McGill

Report of the
Academic Policy Committee D18-41

490th REPORT OF THE ACADEMIC POLICY COMMITTEE TO SENATE – Part A
Items electronically approved by APC on January 17th, 2019

I. TO BE APPROVED BY SENATE

(A) NEW TEACHING PROGRAMS REQUIRING SENATE APPROVAL

Graduate and Postdoctoral Studies
Desautels Faculty of Management
Graduate Certificate in Healthcare Management (15 cr.) – *appendix A*
On January 17th, 2019, APC electronically approved a proposal from the Desautels Faculty of Management to create a new Graduate Certificate in Healthcare Management. This new program, offered in collaboration with the Faculty of Medicine, will provide clinicians and healthcare professionals with crucial managerial skills to navigate the transformation of the healthcare system, led by the rise of digital technologies and innovation. As a self-funded program, this Graduate Certificate will require MEES approval.

APC therefore recommends that Senate approve the following resolution:

Be it resolved that Senate approve the proposed Graduate Certificate in Healthcare Management (15 cr.)

(B) ACADEMIC PERFORMANCE ISSUES / POLICIES / GOVERNANCE/AWARDS - *none*

(C) CREATION OF NEW UNITS / NAME CHANGES / REPORTING CHANGES - *none*

(D) CHANGES IN DEGREE DESIGNATION – *none*

(E) INTER-UNIVERSITY PARTNERSHIPS – *none*

(F) OTHER – *none*

II. TO BE ENDORSED BY SENATE / PRESENTED TO SENATE FOR DISCUSSION – *none*

III. APPROVED BY APC IN THE NAME OF SENATE

(A) DEFINITIONS – *none*

(B) STUDENT EXCHANGE PARTNERSHIPS / CONTRACTS / INTERUNIVERSITY PARTNERSHIPS - *none*

(C) OTHER - *none*

IV. FOR THE INFORMATION OF SENATE

A) ACADEMIC UNIT REVIEWS – *none*

B) APPROVAL OF COURSES AND TEACHING PROGRAMS

1. Programs

a) APC Approvals (new options/concentrations and major revisions to existing programs)

i. New Programs- *none*

ii. Major Revisions of Existing Programs
Approved by SCTP on December 6th, 2018 and approved by APC on January 17th, 2019

Graduate and Postdoctoral Studies
Faculty of Arts
Master of Public Policy; Non-Thesis (45 cr.)

Faculty of Engineering
M.Eng. in Electrical Engineering; Non-Thesis (45 cr.)

b) APC Subcommittee on Courses and Teaching Programs (SCTP) Approvals
(Summary Reports: http://www.mcgill.ca/sctp/documents/)

i. Moderate and Minor Program Revisions
Approved by SCTP on December 6th, 2018 and reported to APC on January 17th, 2019

Faculty of Arts
B.A.; Honours in English; Literature (54 cr.)
B.A.; Honours in English – Drama and Theatre (54 cr.)
B.A.; Honours in English; Cultural Studies (54 cr.)
B.A.; Joint Honours – English Component; Literature (36 cr.)
B.A.; Joint Honours – English Component; Drama and Theatre (36 cr.)
B.A.; Joint Honours – English Component; Cultural Studies (36 cr.)
B.A.; Minor Concentration in Russian (18 cr.)
B.A.; Minor Concentration in Russian Culture (18 cr.)
B.A.; Minor Concentration in Communication Studies (18 cr.)

Faculty of Engineering
B.Eng.; Major in Bioengineering (142-152 cr.)
B.Eng.; Co-op in Mining Engineering (150-151 cr.)
B.Eng.; Major in Mining Engineering (144-145 cr.)
B.Eng.; Minor in Physics (18 cr.)

Graduate and Postdoctoral Studies
Interfaculty Studies
M.Eng. in Biological and Biomedical Engineering (45 cr.)

Faculty of Medicine
M.Sc. in Experimental Medicine (45 cr.)
Ph.D. in Experimental Medicine (0 cr.)
Graduate Diploma in Clinical Research (30 cr.)
M.Sc. in Microbiology and Immunology (45 cr.)
M.Sc.(Applied) in Occupational Health; Non-Thesis (Resident) (46 cr.)
Ph.D. in Epidemiology (0 cr.)

