Lakehead University

New Program Proposal Brief
for the
MSc
in
Mechanical Engineering

Submitted to the
Office of the Vice-President Academic
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VOLUME I: The Program

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1. An Introduction & Rationale for the Proposed Program

1.1 Overview of the Home Unit

The Department of Mechanical Engineering wishes to establish its first graduate program in Mechanical Engineering. Faculty members in this department have participated in two interdisciplinary graduate programs: MSc Eng in Control Engineering (established in 1995), and MSc Eng in Environmental Engineering (established in 2004). The Faculty of Engineering is also pursuing the introduction of a PhD in Electrical and Computer Engineering. The proposed graduate program will lead to the degree of Master of Science (MSc) in Mechanical Engineering and will be a thesis-based degree.

1.2 Objectives of the Program

The objectives of the proposed MSc are to develop research capabilities and offer advanced learning opportunities in the general area of Mechanical Engineering at Lakehead University. The program aims to attract students from the existing BEng program in Mechanical Engineering at Lakehead University and also attract qualified students from other Canadian and international universities. The specific objectives of the program are:

(a) to provide an opportunity for students to specialize in specific areas of Mechanical Engineering;
(b) to develop research and development engineers in the field of Mechanical Engineering for the Industry;
(c) to provide practising engineers an opportunity to develop as researcher and contribute to engineering sciences;
(d) to lay a foundation for students to pursue doctoral studies in Mechanical Engineering and related disciplines;
(e) to foster the scholarly skills and independent research abilities of students in the program through advanced courses, doing research, writing theses and scientific papers, participating in seminars and an oral defence;
(f) to promote the research capabilities of the faculty members in Mechanical Engineering at Lakehead University; and
(g) to improve and expand research facilities at Lakehead University by attracting additional research funding.

Graduating students from the program are expected to specialize in sub-disciplines within Mechanical Engineering by taking advanced-level courses, reviewing and critically evaluating existing literature in specific research areas, conducting research and contributing to the advancement of engineering sciences in specific areas, preparing and presenting scholarly publications, and writing and defending a thesis. In addition, students will acquire skills to help them in academic careers by marking assignments in undergraduate courses and monitoring undergraduate student activities in laboratories.

1.3 Rationale for the Development of the New Program

The Department of Mechanical Engineering has consistently maintained a high enrolment in its undergraduate program and has attracted students from across the country. The quality of its undergraduate program has been regularly affirmed by the Canadian Engineering Accreditation Board. The Department believes it is now ready to expand into graduate studies, to establish itself as a centre of advanced studies and specialized research. The proposed MSc is aligned with the University's Mission and Vision and with the priorities of the 2012 Academic Plan. The proposal fits specifically with the university's stated strategic objective: *"New graduate programs will build upon and extend existing undergraduate programs of high demand and enrolment."*

In particular, the objectives of this MSc in Mechanical Engineering will be as follows:

(a) recruitment and retention of outstanding faculty;
(b) attracting outstanding undergraduate students;
(c) attracting research funds from federal and provincial agencies and industrial sectors;
(d) support of Lakehead University's strategic research goals for the region and beyond;
(e) strengthening of the University's graduate programming and training of highly-qualified personnel; and
(f) innovative research contributions to the region, the country and the world.

Most faculty members in the Department of Mechanical Engineering have participated in the interdisciplinary graduate programs in Control Engineering, and Environmental Engineering. The diversity of research areas of the faculty members and the need for graduate students in their respective areas necessitate the establishment of the program. The program will focus on emerging sectors such as Mechatronics, Alternative Energy and Bio-Fuels, as well as new research perspectives within Solid Mechanics, Fluid Mechanics and Manufacturing.

1.4 Relationship between the Proposed MSc Program and the Available Graduate Programs

Currently there are three MSc graduate programs in the Faculty of Engineering: Control, Environmental, and Electrical and Computer Engineering. Most faculty members in the Department of Mechanical Engineering have participated in the interdisciplinary graduate programs in Control Engineering and Environmental Engineering. Unfortunately these two interdisciplinary graduate programs are not attractive to our undergraduate students, with very few applications from the Departments of Mechanical Engineering and Civil Engineering to these graduate programs due to background limitations. After MSc graduate programs have been established in the related departments such as Mechanical, Civil, and Chemical Engineering, the status of these two existing interdisciplinary graduate programs will be re-evaluated by the Faculty of Engineering based on comprehensive considerations related to program perspective and resource availability.

1.5 Program Demand

Mechanical Engineering is a versatile and broad engineering discipline that has maintained a consistent demand throughout the past several decades in Canada. A Master's degree level program in this area is expected to do very well because the potential employers are familiar with graduates from such programs. The enrolment keeps growing substantially in the past decade. According to a recent report in May 2012 from the National Center for Science and Engineering Statistics of NSF (National Science Foundation), the graduate enrolment in Mechanical Engineering increased about 48% from year 2000 to year 2010 in the USA. This trend is similar in Canada. In the Province of Ontario in particular, based on the report of the Ontario Universities' Enrolment (headcount at November 1, 2011), the enrolment (both full-time and part-time) in Master of Science in Mechanical Engineering in Ontario Universities has increased about 57% over the past 6 years from year 2005/2006 (488 full-time and 206 part-time) to year 2010/2011 (841 full-time and 246 part-time).

The discipline of Mechanical Engineering itself, while maintaining its traditional roots (e.g., design, manufacturing, materials, and mining-related field), has evolved to include new and emerging areas such as Mechatronics, Alternative Energy, and Bio-Fuels. Consequently, graduates from Mechanical Engineering often feel the need to upgrade their qualifications to keep up with rapidly changing technologies.

The Industry has recognized the need to have a work-force that is creative and capable of conducting cutting-edge research to keep it competitive in a global environment. An advanced degree in Mechanical Engineering helps address this need. Furthermore, the emerging Mechatronics, Alternative Energy and Bio-Fuels industries in Canada also provide a strong and sizeable market for employment opportunities for graduates from the proposed MSc program.

The development of an MSc program in Mechanical Engineering would provide an opportunity for students in the region, who wish to pursue advanced studies, which is especially important due to the remote location of Lakehead University. The existing graduate programs in the Faculty of Engineering are not attractive to our graduates in Mechanical Engineering. For example, only 3 out of 62 graduates (in year 2010) and 2 out of 68 graduates (in year 2011) in the Department of Mechanical Engineering applied for our existing graduate programs in Control Engineering and Environment Engineering, respectively. In 2012, none of our 80 graduates in Mechanical Engineering have applied for our exiting graduate programs, even though about 6 of them will go to other universities for their MSc graduate studies. With the proposed MSc in Mechanical Engineering, it is expected that at least five of our graduates in Mechanical Engineering will applied for this graduate program each year.

1.6 Degree Nomenclature

Graduates will have the degree of "Master of Science in Mechanical Engineering." The related Master's programs in most of the research universities in the USA are called MSc in Mechanical Engineering, such as M.I.T, Stanford University, and the University of California in Berkeley.

The MSc in Mechanical Engineering is obtained through a combination of formal course work and thesis work. Graduates are expected to gain a broad knowledge in the fields related to the program by taking graduate courses, mentoring undergraduate students, and leading laboratory sessions. Research skills are also acquired by reviewing the literature, conducting research, writing a thesis, and presenting research results.

Graduate students in the program are required to:

(a) complete the required course work;
(b) conduct independent research;
(c) present a research seminar;
(d) accomplish an oral defence; and
(e) report their research work in a thesis.

2. Program Learner Outcomes

2.1 Program Learner Outcomes (PLO)

Through the proposed MSc graduate program, the graduate students would be able to develop the following capabilities:

(a) To critically evaluate existing literature in the related Mechanical Engineering research fields and demonstrate systematic understanding of knowledge with the required depth and breadth, which is assessed though the course work, literature review reports, the seminar, and the thesis.
(b) To conduct independent research and show competence in the research process of a specific area within the general Mechanical Engineering fields (e.g., dynamics, design, manufacturing, fluid science, material engineering, mechanics, vibration and control), and the new and emerging areas such as mechatronics, alternative energy and bio-fuels using pertinent advanced mathematical, scientific, and engineering concepts, which is assessed through the thesis.
(c) To design and conduct experiments and/or numerical simulations depending on the nature and scope of the thesis research, which is assessed through the thesis and/or the course projects.
(d) To develop novel solutions and demonstrate originality to engineering problems through the use of analytical, computational and/or experimental techniques, which is assessed through the course work and the thesis.
(e) To treat and analyze complex issues based on established principles and techniques within the discipline of Mechanical Engineering, which is assessed through the course projects and the thesis.
(f) To demonstrate personal responsibility and accountability in conducting the related research and develop the capability to appreciate the broader implications of applying knowledge to particular contexts, which is assessed through the course work and thesis.

(g) To communicate ideas, issues and conclusions clearly and effectively, which is evaluated through course project presentations, seminar and thesis presentations.
(h) To recognize the complexity of knowledge through the course of research and potential contributions of other technologies, which is assessed through the seminar and the thesis.

2.2 Alignment of the Program Learner Outcomes with the University Degree Level Expectations

The aforementioned Program Learner Outcomes (PLO) of the proposed MSc in Mechanical Engineering will meet the Graduate Degree Level Expectations at Lakehead University:

(1) Depth and Breadth of Knowledge: They are related to item (a) of the PLOs. The literature review report(s), project seminar and thesis will ensure that the candidate has a systematic understanding of knowledge and an awareness of current problems in the field of research. The candidate will perform a thorough and in-depth review of the knowledge in the field related to their research project. This review must show a solid understanding of the foundations of the area, and provide an overview of the latest developments.

(2) Research and Scholarship: They are related to items (b, c, d) of the PLOs. The MSc candidate will be capable of making a thorough evaluation of current research and scholarship in his/her research field. The candidate should be able to present a treatment of engineering problems based on established principles and techniques. The candidate's research and scholarly abilities will be reflected and evaluated in their thesis. The thesis will be evaluated by a thesis committee composed of professors with expertise in the research area.

(3) Level of Application of Knowledge: It is related to item (e) of the PLOs. By completing all the requirements of the program, the candidate will demonstrate a competence by applying an existing body of knowledge in the critical analysis of a new question or of a specific problem or issue in a new setting. The learning and problem-solving skills that the candidates develop will allow them to undertake new academic and professional projects in different areas of Mechanical Engineering.

(4) Professional Capacity/Autonomy: It is related to item (f) of the PLOs. The candidate will learn and understand the importance of being systematic and disciplined in keeping records and applying objectivity in the evaluation of scientific results. By working with faculty members as mentors, candidates will engage in research and knowledge-transfer that will have continuity. They will learn both the importance of building upon others' work and of properly documenting their work so that others can build upon it. It is expected that graduates from the program will register as Professional Engineers and will abide by the association's code of professional conduct and ethics.

(5) Level of Communication Skills: It is related to item (g) of the PLOs. A successful MSc candidate is expected to present her/his work orally to a group of peers during course project presentations, the seminar and the final thesis defence. On these occasions, the candidate will be evaluated on her/his ability to provide a clear, complete and scientifically-accurate presentation of her/his research work and defend the results and conclusions to an audience of peers and experts constituting his/her thesis committee. In addition, MSc candidates will be encouraged to participate in conferences by giving oral presentations or poster sessions to present their research work.

(6) Awareness of Limits of Knowledge: It is related to item (h) of the PLOs. In the literature review in the thesis and in oral presentations, the candidate is expected to study and discuss the extent of knowledge in her/his area. This will create self-awareness of the potential limitations of the knowledge in their research area and possible future solutions.

3. Admission Requirements

3.1 A Summary of the Admission Requirements

For admission to the MSc in Mechanical Engineering, applicants must hold a Bachelor's degree in Mechanical Engineering or a closely related field from a recognized university and have a minimum of 70% cumulative average. An applicant to the program may be required to take additional make-up courses from the undergraduate program at Lakehead University if the student's background is assessed to be deficient in Mechanical Engineering. The applicants must also meet all other general requirements as outlined by the Faculty of Graduate Studies at Lakehead University.

3.2 Appropriateness of the Program's Admission Requirements for the Learning Outcomes Established for Completion of the Program

The stated admission requirement to the MSc in Mechanical Engineering (i.e., a four-year Bachelor's degree in Mechanical Engineering or closely related field from a recognized university with a minimum of 70% cumulative average) is necessary to guarantee the selected students will have the technical background and experience needed to take the advanced engineering courses and carry out research work in Mechanical Engineering and to meet the stated learner outcomes for the program.

The University's admission requirement for fluency in English will ensure that the candidate has the necessary communication skills to meet all requirements of the program and develop new skills to meet the learning outcomes of the program.

3.3 A Sufficient Explanation of Alternative Requirements

Credit for two half-courses may be given to candidates transferring from other Canadian universities. The Engineering Graduate Studies Committee will evaluate the suitability of courses for credit transfer.

4. Structure

4.1 Program Regulations and Requirements

The Calendar entry for the proposed program can be found in Appendix D and an extract of the current Calendar with general University Graduate Studies Regulations is provided in Appendix F.

4.2 Explanation for how the program's structure will result in students meeting the specified program learning outcomes and degree-level expectations. A discussion of the teaching component and what it provides the student

The structure of the proposed MSc program is designed to result in students meeting the specified Program Learning Outcomes as well as Degree Level Expectations.

The student begins the program by taking at least four half-credit courses, each of which is chosen in consultation with the supervisor. At least two of the graduate half-credit courses will be from the core courses in Mechanical Engineering. At least one of the half-credit courses will be from the elective graduate courses in Mechanical Engineering. One of the four half-courses may be taken from another existing graduate program at Lakehead University. These courses will provide students systematic understanding of knowledge in the related research fields in Mechanical Engineering, as well as advanced mathematical, scientific, and engineering concepts and tools to tackle general engineering problems. Each course has a set of carefully designated Student Learner Outcomes (SLOs) as listed in Appendix E, which are aligned to achieve the Program Learner Outcomes and Graduate Degree Level Expectations. During these courses, the student will develop skills and learn methodologies that are useful over the course of the research work. The related course SLOs are assessed based on assignments, course project, project presentation, and examinations.

A student can take a graduate reading course which is directly related to the research project of the student. Through the reading course, the student will learn advanced analytical, computational and/or experimental techniques and tools, directly related to his/her research project. The SLOs of the specific topic of the reading course will be assessed through assignments, project, project presentation, and/or examination. But at most one reading course can be credited as a half-course.

A student can take a half-credit senior undergraduate course with the approval of his/her supervisor and the graduate coordinator. The undergraduate course aims to provide the student supplementary background knowledge related to his/or research work. The course SLOs will be evaluated through assignments, course project and/or project presentation, and examinations.

The project seminar is the first major evaluation of the students' research work. It will allow the students to share what they have learned during their background review and research work, and to explain their proposed research methodologies to their committees. Another SLO of the seminar is to make sure the student can communicate ideas, issues and conclusions clearly and effectively. On the other hand, the student is required to attend seminars of his/her peers to get knowledge and problem solving strategies in other research areas, and to learn critical thinking through asking and answering questions.

