



Senate Committee on Academic Development
Report to Senate – Meeting of October 23, 2008

**Proposal to introduce a Master of Engineering Education
in the School of Graduate Studies and Research**

Introduction

The proposal to introduce a Master of Engineering Education in the School of Graduate Studies and Research (SGSR) was reviewed by the Senate Committee on Academic Development (SCAD) at its meeting of October 1, 2008. B. Brouwer, Associate Dean of SGSR, Caroline Baillie, Professor and Dupont Chair of Engineering Education, Research and Development in the Faculty of Applied Science, and Brian Frank, Director of Program Development in the Faculty of Applied Science, attended the SCAD meeting to speak to the proposal and answer questions from members of SCAD. Members of SCAD were also provided with the Program Approval Submission Form, which outlines the major components of the proposal. A copy of the proposal is attached to this report.

Analysis and Discussion

The following should be noted:

- the proposed program will be offered as a thesis-based or a project-based graduate program, and it will be available either full time, part time or as a blended learning program (on campus and distance);
- this proposed program will be offered in collaboration with the Faculty of Education;
- there is an increased student demand for this type of program and it will be the first of its kind in Canada;
- students will learn to develop pedagogical skills in engineering education including development of curriculum, assessment and teaching;
- targeted enrolment will be five to seven students initially;
- there will be four dedicated faculty members involved in this proposed program, and faculty members from the Faculty of Applied Science and the Faculty of Education have expressed an interest in thesis supervision and co-supervision of student projects;
- graduates of this proposed program will work in fields including academia, teaching, training and development, and in industry.

Conclusions/Recommendation

Recommendation:

On academic grounds, SCAD recommends that Senate approve the establishment of a Master of Engineering Education in the School of Graduate Studies and Research.

Respectfully submitted,



Patrick Deane
Chair, Senate Committee on Academic Development

Committee Members:

Members

C. Baker
J. Coates
P. Deane (Chair)
M. Lombardi
D. McKeown
K. O'Brien (Secretary)
P. Oosthuizen
M. Roberts
D. Stockley
M. Whitehead



Senate Budget Review Committee

Report to Senate – October 7, 2008

Proposal to establish the program Master in Engineering Education.

Introduction

On October 7, 2008, the Senate Budget Review Committee (SBRC) met to discuss the Proposal to establish the program Masters in Engineering Education.

Analysis and Discussion

The projected expenses for the program were primarily for administration and web development. It was explained that the required 0.3 FTE staff position already existed and would be filled by someone with extra capacity from a department where enrolment levels were lower than normal. The web design work will be part of a larger initiative within the Faculty to move towards the delivery of distance learning in the future.

The majority of the discussion concerned teaching and supervision of additional students in the Faculty of Applied Sciences. Within the proposal it stated that specific faculty members, who were named, have “agreed with their department Heads that any additional workload that this entails would not affect their other duties, nor require financial compensation.” The members of the committee are troubled by this statement and strongly urge the members of the Faculty of Applied Science to absorb the additional teaching into the agreed workload of the members. While the two named members may be willing, it may not be the case for new faculty and a program should not be considered viable over the long term with faculty teaching overload.

Conclusions/Recommendation

The committee agreed to recommend to Senate that it approve the program Masters in Engineering Education. The members of the SBRC look forward to hearing of the progress of this exciting innovative program and wish them all success for the future.

Respectfully submitted,



J. Medves,
Chair, Senate Budget Review Committee

Committee Members:

H. Averno
K. Brock
F. Davis
D. Hallett
J. Helland
D. Janiec
M. Koichopolos
M. Lombardi
J. Medves (Chair)
G. Willmott
I. Young



Queen's
UNIVERSITY

UNIVERSITY SECRETARIAT
Mackintosh-Corry Hall, Room B400
Queen's University
Kingston, Ontario, Canada K7L 3N6
Tel 613 533-6095
Fax 613 533-2793
www.queensu.ca/secretariat

Memo

TO Patrick Deane, Chair, SCAD
Jennifer Medves, Chair SBRC
FROM Georgina Moore, Secretary of the Senate
DATE September 22, 2008
SUBJECT Proposed Masters of Engineering Education

The attached proposal has been submitted to the Senate by the School of Graduate Studies and Research and is referred to SCAD and Budget Review for approval. The proposed new Masters in Engineering Education was approved by the Graduate Council on September 10, 2008 and the Faculty of Applied Science Faculty Board on May 23, 2007 and is submitted to the Senate for approval.

Please review the proposal and report back to Senate with your committee's recommendation. Professor Caroline Baillie, Faculty of Applied Science should be contacted if you have any questions or if you would like her to attend a committee meeting. Please contact her directly at ext. 36249 or by email at caroline.baillie@queensu.ca.

Thank you for your attention to this matter.

Georgina Moore
Secretary of the Senate

copy: Kathy O'Brien, Secretary, SCAD + copy of Proposal
Bob Cooke, Secretary, SBRC + copy of Proposal
Janice Deakin, Associate Vice-Principal and Dean, School of Graduate Studies and Research
Caroline Baillie, Faculty of Applied Science
Kim Woodhouse, Dean, Faculty of Applied Science

Senate Referral File
ATT:

RECEIVED

SEP 22 2008

Office of the
Vice-Principal (Academic)

**Committee on Academic Development
and
Senate Budget Review Committee**

Program Approval Submission

This form is to be used when seeking approval for all new or substantially revised programs of study leading to a degree, diploma or certificate

FACULTY/SCHOOL: School of Graduate Studies and Research

PROPOSED NEW PROGRAM: Masters in Engineering Education

PROPOSED IMPLEMENTATION DATE: Sept 2009

DATE OF FACULTY BOARD (APPLIED SCIENCE) APPROVAL: May 23rd 2007

DATE DIVISION II APPROVAL March 25th 2008

DATE DIVISION III APPROVAL: May 15th 2008

DATE OF SCHOOL OF GRADUATE STUDIES COUNCIL APPROVAL: Sept. 10th 2008

SUBMISSION CONTACT

NAME: Caroline Baillie

TELEPHONE: 533-6249

EMAIL: caroline.baillie@queensu.ca

SIGNATURE OF THE DEAN: _____

DATE: _____

Sept 17/08

Please note that program proposals must receive the approval of Faculty Board prior to being submitted to the Senate Office for referral to the Senate Committee on Academic Development (SCAD) and the Senate Budget Review Committee (SBRC), which will then make their recommendations to Senate.

PART A

The criteria requested in PART A should be regarded as the minimum criteria for the assessment of academic programs. Any unit planning a new program should show how not only the criteria listed below but also, where appropriate, those required by the Undergraduate Program Review Audit Committee and those of the Ministry of Training, Colleges & Universities have been taken into account. For further information, please refer to the Senate Policy "Policies and Procedures for Establishing New Undergraduate Programs" (<http://www.queensu.ca/secretariat/senate/policies/newprog/index.html>)

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PART A

1 Objectives

Over the last ten to fifteen years there have been repeated calls by prominent engineering bodies, in the US, Canada, Australia, Europe and South Africa in particular, for development in the pedagogy of engineering education, following a similar pattern to the education of medical students decades ago. This involves the study of how engineering knowledge, skills and attitudes are developed and draws on engineering practise, engineering research and educational technologies.

The Masters in Engineering Education (MEngEd) program is designed to enhance capacity for technological development by enhancing pedagogical skill in engineering education. It is becoming evident that, with the rapidly changing nature of engineering and global and societal pressures, evidence-based theories of engineering education and how students develop engineering skills are critical.

The overall objective of the degree program is to provide students with a pedagogical framework for developing curricula, assessment and teaching in areas of engineering as well as understanding the impact of these on student learning. The program will enable students to learn how to develop knowledge in the field of engineering education – both through pedagogy and research.

