Faculty suggestions are most welcome) by Subject Specialist Librarians both directly from noteworthy academic publishers (e.g. Wiley, CRC Press, Sage, Elsevier, Academic Press, Addison-Wesley, Kluwer, Springer-Verlag, Pearson Prentice Hall) and from Blackwell's Book Services, an arrangement that allows for the simultaneous purchase of titles from a wide array of vendors.

The importance of specialty publishers for both print and online documents is also recognized. The Library will access and/or purchase as necessary standards, proceedings, and technical reports from key scientific organizations. Example sources include the American Society for Testing and Materials (ASTM), the Society of Automotive Engineers (SAE), the American Society of Mechanical Engineers (ASME), the Canadian Standards Association (CSA), the American National Standards Institute (ANSI), and the National Research Council – Canada Institute for Scientific and Technical Information (NRC-CISTI).

With over 15,000 titles (not included in the total above), e-books are an integral part of the UOIT library collection. Currently, Access Science and the Encyclopedia of Materials Science and Technology are the databases most likely to interest the Program's students and faculty. Especially given UOIT's commitment to the laptop university concept, the Library's e-book collection is destined to grow.

<u>Journals, Transactions and Conference Proceedings</u>

In addition to the indexing and abstracting that the Library provides for thousands of periodicals (journals, magazines, newspapers) through its electronic databases, 30,000 of these titles are available in full text electronically and 350 in paper. Of relevance to the Automotive Engineering masters program is that over 2,800 full text titles are categorized under the heading of Science with approximately 200 of these titles designated as chemistry, 250 as physics, and 270 as mathematics. There are nearly 11,000 full text Technology journals of which approximately 100

each focus directly on manufacturing and mechanical engineering, and another 20 are particular to the automotive industry. Electronic databases are not only a venue for periodicals. Many such as IEEE and SAE also offer technical reports, conference proceedings, and standards.

UOIT library databases believed to support this postgraduate program are categorized and then listed alphabetically below. Top priority is of course given to those products exclusively focused on Engineering.

Extremely Relevant:
Compendex
IEEE (Institute of Electrical and Electronics Engineers)
Inspec (IEE- Institution of Electrical Engineers)
SAE (Society of Automotive Engineers)

Very Relevant:
ACM (American Computing Machinery)
CCOHS (Canadian Centre for Occupational Health & Safety – collection of databases focusing on chemicals highlighting their properties, uses, hazards and availability – includes MSDS (Material Safety Data Sheets) and associated Ontario and federal legislation and standards
Elsevier Science/Science Direct
IOP (Institute of Physics)
Materials Science: A Sage Full-text Collection
MathSciNet
Proquest Science
RSC (Royal Society of Chemistry)
Science Citation Index Expanded (Part of ISI Web of Science)
Scitation (AIP – American Institute of Physics and ASME – American Society of Mechanical Engineers)

Relevant (multidisciplinary databases):
Academic Search Premier
Cambridge University Press
Kluwer
Sage
Springer-Verlag
Wiley/Interscience

Please note that there are several ways to access electronic journals. UOIT is a member of both OCUL (Ontario Council of University Libraries) and CRKN (Canadian Research Knowledge Network) – the provincial and national university library consortia, respectively, that provide for the effective group purchase and distribution of electronic resources. Scholars Portal and E-Journals at Scholars Portal are OCUL platforms that allow an individual to access a number of databases simultaneously. The UOIT Library also provides Faculty and subject guides highlighting pertinent indexes and databases, a searchable alphabetical list of all indexes and databases, a searchable alphabetical list of all periodical (journal, magazine and newspaper) titles, and a citation locator that checks for either journal or article availability. Further, cross-referencing amongst databases is provided by a federated search engine or linking software called “Find It @ UOIT”. If a patron is searching one database, but the article is available in another, he/she will be redirected to this resource. If the article is not available at UOIT, the option to request an ILL (interlibrary loan) is

displayed.

The Library also hosts Refworks, a software tool that allows for citations to be "harvested" from various periodical databases or imported directly so bibliographies can be easily prepared. The user selects the appropriate bibliographic format (e.g. MLA, APA) and Refworks applies it to the references that have been assimilated. The complementary component is Refshare; it allows for bibliographies to be shared amongst colleagues and/or to be used as electronic reserve listings. Students are directed to an article by their professor and simply authenticate into the Library system.