A student is required to do literature survey, before systematic research work starts, to critically evaluate existing literature in the related research field and demonstrate systematic understanding of knowledge with the required depth and breadth. The literature survey report(s) should be assessed by the supervisor.

The majority of the time of a student to spend in the program is dedicated to independent research work, in consultation with his/her supervisor. The student should show competence in the research process and demonstrate advanced research and scholarship of a specific area. The student should design and conduct experiments and/or numerical simulations depending on the nature and scope of the thesis research, and to develop novel solutions and demonstrate originality to engineering problems through the use of analytical, computational and/or experimental techniques.

The final component of the graduate curriculum is the production of a thesis and its oral presentation to the committee at an oral defence. The student must demonstrate the ability to communicate his/her research work, results and conclusions in clear, complete and scientifically-accurate presentations to an audience of peers and the Committee.

4.3 Times-to-Completion

Students will enrol full-time in the program. The Faculty of Graduate Studies will consider requests for part-time registration. Graduate students registered part-time may not take more than one full course equivalent during an academic year. The graduate students will start to formulate their thesis research topic soon after the end of the first semester of their registration, in consultation with their supervisors. This task includes a review of the literature related to the thesis topic, determining the research objectives, approaches, and anticipated research results. Within the third semester of registration, the graduate students are expected to present their work including any preliminary results, to an audience composed of Mechanical Engineering faculty members, graduate and undergraduate students.

Full-time registered students admitted to the program will normally complete all requirements for the program within six consecutive terms (24 months) from commencement of study. Work on a Master's degree must be completed within three consecutive calendar years after the student's first registration (See Graduate Calendar for full-time limit requirements).

5. Program Content

5.1 Curriculum

In order to complete the requirements for the MSc in Mechanical Engineering, all students will be required to complete course work, a seminar, and a thesis. Students will specialize in an area of faculty expertise through their choice of course work and choice of seminar and thesis topics. The areas of specialization in the proposed MSc program include not only the general Mechanical Engineering fields (e.g., dynamics, design, manufacturing, fluid science, material engineering, mechanics, vibration and control), but also new and emerging areas such as mechatronics, alternative energy and bio-fuels. The expertise of the core faculty members covers these subdisciplines. Evidence

for this is provided in the curriculum vitae of the individual core faculty members (Volume II).

5.2 Program Innovations

The Mechanical Engineering MSc program at Lakehead University will cover and serve a large geographical area of Northwestern Ontario. An innovative feature of the proposed MSc program is that faculty members will consult with local industry sectors and government agencies, and will pursue industry-based research projects that will provide graduate students with a cutting-edge and application-oriented program that will lead to opportunities for excellent jobs locally and nationally.

5.3 Research Requirements

Each student will be assigned a supervisor at the point of admission by the Graduate Studies Committee. Active supervision of all graduate students will be provided by their supervisor and co-supervisor when one is involved. All students are required to report their progress to their supervisors on a mutually agreed basis.

The MSc program culminates in the preparation of a thesis that reports the results of an independent research investigation that may be fundamental in nature, or applied, and that incorporates a creative design. Students will be expected to give evidence of competency in research, and present a sound understanding of the area of specialization.

Graduate students will be required to give at least one presentation at departmental seminars to gather comments on their research work from professors and other students prior to their oral thesis defence. The seminar should provide a comprehensive survey of existing literature in the related research field and demonstration of systematic understanding of knowledge with the required depth and breadth. The seminar is also assessed based on the effectiveness of oral presentation and question answering. The seminar presentation is evaluated by the Supervision Committee including the student's supervisor(s) and at least one more faculty member who is familiar with the topic of research. A student is also required to attend other departmental seminars and engage in other specified academic activities.

The MSc thesis defence is the final evaluation of an MSc candidate's work. The candidate's entire committee must attend either in person, or via teleconference, or through the proxy of another faculty member to whom they have given clear questions and instructions to evaluate the candidate.

The student must produce an MSc thesis, which must be submitted to each member of the committee at least one month prior to the defence. Arrangements for oral examination will be made by the thesis supervisor, in consultation with the Graduate Coordinator. The supervisor will serve as Chair of the exam.

All MSc oral examinations are open to the public, unless otherwise requested by both the student and the supervisor. At the beginning of the defence, the student will make the presentation of the thesis followed by a question period related to the thesis from the Committee. The presentation is limited to 45 minutes. After the presentation, the student will take questions from the audience. The candidate and audience will then be asked to leave the room, as the Committee deliberates. If a candidate has more than one supervisor, only one supervisor may vote. After the exam, the votes are recorded

by the exam chair and the results are returned immediately to the Graduate Coordinator. The deliberations must take into account the thesis, the presentation and the student's answers to the oral questions in the question period. Once the Committee makes its decision, the candidate will be called back into the room and informed of the decision. One of four decisions may be reached:

(a) The candidate passes the defence. This decision may be qualified by the requirement of minor revisions, such as the correction of grammatical errors identified by the Committee members in the thesis or the clarification of specific statements in the thesis. It may or may not be requested that the supervisor reviews these corrections.
(b) The candidate conditionally passes the defence. This decision must be justified by a non-trivial amount of remedial work, such as a significant discussion to be added to the background review, a supplementary set of empirical experiments needed to study the problem, or an important analysis of the results to be conducted. This work should normally take about a month to complete. These corrections must be reviewed by the supervisor, and optionally by any other committee member who deems it necessary.
(c) The candidate is required to repeat the defence. This decision means that major work remains to be done in the research, and this additional work will require several months to complete. This work should normally be of both a theoretical and applied nature, and must be clearly identified by the Committee members. Subsequently, the candidate will have to update the thesis and repeat the defence.
(d) The candidate fails the defence. This decision means that the research is fundamentally flawed and the project is unsalvageable. The candidate who fails the defence is automatically expelled from the program.

In addition, MSc students are encouraged to present their research results at academic conferences. Lakehead University provides a Graduate Student Professional Development Bursary of $500 and a Travel Grant of $150 to support graduate students to attend conferences and other related research activities in which the students makes the presentation.

5.4 Course Requirements

(1) Degree Requirements

The requirements for the Msc program are 5 full-credit equivalent (FCE) courses made up of: 4 half-courses (2 FCEs), a seminar course (0.5 FCE) and a thesis (2.5 FCEs).

Graduate Core Courses:

All students must take at least two of the following four core half-courses:

Engineering 5171: Computational Mechanics
Engineering 5172: Advanced Thermal-Fluids
Engineering 5173: Intelligent Tools for Engineering Applications
Engineering 5174: Modeling and Control of Mechanical Systems

At least two core half-courses will be offered each year, and all four core half-courses will be offered in the period of two years.

Graduate Elective Courses:
All students must take at least one of the following elective half-courses:

Engineering 5175: Applied Elasticity
Engineering 5271: Alternative Energy Engineering
Engineering 5272: Combustion and Emissions in IC Engines
Engineering 5273: Mechatronics
Engineering 5274: Advanced Manufacturing
Engineering 5275: Mechanical Systems and Signal Processing
Engineering 5371: Vibration Theory and Applications
Engineering 5671: Advanced Topics in Mechanical Engineering

At least two of these elective half-courses will be offered each year.

One of the four half-courses may be taken from another existing graduate program at Lakehead University.

Engineering 5671 (Advanced Topics in Mechanical Engineering) is usually given as a graduate reading course. At most one reading course, either from Mechanical Engineering or from other related graduate programs, can be credited as a half-course.

One of the four half-courses may be a senior undergraduate half-course that has not previously been taken. The student's choice of courses must be approved by the graduate supervisor and the Graduate Program Coordinator.

The student learner outcomes of the listed graduate courses are summarized in Appendix E, which are aligned with the Program Learner Outcomes and the Graduate Degree Level Expectations.

(2) Examinations

All graduate students must maintain a minimum mark of 70% ~~(B)~~ in each half-course. A grade of less than 70% will constitute a failure. A failed half-course may be repeated or replaced only once, by another course specified by the supervisor. Any student with more than one failure must withdraw from the program.

6. Mode of Delivery

6.1 A Description of Mode(s) of Delivery

This program will combine several modes of delivery:

(a) Course work: students are expected to take four half-credit courses.
(b) Research work: this program is research-oriented, and students are expected to accomplish independent research work. While the details will vary and be at the discretion of the supervisor, this research will normally have both a theoretical and an experimental component.

(c) Thesis: students are expected to produce a thesis to describe their research work.
(d) Oral presentations: students are expected to pass an oral research seminar and an oral thesis defence.

6.2 A Discussion on the Appropriateness of the Proposed Mode(s) of Delivery to Meet the Intended Program Learner Outcomes and Degree Level Expectations

The modes of delivery relate directly to the learners outcomes defined previously.

(a) Course work: This will provide students with foundations in the concepts, tools and methods in their area of study. It will be useful for them to get started on the background review, and to get ideas for methods throughout their research work.
(b) Research work: Producing independent research work is central to the MSc program. Students must solve a variety of problems similar to those they will encounter in their future employment/research work, obtain valid results and analyze them objectively.
(c) Thesis: Scientific research is not simply conducting experiments, but also is concerned with properly documenting the methodology and conditions used and the results obtained. The production of a thesis is the culmination of the research work in the previous point.
(d) Oral presentations: Students must develop the ability to communicate their research work, results and conclusions in clear, complete and scientifically-accurate presentations to an audience of peers not necessarily versed in that specific area of knowledge. The two oral presentations in the program, the Seminar and Defence, accomplish this goal.

7. Assessment of Teaching and Learning

7.1 Student Assessment

Each component of the MSc curriculum will be assessed as described below in order to ensure that graduates of the program achieve the stated Program Learner Outcomes and meet the Degree Level Expectations.

(a) Students will achieve a grade of at least 70% in each of the four half-credit courses they take, and will maintain an overall average of at least 70%. The course work is assessed based on the related Student Learner Outcomes (Appendix E) through assignments, project, project presentation, and examinations.
(b) The seminar presentation is evaluated by the Supervision Committee including the student's supervisor(s) and at least one more faculty member who is familiar with the topic of research. The assessment is through the survey of existing literature in the related research field, demonstration of depth and breadth of knowledge, as well as the effectiveness of the presentation and question answering.

(c) The progress of the student through the program is monitored by the Supervision Committee including the student's supervisor(s) and at least one more faculty member who is familiar with the topic of research.
(d) The final thesis defence is evaluated by the Graduate Examination Committee. The composition of the committee will consist of the student's supervisor(s) and at least two thesis examiners. One of the examiners will be external to the graduate program of the candidate, to ensure objectivity. Selection of the external examiner is made by the supervisor, in consultation with the Graduate Coordinator.

8. Resources for Graduate Programs

8.1 Faculty and Staff

Evidence of how supervisory loads will be distributed, and the qualifications and appointment status of faculty who will provide instruction and supervision

TABLE 1. Faculty Members

Name and Rank	M/F	Year Appointed	Home Unit at University	Supervisory Privileges	Mechanical Engineering
Category 1 Core Faculty					
H. Bai - Assoc. Prof.	M	2003	Mech. Eng.	Full	X
B. Ismail - Assoc. Prof.	M	2005	Mech. Eng.	Full	X
K. Liu - Prof.	M	1998	Mech. Eng.	Full	X
M. Liu - Assoc. Prof.	F	1993	Mech. Eng.	Full	X
M. Roy - Assist. Prof.	M	2011	Mech. Eng.	Full	X
B. Singh - Prof.	M	1987	Mech. Eng.	Full	X
S. Siddiqui - Assoc. Prof.	M	2000	Mech. Eng.	Full	X
W. Wang - Assoc. Prof.	M	2004	Mech. Eng.	Full	X
Category 2 Core Faculty					
X. P. Liu - Prof.	M	2001	Electrical Eng.	Full	X

A. Tayebi - Prof.	M	1999	Electrical Eng.	Full	X

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.

Category 2: 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.

Of the listed core faculty members, Dr. M. Roy is a new faculty member starting in 2011. Most faculty members have been actively involved in teaching and supervision in the Master's Programs in Control Engineering, Environmental Engineering, and Electrical and Computer Engineering. These faculty members will teach courses and supervise students in the proposed MSc in Mechanical Engineering.

Dr. A. Tayebi and Dr. X. P. Liu will supervise MSc students mainly in the area of Mechatronics Engineering.

Most of the core members are active researchers who have a continuing record of producing peer-reviewed publications. More details are summarized in Volume II.

8.2 Research Funding

Operational research funding awarded to core faculty members over the past seven years amounted to $1,451,430, as detailed in Table 2a.

TABLE 2a. Operational Research Funding by Source and Year

Year[1]	Source				
	Federal Granting Councils[2]	**Other Government Grants[3]**	**Foundations**	**Industry & Contracts**	**Others**
2004-05	$100,370	$37,000			$13,000
2005-06	$138,070	$32,000			$8,470
2006-07	$142,070	$223,770			$22,890
2007-08	$167,550	$9,620		$58,950	$7,200
2008-09	$132,550	$9,620		$58,950	$7,200
2009-10	$105,980	$6,620			$11,720
2010-11	$128,080	$6,620			$23,130
Totals	*$914,670*	*$325,250*		*$117,900*	*$93,610*

[1] Academic year.
[2] Includes: Examples: NSERC Discovery and Strategic.
[3] Includes: Examples: CFI; Ontario Innovation Trust (OIT); FedNor; Industry Canada.

Funding awarded for research instrumentation to core faculty over the past seven years amounted to $38,938, as detailed in Table 2b.

TABLE 2b. Research Instrumentation Funding by Source and Year

Year[1]	Source				
	Federal Granting Councils[2]	Other Government Grants	Foun-dations	Industry & Contracts	Others
2004-05		$4,000			
2005-06		$4,000			
2006-07		$3,000			
2007-08	$22,444	$3,000			$2,494
2008-09					
2009-10					
2010-11					
Totals:	$22,444	$14,000			$2,494

[1] Academic years.
[2] Includes: Examples are: NSERC-RTI.