1.1 Learning objectives

The specific objectives of the program are to develop the skills such that graduates will be able to:

- develop clear curriculum goals, and constructively align teaching and assessment methods for effective student learning in engineering;
- facilitate professional (learning/transferable) engineering skills;
- incorporate innovations into teaching and learning programs in engineering;
- develop an appreciation of needs for implementation of different curricula forms in engineering such as enquiry based learning, problem based learning etc.;
- translate educational theory into engineering education practice;
- examine the process of teaching engineering design
- develop their own students ability to transform conceptual and then determinable models to create target systems with performance measures
- conduct project and evaluation studies
- develop academic skills including critical thinking, integration of research literature, and application of research findings to engineering teaching practice

1.2 Governance and relation of the program to existing faculties, programs, and departments

The MEngEd program is a multidisciplinary program administered by the Faculty of Applied Science and with supporting instruction by the Faculty of Education, Development Studies and Sociology. As is occurring at other institutions developing graduate programs in engineering education, the program will be administered and housed by engineering faculty since the field requires an appreciation and creation of discipline specific ways of thinking and practising.

Four lead faculty members from the Faculty of Applied Science will comprise the MEngEd Committee which will act as admissions committee, ensuring the quality and appropriateness of the student intake, and act as an advisory committee ensuring that each student's program of courses are ideally suited to their needs. These faculty include two core faculty appointed directly to the Faculty to promote Engineering Education and Design as well as a University Chair in Teaching focusing on inquiry based learning. They will be the key contacts for all administrative functions, IAR, OCGS and other reviews processes.

1.3 Capacity for the proposed program

Queen's Faculty of Applied Science is a world leader in the emerging field of Engineering Education research and a key player in the development of this field worldwide, advising and reviewing for international Engineering Education conferences, committees, journals, and frequently giving invited keynote lectures in the US, Canada and Europe. The faculty is ideally resourced to deliver this program, with the recent development of the Integrated Learning Centre for engineering students to learn in new and innovative ways, two core faculty members appointed directly to promote Engineering Education and Design as well as a University Chair in Teaching focusing on inquiry based learning. This program will continue to develop the reputation of the University and enhance national capacity in this field.

1.4 Relationship to Institutional objectives

The proposed MEngEd supports several of the strategic goals of Queens University by: strengthening research and graduate programs in a strategic area; enhancing Queen's distinctive environment for learning; enhancing Queen's distinctive role as a national resource; deepening Queen's international engagement and building Queen's profile and strengthening relationships with external constituencies to advance institutional goals.

1.5 Academic quality

The program will be guided by principles of best practise in higher education. These will include regular interaction and cooperation among students and faculty to ensure engagement with the program and development of identities as educational professionals. Students will be involved in a variety of active learning activities that respect the diversity in learning styles. Instructors will use formative and summative assessment strategies to provide prompt and regular feedback.

The program will be Instructed by leading academics in the fields of engineering education development and engineering design education.

Students will be expected to interact with the broader community by participating and presenting at local seminars, and at national and international conferences on engineering education.

2 Admission Requirements

Applicants will be accepted into the program with a minimum of a second class standing in an honours bachelor degree in Engineering or related discipline if accompanied by experience in Education (such as volunteer teaching, tutoring or teaching others in a non scholarly activity). Applicants without an engineering degree who are accepted will be guided by the MEngEd committee to a suitable program of coursework.

The four lead faculty will be members of the MEngEd committee which acts as the Admissions committee as well as an overview committee for student progress. They will decide which students may enter the program and help students create their optimal set of courses. The MEngEd committee will receive all applications and will interview (in person or on telephone) all students who meet the criteria to discuss the ideal program of study for each student. Students will be allocated supervisors who match as closely as possible to their education and engineering interests, backgrounds and career paths. This supervisor will normally also act as the project or thesis supervisor.

Anticipated enrolment for the first seven years is given in Table 1 below. It is anticipated that the program will grow gradually in size until the steady state size is reached after five years. It is anticipated that 25-50% of the students will be employed externally to Queen's and be taking the program part time.

Table 1- Anticipated enrolments

Year	Full time Intake	Enrolment	Part time Intake	Enrolment	Total
2009	4-6	4-6	1-2	1-2	5-7
2010	4-6	8-12	2-3	3-5	11-17
2011	5-7	9-13	2-3	4-6	13-19
2012	6-7	11-14	2-3	4-6	15-20
2013	7-8	13-15	2-3	4-6	17-21
2014	7-8	14-16	2-3	4-6	18-22
2015	8	15-16	2-3	4-6	19-22

The lead faculty will develop and teach the core and elective ENED courses. A team of faculty from engineering and education are also participating members and will supervise and co-supervise projects and theses.

3 Curriculum

The program focuses on the scholarship of teaching, education development and education research in engineering disciplines. Students are offered a basic foundation in Engineering

Education together with supporting courses in engineering and in education as well as electives in development studies and sociology. The MEngEd program will enable graduates to take on more education responsibilities in their own work (school teaching, junior faculty, trainers, engineers working in capacity building in developing countries).

The program is offered in two patterns: (1) thesis pattern, requiring students to complete four courses and a thesis, and (2) project pattern, requiring 7 courses plus a project. The program will be offered in three options: (1) full time (2) part time, and (3) blended learning (a combination of some distance learning courses and some with on-campus requirements). The flexibility in delivery is important to accommodate the varied needs of the target groups.

The degree program will be offered in two options, by coursework and by thesis. Strong interest a part time/distance program to complement the full time offering has been expressed by faculty at Queens, across Canada and internationally, who are interested in enhancing their scholarship of teaching in engineering but cannot take an extended leave from their positions.

Students are expected to be drawn from several groups, including: engineering faculty with an interest in engineering education pedagogy; trainers from human resource departments in industry; undergraduates with an interest in engineering education as a research area; teachers with a science/engineering background who have an interest in obtaining a masters degree for advancement. Another group of interested participants are associated with human resource departments in engineering companies. It is rare that industrial trainers of technical knowledge will have received any knowledge on how to teach, particularly within a technical area and yet many of the same educational issues apply for engineers within industry as within a University. With the developing knowledge economy, it is increasingly important that managers understand the most effective ways to enhance their employee's knowledge. Individuals who are currently employed as faculty or in industry may take advantage of the distance/part time option developed to meet their needs.

3.1 Program options

The Master's program leads to the degree of MEngEd, which requires students to complete coursework and either a thesis or a project. The two options are:

1. MEngEd (Thesis): This option requires students to complete two core courses in Engineering Education, a thesis and two elective courses. The thesis will be in an area relevant to Engineering Education and will be supervised by participating faculty from Applied Science and Education.
2. MEngEd (coursework): This option requires students to complete two core courses in Engineering Education, 5 elective courses and a project on a topic relevant to Engineering Education.

Student may pursue their studies full time, part time or part time at a distance. Full time students may complete the coursework option in one year or the thesis option in two years.

Part-time students will be expected to take twice as long to complete the degree requirements

Each student will work with a mentor/supervisor(s) (assigned on the basis of related project/thesis interest/ student background), to develop the most appropriate set of electives for their background and future career path.