Following the mandate of the University of Ontario Institute of Technology as a laptop university with "round the clock" accessibility to resources, wherever possible, the Library will purchase significant holdings to a journal including archives in electronic format. It is, however, realized that paper copies may sometimes be essential, and must be purchased accordingly.
Internet:

While the prevalence and importance of the Internet is recognized, it is also realized that not all information on the Internet is of equal value and/or prominence, and that not all people have equal search skills. The Library, therefore, strives to make staff and students aware of quality web sites appropriate to their Program. Listings of Recommended Web Sites are part of the Library Faculty Guides that are prepared with each UOIT program in mind. Posted on the Library web site www.uoit.ca/library , these Faculty Guides are discussed in detail under "Accessibility". For example, amongst the relevant sites for this Masters program are: EEVL (Edinburgh Engineering Virtual Library – Heriot Watt University), efunda (Engineering Fundamentals), Project Euclid (Cornell University) and Scirus (Elsevier) along with specific societal sites such as SAE International (Society of Automotive Engineers), ASTM (American Society for Testing and Materials), and ASME (American Society of Mechanical Engineers – Manufacturing Engineering Division).

Data Liberation Initiative:

The DLI is an expansive collection of detailed statistical sets assimilated and maintained by Statistics Canada and offered through the IDLS (Internet Data Library System) hosted by the University of Western Ontario's Social Science Computing Laboratory. Those files that relate to manufacturing will be of interest to researchers in the Automotive Engineering masters program.

D-Space:

The Library has already acquired the necessary server and is planning to launch its own D-Space within the next few months. This is an open archive initiative (OAI) developed by the Massachusetts Institute of Technology (MIT) that allows for the capturing, storing, indexing, preserving and distributing of digital research material. Faculty members are invited to post their research findings and papers in this institutional repository thus encouraging collaboration amongst colleagues.

Accessibility

The Building:

A new state-of-the-art, 73,000 square foot Library was opened in August 2004. The intent of the design is to create a print/electronic library that accommodates new and emerging technologies without sacrificing the personal warmth of a traditional library. The building offers various types of study and activity spaces to accommodate different learning styles and user needs. These spaces include:

- Quiet public study spaces as well as a formal Reading Room, all within a "wireless" environment
- Collaborative learning spaces for groups of various sizes
- Common spaces and public service research workstations that facilitate intellectual interaction and engagement
- Electronic classrooms for regular ongoing educational sessions on library resources and research strategies
- Attractive and appealing display areas for art and library exhibitions
- Special needs adaptive technology equipment

Staff, students and faculty have welcomed this new building with its seating for over 500 patrons and 150 public access workstations with Internet access. The grand opening was October 29, 2004.

ON CAMPUS REFERENCE ASSISTANCE:

Reference services are provided by professional librarians for 68 hours of the 89 hours per week that the Library is physically open or 76.5% of the time. Librarians liaise with professors so classes specific to student research topics can be offered, and general information literacy sessions are offered campus-wide throughout the year. Topics such as the research process, Internet site evaluation, and bibliographic citation are addressed. Making individual or small group appointments with a librarian is encouraged too.

Library Web Page:

The Library web page is available at www.uoit.ca/library and is accessible 24 hours a day, seven days a week. Both a general Library e-mail address and a Reference Desk e-mail are provided as well as telephone information so individuals can leave messages at any time. In collaboration with other Ontario University Libraries, the Library is also currently investigating a web-based service such as the Virtual Reference Desk (www.lssi.com) which uses chat software to deliver reference service to users regardless of time and location. The Librarian can "push" pages to patrons so they can literally see both the steps involved and the results achieved with a given search. Consequently, this technology promises to be more effective than e-mail and telephone. Beginning with limited hours and an after-hours e-mail default, the ultimate goal is to make virtual reference a "round the clock" service.

General reference assistance is provided through Library web page sections that explain topics such as computer search techniques, article searching, internet evaluation, and bibliographic citation. Amongst the services outlined are circulation procedures, reserves, and interlibrary loan. What makes the UOIT Library web page truly unique is its Faculty Guides. Prepared with each program in mind for a particular Faculty, every Guide outlines and links to pertinent Electronic

Databases and Indexes; provides sample listings with links to relevant journals along with subject headings for further investigation; highlights the Catalogue with suggestions from the Reference collection; describes and links to the most appropriate E-book databases; and offers Recommended Web Sites. These Guides are indeed resource portals. As UOIT's Faculties are becoming more and more diverse, Subject Guides are also being launched. These are of particular assistance to students taking electives from areas outside their discipline.