8.3 Teaching Assignments

TABLE 3a. Teaching Assignments for 2008/09

Faculty Member	Rank	Teaching Assignments for 2008/09[1]		
		Undergraduate	Graduate	Comments[2]
Category 1				
H. Bai	Assoc. Prof.	Engi-2111-3 Engi-3055-3 Engi-1533-3 Engi-0450-3 Engi-2969-3		

Faculty Member	Rank	Teaching Assignments for 2008/09[1]		
		Undergraduate	Graduate	Comments[2]
B. Ismail	Assoc. Prof.	ENGI-2033-3 ENGI-3015-3 ENGI-3436-3 ENGI-0657-3	ENGI-5651 (2) ENGI-5611 (1) ENGI-5901 (2)	
K. Liu	Prof.	Engi 3016-3 Engi 0579-3 Engi 4436-3 Engi 4438-3 Engi 3451-3	Engi 5901 (1) Engi 5611 (1)	
M. Liu	Assoc. Prof.	Engi 3021-3 Engi 4438-3 Engi 3055-3 Engi 0574-3 Engi 1552/3016-3	Engi 5611 (1)	
M. Roy	Assist. Prof.			New faculty member starting from Fall 2011
B. Singh	Prof.	Engi 0537-3 Engi 3337-3 Engi 3453-3 Engi 3454-3		
S. Siddiqui	Assoc. Prof.	ENGI-1553-3 ENGI-1111-3 ENGI-4539-3		
W. Wang	Assoc. Prof.	Engi 1233-3 Engi 2333-3 Engi 4032-3 Engi 0659-3	Engi 5901 (2) Engi 5611 (2)	
Category 2				
X. P. Liu	Prof.	Engi-4258-3	Engi-5211-3	Sabbatical leave (winter term)
A. Tayebi	Prof.	Engi-3334-3	Engi-5111-3	Sabbatical leave (winter term)

[1] The course designation "– *n*" means *n* contact hours per week for one term (excluding laboratory and tutorial hours). In the case of thesis supervision, the number of students is given parenthetically.
[2] Reduced teaching load.

TABLE 3b. Teaching Assignments for 2009/10

Faculty Member	Rank	Teaching Assignments for 2009/10[1]		
		Undergraduate	Graduate	Comments[2]
Category 1				
H. Bai	Assoc. Prof.	Engi-1533-3 Engi-0450-3 Engi-2969-3	Engi-5611 (2)	Sabbatical leave (fall term). Engi-5611: Graduate reading course
B. Ismail	Assoc. Prof.	ENGI-2033-3 ENGI-3015-3 ENGI-3436-3 ENGI-0657-3	ENGI-5651 (2) ENGI-5611 (1) ENGI-5901 (1)	
K. Liu	Prof.	Engi 3016-3 Engi 0579-3 Engi 4436-3 Engi 3451-3	Engi 5901 (1) Engi 5611 (1)	
M. Liu	Assoc. Prof.	Engi 3021-3 Engi 2111-3 Engi 1230-3 Engi 4438-3 Engi 3055-3	Engi 5611 (1)	
M. Roy	Assist. Prof.			New faculty member starting from 2011
B. Singh	Prof.	Engi 3454-3 Engi 1635-3 Engi 2336-3 Engi 2032-3 Engi 3015-3		
S. Siddiqui	Assoc. Prof.	ENGI-1111-3 ENGI-3555 -3 ENGI-4539-3		
W. Wang	Assoc. Prof.	Engi 1233-3 Engi 2333-3 Engi 3451-3 Engi 4032-3	Engi 5901 (2) Engi 5611 (3)	
Category 2				
X. P. Liu	Prof.	Engi-3334-3 Engi-0138-3 Engi-1552/3016- 4	Engi-5111-3	

Faculty Member	Rank	Teaching Assignments for 2009/10[1]		
		Undergraduate	Graduate	Comments[2]
A. Tayebi	Prof.	Engi-4258-3 Engi-2430-3 Engi-0573-3	Engi-5211-3	

[1] The course designation "– *n*" means *n* contact hours per week for one term (excluding laboratory and tutorial hours). In the case of thesis supervision, the number of students is given parenthetically.
[2] Reduced teaching load.

TABLE 3c. Teaching Assignments for 2010/11

Faculty Member	Rank	Teaching Assignments for 2010/11[1]		
		Undergraduate	Graduate	Comments[2]
Category 1				
H. Bai	Assoc. Prof.	Engi-1233-3 Engi-3055-3 Engi-1533-3 Engi-0450-3 Engi-2969-3		Engi-2969: Technology project
B. Ismail	Assoc. Prof.	ENGI-2033-3 ENGI-3015-3 ENGI-3436-3 ENGI-0657-3	ENGI-5651 (2) ENGI-5611 (1) ENGI-5901 (2)	ENGI-5651: Graduate reading course
K. Liu	Prof.	Engi 3016-3 Engi 0579-3 Engi 4436-3 Engi 3451-3	Engi 5901 (1) Engi 5611 (1)	Sabbatical leave (winter term)
M. Liu	Assoc. Prof.	Engi 3021-3 Engi 2111-3 Engi 1230-3 Engi 0656-3 Engi 1552/3016-3		
M. Roy	Assist. Prof.			New faculty member starting from 2011
B. Singh	Prof.	Engi 0537-3 Engi 3337-3 Engi 3453-3 Engi 3454-3 Engi 1635-3		

Faculty Member	Rank	Teaching Assignments for 2010/11[1]		
		Undergraduate	Graduate	Comments[2]
S. Siddiqui	Assoc. Prof.	ENGI-1553 -3 ENGI-4130-3 ENGI-1111-3		
W. Wang	Assoc. Prof.	Engi 2434-3 Engi 2333-3	Engi 5901 (2) Engi-5611 (1)	Sabbatical leave (Fall term)
Category 2				
X. P. Liu	Prof.	Engi-3334-3 Engi-0138-3	Engi-5111-3 Engi-5611-3	
A. Tayebi	Prof.	Engi-4258-3 Engi-2258-3 Engi-2430-3	Engi-5211-3	

[1] The course designation "– *n*" means *n* contact hours per week for one term (excluding laboratory and tutorial hours). In the case of thesis supervision, the number of students is given parenthetically.
[2] Reduced teaching load.

9. Financial Support for Graduate Students

9.1 Scholarships

Graduate students in the proposed program may compete for external scholarships, such as Ontario Graduate Scholarship (OGS) and NSERC Graduate Scholarships. Graduate Studies awards a top-up of $5,000 to every graduate student holding an NSERC Graduate Scholarship.

9.2 Graduate Assistantships

Lakehead University provides Graduate Assistantships (GAs) for Canadian and permanent resident full-time graduate students (including some international students) at a rate of $9,303 per year at the Master's level (level of support for 2012-2013). The GAs are available during the Fall and Winter terms. The normal duties of a regular GA recipient are marking and consulting with students and performing no more than 10 hours of work per week over the Fall and Winter terms.

Tuition for international students is currently $14,850 per year (2012-13). It is anticipated that approximately 30% of the tuition fees from international students will be used as international GAs in the Faculty of Engineering.

Additional faculty research funding may be offered to qualified graduate students by their graduate supervisors from research grants.

Lakehead University also provides Graduate Scholarships, Awards, and Bursaries to qualified graduate students. These are available exclusively to full-time graduate students in the Faculty of Engineering.

10. Physical & Financial Resources

10.1 Library Resources:

Existing library resources, as described by the Chief Librarian in Appendix A, are adequate to support the proposed program. Some additions to the library as outlined in the Appendix may be desirable in the future.

10.2 Classroom, Laboratory and Research Equipment and Facilities:

A summary of the main research equipment and common facilities available to the proposed program is given in Appendix B.

These available research facilities represent industry-standard equipment, which have been effectively used to support research activities of the graduate students and postdoctoral fellows in the existing Control Engineering and Environmental Engineering Programs. These research facilities will be adequate to support the planned research activities of the proposed MSc-ME program.

10.3 Computer Facilities and Information Technology Support:

Networked computer facilities will be available to the students of the proposed program. There are several general computer labs and classrooms, which are maintained by the Technology Services Centre (TSC) at Lakehead University. A summary statement by the Supervisor of Client Services of the Technology Services Centre of the University is provided in Appendix C.

All faculty members in the proposed program have Internet access in their offices.

10.4 Office Space for Faculty and Graduate Students:

All faculty members have private offices with telephones and internet connections.

Adequate space is made available for all graduate students. For those students who have a Graduate Assistantship, the space requirement is mandated by the Collective Agreement for CUPE 3905, the union to which all students with Graduate Assistantships belong.

Table 4 - Space Allocations of Program Faculty and Students at Lakehead University.

Faculty Member	Home Unit	Office/Lab Spaces & Desks for Students			
		Office Space	Lab Space	Student Desks #1	Student Desks #2
Category 1 Core Faculty					
H. Bai - Assoc. Prof.	Mechanical Eng	12 m^2		3	2
B. Ismail - Assoc. Prof.	Mechanical Eng	12 m^2	20 m^2	3	3

K. Liu - Prof.	Mechanical Eng	12 m^2	30 m^2	4	3
M. Liu - Assoc. Prof.	Mechanical Eng	12 m^2		1	2
M. Roy - Assist. Prof.	Mechanical Eng	12 m^2			2
B. Singh - Prof.	Mechanical Eng	12 m^2			2
S. Siddiqui - Assoc. Prof.	Mechanical Eng	12 m^2			2
W. Wang - Assoc. Prof.	Mechanical Eng	12 m^2	40 m^2	4	3
Category 2 Core Faculty					
X. P. Liu - Prof.	Electrical Eng	13 m^2	10 m^2	3	1
A. Tayebi - Prof.	Electrical Eng	13 m^2	50 m^2	3	1
Totals:		***122 m^2***	***143 m^2***	***21***	***21***

"Student Desk #1" specifies spaces allocated to the current graduate students in the programs of Control Engineering and Environmental Engineering. "Student Desk #2" specifies the spaces available for the students in the proposed MSc-ME program.

A campus map is attached to Appendix G to specify the buildings where office and lab spaces are located.

11. Quality and Other Indicators of the Related Faculty Members

Most of the core faculty members in the proposed MSc in Mechanical Engineering are active researchers with a continued record of peer-reviewed publications, as summarized in Table 5.1. Details can be found in Volume II.

Table 5.1 - Summary of research contributions of the core faculty members

Category 1 Core Faculty	Refereed Journal Papers	Refereed Conference Papers	Book Chapters
H. Bai	13	15	
B. Ismail	15	6	1
K. Liu	40	23	1

M. Liu	15	38	
M. Roy	24	22	
B. Singh	15	20	1
S. Siddiqui	5	3	
W. Wang	30	12	2
Category 2 Core Faculty			
X. P. Liu	109	54	
A. Tayebi	26	44	1

The core faculty members in the proposed MSc in Mechanical Engineering also have rich experience in supervising highly-qualified personal including MSc and PhD students and postdoctoral fellows, as summarized in Table 5.2. The listed include those graduate students both completed and in-progress. As the proposed program has not yet been offered, all supervision is from other programs. The Masters students are from the existing graduate programs in Control Engineering, Environment Engineering, and Electrical and Computer Engineering.

As there is currently no PhD program in the Faculty of Engineering, several core faculty members have been appointed with other universities to supervise PhD students. For example, (a) Dr. K. Liu is an Adjunct Professor in the Faculty of Engineering and Applied Science, University of Ontario Institute of Technology, and the Department of Aerospace Engineering, Ryerson University, supervising doctoral students; (b) Dr. A. Tayebi is an Adjunct Professor in the Department of Electrical and Computer Engineering at the University of Western Ontario, supervising doctoral students; (c) Dr. W. Wang is an Adjunct Associate Professor in the Department of Mechanical and Mechatronics Engineering at the University of Waterloo, supervising doctoral students.

Table 5.2 - Summary of thesis supervision of the core faculty members

Category 1 Core Faculty	**Master Students**	**PhD Students**	**Postdoctoral Fellows**
H. Bai	6		
B. Ismail	7		
K. Liu	10	2	

M. Liu	3		
M. Roy			
B. Singh	1		
S. Siddiqui	2		1
W. Wang	12	5	3
Category 2 Core Faculty			
X. P. Liu	17	5	3
A. Tayebi	11	2	2

12. Budget

1) There are eight Category-1 faculty members, two Category-2 faculty members, as well as 3 technologists in the Department of Mechanical Engineering. This is sufficient to begin the MSc graduate program. An additional faculty member may be hired once the MSc-ME program grows sufficiently.

2) We expect to reach a steady state in the program in five years. Projected steady-state enrolment is 20 MSc students including 10 domestic and 10 international students. Each Category-1 core faculty is assumed to supervise 2 to 3 students each year, and each of the Category-2 faculty is assumed to supervise 1 student each year. Table 12.1 summarizes projected graduate enrolments in the proposed program and the related budget.

3) It is assumed that we can keep a retention rate of 100% in the MSc-ME program (i.e., no students leaving the program uncompleted). It is based on our current state in the programs of Control Engineering and Environmental Engineering, in which most students could finish their graduate programs.

4) Tuition (2012-13 values) for domestic students is set at $2508 per term (for the first three terms of a program) and $2277 for any subsequent terms. Domestic tuition estimates in the table are based on completion times of six terms (i.e., two years).

5) Currently Lakehead University provides Graduate Assistantships (GAs) for full-time domestic MSc graduate students (including some international students) at a rate of $9,303 per year (level of support for 2012-2013).

6) Graduate students may also be offered additional Faculty Research Funding by their graduate supervisors from research grants, and various donor-funded awards. These are not included in this budget.

7) This budget is based on 2012 dollar values, and does not account for increases in salaries, costs, tuition, funding, etc.

8) In calculating expenses of GAs assigned by the Faculty of Graduate Studies, it is assumed that all of the domestic students are to be assigned GAs, which is the current practice, and none of the international students will have GAs.

9) Tuition for international students is currently $4,950 per term or $14,850 per year (2012-13). It is anticipated that approximately 30% of the tuition fees from international students will be used as international GAs in the Faculty of Engineering.

10) A new faculty member, Dr. M. Roy, was hired in August 2011, who will teach 4 half-courses each year - typical load of colleagues in Engineering. As a result, it is assumed that no extra sessional instructors are to be hired and the graduate courses are taught by the current faculty members in Mechanical Engineering. In course scheduling, the Faulty of Engineering may comprehensively balance the course requirements among different graduate programs, and offer some courses that most graduate students from different graduate programs and/or senior undergraduate students can take.

Research-related lab experiments in Mechanical Engineering are led mainly by the students' supervisors. Thus, there is no need to hire any new technologists to support the proposed MSc-ME program.