Schulich School of Music
M.Mus. in Performance; Jazz Performance (45 cr.)

Desautels Faculty of Management
B.Com.; Honours in Investment Management (81 cr.)
B.Com.; Major in General Management; Concentration in Entrepreneurship (15 cr.)
B.Com.; Freshman Program (30 cr.)

Faculty of Science
B.Sc.; Minor in Chemistry (19-20 cr.)

ii. Program Retirements
Approved by SCTP on December 6th, 2018 and reported to APC on January 17th, 2019
Faculty of Arts
B.A.; Honours in Canadian Studies (57 cr.)
B.A.; Joint Honours – Canadian Studies Component (36 cr.)
B.A.; Major Concentration in Canadian Studies (36 cr.)

Graduate and Postdoctoral Studies
Faculty of Science
M.Sc. in Computer Science; Computational Science and Engineering (45 cr.)

2. Courses

a) New Courses
Reported as having been approved by SCTP on December 6th, 2018: 49
Faculty of Agricultural and Environmental Sciences: 1
Faculty of Arts: 23
School of Continuing Studies: 8
Faculty of Engineering: 7
Desautels Faculty of Management: 6
Faculty of Medicine: 2
Schulich School of Music: 1
Faculty of Science: 1

b) Course Revisions
Reported as having been approved by SCTP on December 6th, 2018:24
Faculty of Agricultural and Environmental Sciences: 2
Faculty of Arts: 8
Faculty of Engineering: 5
Faculty of Medicine: 3
Schulich School of Music: 1
Faculty of Science: 5

c) Course Retirements
Reported as having been approved by SCTP on December 6th, 2018: 14
Faculty of Arts: 12
Schulich School of Music:1
Faculty of Science: 1

3. Other

490th REPORT OF THE ACADEMIC POLICY COMMITTEE TO SENATE – Part B
Items electronically approved by APC on February 14th, 2019

I. TO BE APPROVED BY SENATE

(A) NEW TEACHING PROGRAMS REQUIRING SENATE APPROVAL

Graduate and Postdoctoral Studies
Faculty of Engineering
M.Eng. in Sustainability in Engineering and Design; Non-Thesis (45 cr.) – *appendix A*
On February 14th, 2019, APC electronically approved a proposal from the Faculty of Engineering to create a new M.Eng. in Sustainability in Engineering and Design; Non-Thesis. It is nowadays undeniable that industrial and urban developments have put the earth's natural resources at risk and that sustainability has become a growing concern in our current society. The proposed M.Eng. will be the first program in Canada to offer a broad approach to teaching sustainability in Engineering and Design, where students will develop a critical expertise in sustainability in Engineering while still being able to specialize in the Engineering field of their choice. There is a strong demand both provincially and nationally for trained sustainability experts in Engineering, and a real interest from the student population for such a program. As a new degree program, the proposed M.Eng. in Sustainability in Engineering and Design; Non-Thesis will require BCI and MEES approval.

APC therefore recommends that Senate approve the following resolution:
Be it resolved that Senate approve the proposed M.Eng. in Sustainability in Engineering and Design; Non-Thesis (45 cr.)

Faculty of Medicine
Graduate Certificate in Regenerative Medicine (15 cr.) – *appendix B*
On February 14th, 2019, APC electronically approved a proposal from the Faculty of Medicine to create a new Graduate Certificate in Regenerative Medicine. Regenerative Medicine represents both a current therapeutic approach but also the future of Medicine. This new Graduate Certificate will fill a gap, as there is currently no overarching program that links all the disparate aspects of regenerative medicine from stem cell biology to stem cell generation and modification, clinical trials and translation.

APC therefore recommends that Senate approve the following resolution:
Be it resolved that Senate approve the proposed Graduate Certificate in Regenerative Medicine (15 cr.)