Table 2 - Coursework for Thesis option (2 core plus 2 electives plus thesis)

Course Number	Title	Instructor
ENED 840* (CHEE 840*)	Introduction to Learning and Teaching in Engineering (core)	Baillie
ENED 841* (CHEE 841*)	Engineering Education: Theory into Practice (core)	lead faculty
1 elective	ENED elective selected from list A	
1 elective	any graduate course offered by the Faculty of Education	
ENED 899*	Master's Thesis	supervisor

Table 3 - Coursework for Project option (2 core plus 5 electives plus project)

Course Number	Title	Instructor
ENED 840*	Introduction to Learning and Teaching in Engineering (core)	Baillie
ENED 841*	Engineering Education: Theory into Practice (core)	lead faculty
1 elective	ENED elective selected from List A	
4 electives	Selected from Lists A and B	

List A: Electives in engineering education

- ENED 842* Engineering Design Education (Faculty member: Strong)
- ENED 843* Special Topics in Engineering Education (Faculty member: Remenda)
- ENED 844* Assessing Student Learning in Engineering Disciplines (Faculty member: Frank)

List B*: Elective options

- any graduate course in Faculty of Applied Science
- any graduate course in Faculty of Education
- SOCY 917* Quantitative Methodology
- SOCY 921* Social Construction of Science and Technology
- DEVS 801* Development Theory in Contemporary and Historical Perspective
- DEVS 802* Methods in Development Studies

(*) Denotes term length courses.

All MEngEd students will be required to take the following two core courses (existing course number given in brackets where this exists):

ENED 840 Introduction to Learning and Teaching in Engineering (CHEE 840*)*

This course is intended to help students understand the basic issues of learning and teaching in engineering disciplines from a practical perspective. We will consider teaching practices which facilitate the development of knowledge, skills and professional attitudes in engineering students. We will explore all common forms of teaching e.g. laboratory classes, tutorials, lectures, project work as well as more innovative forms of teaching. Drawing on recent engineering education and education literature this course will be discussion based, with key weekly readings.

ENED 841 Engineering Education: Theory into Practice (CHEE 841*)*

This course is intended for students who are interested in developing their understanding of pedagogy within engineering. It draws on recent education literature from 1970s to the present within the 'experiential student learning' field of educational development and research and applies this to an engineering context. It also draw on the fundamental principles of engineering design as core to the understanding of engineering knowledge development. We will explore examples of research into students' experiences of learning and how this informs the way we design curricula, teach and assess engineering students. Participants in the course will be expected to apply the theory to their own engineering teaching practices by conducting a term long project.

3.1.1 Thesis option

Students in the thesis option will be enrolled in ENED 899 throughout their program

ENED 899 Master's Thesis

Students will undertake a research thesis in an area relevant to engineering education under supervision of a participating faculty member.

3.1.2 Project option

Students in the project option will be enrolled in ENED 898 throughout their program.

ENED 898 Master's project

Students will complete a project which might involve the evaluation of a teaching innovation, in consultation with a supervisor and the instructor of the course to be evaluated. A supervisor will be assigned from the list of participating faculty members.

3.1.3 Elective Courses

In consultation with their supervisor(s), students can tailor their programs to complement their background, interests and future careers.

Electives within Engineering Education (numbers to be assigned upon program approval)

ENED 8XX Engineering Design Education*

This course will address the special features required in the teaching and assessment of engineering design. Students will be taken through the stages of advanced design procedures and applications and will take part in design teams. They will explore the educational requirements of engineering design and place these in the differing contexts of high school design and technology courses, University design courses, service learning courses and industry based design challenges. Recent approaches to design based education will be discussed including CDIO (Conceive, Design, Implement, Operate), multidisciplinary Design-based Education and Problem Based Learning.

ENED 8XY Special Topics in Engineering Education*

This is a reading course offered by participating faculty members. The content is framed around Engineering Education literature relevant to the students' theses or projects.

ENED 8XZ Assessing student learning in engineering disciplines*

This course will focus on assessment strategies and examine the constructive alignment with desired learning outcomes in various modes of engineering instruction and in different disciplines. Students will learn assessment theory in education, including summative and formative assessment principles.

Elective Courses in Engineering

Any graduate level course in Applied Science may be taken as an elective providing the prerequisites are met. It is expected that students with an engineering degree will take courses appropriate to their base discipline.

3.1.4 Elective Courses in Education

By arrangement with the Faculty of Education, students may take any graduate level course offered by the Faculty of Education, subject to approval by the instructor. Examples of courses that students might take are given below.

EDUC 890 Introduction to Education Research*

An introduction to educational inquiry and, its principal approaches. The course involves students in activities associated with educational inquiry, and is an initial preparation for thesis and project work. Because the course is introductory, it exposes students to the tools and conventions of educational inquiry: for example, library searches, use of primary and secondary sources, writing graduate assignments.

EDUC 840* *Issues in Mathematics, Science, and Technology Education*

An interdisciplinary seminar critically examining the cultural, social and political context of mathematics, science and technology education as it exists in schools (kindergarten to graduation), tertiary institutions (trade schools, colleges, universities), and informal settings (museums, science centres). Topics include related issues in ethics, ecology, and environmental education; policy making and political control of education, equity, and career opportunities; public images of mathematics, science and technology; the challenge of creating interdisciplinary themes; and an aesthetic perspective on mathematics, science, and technology.

EDUC 841* *Topics in Mathematics or Science or Technology or Computer Science Education*

Current trends in the curriculum of and research in the teaching and learning of one of the four subject areas as they occur in schools (kindergarten to graduation), tertiary institutions (trade schools, colleges, universities), and informal settings (museums, science centres). Philosophical, psychological, sociological, and cultural issues will be addressed. International trends and the impact of information and communication technology (ICT) on the discipline and its teaching and learning will be examined. This course will be offered every other year and will focus on the discipline (mathematics, science, technology, computer science) warranted by student numbers. When numbers do not permit this course to be offered with a particular subject focus it may be possible for students to take the course in independent study mode.

3.1.5 Elective Courses from other Graduate Program listings that may be suited to MEngEd students

SOCY 917* *Quantitative Methodology*

This is a graduate level course designed to provide a solid and comprehensive training in quantitative methods employed extensively in the Social Sciences in general and Sociology in particular. It is planned not only to prepare students to carry out and interpret research using a variety of statistical methods but also to acquaint students with problems that arise with the use of these models.

SOCY 921* *The Social Construction of Science and Technology*

The evolution of science and technology is neither linear nor cumulative. By drawing upon theories of sociology of science and technology, the course argues through the use of case studies that, like other forms of knowledge, scientific and technical knowledge is socially constructed and is embedded in general social relations.

DEVS 801* *Development Theory in Contemporary and Historical Perspective*

This course will examine the foundational theoretical texts in the field of development

studies as well as contemporary debates. The course is intended to ensure that students have a high-level knowledge and understanding of the major philosophical tenets in development theory as well as their historical contexts and contemporary shifts.

DEVS 802 Methods in Development Studies*

This course exposes students to a range of research methodologies and ethical questions which engage students of development. The aim is to ensure that students have a high-level knowledge and understanding of the major methodological debates in the field of development studies and to promote methodological literacy beyond the student's own area of expertise, with particular emphasis on understanding the significance of cross-cultural differences/similarities and the strengths and challenges of conducting interdisciplinary research.

3.2 Calendar description

Faculty

Professor

Baillie, C., Hill, A., Holt, R., Jonker, L., McLellan, J., Strong, D., Taylor, P., Woodhouse, K.

Associate Professor

Egnatoff, W., Frank, B., Remenda, V., Wilcox, S.

Overview

Students in the program will develop a framework for developing curricula, assessment, and teaching in the areas of engineering and an understanding of student learning. Graduates will be able to take on a variety of educational responsibilities in secondary and higher education, industry, and capacity building organizations in developing countries.

The program offers two options: (a) a thesis option, where students will complete four graduate courses and an independent research thesis, and (b) project option, where students will complete seven graduate courses and a project. Courses are drawn from engineering education courses, education courses, and relevant courses from other disciplines including sociology and development studies.