TABLE 12.1. Projected enrolment for graduate students in the proposed program and the related budget

	2013/ 2014	**2014/ 2015**	**2015/ 2016**	**2016/ 2017**	**2017/ 2018**
New full-time domestic students	5	5	5	5	5
Continuing full-time domestic students	0	5	5	5	5
New full-time international students	3	5	5	5	5
Continuing full-time international students	0	3	5	5	5
Part-time students	0	0	0	0	0

TOTAL students	**8**	**18**	**20**	**20**	**20**
Tuition for domestic students ($2508 or $2,277/term)	37,620	71,775	71,775	71,775	71,775
Tuition for international students ($4,950/term)	44,550	118,800	148,500	148,500	148,500
Funding (BIU) for domestic students ($13,600/year)	68,000	136,000	136,000	136,000	136,000
TOTAL Revenues	**$150,173**	**$335,575**	**$356,275**	**$356,275**	**$356,275**
Graduate Assistantships ($9,303/year)	46,515	93,030	93,030	93,030	93,030
International Graduate Assistantships in the Faculty of Engineering	13,365	35,460	44,550	44,550	44,550
New faculty member ($100,000/year)	0	100,000	100,000	100,000	100,000
New technologist	0	0	0	0	0
New sessional instructor ($8,000/course)	0	0	0	0	0
Consumables	10,000	10,000	10,000	10,000	10,000
Marketing	10,000	10,000	10,000	10,000	10,000
TOTAL Expenditures	**$79,880**	**$248,490**	**$257,580**	**$257,580**	**$257,580**
NET INCOME	**$70,293**	**$87,085**	**$98,695**	**$98,695**	**$98,695**

Appendix A: Library Resources

PROPOSED MSc PROGRAM IN MECHANICAL ENGINEERING LIBRARY RESOURCES

Collections

The Chancellor Paterson Library maintains a solid collection of monographs and serial publications on the subject of Mechanical Engineering and a well established collection of resources in related engineering disciplines that will support the proposed Master of Science Program. The library currently supports existing graduate level engineering programs in the related interdisciplinary Control Engineering program, as well as Environmental Engineering, and Electrical and Computer Engineering.

The Library's journal collection, in particular the electronic journals, is strong. In addition to subscriptions paid from library budget for the Faculty of Engineering, the library provides access to electronic journals through participation in the Canadian Research Knowledge Network (CRKN) and consortial subscriptions through the Ontario Council of University Libraries (OCUL). This includes suites of electronic journals such as *Elsevier's Science Direct, IEEE/IET Electronic Library (IEL), SpringerLink*, and *Taylor and Francis*. Additional journals are available through ABI Inform as well as through Knowledge Ontario resources *Academic One-File* and *Expanded Academic ASAP*. Through resources like these, there are approximately 870 electronic journals of interest to mechanical engineering.

The library has approximately 23,800 print and electronic monographs in the library of congress classification for Technology and across the broad spectrum of engineering disciplines. Of these, there are approximately 1,600 print and electronic monograph titles specific to Mechanical Engineering and 1,500 titles on the subject of Manufacturing. E-book packages purchased consortially, such as the Springer collection, add substantially to the depth and currency of the monograph collection. Nearly one quarter of the material is in electronic format.

Selection

The Faculty of Engineering is responsible for selecting appropriate library resources. A library representative from the Faculty of Engineering liaises with a designated Collections Development Librarian with respect to the Faculty's library budget, the acquisition process, and consortia and serials management. It is the responsibility of the Collections Development Librarian to ensure relevant information regarding new publications is forwarded to the Faculty's representative for consideration.

Budget

The portion of the Library's books and periodicals budget expended by the Faculty of Engineering for 2009/10 was $55,263. This figure does not include the cost of indexes, abstracts and other reference materials that are paid for from other library funds. It also does not include the cost for purchasing suites of electronic books such as the Springer collections or the costs for subscribing to packages of electronic journals through CRKN and OCUL. The Faculty of Engineering also benefits, at no cost, from a suite of electronic resources made available through Knowledge Ontario.

New funding for the library will be required for the ongoing support of this new program.

Access to Resources

Access to Campus Resources

A special room in the Chancellor Paterson Library has been designated for the exclusive use of graduate students. Two computers are available for graduate student use in this area and study carrels are equipped to allow access to the internet via lap top computers. Laptop computers are available for student use and can be checked out from the circulation desk.

Access to the Internet is available in two computer labs and at workstations located throughout the library. One of the computer labs is located on the Library Main Floor and is a component of the Library Learning Commons. The Library Learning Commons also includes group study rooms, tutoring rooms, and a presentation practice room.

The Library's catalogue, Voyager, provides a single access point for the Library's holdings and a variety of resources including indexes, abstracts, e-books and full text electronic journals and government publications.

Availability of Resources to Identify Relevant Information

The Library's collection includes a number of electronic databases which would support the proposed program.

Compendex provides access to over five million summaries of journal articles, technical reports, and conference papers and proceedings in all areas of engineering.

Inspec is a bibliographic database to access 3500 scientific journals and 1500 conference proceedings in the fields of electrical and electronic engineering, physics, information technology, and computer and control systems.

Web of Science provides access to the Institute of Scientific Information's *Science Citation Index Expanded*.

ASTM Standards from IHS Engineering Resource Center, provides access to the full-text of current active standards.

The *Synthesis Digital Library of Engineering and Computer Science* is an information service for the research, development and educational communities in engineering and computer science. The basic component of the library is a self-contained electronic book that synthesizes an important research or development topic, authored by an expert contributor to the field.

The *IEEE/IET Electronic Library (IEL*) provides access to almost a third of the world's current electrical engineering and computer science literature, featuring high-quality content from the Institute of Electrical and Electronics Engineers (IEEE) and the Institution of Engineering and Technology (IET).

Academic One-File is a searchable full-text database of academic and scholarly journals in a variety of subjects. Subjects include physical sciences, technology, medicine and social sciences.

Expanded Academic ASAP is a multidisciplinary database covering arts and the humanities, social sciences, and science and technology.

IngentaConnect is an index to over 22,000,000 current articles taken from over 30,000 multidisciplinary journals.

The Library also provides access to periodical literature and other materials through *Scholars Portal Search*. The interface provides a simple approach to searching across a number of multidisciplinary bibliographic databases across a wide field of subjects.

Proquest Dissertations and Theses (PQDT) is a comprehensive collection of over 2.3 million dissertations and theses from around the world. Bibliographic citations are available for dissertations dating from 1861 and more than 60,000 new citations are added to the database every year. From 1997 dissertations are available in full-text and may be downloaded in pdf format.

The Library provides access to *Theses Canada Portal*, an initiative of Library and Archives Canada, which provides access to full-text versions of Canadian theses and dissertations published from the beginning of 1998 to August 31, 2002. It also includes bibliographic records of all theses in the National Library of Canada theses collection, which was established in 1965.

Provision of Documents and Information Not Held Locally

The library provides document delivery/interlibrary loan services to enable access to articles from a variety of journals and research materials not held in the Lakehead University collection. Users may request an unlimited number of books from Canadian suppliers for free. Faculty and graduate students are eligible to receive 20 articles per term at no cost.

Along with all other Ontario University Libraries, Lakehead uses the RACER system for the management of Interlibrary Loan service. This system is made available through the internet and includes a union catalogue of holdings for Ontario academic libraries as well as search profiles to discover and request materials from most Canadian and select American research institutions and library collections. Lakehead has free reciprocal borrowing agreements with select American institutions and is also a member of the Center for Research Libraries which provides free access to books, newspapers, serials, archival material and microfilm through Interlibrary Loan.

Lakehead is also a participant in the Inter University Borrowing Project (Canada) to facilitate the borrowing of books from other libraries.

User Assistance

Professional Reference Librarians are available to assist graduate students in making full use of the Library's resources. These include but are not limited to the online catalogue, electronic databases, internet resources, e-books, statistical data, and access to other library catalogues. Professional Reference Librarians provide assistance approximately 66.5 hours per week during the fall and winter terms.

In addition, Lakehead University Library is a participant in the *askON* chat reference service which was launched as a pilot project in January 2008. The *askON* service is a project of *Knowledge Ontario* involving the participation of university, college, and public libraries. Approximately 62 hours of live chat reference service is provided by the participating institutions each week during the fall and winter terms.

The Library's web page includes subject guides which present selected print and electronic information sources for each area of study at Lakehead University. These guides were prepared and are updated regularly by the Library's professional librarians. *ER Update*, the Library's electronic resources blog, provides information on new electronic Library resources as well as interface changes, additional features, and maintenance windows.

The Library offers a series of workshops intended to teach research skills and develop a knowledge base for optimizing use of the Library's resources. Advanced level and discipline-specific sessions can be arranged upon request either for individuals or classes. Workshops are also available on the use of *Refworks,* a web-based bibliography and database manager that allows one to create one's own personal database by importing references from text files or online databases.

_____ _____

Anne Deighton Date
University Librarian

Sept 2010

Appendix B: Laboratory Facilities

Modern, well-equipped laboratories are available for both research and teaching. A list of the major research equipment within the academic unit is given below.

1. Thermodynamics Lab

1 110 psi Rankine Cycler Steam Turbine Power System (Turbine, #RC-101)

1 Air Conditioning and Refrigeration System/Heat Pump (Scott, # 9086)

1 15 Horse Power Diesel Engine Testing System (Petter, # PH2W)

1 GE generator (# 5BY202A50A)

1 4-Stroke Gasoline Engine Performance Testing Apparatus (Armfield, CM11)

1 Reciprocating Air Compressor Testing Apparatus (Wade & Broom, # N3)

1 3.5 hp 4-Stroke Engine Testing Apparatus (Honda, #EMWJ)

1 6 Cylinder Engine Testing Apparatus, Ford – Connected to a Dynamometer, Heenan and Froud

2. Materials Science Lab

1 Microhardness Tester, Vickers

1 Creep Testing Apparatus

1 Rockwell Hardness Tester, Wilson, model # Series 2000

1 1000x Microscope, Leitz

1 2200F Heat Treating Oven, Lindberg Hevi-duty

1 Micro Etch Grinding and Polishing Benches, Buehler, model # 39-1470AB

1 Bakelite Sample Mounting Apparatus, Buehler

1 X-ray Viewing Tables

3. Fluid Mechanics Lab

1 Venturi Meter Hydraulic Bench, Tecquipment

1 Centrifugal Pump Performance Testing Apparatus, Gilkes

1 Impact of a Jet Hydraulic Bench, Tecquipment

1 Friction Loss in Pipes Testing Apparatus, Scott, model #9009

1 Turbine Test Apparatus, Gilkes

4. Alternative Energy Engineering Research Lab

1 Geothermal Heat Pump Simulator

1 Solar Energy Assisted Refrigerator

1 Solar Energy Assisted Heat Pump

1 Micro-Weather Logging Station

1 Hydroturbine Power Generation System

1 Mini-Wind Tunnel and Vertical Axis Wind Turbine system

1 Bladeless Disk Turbine Model for Power Generation system

1 Engine Exhaust Gas Heat Recovery Based Thermoelectric Power Generation System

1 Adsorbent Bed Device CO2 Gas Capture System for Industrial Energy Efficiency & GHG Reductions

1 Ceramic Membrane CO2 Gas Separator System for Industrial Energy Efficiency & GHG Control

5. Wind Tunnel Lab

1 Converging-Diverging Nozzle Testing Apparatus, Plint and Partners,

1 12” x 12” Wind Tunnel, New York Blower, Using a Pressure Sensor Transducer, Scanivalve

1 12” NACA 0012 AND 4412 Air Foils

1 24” Research Wind Tunnel,

1 Natural Convection Analysis Apparatus (Temperature Distribution on a Vertical Plate) Using a Cole Palmer Digi-Sense Thermometer

1 Double Pipe Heat Exchanger

6. Vibration and Control Lab

1 Pulse system consisting of Pulse 7700, 4/2-ch module 3109, Lan interface module 7533 B & K

1 dSpace DS1102 and ControlDesk system, dSpace

1 Shaker 4809 B & K

1 Power amplifier 2710 B & K

1 Impact hammer 8202 B & K

1 Universal power supply UPM-2405 Quanser

1 Universal power supply UPM-1503 Quanser
1 Smart structure S12 Quanser
1 Active mass damper L10 Quanser
1 Vibrometer-500 MetroLaser
2 Power supply GPC3030D GWInstek
1 Regulated power supply PSL262X PyleAudio
3 Accelerometer 4393 B & K
2 Accelerometer 4383V B & k
1 Charge amplifier 2635 B & K
1 Charge amplifier 2626 B & K
1 4-channel charge amplifier Nexus B & K
1 Laser position sensor CP24MHT80 Wenglor
1 Wideband amplifier 7602M Krohn Hite
1 Calibration exciter 4294 B & K
1 DC magnetometer AlphaLab
1 Sound level meter 732A BK precision
1 1/2” prepolarized free field microphone 40 AE, 1/2” CCP preamplifier 26CA Current source 4105C G.R.A.S.

7. Lab for Intelligent Mechatronics Systems

1 Machinery Dynamics Simulator (SpectraQuest)
1 Motor Condition Monitoring Workstation
1 Parallel Robot Workstation (ALIO)
1 Flexible Link Vibration Control Workstation (Quanser)
1 2-DOF Robot Control Workstation (Quanser)
1 Web Control Workstation (Quanser)

8. Rapid Prototyping Lab

1 Rapid Prototyping Workstation (Dimension bst)

Appendix C: Computer Facilities

TSC Technology Facilities

The Technology Services Centre (TSC) brings together the skills, knowledge and technology to provide Academic and Administrative Computing, Information Services, Voice and Data Communications and Computing Services in the areas of learning and research. Our goal is to assist the University in fulfilling its Academic mission, and to provide the support and guidance necessary to enhance the effectiveness of the institution in all its' service offerings. With a team of over 30 highly trained and skilled individuals, the TSC remains committed to supporting and strengthening our students' academic careers by providing University-wide access to information and technology resources.

The Advanced Technology Academic Centre (ATAC) opened its doors in September 2003 at Lakehead University, Thunder Bay Campus equipping the University with a modern, high-tech instruction, research and learning facility. In addition to providing more classroom space for students from many faculties, the Centre houses research and teaching laboratories for technology-intensive courses in software engineering, electrical engineering, geographic information systems, and computer science. ATAC's state-of-the-art Technology Enhanced classroom environments have expanded distance education through greater access to video-conferencing and other distributed learning tools. The TSC client base, including students, faculty and staff, have access to the Computer Helpdesk located on the second floor of the ATAC and there are a number of kiosks distributed on the first floor of the building that provide Internet access for our users.

ATAC is home to the following Lakehead University departments, programs and facilities:

- Northern Ontario Medical School (NOSM)
- Technology Services Centre (TSC)
- Computer Science
- Electrical & Software Engineering
- Geographic Information Systems (GIS) Laboratories
- Multi-media Production Studio
- Part-Time Studies & Distance Education
- Robotics Engineering Laboratories
- Virtual Reality Lab

High Performance Research Computing

The High Performance Computing Centre makes its home in the ATAC. This centre offers large scale computing resources to facilitate research, discovery and innovation in all academic fields of study. The TSC staff provides support and expertise for researchers with the use of this leading edge technology and its' tools.

High-performance computing gives researchers in mathematics, engineering, computer science, finance, chemistry and health sciences, as well as any other discipline that

engages in computer modeling, the advantage of having large computing power to crunch the numbers.

Lakehead is a member of SHARCNET (http://www.sharcnet.ca/), a consortium of colleges and universities with high-performance computers across south-central Ontario who have pooled their resources to create The Shared Hierarchical Academic Research Computing Network (SHARCNET).