(B) ACADEMIC PERFORMANCE ISSUES / POLICIES / GOVERNANCE/AWARDS - *none*

(C) CREATION OF NEW UNITS / NAME CHANGES / REPORTING CHANGES - *none*

(D) CHANGES IN DEGREE DESIGNATION – *none*

(E) INTER-UNIVERSITY PARTNERSHIPS – *none*

(F) OTHER – *none*

II. TO BE ENDORSED BY SENATE / PRESENTED TO SENATE FOR DISCUSSION – *none*

III. APPROVED BY APC IN THE NAME OF SENATE

(A) DEFINITIONS – *none*

(B) STUDENT EXCHANGE PARTNERSHIPS / CONTRACTS / INTERUNIVERSITY PARTNERSHIPS - *none*

(C) OTHER - *none*

IV. FOR THE INFORMATION OF SENATE

A) ACADEMIC UNIT REVIEWS – *none*

B) APPROVAL OF COURSES AND TEACHING PROGRAMS

1. Programs

a) APC Approvals (new options/concentrations and major revisions to existing programs)

i. New Programs- *none*

ii. Major Revisions of Existing Programs
Approved by SCTP on January 10th, 2019 and approved by APC on February 14th, 2019
Faculty of Arts
B.A.; Spécialisation en Langue et littérature françaises; Études et pratiques littéraires (72 cr.)

b) APC Subcommittee on Courses and Teaching Programs (SCTP) Approvals
(Summary Reports: http://www.mcgill.ca/sctp/documents/)

i. Moderate and Minor Program Revisions
Approved by SCTP on January 10th, 2019 and reported to APC on February 14th, 2019
Faculty of Agricultural and Environmental Sciences
B.Eng.(Bioresource); Major in Bioresource Engineering (113 cr.)
B.Eng.(Bioresource); Honours in Bioresource Engineering (113 cr.)
B.Eng.(Bioresource); Major in Bioresource Engineering; Professional Agrology (113 cr.)

Faculty of Arts
B.A.; Concentration majeure en Langue et littérature françaises; Études et pratiques littéraires (36 cr.)
B.A.; Double Spécialisation en Langue et littérature françaises; Études et pratiques littéraires
B.A.; Concentration mineure en Langue et littérature françaises; Études et pratiques littéraires (18 cr.)
B.A.; Concentration majeure en Langue et littérature françaises; Traduction (36 cr.)
B.A.; Concentration mineure en Langue et littérature françaises; Traduction (18 cr.)
B.A.; Concentration mineure en Langue et littérature françaises; Langue française

Faculty of Education
B.Ed. in Kindergarten and Elementary Education (120 cr.)
B.Ed. in Kindergarten and Elementary Pédagogie de l'immersion française (120 cr.)
B.Ed. in Secondary English (120 cr.)

B.Ed. in Secondary Mathematics (120 cr.)
B.Ed. in Secondary Social Sciences; History and Citizenship, Ethics and Religious Culture (120 cr.)
B.Ed. in Secondary Science and Technology (120 cr.)
B.Ed. in Secondary Social Sciences; History and Citizenship, Geography (120 cr.)
B.Ed. in Teaching English as a Second Language-TESL Elementary and Secondary (120 cr.)
B.Ed. in Teaching English Second Language-TESL Elementary and Secondary; Teaching Greek Language and Culture (120 cr.)

Faculty of Engineering
B.Eng.; Minor in Computer Science (24-25 cr.)

Graduate and Postdoctoral Studies
Interfaculty Studies
Ph.D. in Quantitative Life Sciences (0 cr.)

Faculty of Medicine
M.Sc. in Experimental Surgery (45 cr.)
M.Sc. in Experimental Surgery; Surgical Education (45 cr.)
M.Sc. in Experimental Surgery; Surgical Innovation (45 cr.)
M.Sc. in Experimental Surgery; Non-Thesis (45 cr.)
Ph.D. in Experimental Surgery (0 cr.)
Graduate Certificate in Surgical Innovation (15 cr.)
Graduate Diploma in Surgical Innovation (30 cr.)
M.Sc. in Family Medicine (45 cr.)
M.Sc. in Family Medicine; Bioethics (45 cr.)
M.Sc. in Family Medicine; Medical Education (45 cr.)
M.Sc.(Applied) in Nursing; Non-Thesis (61 cr.)

Schulich School of Music
D.Mus. in Music; Performance Studies (0 cr.)