Graduate Student Support

Full-time students are encouraged to seek external financial support and are encouraged to apply for NSERC, SSHRC, and OGS graduate scholarships. Fellowships and teaching assistantships are available through the University and are automatically considered upon

admission into a full-time program.

Admission Requirements

The minimum qualification for admission is a second class standing in an honours bachelor degree in Engineering or related discipline if accompanied by experience in Education (such as volunteer teaching, tutoring or teaching others in a non scholarly activity). Applicants without an engineering degree, who are accepted into the program, will be guided by the MEngEd committee to a suitable program of study.

Options

The Master's program leads to the degree of Masters of Engineering Education (M.Eng.Ed.), which requires students to complete coursework and either a thesis or a project. The two options are:

MEngEd (Thesis): This option requires students to complete two core courses in Engineering Education, a thesis and two electives. The thesis will be in an area relevant to Engineering Education and will be supervised by participating faculty from Applied Science and Education.

MEngEd (coursework): This option requires students to complete two core courses in Engineering Education, 5 elective courses and a project on a topic relevant to Engineering Education.

Student may pursue their studies full time, part time or part time at a distance. Full time students may complete the coursework option in one year or the thesis option in two years. Part-time students will be expected to take twice as long to complete the degree requirements

Thesis requirements

General requirements concerning the Master's thesis required of all candidates of the M.Sc. Degree are defined in the Graduate calendar of the University.

4 Teaching

It is proposed to use a problem based learning approach for the core educational program whereby students would study the learning of students in their own context (e.g. faculty teaching undergraduates, TAs tutoring undergraduates, high school teachers teaching students or trainers with trainees). All classes will be workshop or seminar based. The elective courses will all vary in approach depending on the nature of the content and the faculty members chosen style. Some of the courses will be lecture based. All core courses in Engineering Education will be offered at a distance as well as on site. Support for development of distance learning capacity will be provided by the Faculty of Applied Science.

Part time - The expected time to complete the degree requirements on a part time basis is 2.5 years for the coursework option and 4 years for the thesis option. Regulations for

students taking programs on a part time basis at Queen's may be found in Appendix 3.

Blended learning– Several students who take the part time option are expected to live at a distance from Kingston, some in other countries. The School of Graduate Studies and Research has no formal requirements for length of residence, however for this program students will be required to complete two terms (not necessarily consecutive) on campus during their program. Students may transfer to full time status during their period of residency and transfer back again to part time after this. This would enable a broader selection of electives and a faster completion time. All ENED courses, alongside face to face delivery, will also be provided in a distance learning format through the internet and will be available to students enrolled on a part time basis. Materials will be provided for each of these courses online and course instructors will correspond about homework and feedback on progress via email and the main Web CT site and associated programs. Reading materials will be posted for students, alongside assignments.

The blended learning students will be treated as a class of annual cohort groups so that students can get to know one another virtually. There will be an open introductory session and several video conferences each year so that students may develop a sense of community, which will be strengthened by the on-campus experience. All students will be allocated a supervisor who will have regular contact to discuss progress. To maintain a sense of community within courses, students studying at a distance will be taking the classes concurrently with on site students and will be in contact with full and part time on campus students with the use of chat rooms, blogs as well as video conference and telephone conference link ups. The supervisor will monitor the regular input of individual students. Experience of video conferences with students in different countries shows that the students take their classes more seriously and reflect more on their learning, as they have to describe what they are doing to the other students (Baillie and Mannis, Tutoring materials, HEFCE 2007, Dewulf and Baillie, Creativity in Art, Science and Engineering, Department for Education and Employment, 1998).

Students studying at a distance may complete their project or thesis off site. This is especially advantageous for teachers and professors who are actively teaching while registered in the Master's program as they may conduct their project or thesis work within their workplace with supervision provided at a distance.

5 Evaluation of student progress

5.1 Evaluation procedures

Assessment of coursework will be by individual instructors and students must attain a minimum course grade of 65% to remain in good standing.

The core courses will be assessed on term work that may include the following:

- Critical essays on selected readings
- Literature review in the form of a journal paper
- Presentation of a journal paper

- Participation in group meetings
- Learning journal
- Project report and presentation.

These are appropriate methods of assessment as they are intended to help the students demonstrate a *deep* approach to their studies. A deep approach is one in which students try to make meaning from their learning, as opposed to a *surface* approach in which they would simply try to pass the course by memory or mimicry of techniques. As such it is felt that reflective reports and papers in which students can share their developing understanding of engineering education are best suited to access this level of evaluation of students..

Assessment of elective courses will be determined by individual instructors. Usually evaluation is based on coursework and in some cases a final examination.

5.2 Thesis / project evaluation procedures

The thesis or project will be supervised by an individual or co-supervisors. All students in the thesis option will be required to give a seminar about their work in advance of their oral examination.

Students in the thesis option must submit a written thesis in conformity with the regulations of the School of Graduate Studies and Research and defend the work orally in a thesis examination. The regulations of the School of Graduate Studies for the evaluation of theses are set out in Appendix 4 and may be found at <http://www.queensu.ca/calendars/sgr/pg55.html>.

Students in the coursework option must submit a written project which will be assessed by the supervisor and one other faculty member.

6 Equity

One of the main incentives for this program is the overwhelming interest that female students have in educational issues. It is expected that the number of female students enrolling in this program will be at least 50% and as such will increase the number of females in the Faculty. The existence of the graduate program and female role models for undergraduates may help to attract females to the undergraduate engineering program at Queen's. With an average of 20% female undergraduate students and 2% female full engineering professors in Canada it is anticipated also that this course will have a profound effect on the retention of female engineers in the profession or in related professions. We will welcome students from diverse backgrounds and will be including in all courses teaching and learning experiences from students of differing cultures and contexts. We will be addressing basic equity issues at the foundation of the course and it will be known that all course rooms and workshops will be a safe space for students of all sexual orientations.

7 Faculty

As an interdisciplinary program, we are drawing on the expertise of those who have Engineering Education specialisation, as well as those in Engineering with an interest in

Education and those in Education with an interest in technical education.

- *The Dupont Canada Chair in Engineering Education Research and Development in the Faculty of Applied Science.* This position was created with a \$2.5-million endowment from DuPont Canada as part of the Faculty of Applied Science's Integrated Learning Initiative, which aims to join engineering theory, practise and social context in students' day-to-day training. The incumbent will be responsible for chairing the MEngEd committee (which will act as admissions committee and overseeing the progress of students and courses), and instructing core courses in engineering education. The current chairholder, C. Baillie, has a joint pedagogy and engineering academic background.
- *The NSERC Chair in Design Engineering:* The holder of this NSERC-funded position works with all engineering disciplines to enhance students' capabilities in engineering design, innovation, and professional skills. The design chair will be responsible for instructing one of the elective courses in design engineering education, contributing to the core course ENED 841 and will be a member of the MENGED committee. The current chairholder, D. Strong, has an industrial engineering background.
- Two engineering faculty with a research interest in engineering education. These faculty members will each be responsible for one elective course, overseeing projects and theses, and will be members of the MENGED committee:
 - B. Frank, an Associate Professor in the Department of Electrical and Computer Engineering and currently Director of Program Development in the Faculty of Applied Science, and
 - V. Remenda, Associate Professor in the Department of Geological Sciences and Geological Engineering and currently holder of a Chair of Teaching and Learning at Queen's and leader of the Inquiry@Queen's initiative.
- Five other faculty members from the Faculty of Applied Science (R. Holt, L. Jonker, J. McLellan, P. Taylor, K. Woodhouse) will be involved in thesis supervision.
- Three faculty members from the Faculty of Education (W. Egnatoff, A. Hill, S. Wilcox) will co-supervise projects of students in the degree program. These faculty members will teach elective courses in education which students in the Engineering Education degree program may take.