Interlibrary Loan and Document Delivery:

As UOIT is still in its developmental stages, Interlibrary Loan is currently available free of charge to students, staff and faculty. Individuals have the option of making their requests online or in person. RACER (rapid access to collections by electronic requesting) is a VDX (Virtual Document Exchange) interlibrary loan system implemented in OCUL member libraries; this obviously includes both UOIT and Trent. Searches are performed throughout all Ontario university libraries and CISTI (Canada Institute for Scientific and Technical Information). As part of OCUL and the IUTS (Inter University Transit System), the Library now receives book loans in a very reasonable amount of time, and Ariel, an electronic transmission system for periodical articles, allows journal requests to be filled within a few days.

Faculty and students from UOIT may also visit any of Canada's university libraries and may borrow books (Reciprocal Borrowing Agreement) directly from them upon presentation of their UOIT photo identification card. Materials may be returned directly to the lending library or may be left at the UOIT Library where they will be returned to the appropriate lending library.

Since a postgraduate program is being discussed here, the borrowing restrictions that the University of Toronto Libraries have on undergraduates are obviously not applicable.

Research Support, Staffing and Partnerships

The following strategies are established and/or being developed:

1. As described above, the Library as part of a newly formed institution (June 2002) has already made significant progress in terms of collection development, instruction and resource accessibility. Continued efforts will be made to improve and expand information services. As professors arrive on the UOIT campus, librarians are meeting with them to identify their teaching and research objectives.

2. A professionally qualified librarian (M.L.S.) with subject expertise in the sciences and health sciences joined the UOIT Library staff in August 2002. Given the anticipated appearance and evolution of more UOIT postgraduate programs, the hiring of a Graduate Studies Librarian will occur within the next two years.

3. The importance of liaising with the UOIT Centre for Academic Excellence and Innovation (CAEI), a facility where faculty are introduced and mentored in the use of instructional technology such as computerized teaching packages, presentation software, web development, and distance learning delivery is recognized. This would ensure that the Library's resources, in digital format, are included amongst the links for courses developed within the Faculty of Science. A link to the Library Web Page Faculty Guides from each student's "My WebCT" template is planned.

4. The Library will connect to national and global resources that both enhance student employment opportunities and that support high levels of applied scholarly research.

The Library is indeed preparing for the University of Ontario Institute of Technology's initial postgraduate degree offerings, and lends its support to the resource and research needs of both faculty and students.

APPENDIX D: Additional Information

1. PROGRAM DEGREE-LEVEL STANDARD

1.1 Degree-Level Summary

UOIT is committed to providing high quality, challenging graduate programs which clearly meet and/or exceed the standards required for master's degrees. The MASc and MEng programs in Automotive Engineering are master's-level programs as defined in the *Handbook for Public Organizations, 7.1.4*. and their design is guided by benchmarks described in the *Postsecondary Education Quality Assessment Board Handbook for Applicants.* The MASc is a research-oriented master's degree, and the MEng is a professional master's degree program. Both build upon the knowledge and skills of well qualified applicants from relevant undergraduate programs.

The mission of the Faculty of Engineering and Applied Science is to contribute to society through excellence in education, scholarship, and service. We will provide for our graduate students a rigorous education and endeavour to instil in them the attitudes, values, and vision that will prepare them for a lifetime of continued learning and leadership in their chosen careers. We engage in scholarship of discovery, application, and integration.

The master's programs in Automotive Engineering are planned to achieve the following goals:

- *Depth. To provide students with a detailed understanding for the practice and advanced study of advanced technologies related to automotive systems. This includes scientific principles, analysis techniques, and design methodologies.*

- *Breadth – To provide students with the broad and advanced education necessary for productive careers in the public or private sectors and in academia.*

- *Professionalism – To develop skills necessary for clear communication and responsible teamwork, and to inspire professional attitudes and ethics, so that students are prepared for modern work environments with diverse needs and for lifelong learning and enrichment.*

- *Learning Environment – To provide an environment that will enable students to pursue their goals through innovative graduate programs that are rigorous, challenging, and supportive.*

In order for students and faculty engage to in scholarship of discovery, application, and integration UOIT has made every effort to provide state-of-the-art learning resources including the library, learning technologies, and laboratories. For example, students in the MASc and MEng programs will have access to major equipment and state of the art facilities such as: IMC, and ACE. Details about these resources are described in Section 3.2.

The learning outcomes for the MASc program are achieved through a combination of course work, supervised research, a research seminar, and a research thesis.
The main purpose of the MEng program is to provide the opportunity for engineers in industry to upgrade and expand their skills. Graduates of the program will be able to apply what they have learned in a variety of applications in industry. The learning outcomes for the MEng program are

achieved through either a combination of course work and a project, or solely course work depending on which option the student selects. MEng students are exposed to research through course-based research projects.