Faculty of Science
B.Sc.; Major in Neuroscience (65 cr.)
B.Sc.; Honours in Neuroscience (74 cr.)
B.Sc.; Liberal Program – Core Science Component in Physics (45 cr.)
B.Sc.; Joint Major in Physics and Geophysics (69 cr.)
B.Sc.; Honours in Planetary Sciences (78 cr.)
B.Sc.; Joint Major in Computer Science and Biology (63-74 cr.)
B.Sc.; Honours in Computer Science and Biology (67-77 cr.)

ii. Program Retirements
Approved by SCTP on January 10th, 2019 and reported to APC on February 14th, 2019
Faculty of Arts
B.A.; Spécialisation en Langue et littérature françaises; Traduction (54 cr.)
B.A.; Double Spécialisation en Langue et littérature françaises; Traduction (36 cr.)

2. Courses

a) New Courses
b) *Reported as having been approved by SCTP on January 10th, 2019: 30*
Faculty of Arts: 6
School of Continuing Studies: 9
Faculty of Engineering: 4
Faculty of Medicine: 4

Schulich School of Music: 4
Faculty of Science: 3

c) Course Revisions
Reported as having been approved by SCTP on January 10th, 2019: 48
Faculty of Agricultural and Environmental Sciences: 8
Faculty of Arts: 10
Faculty of Education: 18
Desautels Faculty of Management: 2
Faculty of Medicine: 2
Faculty of Science: 8

d) Course Retirements
Reported as having been approved by SCTP on January 10th, 2019: 5
Faculty of Agricultural and Environmental Sciences: 2
Faculty of Science: 3

3. Other

APC APPENDIX A [19-APC-01-24]

McGill

New Program/Major or Minor/Concentration Proposal Form

(2017)

1.0 Degree Title
Please specify the two degrees for concurrent degree programs

Graduate Certificate

1.1 Major (Legacy= Subject)(30-char. max.)

Healthcare Management

1.2 Concentration (Legacy = Concentration/Option) If applicable to Majors only (30 char. max.)

1.3 Minor (with Concentration, if Applicable) (30 char. max.)

2.0 Administering Faculty/Unit

Graduate and Postdoctoral Studies

Offering Faculty/Department

Management

3.0 Effective Term of Implementation
(Ex. Sept. 2004 = 200409)
Term

201905

4.0 Rationale and Admission Requirements for New Proposal

The rise of digital technologies and disruptive innovations, coupled with healthcare leaders willing to lead change, has created a unique opportunity to transform traditional healthcare into a modern, value-based healthcare system fit for the 21st century. This drastic transformation requires empowering and educating clinicians and other healthcare professionals with the range of managerial skills needed to lead this transformation. This certificate program will focus on training healthcare professionals to be agents of its transformation. Applicants must hold a post-secondary 4-year degree with cum. gpa of 3.0 and be a regulated health professional.

5.0 Program Information
Please check appropriate box(es)

5.1 Program Type
- ☐ Bachelor's Program
- ☐ Master's
- ☐ M.Sc.(Applied) Program
- ☐ Dual Degree/Concurrent Program
- ☐ Certificate
- ☐ Diploma
- ☒ Graduate Certificate
- ☐ Graduate Diploma
- ☐ Ph.D. Program
- ☐ Doctorate Program (Other than Ph.D.)
- ☒ Self-Funded/Private Program
- ☐ Off-Campus Program
- ☐ Distance Education Program (By Correspondence)
- ☐ Other (Please specify)

5.2 Category
- ☐ Faculty Program (FP)
- ☐ Major
- ☐ Joint Major
- ☐ Major Concentration (CON)
- ☐ Minor
- ☐ Minor Concentration (CON)
- ☐ Honours (HON)
- ☐ Joint Honours Component (HC)
- ☐ Internship/Co-op
- ☐ Thesis (T)
- ☐ Non-Thesis (N)
- ☐ Other

Please specify

5.3 Level
- ☐ Undergraduate
- ☐ Dentistry/Law/Medicine
- ☐ Continuing Ed (Non-Credit)
- ☐ Collegial
- ☒ Masters & Grad Dips & Certs
- ☐ Doctorate
- ☐ Post-Graduate Medicine/Dentistry
- ☐ Graduate Qualifying
- ☐ Postdoctoral Fellows