As a member of SHARCNET, Lakehead's high-performance computing capability increases from its current level of 132 CPUs to over 3,000 CPUs, and gives researchers unlimited access to resources and support in the form of peer mentors, research collaborations, and software developers.

Come the fall of 2010, the TSC will be commissioning another on-campus Data Centre to provide full redundancy for its centralized computing and storage resources.

Virtual Reality

The Lakehead University Virtual Reality Environment (LUVRE) managed by the TSC, boasts the latest in state-of-the-art imaging and processing technology, truly establishing Lakehead as a leader in Virtual Reality instruction and research. High performance computers (HPC) drive the video display, rendering and complex computations. Coupled with high refresh rate projectors and a curved laser calibrated screen, these robust technologies result in a highly realistic and sophisticated interactive simulation environment that is useful for understanding spatial dynamics as well as relationships among objects, people and places.

The benefits of this system to industry, education and health care include the ability to visualize and interact with models and processes without a safety risk or financial impracticality in addition to relinquishing the need to develop/acquire actual physical models.

Virtual Reality - A Unique Learning Tool

LUVRE offers faculty and students unique experiences that are consistent with successful instructional strategies: hands-on learning, group projects and discussions, simulations and concept visualization. The virtual reality learning environment is experiential and intuitive; it is a shared information context that offers unique interactivity and can be configured for individual learning and performance styles.

LUVRE's Practical Applications

With the ability to perform highly realistic simulations of engineering, industrial planning, GIS/mapping, medical and molecular modeling, LUVRE is only limited by one's imagination. It is a valuable tool that empowers Lakehead University to engage local, national and international companies interested in the use of cost-saving VR techniques in businesses ranging from pulp paper production to health care research to mining operations.

The VR Technology

The LUVRE System utilizes:

- BARCO DLP projectors that operate at the highest possible refresh rate

- Infrared, stereoscopic LCD, CrystalEyes - shutter glasses used for Stereo 3D imaging
- A curved laser calibrated screen
- Surround sound audio system to support professional software applications used in product visualization and simulation

Telephone and the Network

Lakehead University utilizes fully converged network for data, voice and video communications. The backbone of the network is built on a redundant multi gigabit fiber optic network comprising of multiple Layer 3 routable switches, over 40 wiring closets and 8000 plus Ethernet ports. TSC supports 2600 voice over IP phones, Video Conference Units, security cameras, environmental controls, computers, printers and Servers which are all running on the same IP infrastructure.

The Teaching Environment

The Multimedia Service Unit is committed to providing a wide range of technological communication services across campus including the Orillia campus. All classrooms in the ATAC are equipped with multi-media podiums, complete with a touch panel. Furthermore each classroom boasts an in-room PC with a flat panel monitor, two USB ports, CDRom and floppy drives, Internet connects, IP telephone with speaker, laptop dock (video, audio, Internet and power), VCR player, DVD player, and document camera. Individual network ports have been installed in the classrooms for student connectivity. The teaching labs in the ATAC are outfitted with instructor PC's and multimedia equipment as well.

Video Conferencing and teleconferencing technology is available in the three (3) large theatres as well as in multiple designated V/C rooms. A total of twelve rooms (12) in the ATAC are available for video streaming with three (3) other rooms on campus residing in the Nursing building and Regional Centre. Video and Audio digital production is available along with media conversion and linear and non linear editing. Additionally, mobile conferencing units can be deployed anywhere on campus.

General Classroom Details

All computer classrooms on both Campuses are networked. The computers in these rooms have a full range of Internet services including E-mail, web browsers, terminal emulation, FTP etc. They are also equipped with the appropriate applications such as word processors, spreadsheets, database programs, statistical analysis software, compilers and special purpose software. General student computer labs on both campuses are also available. These general student labs are never used as instruction facilities, as they are dedicated for student use at all times.

Students must have an account on the appropriate server before any computer can be used. Accounts are created automatically from student registration information. A Lakehead Web-mail account is also set up for every student at this time. Lakehead's e-mail service is provided by Google as part of a new partnership developed in November of 2006. The e-mail accounts are perpetual, never deleted and may be used by students as a personal account after graduation.

Printing Services
Printing facilities are provided via central and satellite laser printers in both monochrome and colour. The printers are located throughout the ATAC building and other locations on Campus including large scale colour plotting are provided student use.
A networked database controls Lakehead's printing services. Students are given an initial credit upon registration, then they deposit to their account as required in order to continue using these printing services. In addition to the printing services, scanners can be found at various locations on campus for student use.

Computer Classroom Bookings
The Technology Enabled Classrooms are booked for course use through the Registrar's Scheduling Office. This is necessary to ensure that timetable requirements are met. Consultation with the TSC staff is also necessary to ensure that all of the software and operating systems in the classroom match the course requirements. There are multiple software applications installed in each classroom and there is a certain degree of coordination required in order to service all the needs of each Technology Enabled Classroom. Data projectors are provided in all ATAC TSC computer classrooms and by request from the Audio-Visual unit of the TSC for other computer labs.

Computer Classroom Usage
Computer classrooms under the supervision of TSC are available 24 hours a day for student use during the Fall and Winter Terms. This is subject to prior class bookings.
Students not only use these labs to complete course assignments but also use the labs for electronic mail, resumes, projects and personal recreation on the Internet.
Computer classrooms are used for public and high school tours, university-sponsored conferences and staff training.

Classroom Hardware Details
The majority of computer classrooms contain IBM-compatible computers. The following table shows room location, number of computers, operating system and type of computer.

Room Location	Number of Computers	Operating System	Type of Computer
BB1066	20	Windows	Thin Clients
CB1003	24	Windows	Desktops
CB1004 *	18	Windows	Desktops
SB1027	30	Windows	Thin Clients

Agora	12	Windows	Thin Clients (Kiosks)
BL2001	38	Windows	Mac
ATAC 1st Floor	30	Windows	Thin Clients (Kiosks)
AT3001	60	Windows	Desktops
AT3002	60	Windows	Desktops
AT3003	20	Windows	Desktops
AT3010-GIS	20	Windows	Desktops
AT3009-GIS	20	Windows	Desktops

Classroom Software Details

The software available to these systems is dependent upon the operating system. In the main teaching labs, the current standard software available includes:

- SPSS
- Microsoft Office Suite including Word, Excel, Access, FrontPage, PowerPoint, Project, Visio
- Microsoft Visual Studio.Net
- Secure SFTP / Telnet (SSH) / Putty / WinZip
- Adobe Photoshop
- ESRI campus site license for ArcGIS suite of products
- In AT4019, engineering software served from a Solaris Server, includes:
- Hysis
- AutoCAD with Mechanical Desktop
- Ram Scheduler
- Lindo
- Tutsim

Sun Workstation Classrooms

Room Location	Number of Computers	Operating System	Type of Computer
AT4019	54	Solaris 9	Sun Blade 150

The workstations connect to a Sun Solaris server, the Engineering Sun Solaris Server *Sunshine* and the SGI Origin Super Computer, *Giant*. Applications available on *Sleet* include Matlab, Ansys and SPSS along with programming languages such as Lisp, C and Fortran. *Giant* supports SAS, parallel programming, Virtual Reality and other custom applications.

Other Resources

Graphics Lab

A graphics lab with eight SGI 330 workstations, an HP DesignJet 3800 printer and a SGI 1400 server is available for GIS research. The main software packages in use are ArcView and ArcInfo.

Residence

Lakehead University Residences are fully wired with network ports available in every room and VoIP telephony.

Tech Fund

The Lakehead University Student Union (LUSU) has a Tech Fund which also provides additional computer resources for students. General use computer labs have been added through this fund including two labs in the University Library, a smaller lab in the Education Library and another in Visual Arts and Music.

Scanning Stations

Colour scanners are available to students in the main printer room in the Braun Building and in two Library computer labs. Digital still cameras, a digital video camera, laptops and data projectors can be booked by students through the Audio-Visual unit of TSC.

Internet Carousels

The ATAC building has an IBM thin client solution for the Internet Carousel system on the first floor and in the Agora. A SunRay system is used for Internet Carousels in the Centennial Building and outside the main cafeteria.

J. Terry Young

Manager, Technology Services

Lakehead University

Appendix D: Draft Calendar Entry (as of May 22, 2012)

Professor and Dean: H. T. Saliba

MSC (MECHANICAL ENGINEERING)

Graduate Coordinator: W. Wang

Core: Master's Thesis Supervisory

H. Bai
B. Ismail
K. Liu
M. Liu
X. P. Liu (Electrical Engineering)
M. Roy
B. Singh
S. Siddiqui
A. Tayebi (Electrical Engineering)
W. Wang

MSC IN MECHANICAL ENGINEERING

The MSc in Mechanical Engineering satisfies the demand in academia and industry for highly-qualified personnel in the field of Mechanical Engineering. The program is directed to graduates from the existing undergraduate program in Mechanical Engineering at Lakehead University and graduates from undergraduate programs at other universities. The program fosters independent research and development abilities of students. These objectives are achieved through a combination of formal course study and thesis work.

ADMISSION REQUIREMENTS

Candidates are accepted under the Admission Requirements of the Faculty of Graduate Studies Master's Regulations provided that the requirements of the Faculty of Engineering are also satisfied.

To be considered for admission to the MSc program in Mechanical Engineering, the applicant must normally hold a Bachelor's Degree in Mechanical Engineering or other equivalent four-year programs, in addition to all other general admission requirements of the University.

A make-up period of study, as recommended by the Engineering Graduate Studies Committee, may be required where the student is deficient in background undergraduate level courses. Proficiency in the English language is required. Meeting the minimum requirements does not necessarily lead to automatic admission, but depends on the availability of places in the program and on an assessment by the

Engineering Graduate Studies Committee of the applicant's aptitude for graduate studies and research.

The application deadline is **February 1**. Late applications will be considered for admission, but may not be eligible for funding.

ACADEMIC REGULATIONS

In addition to the Faculty of Graduate Studies Master's Regulations of this calendar, Engineering students are also bound by the regulations listed below.

Course Substitution

For MSc in Mechanical Engineering, one of the four half-courses of the program may be taken from another existing graduate program at Lakehead University. A student can take only one graduate reading course under Engineering 5671: Advanced Topics in Mechanical Engineering to be credited as a half-course. One of the four half-courses may be a senior undergraduate half-course that has not previously been taken. The student's choice of courses must be approved by the graduate supervisor and the Graduate Program Coordinator.

Minimum Satisfactory Academic Standing

All graduate students must obtain a minimum mark of 70% ~~(B)~~ in each half-course. A score of less than 70% will constitute a failure. A failed half-course may be repeated or replaced by another course specified by the supervisor only once. Any students with more than one half-course failure on his/her record must withdraw from the program.

Thesis Supervision and Examination

The student will be guided by a thesis supervisor and a supervisory committee to be established by the end of the first term after enrolment. A research thesis topic should be submitted to the student's thesis supervisor by the end of the second term of studies. When completed, the thesis will be examined under university regulations (see Faculty of Graduate Studies Master's Regulations).

MSC PROGRAM IN MECHANICAL ENGINEERING

The requirements for the MSc in Mechanical Engineering (total 5 FCEs) are:

(a) four half-courses (2 FCEs)
(b) the graduate seminar, Engineering 5771 (carries 0.5 FCE credit weight)
(c) the graduate thesis, Engineering 5901 (9901) (carries 2.5 FCE credit weight)

Graduate Core Courses:

All students must take two of the following four core half-courses:

Engineering 5171: Computational Mechanics
Engineering 5172: Advanced Thermal-Fluids
Engineering 5173: Intelligent Tools for Engineering Applications
Engineering 5174: Modeling and Control of Mechanical Systems

At least two core half-courses will be offered each year, and all four core half-courses will be offered in the period of two years.

Graduate Elective Courses:

All students must take at least one of the following elective half-courses:

Engineering 5175: Applied Elasticity
Engineering 5271: Alternative Energy Engineering
Engineering 5272: Combustion and Emissions in IC Engines
Engineering 5273: Mechatronics
Engineering 5274: Advanced Manufacturing
Engineering 5275: Mechanical Systems and Signal Processing
Engineering 5371: Vibration Theory and Applications
Engineering 5671: Advanced Topics in Mechanical Engineering

At least two elective half-courses will be offered each year.

DESCRIPTION OF THE GRADUATE COURSES

Engineering 5171
Computational Mechanics

Credit Weight:
0.5

Description:
Least squares and the conjugate gradient method; approximation and interpolation; fast Fourier transform; numerical solution of non-linear equations; optimization; initial value problems; boundary-value problems; finite difference and finite element methods.

Offering:
3-1.5; or 3-1.5

Engineering 5172
Advanced Thermal-Fluids

Credit Weight:
0.5

Description:
Advanced heat conduction, convection, and thermal radiation; analytical heat transfer; the second law of thermodynamics and entropy generation; exergy; exergo-economics; conservation equations for viscous fluids & boundary layer concept; Navier-Stokes equations; and compressible 1-D flows.

Offering:

3-1.5; or 3-1.5

Engineering 5173
Intelligent Tools for Engineering Applications

Credit Weight:
0.5

Description:
Computational intelligence; fuzzy logic; neural networks; genetic algorithms; hybrid techniques such as neuro-fuzzy schemes; machine learning; softcomputing in engineering applications in system modeling, pattern classification and control.

Offering:
3-1.5; or 3-1.5

Engineering 5174
Modeling and Control of Mechanical Systems

Credit Weight:
0.5

Description:
Modelling of mechanical, electrical, thermal, and fluid dynamic systems; state space analysis; ~~frequency response;~~ controllability, observability and stability; state feedback, output feedback, modal control; introduction to adaptive control, self-tuning regulations, and model reference adaptive systems.

Offering:
3-1.5; or 3-1.5

Engineering 5175
Applied Elasticity

Credit Weight:
0.5

Description:
Introduction to rectangular cartesian tensors; development of equations of classical linear elasticity; applications to plane and torsion problems; exact and approximate analytical methods.

Offering:
3-1.5; or 3-1.5

Engineering 5271

Alternative Energy Engineering

Credit Weight:
0.5

Description:
Alternative clean and renewable energy sources (solar, wind, geothermal, and hydro energy); thermoelectric systems; fuel cells; nuclear energy; cogeneration; waste-heat recovery; energy storage, sustainability, and economics; and GHG emissions, pollution, and global warming.

Offering:
3-1.5; or 3-1.5

Engineering 5272
Combustion and Emissions in IC Engines

Credit Weight:
0.5

Description:
Properties of fuels; combustion of fuels; stoichiometric combustion; analysis of flue gas; pollutant formation and control in IC engines; hydrogen combustion in IC engine; combined heat and power (CHP); analysis of CHP; biofuels combustion.

Offering:
3-1.5; or 3-1.5

Engineering 5273
Mechatronics

Credit Weight:
0.5

Description:
Properties of linear and nonlinear systems; system identification methods; modelling and approximation of dynamic systems; sensor and actuators; computer interfacing; computer control of machines and processes (PLC and PC based).