The combination of courses and/or projects and research, will be designed collaboratively between the student and an assigned faculty advisor/mentor. Each learner will have the opportunity to develop the prerequisites for specialized practice of, or for advanced study in areas within Automotive Engineering, such as Energy, Thermofluids, Mechatronics and Manufacturing, including their scientific principles, analysis techniques, and design methodologies. Learning activities and materials in graduate courses will be carefully designed to ensure that learners are deliberately exposed to study, the majority of which is at, or informed by, the forefront of engineering theory and practice.

The courses have been designed to give students in depth learning in a specialized area of engineering, opportunity for advanced development of generic skills such as communication and teamwork, as well as participation in the scholarly activities of research, seminars, and presentations. Throughout the curriculum, learning activities are planned, and student progress will be monitored to ensure that safety, professional guidelines, and ethical responsibilities relevant to engineering and for specific areas of advanced study are modelled, developed, and evaluated.

UOIT's faculty of Engineering and Applied Science has assembled a team of highly qualified and experienced faculty who will deliver the curriculum in interesting and challenging ways and ensure that students are exposed to knowledge and technical applications which are at the forefront of the discipline.

Successful completion of a master's program in Automotive Engineering will require the students to advance their knowledge and understanding of complex issues in a specialized area of engineering, to identify problems and to search for approaches in systematic and innovative ways.

Relevant Knowledge and Understanding

The master's program is designed to enable students to acquire a high level of knowledge and to develop skills to tackle problems in the rapidly evolving discipline of automotive engineering. The program draft has been reviewed by academics and industry professionals. Courses have been designed to help students develop an advanced expertise which incorporates current theory, research, and practice in a specialized area of engineering. The proposed program emphasizes excellence in engineering knowledge and practice and builds upon transferable skills (i.e., interpersonal relations, leadership and team building, communication, critical analysis and decision making) from undergraduate education.

To achieve the overall goals of the program and to ensure that graduates achieve the learning outcomes, the curriculum provides students with advanced theory, research, project management, and technical and laboratory skills, as well as opportunities to apply this learning. The graduate programs in engineering will incorporate relevant lab and technical skills into learning activities and assignments. Graduate students will develop an in-depth understanding of the technological, social, political, economic, and global issues that affect engineering in general, and in particular, their area of specialization.

Application

Students will acquire a systematic knowledge of inquiry and research methods, including qualitative and quantitative approaches. They will use technology models and state of the art equipment, including current versions of Computer-Aided Engineering (CAE) tools and techniques used for engineering practice. They will be expected to demonstrate sound decision-making strategies to address problems.

The MASc Thesis offers students the opportunity to apply core course concepts and techniques to a substantial investigation under the guidance of a faculty expert. Those students who choose the MEng-Project program plan will be required to work with a faculty member in conducting a significant project. Students from both of these program plans will be required to present their findings to a panel of faculty assessors. Their understanding of relevant theory related to a specialized area of engineering, their ability to use appropriate qualitative and quantitative methods of analysis and to create and evaluate a range of options, and their research and project management skills will all be challenged during the design and implementation of the project or thesis and during seminars and presentations. Students who follow the course based MEng will be required, in the majority of their courses, to apply research and project management strategies and to develop professional presentation skills.

Cognitive Skills

Problem solving, critical analysis, and synthesis are cognitive skills essential to success in any discipline. Graduate students in engineering are expected to utilize these skills throughout the program and they will be provided with ample opportunities to refine these skills through such delivery models as problem based learning activities, collaborative and independent work, simulation lab exercises, written critiques of theory and research, debates and discussions in classes, and oral presentations that require justification of decisions. Students will be actively engaged in these intellectual processes as they work with challenges encountered by individuals in the profession. Such realistic and practical assignments will develop and strengthen students' abilities to critically analyze the information they see, hear and read, to identify assumptions and implicit values, to gather appropriate data to inform and guide decision-making, to propose new hypotheses, to create and assess a range of solutions, to predict risks and to evaluate outcomes. Students will be required to work in teams in appropriate courses; they will be exposed to a variety of perspectives and called upon to listen, assess and incorporate the ideas of others into the problem solving process. Collaborative activities will enable them to pose questions, devise and sustain arguments, and, most importantly, to be active participants in the learning process. While engaged in such interactive processes, they will learn from and contribute to the learning of others.