Table 4 lists the faculty members involved in the graduate program, identifies their field affiliation and indicates gender.

Table 4: Faculty involvement

Faculty name and Rank	M/F	Home Unit	Supervisory Privileges
Category 3			
Baillie – Professor	F	Applied science	Full
Egnatoff – Associate	M	Education	Co
Frank – Associate	M	Electrical Engineering	Full
Holt – Professor	M	Mechanical Engineering	Co
Jonker - Professor	M	Mathematics	Co
Hill– Professor	F	Education	Co
McLellan – Professor	M	Chemical Engineering	Co
Remenda – Associate	F	Geological Sciences and Geological Engineering	Full
Strong – Professor	M	Applied Science	Full
Taylor - Professor	M	Mathematics	Co
Wilcox – Associate	F	Education	Co
Woodhouse - Full	F	Applied Science	Co

Category 3: tenured or tenure-track core faculty members who are involved in teaching and/or supervision in other graduate program(s) in addition to being a core member of the graduate program under review.

The expertise of the faculty relevant to this program is shown in the table below.

Faculty	Technical expertise	Education expertise	Engineering education expertise
Baillie	Materials engineering		Engineering education development, threshold concepts
Egnatoff		Technology for teaching and learning	
Frank	Electrical engineering		Assessment, project-based learning
Holt	Mechanical engineering		
Jonker	Mathematics		Mathematics education
Hill		Problem based learning, curriculum development	Technology and design education
McLellan	Chemical engineering		
Remenda	Geological engineering		Inquiry-based learning
Strong	Mechanical engineering		Design education
Taylor	Mathematics, Biology		Mathematics curriculum
Wilcox		Higher and professional education	
Woodhouse	Chemical engineering		

Support staff involved includes

- 0.3FTE administrative graduate assistant. This will be provided by one of the Departments of the Faculty of Applied Science as appropriate, as advised by the Dean of Applied Science in agreement with the Head of Department.
- Technical support through IT services and the Faculty of Applied Science for any technical use of the ILC and its equipment and as usual for graduate students and their use of computer clusters and other services provided by their supervisor's Department.

8 Physical and Informational Resources

Office space for MEngEd students will be provided by the Faculty of Applied Science or by project and thesis supervisors in their own Departments both in Applied Science and Education. All courses will be held in regular classrooms. The workshops and problem based learning sessions will be held in the Integrated Learning Centre, located in the Beamish-Munroe Hall which has many different learning spaces and 42 breakout rooms for use by engineering students. Two core faculty members also have offices in this space.

The teaching spaces in the Integrated Learning Centre will act as a laboratory to new teaching approaches. Any 'experimental' work will go on in classrooms, after appropriate ethics clearance and will not require any additional space.

All faculty and graduate students are provided with a university account with access to electronic mail facilities, internet and a variety of free software. Other software required can be downloaded as freeware, such as for educational video processing of data. Packages are also available at discounted rates through the University's Computer store. All students will have access to computing facilities in their supervisor's home department.

The blended learning option will require some courses to be offered at a distance. Individual instructors will be responsible for providing any online material and will be supported by existing resources within the Faculty. A web-based portal has recently been developed within the Faculty of Applied Science which allows for online submission of assignments and feedback to students, storing of grades, completion of surveys and student feedback as well as chat groups and a discussion forum. There are a range of software products which are freely available in the web and which are already being used by faculty members to hold online video conferences at no cost. The University has just made available a wiki, which will allow reports to be developed collaboratively at a distance. Information Technology Services at the University is also available to support instructors who wish to develop online material for their classes. The Faculty plans to continue expanding tools available for distance learning.

Sharon Murphy, Head Librarian of the Engineering and Science Library wrote a report, which is available on request, regarding the Discipline Assessment for Engineering Education. The report includes data for the financial support of the collection over the past seven years. Additionally the Integrated Learning Centre has its own librarian (Nasser Saleh), who is appointed to the Engineering Library, and its own collection of materials for reference use by students of the program as well as faculty and the new Integrated Learning librarian intends to create a portal for Engineering Education. A budget has recently been created by the Engineering Library, especially for books on Engineering Education. No new resources will be needed.

9 Financial Resources

Financial resources required to run the program will be minimal as support for the program will come from existing faculty, administrative and technical staff services, space, computer and library resources.

The two core courses ENED (CHEE) 840* and ENED (CHEE) 841* are already running and the elective ENED courses will be created and run by the existing lead faculty. The Lead faculty will also act as MEngEd committee and will admit students and oversee the programs of individual students as well as overall running of the program. The program will be administered within existing resources of the Faculty of Applied Science.

There will be no financial impact of this program on existing programs. The two core faculty Baillie and Strong are employed for the purposes of promoting Faculty wide education and running this program is within their original mandate. The two remaining lead faculty, Frank and Remenda, have elected to support these programs in addition their usual workload as an elective graduate course. They have agreed with their department Heads that any additional workload that this entails will not affect their other duties, nor require financial compensation. All other electives will be run as usual with a small extra load in numbers of enrolments. Project course and thesis supervision will be extra workload for supervisors and it is recommended that only one student be taken on per faculty member. There are no financial implications arising from the extra workload.

Thesis students will be offered a stipend made available from Graduate Awards, teaching assistantships for undergraduate courses offered through the Faculty of Applied Science, contributions from research grants and contracts and internal and external scholarships and awards.

The 0.3FTE Graduate Assistant will be provided within the Faculty of Applied Science

The only additional funding expected is for operating costs (phone calls, office costs) and course development for the blended learning materials.

10 Societal Needs and Student demands

As stated in section 1, there have been repeated calls for development in the pedagogy of engineering education.

In the 1996 review of Engineering Education in Australia it was stated that

“The Review of Engineering Education is recommending no less than a culture change in engineering education which must be more outward looking with the capability to produce graduates to lead the engineering profession in its involvement with the great social, economic, environmental and cultural challenges of our time.” (*Changing the Culture: Engineering Education into the Future, Report of the Review of Engineering Education, 1996, Institution of Engineers Australia p1.*)

In order to address these challenges, the National Academy of Engineering in the U.S.A. has recommended that engineering programs develop more innovative programs, and to this end, stated in 2005:

“The engineering education establishment, for example, the Engineering Deans Council, should endorse research in engineering education as a valued and rewarded activity for engineering faculty as a means to enhance and personalize the connection to undergraduate students, to understand how they learn, and to appreciate the

pedagogical approaches that excite them.” (*Educating the Engineer of 2020: Adapting Engineering Education to the New Century* (2005), National Academies Press, p. 54)

Similarly, a recent study by the Millennium Project initiated to examine the future of the engineering profession made several recommendations related to the education of engineers, including:

“...Stimulate more activity in the scholarship of engineering education and learning, encouraging investment in research and the adoption of evidence-based approaches to innovation and continuous improvement” (*Engineering for a Changing World: A Roadmap to the Future of Engineering Practice, Research, and Education* (2008), The Millennium Project, The University of Michigan, p. 88).

The proposed MEngEd program will allow the development of these skills that are critical to development of the engineering profession. The development of Engineering Education as a scholarly activity may be likened to the nucleation of Science Education as a research discipline in the 1970s, where there was a change in the community from those who talked about science teaching to those who took a more scholarly approach. There are now many education research groups within the discipline itself as it is considered more appropriate for an understanding of the production of knowledge to rest within the discipline itself. Examples include physics education, mathematics education and medical education. In recent years programs have been created specifically on engineering education in Europe and the US and these are rapidly growing in number. To demonstrate the growth of this new area, there have been 16 new appointments to the position of Professor of Engineering Education in North America, in the last three years and SSHRC is now actively funding Engineering Education research.