Offering:
3-1.5; or 3-1.5

Engineering 5274
Advanced Manufacturing

Credit Weight:

0.5

Description:
Solid modeling theory; part creation; assemblies and rigid bodies; mechanism simulation; optimization of manufacturing processes; graphical modeling of milling and turning; B-splines; data exchange; CNC machining and inspection.

Offering:
3-1.5; or 3-1.5

Engineering 5275
Mechanical Systems and Signal Analysis

Credit Weight:
0.5

Description:
Data representation; signal conditioning; error analysis; sampling characteristics; deterministic and random signal analysis; ~~FFT;~~ statistical analysis; digital filters; fault detection in general mechanical systems such as gears, bearings, and shafts.

Offering:
3-1.5; or 3-1.5

Engineering 5371
Vibration Theory and Applications

Credit Weight:
0.5

Description:
Single and multiple DOF systems; eigenvalue problems; impedance and mobility of dynamic systems; modal analysis; orthogonality and frequency response functions; experimental modal analysis; vibration control.

Offering:
3-1.5; or 3-1.5

Engineering 5671
Advanced Topics in Mechanical Engineering

Credit Weight:
0.5

Description:
Current developments and specialized topics in Mechanical Engineering.

Special Topic:
Y

Offering:
3-0; or 3-0;

Engineering 5771
Seminar Mechanical Engineering

Credit Weight:
0.5

Description:
An ordered and critical exposition of the literature on an appropriate topic in mechanical engineering.

Offering:
1-0; or 1-0

Notes:
May only be taken by students in Mechanical Engineering.

Appendix E: Student Learner Outcomes of the Graduate Courses

Engineering 5171
Computational Mechanics

Student Learner Outcomes

1) Develop the ability to compare the properties of Lease Squares Estimate (LSE) method and conjugate gradient algorithm and recognize their application limitations. (Links to Program Learner Outcomes: a, e)
2) Demonstrate the ability to use the approximation and interpolation methods in modeling physical systems. (Links to Program Learner Outcomes: a, e)
3) Develop the ability to describe the algorithm and implementation of the fast Fourier transform (FFT). (Links to Program Learner Outcomes: a, e)
4) Develop the ability to state fundamental measurement, instrumentation, and data processing techniques for analysis. (Links to Program Learner Outcomes: a, e)
5) Demonstrate the ability to apply the FFT software for frequency analysis of the related physical systems. (Links to Program Learner Outcomes: a, e)
6) Develop the ability to discuss numerical solution of non-linear equations. (Links to Program Learner Outcomes: a, e)
7) Develop the ability to analyze optimization models. (Links to Program Learner Outcomes: a, e)
8) Develop the ability to define initial value problems and boundary-value problems. (Links to Program Learner Outcomes: a, d, e)
9) Demonstrate the ability to formulate finite difference and finite element methods. (Links to Program Learner Outcomes: a, e)
10) Demonstrate personal responsibility and accountability in conducting the related assignments and term project. (Links to Program Learner Outcomes: f)
11) Demonstrate the ability to communicate ideas, issues and conclusions clearly and effectively related to assignments and term project. (Links to Program Learner Outcomes: g)

Engineering 5172
Advanced Thermal-Fluids

Student Learner Outcomes

1) Develop the ability to critically evaluate existing literature in the specific field of advanced thermal-fluids and demonstrate systematic understanding of knowledge with the required depth and breadth. (Links to Program Learner Outcomes: a)
2) Develop the ability to analyze advanced heat conduction engineering problems and develop the ability to appreciate the broader implications of applying knowledge to particular contexts of conduction heat transfer. (Links to Program Learner Outcomes: a, e)

3) Develop the ability to analyze advanced heat convection engineering problems and develop the ability to appreciate the broader implications of applying knowledge to particular contexts of convection heat transfer. (Links to Program Learner Outcomes: a, e)
4) Develop the ability to analyze advanced thermal radiation engineering problems and develop the ability to appreciate the broader implications of applying knowledge to particular contexts of thermal radiation. (Links to Program Learner Outcomes: a, e)
5) Demonstrate the ability to apply complex techniques (e.g. exergy and thermo-economics methods) for solving advanced thermodynamics engineering problems. (Links to Program Learner Outcomes: a, d, e)
6) Demonstrate the ability to explain and apply entropy generation concept pertinent to complex thermodynamics engineering systems. (Links to Program Learner Outcomes: a, e)
7) Demonstrate the ability to explain and apply maximum entropy principle pertinent to complex thermodynamics engineering systems. (Links to Program Learner Outcomes: a, e)
8) Demonstrate the ability to explain and apply the conservation equations for viscous fluids & boundary layer concept. (Links to Program Learner Outcomes: a, e)
9) Develop the ability to apply Navier-Stokes equations and analyze compressible 1-D flows. (Links to Program Learner Outcomes: a, e)
10) Develop the ability to conduct independent term project and show competence in the research process and demonstrate advanced research and scholarship within advanced thermal-fluids area using pertinent mathematical, scientific, and engineering concepts. (Links to Program Learner Outcomes: a, d, e)
11) Demonstrate ability to conduct numerical simulations in the area of advanced-thermal fluids. (Links to Program Learner Outcomes: a, e)
12) Demonstrate personal responsibility and accountability in conducting the related assignments and term project. (Links to Program Learner Outcomes: f)
13) Demonstrate the ability to communicate ideas, issues and conclusions clearly and effectively related to assignments and term project. (Links to Program Learner Outcomes: g)

Engineering 5173
Intelligent Tools for Engineering Applications

Student Learner Outcomes
1) Demonstrate the ability to interpret the relationship between a conventional system and softcomputing tool-based intelligent system. (Links to Program Learner Outcomes: a)
2) Demonstrate the ability to explain artificial intelligence concept and their range of applicability. (Links to Program Learner Outcomes: a)
3) Demonstrate the knowledge of fuzzy logic. (Links to Program Learner Outcomes: a)
4) Develop the ability to construct fuzzy logic models for general reasoning problems. (Links to Program Learner Outcomes: a, e)

5) Demonstrate the knowledge of neural networks including feedforward networks, recurrent networks, and RBFN. (Links to Program Learner Outcomes: a)
6) Develop the ability to construct neural network models with the help of MATLAB or other available software. (Links to Program Learner Outcomes: a, e)
7) Develop the ability to properly integrate neural networks and fuzzy logic for hybrid reasoning paradigms such as neuro-fuzzy and fuzzy neural schemes. (Links to Program Learner Outcomes: a, e)
8) Demonstrate the ability to discuss the commonly used training methods, such as LSE, gradient algorithm, and genetic algorithms. (Links to Program Learner Outcomes: a, e)
9) Demonstrate the ability to program fuzzy logic, neural networks, and neuro-fuzzy schemes in MATLAB. (Links to Program Learner Outcomes: a, e)
10) Demonstrate the ability to program LSE and gradient algorithm to train neuro-fuzzy systems in MATLAB. (Links to Program Learner Outcomes: a, e)
11) Demonstrate the ability to apply the related softcomputing tools to solve problems of a particular domain such as modeling (e.g., forecasting), or control, or pattern classification. (Links to Program Learner Outcomes: a, d, e)
12) Demonstrate personal responsibility and accountability in conducting the related assignments and term project. (Links to Program Learner Outcomes: f)
13) Demonstrate the ability to communicate ideas, issues and conclusions clearly and effectively related to assignments and term project. (Links to Program Learner Outcomes: g)

Engineering 5174
Modeling and Control of Mechanical Systems

Student Learner Outcomes
1) Demonstrate the ability to build mathematic models for various physical systems such as mechanical, electrical, thermal, and fluid systems. (Links to Program Learner Outcomes: a, e)
2) Demonstrate the ability to derive analytical solutions of the mathematical models analytically. (Links to Program Learner Outcomes: a, e)
3) Demonstrate the ability to derive analytical solutions of the mathematical models numerically. (Links to Program Learner Outcomes: a, e)
4) Demonstrate the ability to derive a state-space model for a physical system.
5) Demonstrate the familiarity with key concepts such as stability, controllability, and observability. (Links to Program Learner Outcomes: a, e)
6) Demonstrate the ability to control a system using various methods such as state feedback, optimum control, adaptive control, and modal control, etc. (Links to Program Learner Outcomes: a, e)
7) Demonstrate the ability to critically evaluate existing literature in the specific field of system modeling and control and demonstrate a systematic understanding of knowledge with the required depth and breadth. (Links to Program Learner Outcomes: a)

8) Demonstrate the ability to conduct independent term project and show competence in the research process and demonstrate advanced research and scholarship within system modeling and control area using pertinent mathematical, scientific, and engineering concepts. (Links to Program Learner Outcomes: a, d, e)
9) Demonstrate personal responsibility and accountability in conducting the related assignments and term project. (Links to Program Learner Outcomes: f)
10) Demonstrate the ability to communicate ideas, issues and conclusions clearly and effectively related to assignments and term project. (Links to Program Learner Outcomes: g)

Engineering 5175
Applied Elasticity

Student Learner Outcomes
1) Demonstrate the ability to use properties of tensors of second order, including transformations and principal values, for stress and strain applications, and invariants. (Links to Program Learner Outcomes: a, e)
2) Demonstrate the ability to analyze problems using generalized Hooke's law and relationships between the various elastic constants. (Links to Program Learner Outcomes: a, e)
3) Demonstrate the ability to analyze 2D elasticity problems using inverse and semi-inverse methods, Airy's stress function, and complex variable methods. (Links to Program Learner Outcomes: a, e)
4) Demonstrate the ability to analyze 2D elasticity problems in polar coordinates. (Links to Program Learner Outcomes: a, e)
5) Demonstrate the ability to analyze axisymmetric bodies. (Links to Program Learner Outcomes: a, e)
6) Demonstrate the ability to analyze torsional problems of prismatic bars. (Links to Program Learner Outcomes: a, e)
7) Demonstrate the ability to analyze 2D elasticity problems using energy and variational methods. (Links to Program Learner Outcomes: a, d, e)
8) Demonstrate the ability to analyze thermal elasticity problems. (Links to Program Learner Outcomes: a, e)
9) Demonstrate the ability to analyze 3D elasticity problems. (Links to Program Learner Outcomes: a, e)
10) Demonstrate personal responsibility and accountability in conducting the related assignments and term project. (Links to Program Learner Outcomes: f)
11) Demonstrate the ability to communicate ideas, issues and conclusions clearly and effectively related to assignments and term project. (Links to Program Learner Outcomes: g)

Engineering 5271
Alternative Energy Engineering

Student Learner Outcomes

1) Develop the ability to evaluate existing literature in the specific field of alternative energy engineering and demonstrate systematic understanding of knowledge with the required depth and breadth. (Links to Program Learner Outcomes: a)
2) Develop the ability to analyze and evaluate the resources of solar/wind/geothermal/hydro energy and develop the ability to appreciate the broader implications of applying knowledge to particular contexts. (Links to Program Learner Outcomes: a)
3) Develop the ability to analyze and evaluate the performance of hybrid power systems. (Links to Program Learner Outcomes: a, e)
4) Develop the ability to analyze and evaluate the performance of trigeneration systems. (Links to Program Learner Outcomes: a, e)
5) Develop the ability to analyze and evaluate the performance of thermoelectric power generation systems. (Links to Program Learner Outcomes: a, e)
6) Develop the ability to analyze and evaluate the performance of waste-heat and combined power systems. (Links to Program Learner Outcomes: a, e)
7) Demonstrate the ability to apply novel solutions for energy storage given an alternative energy technology. (Links to Program Learner Outcomes: a, d, e)
8) Develop the ability to conduct independent term project and show competence in the research process and demonstrate advanced research and scholarship of a specific technology area within alternative energy using pertinent mathematical, scientific, and engineering concepts. (Links to Program Learner Outcomes: a, d, e)
9) Demonstrate ability to conduct numerical simulations of the performance and characteristics of various alternative energy systems at different operating conditions. (Links to Program Learner Outcomes: a, e)
10) Demonstrate personal responsibility and accountability in conducting the related assignments and term project. (Links to Program Learner Outcomes: f)
11) Develop the ability to explain the global warming effect and emissions associated with a given alternative energy system. (Links to Program Learner Outcomes: a, e, g)
12) Demonstrate the ability to communicate ideas, issues and conclusions clearly and effectively related to assignments and term project. (Links to Program Learner Outcomes: g)
13) Demonstrate the ability to apply complex techniques (e.g. exergy and thermo-economics methods) for evaluating alternative energy engineering systems. (Links to Program Learner Outcomes: a, e)

Engineering 5272

Combustion and Emissions in IC Engines

Student Learner Outcomes

1) Demonstrate the ability to recall properties of perfect gases and thermodynamic cycles and to describe fuel properties and requirements of a good fuel. (Links to Program Learner Outcomes: a)
2) Develop the ability to discuss ultimate and proximate analysis of fuels and experimental determination of higher calorific value. (Links to Program Learner Outcomes: a, e)
3) Demonstrate the ability to apply combustion equation to determine theoretical air requirement and products of combustion. (Links to Program Learner Outcomes: a, e)
4) Develop the ability to formulate combustion equation for different fuels and analyze flue gases. (Links to Program Learner Outcomes: a, e)
5) Demonstrate the ability to estimate the engine size and power of IC engines. (Links to Program Learner Outcomes: a, e)
6) Develop the ability to compare the engine performance parameters of IC engines and prepare heat balance sheet for IC engines. (Links to Program Learner Outcomes: a, e)
7) Demonstrate the ability to explain combustion stages and effect of engine variables on knocking of IC engines, and discuss hydrogen combustion in IC engines. (Links to Program Learner Outcomes: a, e)
8) Develop the ability to compare efficiency and losses in boilers and estimate boiler capacity from design data. (Links to Program Learner Outcomes: a, d, e)
9) Develop the ability to compare emissions in IC engines. (Links to Program Learner Outcomes: a, e)
10) Demonstrate the ability to discuss combined heat and power and biofuels combustion. (Links to Program Learner Outcomes: a, e, g)
11) Demonstrate the ability to develop a project on combustion and emissions through a term project. (Links to Program Learner Outcomes: a, c)
12) Demonstrate personal responsibility and accountability in conducting the related assignments and term project. (Links to Program Learner Outcomes: f)
13) Demonstrate the ability to communicate ideas, issues and conclusions clearly and effectively related to assignments and term project. (Links to Program Learner Outcomes: g)

Engineering 5273
Mechatronics

Student Learner Outcomes
1) Demonstrate the ability to analyze the properties of the related linear and nonlinear systems. (Links to Program Learner Outcomes: a)
2) Demonstrate the ability to apply system identification methods to model the plant to be controlled. (Links to Program Learner Outcomes: a, e)
3) Develop the ability to analyze the characteristics of the generally used pneumatic, hydraulic, mechanical and electrical systems. (Links to Program Learner Outcomes: a, e)