Lifelong Learning

Realistic case studies and lab exercises, presentations by representatives from industry, and the research, projects, and seminars will expose students to the complexities and challenges and dynamics of engineering. Master's level engineering graduates will need to be prepared to work in complex and unpredictable environments, in different types of corporations and institutions, and with a wide range of colleagues and clients. Change and ambiguity are normal features of an engineering environment and students will develop positive attitudes and pro-active strategies to

manage them. Students will come to recognize that a strong foundation of technical knowledge, an ability to locate and utilize up-to-date resources, and ability to make informed decisions will be required in the demanding situations and changing environments of engineering practice, research and education. They will have developed the commitment and strategies necessary for the lifelong learning required for their profession.

Students will learn how to engage in advanced research by using print and electronic publications, including scholarly journals, books, and research websites for the most up-to-date information. They will recognize the need for independent and ongoing learning to maintain currency in a rapidly changing field and to further develop their professional skills. Graduates will have the advanced knowledge base and skill set needed to undertake further education to support and advance their careers.

Transferable Skills

The curriculum has been designed to emphasize the development of qualities and transferable skills which contribute to the students' success as independent learners and as team players. Throughout the program, graduate students will be involved in a variety of tasks that involve the demonstration of effective communication skills using oral, written, graphic and electronic formats. They will be expected to share information in ways which are suitable for both lay and specialist audiences. Students will participate in small and large group activities and hone their skills as both team members and leaders. The coursework in the program will require hours of research along with activities involving practical applications. The demanding workload will require students to organize their time and manage their projects efficiently in order to meet clearly defined standards of performance and expected deadlines.

UOIT is confident that the proposed program is sufficiently comprehensive and rigorous to meet the standards of a master’s level graduate degree program. It aims to develop in students the advanced knowledge base, the enhanced technical, cognitive, and interpersonal skills as well as the positive attitudes that will enable them to experience personal, academic, and professional success during their graduate studies at UOIT and beyond.

2. CAPACITY TO DELIVER STANDARD

2.1 Enrolment Projections and Staffing Implications

PROJECTED INTAKE AND ENROLMENTS **Master of Applied Science in Automotive Engineering**						
YEAR	**Cumulative Enrolment**		**Staff Requirements - Projected**			
	Full-time	**Part-time**	**Cumulative Full-time Faculty FTE**	**Cumulative Part-time Faculty FTE**	**Technical Support**	**Ratio of Full-time Students/ Full-time Faculty**
2007	5-10	1-3	23	0	5	1:2.3
2008	15-25	2-6	38	0	5	1:1.52
2009	20-30	3-9	52	0	5	1:1.73
2010	20-35	3-9	60	0	5	1:1.71

PROJECTED INTAKE AND ENROLMENTS **Master of Engineering in Automotive Engineering**						
YEAR	**Cumulative Enrolment**		**Staff Requirements - Projected**			
	Full-time	**Part-time**	**Cumulative Full-time Faculty FTE**	**Cumulative Part-time Faculty FTE**	**Technical Support**	**Ratio of Full-time Students/ Full-time Faculty**
2007	5-10	5-10	23	0	5	1:2.3
2008	5-20	10-20	38	0	5	1:1.9
2009	5-20	10-20	52	0	5	1:2.6
2010	10-25	10-20	60	0	5	1:2.4

2.2 Resource Renewal and Upgrading

- **For library renewal and upgrading, refer to Appendix C: Library Resources**

- **Computers and Computer Access:**

Refer to OCGS Appraisal Brief Section 3.4 for details on computers and computer access.

- **Classrooms and Physical Facilities:**

Capital Plans are in place to develop two phases of buildings. The government has invested $60 million in development of the University of Ontario Institute of Technology. Initial construction took place on 115 acres immediately adjacent to Durham College. The University has also purchased a scenic 385 acres to the north of this area to accommodate future development.

The first University building, which was ready for occupancy in September 2003, contains classrooms, laboratories, and academic and staff offices. A 300-bed residence was also ready for the first class of UOIT students in September 2003.The second phase of construction, included one additional (200 bed) residence building, two additional academic buildings comprised of classrooms, laboratories, academic and staff offices and a new library shared by UOIT and Durham College. This phase was completed in September 2004.

In early November 2003, engineers completed drilling of a geothermal well field, and it is the largest heating and cooling system of its kind in Canada and the second largest in North America. This is the first phase in development of a thermal energy system that will use the earth's relatively constant temperature to provide highly efficient heating and cooling for campus buildings. Academic buildings feature an environmentally friendly "green" roof comprised of grass that helps reduce heating and cooling costs and improve storm water management.