The first graduate program of Engineering Education began in Purdue in 2004 and their first PhD graduate in 2006 secured a faculty position on graduation, in Physics Education. Similar Masters programs to the one proposed exist in other countries for example at Budapest Technical Polytechnic, Hungary, Michigan Tech, US Virginia Tech, US, and a focused Problem Based Learning in engineering master's program at Aalborg University, Denmark. There are also several successful PhD programs in Engineering Education including Purdue University, US, Cape Town University, South Africa, Linkoping University and KTH, Sweden, RMIT, Australia, Strathclyde University, Scotland and Loughborough University, England. It is timely that a graduate program be offered in Canada.

In order to ascertain interest in this program, students and faculty serving on the Applied Science faculty/student liaison committee (faculty and student representatives from each discipline in Applied Science) were consulted. An email survey was sent out to students currently in their final undergraduate year in Applied Science at Queen's, and also to other Universities through the European and North American Engineering Education Societies. Responses were received as follows:

1. We received 14 responses from undergraduate and postgraduate students enrolled at Universities in Ontario and all were positive. Eight indicated they would take the program if it were available and the remainder would have done so had it been available when they were making their choices for graduate training. This would be sufficient to meet the first year target intake. An example of a response from a

current student is given below

"I would be very interested in taking the degree myself. The program offers the ability to interact with students and unites my passion for teaching with engineering material. I am presenting in the I@Q conference this year and would welcome the opportunity to study education in the future. I think that an Engineering Education Masters MEngEd is a brilliant idea. After working as a Douglas Tutor, and as a tutorial TA I fully appreciate the importance of expert educators and the development of new ways to think and problem solve as an engineering student."

2. We received 10 responses from faculty at Queens and elsewhere - again all were positive. A typical response is given here:

"Yes, I would support this proposed program. Due to the very specialized nature of the engineering profession and the demands of its professional association I think there is a need for a very focused approach to the education of engineers."

3. The following comment reflects the view point of those academics who are very interested in engineering education but currently have no avenue to pursue this:

"Yes, I think it should be developed, and I agree that Queen's is an ideal location for it. Would I be interested in taking the degree myself? - yes. Would I have earlier? probably not - as with most faculty I felt that establishing my research career was paramount at the beginning, but I think now would be a good time for it. It seems to me that the program would be most applicable to mid-career faculty, and that you will find a great deal of interest from those who want to take it 'at a distance'."

Alongside support and interest from several Universities across Canada, there is much support from the international community where we expect to draw several distance students. Responses from coordinators of a new masters program in Engineering Education at Budapest Technical Polytechnic included an invitation to collaborate; the Registrar of Engineers Ireland and the Associate Dean of Engineering at the University of Sydney Australia indicated the importance of this development and offered their support. The Student Chair of SEFI (European Engineering Education Association) further supported the development of the MEngEd program.

11 Outcomes

Students taking the MEngEd (coursework) pattern are expected to graduate in one year full time and the MEngEd (thesis) students will take two years to complete their studies. Students taking the part time option will take a minimum of two years and one term.

The anticipated graduate enrolment will rise from 5-7 to 20-22 steady state within seven years. After that point the enrollment should stay relatively constant unless new faculty are recruited.

The experience of groups of Engineering Education in South Africa, the US, Australia, Sweden and in England is that when posting positions in Engineering Education they have difficulties filling the post. Professorships in Engineering Education are being developed at the

rate of about one every six months at present and the rate is increasing. Most of these positions will supervise PhD students. It is expected that on successful implementation of this program we will submit an application for a PhD program. In the meantime students will be able to take up places in the international PhD programs of Engineering Education (e.g. Purdue University, Aalborg University, Glasgow University, University of Cape Town, University of Western Australia).

Graduates who wish to pursue a traditional career as an Engineering Professor in a technical field will be encouraged to take the coursework option with five technical electives. These students will have both the technical and pedagogical preparation for a PhD position in engineering.

Table 5 gives a summary of additional potential career paths and the recommended pattern and options of study within the program. It is anticipated that part time students will be already employed and will continue with their employment in Higher Education, Industry or school teaching. These students, will most likely, be sponsored by their employers.

Table 5: Recommended programs for career paths.

Career path	Suggested Program	Program outcomes
Technical PhD and Engineering tenure track position in an Engineering Department with no background in Engineering Education	Full time MEngEd (coursework) with all technical electives	Applicants for Engineering faculty positions will be very competitive having the technical qualifications as well as the pedagogical scholarship
Engineering faculty/Ph.D. program in Engineering Department/Faculty with specialization in Engineering Education	Full time MEngEd (thesis)	The program will prepare students for a career in Engineering Education as a field of research.
Engineering development/capacity building in a developing country through NGOs etc	Full time MEngEd (coursework) with electives in engineering, sociology, education and development studies	Graduates will have the technical as well as the educational skills to run development projects as well as develop capacity in technical skills
Human resources within Engineering firms, Technical Learning and Teaching advisory roles, project officers for schools, government bodies	Full time MEngEd (coursework) with electives in engineering and education	Graduates will be able to offer more interesting and engaging training courses
Mid-career engineering faculty with an interest in scholarship of teaching	Part time MEng Ed (coursework) plus education electives These programs may also be taken at a distance for faculty from other Universities. It is expected that they would spent part of their sabbatical on site at Queens.	Graduates from this program will be able to publish in Engineering Education as well as their technical field, alongside developing innovative programs of learning for their students.
Manager of "train-the-trainer" courses in engineering company	Part time MEngEd (project) plus education electives	It is not compulsory but expected that part time students will already be employed and will take courses to compliment their existing career path.

12 Other issues

The proposed M.Eng.Ed. program would be the first in engineering education in Canada, and one of the first in the world. Queen's University has been building a reputation for innovative engineering education worldwide and the necessity for enhanced scholarship in this area has become apparent.

The program will be taught using the most up to date pedagogical developments. The lead Faculty who will teach the core and elective Engineering Education courses, all innovative and award winning teachers, will develop engaging classes for on site students using active learning and inquiry based learning strategies. Distance learning students will also benefit from these strategies using online and video-conference collaborative tools.

The program will be housed in the Integrated Learning Centre (ILC) at Queens, a cutting edge educational facility which is being used as a model for development in Australia, US, UK and many other locations. It includes 42 break-out rooms for student run sessions and group work, a multimedia room, design studio, team space for competitive student teams, and varied teaching spaces. The ILC was designed to facilitate the kinds of innovative teaching strategies that will be studied in the M.Eng.Ed. Program, and will serve as a kind of laboratory for the program. The building itself is also intended as a learning experience for students; it is a 'green' building and has many innovative features such as a green wall and solar panels; it is a 'live' building and has many living structures which students can measure and do experiments so students can study the building itself as an engineering project.

It is expected that students will come from a variety of cultural backgrounds, ages, experiences and interests, and that the shared sessions between on site and distance learning cohorts will allow for a vibrant and diverse environment in which to share experiences. Interdisciplinarity and cultural diversity are well known to support creative thinking in students, and these characteristics will provide an exceptional learning environment.

It is anticipated that the program will help to enhance the number of women entering engineering programs. Engineering education is a very popular subject for women and it is anticipated that the program will attract more women than the average engineering intake of 20% - possibly up to 50% or more. This will not only increase the chances of retention of women in engineering related career paths but the graduates of this program will have positive impact on engineering teaching and the gender inclusivity of the engineering programs they develop in the future.

Career paths for graduates of the program are likely to be varied and this will further develop the diversity of students taking the program. This will be a key feature of the promotion of this program (see Table 5 for Recommended career paths and programs of study).