4) Demonstrate the ability to analyze the properties of the commonly used sensors for measurement of vibration, temperature, flow rate, etc. (Links to Program Learner Outcomes: a, e)
5) Develop the ability to analyze the properties of actuation systems in the forms of mechanical, electrical, pneumatic and hydraulic. (Links to Program Learner Outcomes: a, e)
6) Develop the ability to construct transfer functions of the first-order and second-order systems. (Links to Program Learner Outcomes: a, e)
7) Develop the ability to analyze frequency response of a control system and define its Bode diagrams. (Links to Program Learner Outcomes: a, e)
8) Develop the ability to design a closed-loop controller (e.g., PI, PD, PID) and analyze its stability. (Links to Program Learner Outcomes: a, d, e)
9) Demonstrate the ability to choose an appropriate microprocessor for a control application and to program the microprocessor. (Links to Program Learner Outcomes: a, e)
10) Demonstrate the ability to apply the input/output interface addressing, requirements, and adapters. (Links to Program Learner Outcomes: a, e)
11) Demonstrate the ability to apply MATLAB/SIMILINK to design and simulate a digital control system. (Links to Program Learner Outcomes: a, d, e)
12) Demonstrate personal responsibility and accountability in conducting the related assignments and term project. (Links to Program Learner Outcomes: f)
13) Demonstrate the ability to communicate ideas, issues and conclusions clearly and effectively related to assignments and term project. (Links to Program Learner Outcomes: g)

Engineering 5274
Advanced Manufacturing

Student Learner Outcomes
(1) To develop the ability to critically evaluate existing literature in manufacturing and production research. (Links to Program Learner Outcomes: a)
(2) To develop the ability to conduct independent research in a manufacturing process using pertinent mathematical, scientific, and engineering concepts. (Links to Program Learner Outcomes: a, d, e)
(3) To develop the ability to design and conduct experiments of manufacturing processes. (Links to Program Learner Outcomes: a, c)
(4) To develop the ability to design and conduct computer simulations of manufacturing processes. (Links to Program Learner Outcomes: a, c)
(5) To develop the ability to use the techniques, skills, and modern engineering and scientific tools necessary for research in manufacturing processes and product design. (Links to Program Learner Outcomes: a, e)
(6) Demonstrate personal responsibility and accountability in conducting the related assignments and term project. (Links to Program Learner Outcomes: f)

(7) Demonstrate the ability to communicate ideas, issues and conclusions clearly and effectively. (Links to Program Learner Outcomes: g)

Engineering 5275
Mechanical Systems and Signal Analysis

Student Learner Outcomes

1) Demonstrate the ability to choose the measurement setup and the related measurement characteristics such as frequency range, length of time record, number of averages, etc. (Links to Program Learner Outcomes: a, c)
2) Develop the ability to analyze data properties represented by different measurement such as probability density functions and correlation functions. (Links to Program Learner Outcomes: a)
3) Demonstrate the ability to analyze the errors in measurement, signal reconditioning, and processing. (Links to Program Learner Outcomes: a, e)
4) Develop the ability to analyze sampling processes, aliasing errors, and windowing functions. (Links to Program Learner Outcomes: a, e)
5) Develop the ability to analyze random signals and the related statistical tools for analysis. (Links to Program Learner Outcomes: a, e)
6) Develop the ability to analyze, design and implement digital filters (e.g., Butterworth and Chebyshev). (Links to Program Learner Outcomes: a, d, e)
7) Demonstrate the ability to perform signal analysis on measured time record in MATLAB. (Links to Program Learner Outcomes: a, e)
8) Demonstrate the ability to choose appropriate signal analysis methodology for a given problem, for example, time or frequency domain analysis, the appropriate type of filtering, etc. (Links to Program Learner Outcomes: a, e)
9) Demonstrate the ability to interpret results from different types of signal analysis, for instance spectra, correlation functions or frequency response functions. (Links to Program Learner Outcomes: a, d, e)
10) Demonstrate the ability to extract representative features for fault detection in commonly used mechanical systems, such as gears, bearings and shafts. (Links to Program Learner Outcomes: a, e)
~~10)~~11) Demonstrate personal responsibility and accountability in conducting the related assignments and term project. (Links to Program Learner Outcomes: f)
~~11)~~12) Demonstrate the ability to communicate ideas, issues and conclusions clearly and effectively related to assignments and term project. (Links to Program Learner Outcomes: g)

Engineering 5371
Vibration Theory and Applications

Student Learner Outcomes

1) Demonstrate the ability to derive equations of motion for single degree of freedom and multiple degree of freedom systems. (Links to Program Learner Outcomes: a, d, e)
2) Demonstrate the ability to derive analytical solutions to single degree of freedom system equations for free and harmonically excited problems. (Links to Program Learner Outcomes: a, d, e)
3) Demonstrate the ability to derive equations of motion for a multiple degree of freedom system. (Links to Program Learner Outcomes: a, e)
4) Demonstrate the ability to construct mass matrix, stiffness, flexibility matrices for multiple degree of freedom systems. (Links to Program Learner Outcomes: a, e)
5) Demonstrate the ability to use the modal analysis method for multiple degree of freedom systems. (Links to Program Learner Outcomes: a, e)
6) Demonstrate familiarity with key concepts and methods of vibration control. (Links to Program Learner Outcomes: a, e)
7) Demonstrate the ability to solve vibration problems of distributed-parameter systems. (Links to Program Learner Outcomes: a, e)
8) Demonstrate the ability to use finite element methods to solve vibration problems. (Links to Program Learner Outcomes: a, e)
9) Demonstrate ability to conduct experimental modal analysis for a 2 degree of freedom apparatus. (Links to Program Learner Outcomes: a, c)
10) Develop the ability to conduct independent term project and show competence in the research process and demonstrate advanced research and scholarship within mechanical vibration area using pertinent mathematical, scientific, and engineering concepts. (Links to Program Learner Outcomes: c, d, e)
11) Demonstrate personal responsibility and accountability in conducting the related assignments and term project. (Links to Program Learner Outcomes: f)
12) Demonstrate the ability to communicate ideas, issues and conclusions clearly and effectively related to assignments and term project. (Links to Program Learner Outcomes: g)

Engineering 5671
Advanced Topics in Mechanical Engineering

It is a reading course, and the subject is prepared by an individual professor in Mechanical Engineering. But the course Student Learner Outcomes must be aligned with the Program Learning Outcomes and the Graduate Degree Level Expectations. (Links to Program Learner Outcomes: a, c, d, e, f, g)

Engineering 5771
Seminar Mechanical Engineering

Student Learner Outcomes
1) Demonstrate the ability to perform comprehensive literature survey in the related research field. (Links to Program Learner Outcomes: a)

2) Demonstrate the ability of systematic understanding of knowledge in the related research area with the required depth and breadth. (Links to Program Learner Outcomes: a, e)
3) Demonstrate the ability to recognize current problems in the field of research and effectively explain the proposed research methodologies to be used to tackle the problems in the research project. (Links to Program Learner Outcomes: b, e, h)
4) Demonstrate the ability to provide a clear, complete and scientifically-accurate presentation to an audience of peers and experts constituting his/her thesis committee. (Links to Program Learner Outcomes: g)

Appendix F: General Graduate Studies Regulations
(As of May 22, 2012, revisions to these regulations are currently in progress)

FACULTY OF GRADUATE STUDIES

GRADUATE PROGRAMS

Dean of Graduate Studies
Dr. T. Philip Hicks

The University offers programs leading to the following degrees:
Master of Arts
Master of Business Administration
Master of Education
Master of Environmental Studies
Master of Forestry
Master of Science
Master of Science in Engineering
Master of Science in Forestry
Master of Science in Management
Master of Public Health
Master of Social Work
Doctor of Philosophy in Biotechnology
Doctor of Philosophy in Clinical Psychology
Joint Doctor of Philosophy in Educational Studies
Doctor of Philosophy in Forest Sciences

The University also offers collaborative programs with the following specializations:
Specialization in Gerontology
Specialization in Women's Studies

The University also offers programs which include the following graduate diploma:
Health Services and Policy Research

Not all courses listed in the Calendar are offered every year. Supplementary information regarding course offerings and course instructors is available from the Office of the Registrar and posted in the online Course Timetable.

Introduction to the Faculty of Graduate Studies

Responsibility for graduate studies resides with the Senate of the University. The Senate is advised on graduate matters by the Faculty of Graduate Studies Council. This Council is administered through the Office of Graduate Studies. It is the responsibility of

this Council, through its Chair, to provide leadership in all matters pertaining to graduate studies.

Graduate Programs
The University offers courses of study leading to the following graduate degrees:
- Master of Arts (MA) in Clinical Psychology, Economics, English, History, Mathematical Sciences, Sociology;
- Master of Science (Msc) in Biology, Chemistry, Computer Science, Experimental Psychology, Geology, Kinesiology, Mathematical Sciences, Physics;
- Master of Education (MEd) in Educational Studies;
- Master of Science in Engineering (MScEng) in Control Engineering, Electrical and Computer Engineering, Environmental Engineering;
- Master of Environmental Studies (MES) in Nature-Based Recreation and Tourism, Northern Environments and Cultures;
- Master of Forestry (MF)
- Master of Science in Forestry (MScF);
- Master of Social Work (MSW)
- Master of Public Health (MPH)
- Master of Business Administration (MBA)
- Master of Science in Management (MSc(Mgt))
- Doctor of Philosophy (PhD) in Biotechnology, Clinical Psychology, Educational Studies, Forest Sciences.

Collaborative Programs
- Specialization in Gerontology (Education, Kinesiology, Psychology, Social Work, Sociology)
- Specialization in Women's Studies (Education, English, History, Psychology, Public Health, Social Work, Sociology)
To be accepted into a Collaborative Program, students must first be admitted to the master's program of a collaborating academic unit.

Graduate Diploma
-Health Services and Policy Research
The Graduate Diploma in Health Services and Policy Research is offered in conjunction with a master's or doctoral degree (Economics, Public Health, Social Work, Sociology).

Master's Regulations

A graduate student is governed by the general University Regulations section of this Calendar as well as the following regulations, which are specific to graduate students.

GENERAL ADMISSION REQUIREMENTS

Application for admission to a graduate program must be made to the Office of Graduate Studies, Lakehead University by the deadline date of **February 1**. Late applications may be considered for admission, but may not be considered for funding.

Applicants for admission must be graduates of a recognized university, college or institute, and show evidence of scholarly achievement. Except where otherwise stated in the Admission Requirements of a particular program, degree students must have a four year bachelor's degree or its equivalent with at least second class standing (B) based on their last 20 half courses or equivalent.

An applicant holding a degree other than one in the discipline area to which admission is sought will be considered on the basis of courses taken and academic standing. A Qualifying Year at the undergraduate level may be required to meet the admission standards. Courses taken as part of a Qualifying Year can not be used as credit towards a graduate degree.

Applicants applying from a university other than Lakehead University must forward official transcripts of their university record and may be required to take an examination, such as the Graduate Record Examination (GRE).

Meeting the minimum requirements does not necessarily guarantee admission. No candidate will be admitted unless the academic unit recommends admission. All applicants will be advised in writing by the Office of Graduate Studies of their admission status.

ADVANCED STANDING

With the consent of the academic unit, applicants may be granted Advanced Standing for up to one graduate level full course equivalent. No advanced credit from previous study will be given for undergraduate courses. Courses credited towards a previous degree or Qualifying Year can not be considered for Advanced Standing.

Requests for Advanced Standing must be submitted and approved at the time of admission to the program. To be considered for Advanced Standing, students must submit a formal request to the Office of Graduate Studies, along with the official transcript and institutionally prepared course description(s).

PROFICIENCY IN THE ENGLISH LANGUAGE	
The language of instruction at Lakehead University is English. Students whose first language is not English must demonstrate that they can cope with the language demands of an English language university.	
Applicants whose native language is not English, and who cannot verify having studied in an English language school system for more than three full years, will be required to present proof of English facility by:	
1. Achieving appropriate standing on one of the following tests:	
TEST	**Minimum Score**

TOEFL - Test of English as a Foreign Language	
TOEFL paper based	550 (with no component score less than 50)
TOEFL computer based	213 (with no component score less than 17)
TOEFL internet based	80 (with no component score less than 19)
IELTS - International English Language Testing System	6.5 (no individual band score less than 6.0)
MELAB - Michigan English Language Assessment Battery	85
CAEL - Canadian Academic English Language Assessment	60
Or	
2. Successfully completing the English for Academic Purposes (EAP) program offered jointly by Confederation College and Lakehead University. For more information, see Admission Requirements, V Requirements for Admission to Graduate Degree Programs.	
Certain academic units may require higher scores. Meeting the minimum requirements does not guarantee admission to Lakehead University.	
Where the language of instruction and examination in undergraduate studies has been uniformly in English, official documentation from the institution indicating that the primary medium of instruction is English must be submitted upon request. This official documentation must come directly from the institution in the form of an official letter that states that the student's medium of instruction was English for 3 years or more. This letter must be signed by the institution's Registrar or Chief Officer. This letter must also bear the original stamp or seal of the institution or a Notary Public.	
Lakehead University's Institution Code for TOEFL scores is 0888.	

READMISSION TO A GRADUATE PROGRAM

Students applying to enter a graduate program, who have previously withdrawn from the same or similar graduate program, must apply for re-admission to the program and pay the application fee. Students will be credited with previous courses completed and work undertaken towards completion of program requirements at the discretion of the academic unit. The academic unit may decline to allow previously completed courses to be accredited towards the graduate program applied for and/or may require a previous thesis topic to be changed in whole or in part.

The academic regulations and program requirements in effect at the time of re-admission shall apply. The allowable time-to-completion will include all previous terms in the program. Students who have reached their time limit in the program at the point of re-admission must complete the program within three consecutive terms.

REGISTRATION STATUS

Full-Time Graduate Student

A full-time graduate student must:

1. be designated by the University as a full-time graduate student;
2. be pursuing his or her studies full-time; and
3. normally, be geographically available and visit the campus regularly.

Without forfeiting full-time status, a graduate student, while still under supervision, may be absent from the university (e.g. visiting libraries, doing field work, attending a graduate course at another institution) provided that, if any such period of absence exceeds four weeks in any one term, written evidence shall be available in the Faculty of Graduate Studies to the effect that the absence has the approval of the supervisor and the Graduate Co-ordinator/Chair of the academic unit.

In accordance with the Ontario Council on Graduate Studies policy, the University recommends that a full-time graduate student will normally not be employed for more than an average of ten hours per week for any term. When the student is employed as a Graduate Assistant, the ten hours per week should represent the total time spent by the student in connection with this appointment. Requests for exceptions to this rule must be approved by the Dean of Graduate Studies.

Part-Time Graduate Student

All active graduate students, other than full-time graduate students as defined above, are part-time graduate students. **Graduate students registered part-time may not take more than one FCE during an academic year.**

REGISTRATION AND SELECTION OF COURSES

A student is not permitted to register as a graduate student until the application for admission has been approved. A graduate student proceeding to a degree is governed by the academic regulations and program requirements in the term of admission.