The initial core facilities for teaching and research at the UOIT are housed in the three academic buildings. Together with the new University library, these buildings overlook the landscaped campus commons. This precinct is the heart of the University and will be its central crossroads.

A key characteristic of each academic building is the provision of generous student study and lounge space. These are complemented by a faculty lounge, Council room and student club offices. The lounge and study spaces are concentrated around a central skylit atrium which provides a point of orientation, gathering and connection for students and faculty. The buildings are designed to be highly flexible, adaptable to programs and teaching configurations as yet unknown. Wired and wireless connections are provided through all dedicated and informal teaching spaces.

The new University library has been is designed as the intellectual and social commons for this 21st century university. In particular, the library has two points of focus; the provision of access to electronic collections and resources and work and study space for 750 students. While the library will house a print collection of about 125,000 volume equivalents, with an emphasis on reference materials, it is in the provision of access through wired and wireless connection to electronic collections that the library will be distinguished. The building is designed on three floors with the connectivity and staff resources to fulfill this mission. Much attention has been devoted to the quality and variety of student space. Large study halls overlook the landscape commons and provide a variety of table, carrel and soft lounge seating. Many enclosed rooms are also provided for group study, seminar discussion and quiet work activities.

Construction of the new engineering building was started in early 2005 with completion for student use scheduled for summer 2006.

- **Laboratories/Equipment:**

Refer to OCGS Appraisal Brief Sections 3.2 and 3.3 for details of current and planned laboratory resources.

3 CREDENTIAL RECOGNITION STANDARD

3.1 Program Design and Credential Recognition

UOIT is committed to providing high quality, challenging graduate programs which clearly meet and/or exceed the standards required for master's degrees. The design of the master's programs in Automotiver Engineering has been guided by benchmarks described in the *Postsecondary Education Quality Assessment Board Handbook for Applicants.*
(Program Degree Level, Benchmark 1, Handbook – Public, 7.1)

Research was conducted and documentation is on file, to compare the breadth and rigour of the elements of this proposed Master's program in Automotive Engineering to similar programs, in Canada and elsewhere. The plans for the UOIT curriculum certainly achieve the breadth and rigor of these similar programs. Information about programs available at other universities can be found in Section 1.3 of the OCGS brief.

The main objective of the MASc program is to prepare students for a career as a R&D engineer. Graduates of the program will be prepared for a career in research and development or other employment which requires advanced preparation in Automotive Engineering. They will also be able to continue their education and pursue a doctorate degree. It is understood that applications for graduate school are considered on a case-by- case basis by the admitting university.

The main objective of the MEng program is to provide the opportunity for engineers in industry to upgrade and expand their skills. Graduates of the program will be able to apply what they have learned in a variety of applications in industry. This is a terminal degree developed for students who do not intend to proceed to a doctorate degree.

3.2 Consultation

Academic details of the proposed program were submitted to UOIT's Curriculum and Program Review Committee for examination in May 2006. The proposal was then referred to the University's Academic Council and approved by that administrative body in June, 2006. These advisory and decision-making bodies endorsed the design of the MASc and MEng in Automotive Engineering and authorized the submission of this document to OCGS and PEQAB.

UOIT has initiated formal consultation with universities in Ontario which offer related programs, in order to ensure recognition of its degree credentials for students who wish to transfer or to proceed to other graduate degrees. Letters which confirm consultation are attached on the pages which follow.

John D. Wood, P.Eng.
Senior Advisor
R&D and Technology

General Motors of Canada
Mail Code: CA1-098-001
1908 Colonel Sam Drive
Oshawa, Ontario L1H 8P7
john.wood@gm.com

April 24, 2006

Dr. Marc A. Rosen, P.Eng.
Professor and Dean
Faculty of Engineering and Applied Science
University of Ontario Institute of Technology
2000 Simcoe Street North
Oshawa, Ontario L1H 7K4

Dear Dr. Rosen:

Subject: Proposal for the UOIT Masters Programs in Automotive Engineering

I have recently reviewed your plans for the proposed UOIT Masters programs in Automotive Engineering and am very pleased to provide this letter of support and enthusiastic endorsement. The plans for both the M.A.Sc. and the M.Eng. programs are well thought out. Clearly, to support the university's founding theme as an institute of technology, the M.Eng. program will generate graduates very well educated and trained for future industrial employment, and aligned with the needs for more highly qualified personnel in ever-increasing numbers. The M.A.Sc. program likewise is designed to promote candidates into more investigative, exploratory roles in organizations with needs for R&D personnel, and just as importantly, into succeeding Ph.D. programs for eventual positions as qualified industrial researchers or into academic careers.