PART B – RESOURCE IMPLICATIONS

1. SUMMARY OF RESOURCES REQUIRED

Additional resources needed

- a) FACULTY: No additional faculty are required and there are no extra costs associated with extra workload.
- b) STAFF : No additional staff are required. 0.3FTE of an existing graduate assistant position will be provided within the Faculty of Applied Science. A web developer within the Faculty of Applied Science will support this program to a maximum of \$4,000 per year.
- c) TEACHING ASSISTANTS No new positions required
- d) OTHER A small amount is requested to support admin costs and course development

d) PHYSICAL FACILITIES

Offices: Office space for MEngEd students will be provided by the Faculty of Applied Science or by project and thesis supervisors in their own Departments both in Applied Science and Education.

e) INFORMATION FACILITIES

- 1. Software/Internet: The Faculty of Applied Science will support the development of distance learning capacity for the blended learning cohort.
- 2. Audio- Visual: Multimedia facilities in the ILC building will be used.
- 3. Telecommunications: No new requirements

f) LIBRARY SERVICES

No additional resources required

g) UNIVERSITY REGISTRAR

- 1. Scholarships: Full-time thesis students will be eligible for graduate fellowships
- 2. Registration/ SIS: As this is a small program, this will have little impact.
- 3. Timetable: No requirements.
- 4. Admission: As this is a small program, this program will have little impact.
- 5. Convocation: As this is a small program, this program will have little impact.

h. OTHER UNIVERSITY SERVICES

- 1. Financial services: No additional resources needed.
- 2. Human Resources: No additional resources needed.
- 3. Advancement: As this is a small program, this program will have little impact.
- 4. Student services: As this is a small program, this program will have little impact.
- 5. Residences: As this is a small program, this program will have little impact.
- 6. Other None

2. NEW EXPENDITURES

The following table presents a summary for year 1 with expected intake of 5 students. For full details and future years projection please see attached spreadsheet

	One time\$	Base budget\$
FACULTY		
STAFF		\$16,000*
TEACHING ASSISTANTS		
OTHER NON SALARY		\$1,000**
TOTAL		\$17,000

*Staff position level 5, 0.3 FTE and \$4,000 for web developer per year

**Operating costs.

3.FUNDING SOURCES

The following table presents a summary for year 1 with expected intake of 5 students. For full details and future years projection please see attached spreadsheet

	One time\$	Base budget\$
DEPARTMENTAL BUDGET		
FACULTY BUDGET		
UNIVERSITY BUDGET (BIU)		\$37,284*
TUITION REVENUE		\$11,705**
OTHER SOURCES		
TOTAL		\$48,989

*Less 30% tuition shared with Central

**Less QGA allocation to SGSR

4.IMPACT ON ENROLMENT

a 5-22 students expected over the next seven years

b 5-22 new students - Most of the students will be attracted to Queens or to stay on at Queens

c At least 10 of the students will require co-supervision by faculty from Education and other Departments in Engineering.


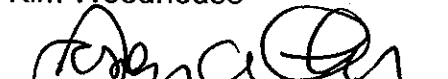
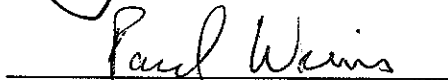



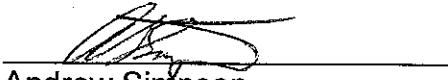
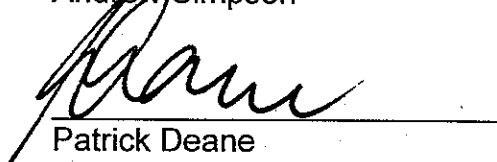
5.NET IMPACT OF THE PROPOSAL

There will be no negative impact of the program as it will be accommodated within existing resources of personnel and services, space and equipment already supplied by the Faculty of Applied Science. There will be a positive impact of the presence of a diverse group of interested students, who will, in addition to enhancing the diversity and intellectual stimulation of existing students, help to provide an increasingly excellent team of TAs to tutor

undergraduate students. There will be a positive impact on the enhanced reputation of the Faculty and Queen's University as a location of excellence in Engineering Education.

6. SIGN OFF

Supplementary comments are appended where indicated

Title	Comments appended	Signature
Dean	<input type="checkbox"/>	 Kim Woodhouse
Dean of Student Affairs	<input type="checkbox"/>	 Jason Laker
University Librarian	<input checked="" type="checkbox"/>	 Paul Wiens
Director IT Services	<input type="checkbox"/>	 Sean Reynolds
University Registrar	<input type="checkbox"/>	 Jo-Anne Brady
Associate Vice-Principal (Operations and Facilities)	<input type="checkbox"/>	 Daniel Hogg
Vice-Principal (Operations and Finance)	<input type="checkbox"/>	 Andrew Simpson
Vice-Principal (Academic)	<input type="checkbox"/>	 Patrick Deane

MEngEd OCGS Library review for proposed program:

Appendix 2: LIBRARY REVIEW

LIBRARY RESOURCES IN ENGINEERING EDUCATION

Queen's University Library serves a user community of approximately 18,000 students and 800 faculty members with research collections exceeding 7 million items, a staff of 160, and a budget exceeding \$17 million. The Queen's University Library (QUL) consists of five main facilities. There are three faculty libraries - Education, Health Sciences, Law, an Engineering and Science Library, a special collections and music library, and a social sciences and humanities library. A team-based organization based on the goals of the learning organization was introduced in 1999 to encourage innovation and flexibility in meeting the service needs of the Library's users. The Library is a member of the Association of Research Libraries (ARL) and the Canadian Association of Research Libraries (CARL).

Collection Support

Queen's University has a strong commitment to the excellence of library collections. The acquisitions budget represents over half of the total library budget. Collections are developed by subject specialist librarians in consultation with faculty members and students. There is a constant review of book, journal, database, and reference collections and careful attention is paid to the needs of students and faculty when orders are placed. It is the library's avowed policy to continuously review and renew the acquisition program to maintain a sound working library for teaching, learning, research, and professional practice.

Together, the Head of the Engineering and Science Library and the Integrated Learning Librarian select resources for Engineering Education. The Integrated Learning Librarian position, part of the Engineering and Science librarian complement, was newly created with the launch of the Integrated Learning initiative in the Faculty of Applied Science. Collections support of engineering education predates this position as the library supports both teaching and the scholarship of teaching for Applied Science Faculty. We select journals, conference proceedings and books in this area and purchase from our general Engineering and Science fund.

In collection practice there is a growing emphasis on electronic resources, including books, journals, databases, and references sources that provide currency of content, and point-of need 24/7 access from any computer with internet access. QUL currently provides access to over 18,000 electronic

journals, including subscribed and open access titles, and is actively selecting full-text e-books and e-journals where they are available and appropriate. The entire suite of electronic journals from publishers such as Elsevier, Wiley, Springer, Blackwell, Oxford, Cambridge, Sage and Taylor and Francis are available to students and researchers. Titles of note in our collection include:

- *Chemical Engineering Education*
- *Computer Applications in Engineering Education*
- *Engineering Science and Education Journal*
- *IEEE Transactions on Education*
- *International Journal of Electrical Engineering Education*
- *International Journal of Engineering Education*
- *International Journal of Mechanical Engineering Education*
- *International Journal of Technology and Design Education*
- *Journal of Engineering Education*
- *Journal of Professional Issues in Engineering Education and Practice*
- *Journal of Research in Science Teaching*
- *Journal of STEM (Science, Technology, Engineering and Math) Education: Innovations and Research*

Critical engineering education research is published via conferences and colloquia. Our current collection is strong with access to the following of note:

- American Society for Engineering Education Annual Conference
- Canadian Conference on Engineering Education
- Frontiers in Education
- International Conference in Engineering Education
- World Conference on Engineering Education

The Library provides access to over 500 indexing and abstracting databases in all disciplines. Some relevant databases include:

- *Compendex*
- *ERIC*
- *IEEE Xplore*
- *Web of Science*

A complete list of databases, many more of which are relevant to this program, is available at http://library.queensu.ca/db_index.htm. To expedite access to the electronic content, the ability to link from database citations to the remote full-text to which QUL subscribes or to the Queen's Library Catalogue (QCAT) has been enabled.