Before registering, students proceeding to a graduate degree must arrange their program with the assistance of the Graduate Co-ordinator of the program. Graduate students must complete all registration and withdrawal from courses by the published

deadlines in the Academic Schedule of Dates. Late registration fees will apply after these dates. Any change in registration after the published deadlines must be formally requested on a "Request for Change in Registration" form.

The calendar year is divided into three terms: Fall Term (September-December); Winter Term (January-April) and Spring/Summer Term (May-August). Graduate students registering for the first time normally commence their program in the Fall Term. However, in some academic units students are permitted to commence their studies in January or May.

Registration is not complete until tuition http://mycoursecalendar.lakeheadu.ca/pg73.html**and activity fees have been paid** (or arrangements have been made to pay all fees) by the deadlines published in the University Fees, Fees Payment Information section of this Calendar. Default in fee payment may result in a student being de-registered. A student with amounts owing to the University will not be permitted to register in future sessions nor to receive a transcript or record of academic progress.

CONTINUANCE OF REGISTRATION

All graduate students must maintain continuous registration from initial registration until they have completed the requirements of their program. It is the student's responsibility to ensure they are registered by the appropriate deadline for each term. Students who have failed to register by the deadline and have not applied for a Leave of Absence will be registered in a University placeholder course and will be assessed appropriate fees.
Students who have failed to register for two consecutive terms will be considered to have left the program and will be withdrawn. Students wanting to complete their program must apply for re-admission and pay the application fee.

PERIOD OF STUDY

Masters Programs

Students in a Master's program are expected to complete all requirements within six terms (2 years) of continuous full-time registration.

An exception to this Period of Study is the Flexible (Flex) Full-Time option, available to students in the *Master of Education* and *Master of Public Health programs*. Students in this option are expected to complete all requirements within twelve consecutive terms (four years) as follows:
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- Six terms of continuous full-time registration
- Followed by up to six additional terms of continuous registration, during which no fees are required.

As the Flexible Full-time option is intended for working professionals, students admitted will not be considered for financial support from the University.

Under exceptional circumstances, a student may be allowed to complete a Master's program on a part-time basis with the following conditions:

- A student is admitted to the program part-time with the approval of the Office of Graduate Studies, based on special circumstances, provided at the time of application.
- A part-time student may take no more than one full course equivalent per calendar year (12 months)
- Part-time students are expected to complete all requirements within a minimum of fifteen terms (5 years) of continuous part-time registration.
- Part-time students will not be considered for financial support from the University.

For co-op students, the duration of the co-op placement will be added to the above time limits.

LEAVE OF ABSENCE

A **Leave of Absence** from a graduate program will be granted for exceptional circumstances only which will include: a limited term of external employment closely related to the program of study; health problems; parenting; compassionate grounds or other compelling circumstances. Leaves of Absence will be considered up to a three term limit.

A **Maternity/Parental Leave of Absence** from a graduate program will be granted to students that are either biological or adoptive parents, while they are caring for a new-born or newly adoptive child of any age. Maternity/Parental Leaves of Absence will be considered up to a three term limit per pregnancy or adoption and are in addition to any other Leave of Absence terms granted.

All Leave of Absence requests will be considered on an individual basis on the recommendation of the academic unit by the Faculty of Graduate Studies Council. A "stop-the-clock" policy will prevail with respect to payment of tuition fees and Period of Study. A graduate student granted a Leave of Absence will not have access to University faculty, library, laboratory or other facilities.

TIME EXTENSION

A **Time Extension** in a graduate program will be granted for exceptional circumstances on a per term basis up to a three term limit.

First Term Time Extension

Recommendations for the first term beyond the allowed Period of Study originates with the Supervisor for approval by the academic unit. It is the responsibility of the academic unit to send notice, including reasons for this approval, to the Office of Graduate Studies.

Second Term and Final Term Time Extensions

Recommendations for the second term and for the final term beyond the allowed Period of Study will be forwarded by the academic unit to the Faculty of Graduate Studies Council for consideration and final approval.

A graduate student who does not complete all requirements within one of the prescribed Periods of Study and does not receive an approved Time Extension is considered to have failed the program, unless the student applies for and is granted re-admission to the program.

A graduate student who does not successfully complete a graduate degree within the prescribed Period of Study must apply for re-admission to the program and pay the application fee. The academic regulations and program requirements in effect at the time of re-entry to the academic program shall apply.

WAIVER OF FEES DURING AN APPROVED TIME EXTENSION

Waiver of fees during the period of an approved Time Extension will be granted for exceptional circumstances only, which will include such issues as unavailability of supervision, required courses or resources. Cases will be considered on an individual basis by the Faculty of Graduate Studies Council, normally on the recommendation of the academic unit in which the student is enrolled. At the time of request for a waiver, the Graduate Co-ordinator must present a plan to the Council outlining how and when the issues will be resolved.

PROGRAM OF STUDY

The requirements of each graduate program are described in sections of the Calendar under the heading for the academic unit. Each student in a graduate program shall comply with any additional requirements of the academic unit in which the student is registered.

The course requirements for the degree will normally be at the fifth-year level. With the approval of the academic unit, a maximum of one full course equivalent at the fourth-year level may be accepted towards the Master's degree, provided the course has not been taken previously. Individual programs of study must be approved by the appropriate academic unit.

When a thesis is required, it will be on a subject approved by the appropriate academic unit upon the recommendation of the Supervisor following consultation with the student.

Each graduate student undertaking a thesis shall have the guidance of a Thesis Committee. The Committee is chaired by the Supervisor and consists of at least one other member of the academic unit. In addition, faculty from cognate academic units and other qualified persons from inside or outside the University may be appointed. An adjunct professor may be a Thesis Supervisor or a member of a thesis committee.

It is the responsibility of the Thesis Supervisor to ensure that a thesis involving human subjects and non-human vertebrates are approved, respectively, by the Senate Research Ethics Board, and the University Animal Care Committee, **before** a student's research begins. A copy of the approval notice must be forwarded to the Office of Graduate Studies for inclusion in the student's file.

Any change to a student's program (e.g. from thesis to course degree, field of specialization, supervisor) must be formally requested on the "Graduate Request for

Program Change" form and approved by the Graduate Coordinator and the Office of Graduate Studies before being submitted to the Office of the Registrar.

GRADING SYSTEM

Course standings in the graduate programs will be reported as follows:

A+	90	to	100%
A	80	to	89%
B	70	to	79%
C	60	to	69%
Fail	1	to	59%
F	Academic Dishonesty		0
INC	Incomplete		

(see University Regulations, V Standing)

(For the exception regarding a failing grade, see Graduate Programs in the Faculty of Engineering, Academic Regulations.)

To maintain registration as a graduate student, a student must achieve and maintain satisfactory academic standing at all times. A student whose academic performance does not meet the minimum standing will be required to withdraw from the program.

MINIMUM SATISFACTORY ACADEMIC STANDING

Graduate students must maintain at least a B overall average in their courses with no more than one full course equivalent graded C. A mark of less than 60% in a graduate course, or in an undergraduate course used towards a graduate degree, constitutes failure. A graduate student with "a passing mark" or "a mark of 50 to 59%" in an undergraduate or graduate course may repeat the course. No more than one full course equivalent may be repeated. If after exercising this avenue for improving course marks, a student is still unable to achieve the minimum B overall average, the graduate student will not be permitted to continue in the program. (For exceptions to the regulations in this paragraph, see Graduate Programs in the Faculty of Engineering, Academic Regulations.)

Course marks below 50% are unacceptable in a graduate program. A graduate student with such a mark (half or full course) will not be permitted to continue in the program. Courses with a mark below 50% may not be repeated.

EXAMINATIONS

Graduate students enrolled in courses for credit must take all examinations in those courses.

A candidate may be required to take an oral examination during the Master's program.

COMPREHENSIVE EXAMINATIONS

Comprehensive examinations testing the student's knowledge in specified areas are required by some academic units.

SPECIAL EXAMINATIONS

Special examinations are not permitted for students registered in a graduate program.

THESIS EXAMINATION

The Master's thesis will be evaluated by at least two examiners, one of whom must be external to the academic unit/program. Upon receipt of each Examiner's Report a copy must be submitted to the Office of Graduate Studies.

Internal Examiners are appointed following a procedure established by the academic unit/program. An oral defense of the thesis may be required as part of the internal examination.

The **External Examiner** is recommended by the student's Thesis Committee and approved by the academic unit. Following the approval of the External Examiner, a completed thesis is submitted by the Supervisor to the Graduate Coordinator. All correspondence with the External Examiner is conducted by the academic unit.

In evaluating the thesis, the Examiners will make one of the following assessments:

1. Thesis Accepted
2. Accepted Subject to Revisions
3. Appreciable Revisions Required
4. Thesis Rejected.

A thesis evaluated as 'Appreciable Revisions Required' must be revised and returned to the Examiner for re-evaluation, through the Graduate Coordinator of the academic unit. Upon receipt, a copy of the assessment of the revised thesis must be submitted to the Office of Graduate Studies. If recommended by the Thesis Committee, a candidate receiving an evaluation of 'Thesis Rejected' will be allowed to resubmit the thesis to the Thesis Committee.

The final decision on accepting a thesis is made by the Thesis Committee after considering the reports of the Examiners. The student has failed the program if the thesis is rejected by the Thesis Committee following re-examination.

THESIS SUBMISSION PRIOR TO GRADUATION

The final thesis must be produced in a format acceptable to the academic unit which may include an electronic format that meets OCUL (Ontario Council of University Librarians) standards (see also requirements in the Department of Geology graduate program). A hard copy thesis must be legible and typed or printed on good quality bond paper, not less than 20 lb. weight. Laser-quality printing or equivalent is acceptable.

Three unbound copies of the final approved thesis are to be submitted to the Office of Graduate Studies. At least one copy must contain a frontispiece signed by the

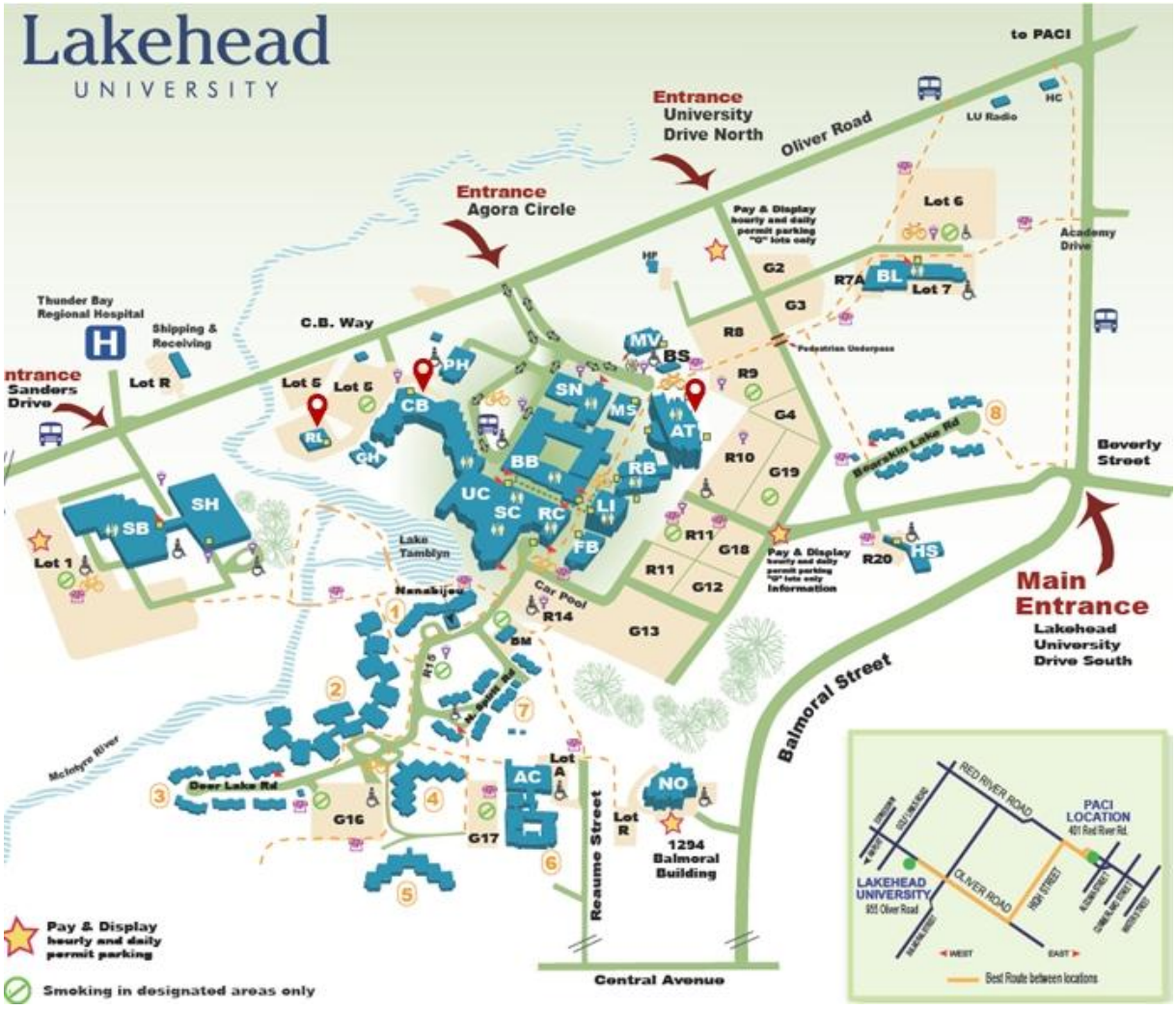
Supervisor. The signature will signify that all comments made by Examiners have been considered by the author of the thesis and specified corrections have been made. Along with the thesis, the "License to the University" and the National Library of Canada forms must be signed by the student and submitted.

The graduate student will arrange payment for binding all three copies of the thesis. One copy of the thesis will be forwarded to the Library, one to the Supervisor, and one to the student. Each student must complete an Application to Graduate form and submit it to the Office of the Registrar by the **deadline dates** published in the Academic Schedule.

FEES FOR GRADUATE STUDENTS

For information regarding payment of fees, deadlines, methods of payment, refund schedule, miscellaneous fees, schedule of fees, co-op fees, and residence fees, see the Fees section of this Calendar.

Appendix G: Campus Map for the Locations of Offices and Labs



The office and the lab of Dr. A. Tayebi as well as the offices of his graduate students are located at ATAC building as indicated by AT on the campus map of Lakehead University.

The office of Dr. X. P. Liu is located at AT building. His lab is in CB building as indicated by CB on the campus map.

The offices of other core faculty members are located at CB building. The labs are located in both CB building and RL building.

The offices of graduate students are located in the CB building and RL building.