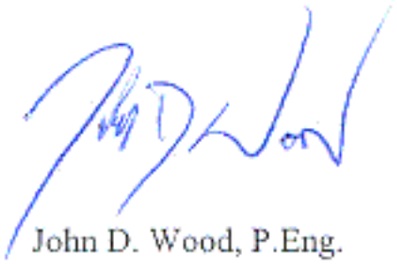
The proposal describes a well-planned curriculum, with appropriate course and projects/thesis tracks, as appropriate. With the sophisticated infrastructure support in the university, I believe that the right level of learning environment is being provided, not the least of which is world class research and teaching laboratories. The calibre of the faculty is already outstanding – UOIT's Canada Research Chair, Premier's Research Excellence Award and NSERC Design Chair are great endorsements of the academic capabilities that the UOIT team has already assembled.

General Motors of Canada is very pleased to see this application being made at this point in time. Negotiations with UOIT over the past several years have led to the major Beacon Project investment program , which incorporates plans for the construction of the Automotive Centre of Excellence, along with a major thermodynamic wind tunnel and associated development and research facilities, to be co-located with UOIT's own engineering building. The addition of these Masters programs is absolutely the right next step to further the generation of new graduates in the automotive and related fields who can participate first hand in industrial scale research and development projects

as part of their education. This partnership can only grow deeper as the graduates of this program either find employment in the automotive engineering and manufacturing fields, or as they go on to post graduate studies, building on the success of the Masters programs, and their opportunities within the Automotive Centre of Excellence.

I look forward to the success of UOIT's application for the automotive Masters programs, and wish you and your colleagues all the best in this exciting process.

Sincerely,



John D. Wood, P.Eng.
Senior Advisor
R&D and Technology
General Motors of Canada

SIEMENS

April 12, 2006

Marc A. Rosen, P.Eng
Professor and Dean
Faculty of Engineering and Applied Science
University of Ontario Institute of Technology
2000 Simcoe Street North
Oshawa ON L1H 7K4

Dear Doctor Rosen:

Proposal for UOIT Graduate Programs in Automotive Engineering

I have examined the plans for the proposed UOIT Masters program in Automotive Engineering and I am pleased to offer this letter of endorsement. The graduate curriculum is well developed and it would provide enhanced knowledge and skills in automotive engineering, as well as appropriate degrees of specialization therein. The graduate programs are innovative and they have been designed to respond to defined needs in Canadian industries. The graduate programs will address needs for specialized engineering expertise in Canadian industries and they will provide credentials that will be well recognized for employment opportunities and advanced studies in automotive engineering.

Yours truly,
SIEMENS CANADA LIMITED

Dominic Caranci, P.Eng
Automotive Sector Manager

DC/kb

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FACULTY OF APPLIED SCIENCE AND ENGINEERING

UNIVERSITY OF TORONTO

Dr. Marc A. Rosen, P.Eng.
Professor and Dean
Faculty of Engineering and Applied Science
University of Ontario Institute of Technology
2000 Simcoe Street North
Oshawa, Ontario
L1H 7K4

April 7, 2006

Dear Dr. Rosen:

Re: Proposal for UOIT Graduate Programs in Automotive Engineering

I have closely examined the plans for the proposed UOIT Masters program in Automotive Engineering and I am pleased to offer this strong letter of endorsement.

The graduate curriculum is well developed and it would provide enhanced knowledge and skills in automotive engineering, as well as appropriate degrees of specialization therein. The graduate programs are innovative and they have been designed to respond to defined needs in Canadian industries.

The proposed graduate programs will address needs for specialized engineering expertise in Canadian industries and they will provide credentials that will be well recognized for employment opportunities and advanced studies in automotive engineering.

Regards,

Beno Benhabib
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IBM Canada Limited
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April 6, 2006

Dr. Marc A. Rosen, P.Eng.
Professor and Dean
Faculty of Engineering and Applied Science
University of Ontario Institute of Technology
2000 Simcoe Street North
Oshawa, Ontario, Canada,
L1H 7K4

Subject: Proposal for UOIT Graduate Programs in Automotive Engineering

Dear Dr. Rosen:

The automotive sector is of vital importance to the economy of Canada – one in seven Canadians depend on this industry for employment. Having reviewed the plans for the proposed UOIT Masters program in Automotive Engineering and I am pleased to offer this letter of endorsement.

The proposed graduate curriculum is well developed and will provide enhanced knowledge and skills in automotive engineering, as well as appropriate degrees of specialization. The programs are innovative and clearly have been designed to respond to defined needs in Canadian industries - they will address need for specialized engineering expertise in Canadian industries and will provide credentials that will be well recognized for employment opportunities and advanced studies in automotive engineering.