We maintain a subject guide with links to resources and search tips: <http://library.queensu.ca/webeng/guides/EngEd/index.html>

The Education Library includes collections of resources to support both classroom practice and educational research: a reference collection, children's books, multi-media classroom resources, lesson resources, Ministry of Education documents, a general research collection, a textbook collection, and journal collection comprising almost 1,000 journals that are specifically education-related.

QUL's participation in various consortia has leveraged its purchasing power and dramatically increased the number of electronic books and journals available. Consortia include the Canadian Research Knowledge Network (CRKN), the Ontario Consortium of University Libraries (OCUL), and the Consortium of Ontario Academic Health Libraries (COAHL).

Remote access to most electronic resources is available through the Queen's Proxy, allowing students and faculty members to access a rich array of resources from home, office or practicum placement.

Instruction and assistance

Professional librarians are available in all campus libraries to help students on a drop-in basis on week days. Evening and weekend hours are available at some locations. Graduate students may also book individual consultations with a librarian. Reference services can be accessed via email, instant messaging, telephone, voicemail, and 1-800 numbers allowing students to consult with a librarian whether they are on campus or at a remote location. The Integrated Learning Librarian also maintains office hours in the Integrated Learning Centre for part of the week. We are currently building library resources and research help into the new Applied Science portal.

The Library puts a great deal of effort into teaching information literacy to students, equipping them with the skills for effective access, retrieval and management of information, and to promote lifelong learning. These skills facilitate critical inquiry and evidence based practice. Information literacy programmes are curriculum-integrated to ensure that students learn how to use library resources at a time when they are directly related to the coursework they are engaged in. Programmes for graduate students also include instruction on the use of bibliographic management software (e.g. Reference Manager, RefWorks) and software to search and utilize data such as maps and census data.

Library Services

All campus libraries have been renovated to accommodate the new electronic environment, providing wireless access throughout, laptops for loan and a large

number of hard-wired personal computers, loaded with productivity and other software.

Also in 2005, the Queen's Learning Commons (QLC) was opened in the Stauffer Library. The QLC is a partnership between the Library, Information Technology Services, Learning Strategies Development, Special Reader Services and the Writing Centre. The QLC builds services from a student perspective and provides services to help students with the entire learning process, from getting the most out of lectures and readings to formulating research questions, finding information, writing papers and presenting their knowledge. The QLC is a vibrant mix of over 150 computers, study tables and soft seating that provide opportunities for individual study or group collaboration. A classroom is equipped with an instructor's workstation linked to an overhead projector for classes that include demonstrations and 21 laptops that can be used for hands-on instruction. Stauffer Library and the Douglas Library, which is across the street, share a second electronic classroom with computers for both students and the seminar leader. The large study halls on the top floor of Douglas Library have been refurbished and continue to be popular with students in all disciplines. Stauffer Library and Douglas Library together provide a total of 2,112 study spaces. In fall 2007 the Engineering and Science Library in Douglas Library is opening two new study rooms one of which is a *Collaborative Group Study Room* for booking and use by students.

Faculty and students may reserve group study rooms using a self-serve online booking system. Other amenities include printers, copiers, and scanners.

Resource Sharing

The Libraries' Document Delivery Services acquire books and journal articles not available at Queen's University. Through Docline and Racer, automatic routing systems, the libraries have access to other library collections throughout Canada and the United States. The Queen's Library System has an agreement with the Canada Institute for Scientific and Technical Information (CISTI), which also provides an extremely fast turnaround time for journal article requests. QUL subsidizes heavily its document delivery operation so that users are only charged a nominal fee.

The Library will continue its efforts to provide timely access to information and library resources outside its own collections. There will be a continued monitoring of the balance between on-site and external resources.

Prepared by:

Sharon Murphy, Head, Engineering and Science Library

Jane Philipps, Coordinator of Collection Development, Queen's Library

August 2007

Queen's University at Kingston
Masters in Engineering Education
Pro forma Financial Statements

Enrollment

	(F/W) 2008/09	(S/F/W) 2009/10	(S/F/W) 2010/11	(S/F/W) 2011/12	(S/F/W) 2012/13	(S/F/W) 2013/14	(S/F/W) 2014/15	Notes
Full-time intake in Year 1	4	4	5	6	7	7	8	Use most conservative # based on Table 1, section 2
Full-time in Year 2	4	4	4	5	6	7	7	Use most conservative # based on Table 1, section 2
Full-time	4	8	9	11	13	14	15	
Part-time intake in Year 1	1	2	2	2	2	2	2	Use most conservative # based on Table 1, section 2
Part-time in Year 2	1	1	2	2	2	2	2	Use most conservative # based on Table 1, section 2
Part-time	1	3	4	4	4	4	4	Use most conservative # based on Table 1, section 2
Total Full-time and Part-time	5	11	13	15	17	18	19	Use most conservative # based on Table 1, section 2

Tuition fee - Full-time (per term)
- Part-time (per 0.5 course)

1,858	1,858	1,858	1,858	1,858	1,858	1,858	1,858	2008-09 domestic Master tuition fee
929	929	929	929	929	929	929	929	2008-09 domestic Master tuition fee

Revenues

Tuition fee	14,864	22,296	26,012	31,586	37,160	39,018	42,734	Current model to share 30% with Central BIU rate of \$13,221 per funding eligible student. Use full-time only.
- Full-time	1,858	4,645	5,574	5,574	5,574	5,574	5,574	
- Part-time	16,722	26,941	31,586	37,160	42,734	44,592	48,308	
Less: 30% of tuition shared with Central	(5,017)	(8,082)	(9,476)	(11,148)	(12,820)	(13,378)	(14,492)	\$3,900 per funding eligible student (full-time)
Government grant (BIU)	52,884	105,768	118,989	145,431	171,873	185,094	198,315	
Less: QGA allocation to SGSR	(15,600)	(31,200)	(35,100)	(42,900)	(50,700)	(54,600)	(58,500)	
Total Revenues	48,989	93,427	105,999	128,543	151,087	161,708	173,631	

Expenses

Salaries	0	0	0	0	0	0	0	Existing faculty resources
- Faculty	0	0	0	0	0	0	0	Graduate support provided within Faculty of Applied Sciences
- Staff (level 5, .3 FTE) salary \$40k, plus part time web development assistance @\$4,000 in year 1	12,000	12,600	13,230	13,892	14,586	15,315	16,081	Program development support provided within Faculty of Applied Sciences
- Web developer	4,000	4,000	4,000	4,000	4,000	4,000	4,000	
- Research Assistant	0	0	0	0	0	0	0	
Total Compensation	16,000	16,600	17,230	17,892	18,586	19,315	20,081	Office supplies, phone calls
Operating costs	1,000	1,000	1,000	1,000	1,000	1,000	1,000	
Total Expenses	17,000	17,600	18,230	18,892	19,586	20,315	21,081	
Excess of Revenues over Expense	31,989	75,827	87,769	109,652	131,501	141,393	152,549	
Balance - prior year	0	31,989	107,816	195,585	305,237	436,738	578,131	
Surplus/(Deficit) - end of year	31,989	107,816	195,585	305,237	436,738	578,131	730,680	