This program has my enthusiastic support. If I can be of further assistance please let me know.

Sincerely,

Don Aldridge
General Manager
Higher Education, Research & Life Sciences
daldridg@ca.ibm.com
613-531-2901

4 CONFORMITY WITH MINISTERIAL POLICY DIRECTIVES

4.1 Applicant Acknowledgement and Agreement

The Applicant Acknowledgement and Agreement form, signed by the President of the University, is included on the pages that follow.

Ontario

Ministry of Training, Colleges and Universities

Applicant Acknowledgement and Agreement

(To accompany every application for ministerial consent under the Post-secondary Education Choice and Excellence Act, 2000)

This form must be completed by a representative of the applicant who is authorized to bind the applicant, and must be included with the materials accompanying an application to the Minister for a consent under the Post-secondary Education Choice and Excellence Act, 2000.

Name of applicant: University of Ontario Institute of Technology
Insert name of applicant organization

Purpose of application: MASc / MEng in Automotive Engineering
Insert name of degree and title of program (e.g., Bachelor of Science in physics)

☐ Please indicate if this application relates to use of the term *university*.

1. The applicant hereby **acknowledges** that, in making this application, it understands that:

1.1 The granting of a consent by the Minister of Training, Colleges and Universities under the act is a privilege, not a right.

1.2 A consent by the Minister of Training, Colleges and Universities under the act is normally granted for a specified period of time and remains in force only during that specified period.

1.3 A Minister's consent does not include any express or implied entitlement to:
- a renewal of such consent; or
- a consent for additional or different activities regulated by the act.

1.4 A Minister's consent does not entitle the consent holder to any funding from the Government of Ontario, including but not limited to operating, capital, or research funding.

1.5 A private organization from outside Ontario will be treated no less favourably, in like circumstances, than a private organization from Ontario.

1.6 A private organization, whether from Ontario or from outside the province, is not entitled to treatment that is no less favourable, in like circumstances, than the treatment accorded by the Minister to a public institution.

1.7 A Minister's consent is not transferable, directly or indirectly, to a third party.

1.8 If the applicant fails to comply with any legislative requirements or with the terms and conditions of the consent, the Minister may amend or change the terms and conditions of the consent or suspend or revoke the consent.

1.9 A Minister's consent does not make the consent holder's students eligible to apply for government financial assistance, grants, or awards that are provided directly to students (e.g., assistance under the Ontario Student Assistance Program). Approval of organizations and programs for the purposes of Ontario student loans is established pursuant to the Ministry of Training, Colleges and Universities Act and regulations thereunder, as amended from time to time.

1.10 The Minister's criteria and policy statements related to the review of applications for a ministerial consent may change from time to time.

1.11 All information provided to the Minister or the Postsecondary Education Quality Assessment Board in applications and related documentation may be subject to disclosure under the Freedom of Information and Protection of Privacy Act.

(continued)

1.12 No consent shall take effect until the applicant provides confirmation, in a written form approved by the Minister, that the applicant understands and agrees to comply with all of the terms and conditions attached to the consent.

1.13 Should the Minister grant a consent, the consent holder will be required to ensure that the following statement appears on promotional and other materials, in any media, that relate to the program offered under the consent:

This program is offered under the written consent of the Minister of Training, Colleges and Universities for the period from (day/month/year) *to* (day/month/year). *Prospective students are responsible for satisfying themselves that the program and the degree will be appropriate to their needs (e.g., acceptable to potential employers, professional licensing bodies, or other educational institutions).*

1.14 The consent holder has a positive obligation under the Post-secondary Education Choice and Excellence Act, 2000, to notify the Minister of Training, Colleges and Universities promptly if the consent holder has reason to believe that not all of the terms and conditions of a consent may be met.

2. The applicant hereby **agrees** to provide the Minister or the Postsecondary Education Quality Assessment Board with any additional material required by the Minister or the board to assess the application.

3. The applicant hereby **confirms and warrants** that:

3.1 All information and representations provided by the applicant as part of this application, including information given in the Organization Review Submission and the Quality Assessment Review Submission, are true.

3.2 This application was duly approved by the applicant's governing body or by another representative duly authorized to bind the applicant on

June 20/06

(date of approval)

at

Oshawa, ON.

(place of approval).

Dr Gary Polonsky

Name of authorized representative

President and Vice-Chancellor

Position in applicant organization

Signature

June 20/06

Date