5.4 FQRSC (Research) Indicator
(for GPS) Yes __ No _x_

5.5 Requires Resources Yes __ No _x_

6.0 Total Credits

15

7.0 Consultation with
Related Units Yes ☒ No ☐
Financial Consult Yes ☒ No ☐
Attach list of consultations.

8.0 Program Description (Maximum 150 words)

The Graduate Certificate in Healthcare Management focuses on a range of managerial skills to positively impact the quality, efficiency and fiscal responsibility of health care delivery. This includes: leading transformation, financial management and analysis, leading and managing people, conflict resolutions and negotiations, process analysis in health care settings, managing and improving quality in health care systems, and health management. The program will be offered in collaboration with the Faculty of Medicine.

9.0 List of proposed program for the New Program/Major or Minor/Concentration.

If new concentration (option) of existing Major/Minor (program), please attach a program layout (list of all courses) of existing Major/Minor.

Proposed program (list courses as follows: Subj Code/Crse Num, Title, Credit weight under the headings of: Required Courses, Complementary Courses, Elective Courses)

Graduate Certificate in Healthcare Management (15 credits)

Required Courses (15 credits)
ACCT 645D1/D2 Financial Management in Healthcare (2 credits)
BUSA 647D1/D2 Healthcare Management Practicum (4 credits)
MGCR 629 Global Leadership (1 credit)
MGSC 641D1/D2 Operations Management in Health Services (2 credits)
MGSC 642D1/D2 Quality Management in Healthcare (2 credits)
ORGB 643D1/D2 Leading and Managing People in Healthcare (2 credits)
ORGB 644D1/D2 Managerial Negotiations in Healthcare (2 credits)

Attach extra page(s) as needed

10.0 Approvals

Routing Sequence	Name	Signature	Date
Department	Liette Lapointe, Vice-Dean (Programs)		Oct 19, 2018
Curric/Acad Committee	Isabelle Bajeux-Besnainou, Dean		Oct 26, 2018
Faculty 1	Isabelle Bajeux-Besnainou, Dean		Nov 2, 2018
Faculty 2			
Faculty 3			
CGPS	SCTP APPROVED	CGPS APPROVAL	November 12, 2018
SCTP			Dec. 6, 2018
APC		APC	January 17, 2019
Senate		SENATE	February 20, 2019

Submitted by

Name	Beste Kucukyazici
Phone	514 398 2609
Email	beste.kucukyazici@mcgill.ca
Submission Date	October 16, 2018

To be completed by ARR:

CIP Code

McGill

New Program/Major or Minor/Concentration Proposal Form

D18-41 - Part B, Appendix B

(2017)

1.0 Degree Title
Please specify the two degrees for concurrent degree programs

Graduate Certificate (Gr.Cert.)

1.1 Major (Legacy = Subject) (30-char. max.)

Regenerative Medicine

1.2 Concentration (Legacy = Concentration/Option) If applicable to Majors only (30 char. max)

1.3 Minor (with Concentration, if Applicable) (30char. max)

2.0 Administering Faculty/Unit

Graduate and Postdoctoral Studies (GPS)

Offering Faculty/Department

MD - Experimental Medicine

3.0 Effective Term of Implementation
(Ex. Sept. 2004 = 200409)
Term

201909

4.0 Rationale and Admission Requirements for New Proposal

Rationale: Regenerative medicine represents both a current therapeutic approach but also the long term future of medicine. At present, there is no such overarching program that links all the disparate aspects of regenerative medicine from stem cell biology, stem cell generation and modification, clinical trials and translation. Further, our understanding of disease and our ability to treat it both suffer from our inability to model and understand subclinical progression.

Admission Requirement: must hold a B.Sc. degree with a minimum cGPA of 3.0 out of 4.0 or 3.2 out of 4.0 in the last two years of academic studies. Must have completed with success the following courses: BIOL 200 (Molecular Biology), BIOL 202 (Basic Genetics), and CHEM 212 (Introduction to Organic Chemistry), their equivalent or permission of the coordinators.

5.0 Program Information

Please check appropriate box(es)

5.1 Program Type

- ☐ Bachelor's Program
- ☐ Master's
- ☐ M.Sc. (Applied) Program
- ☐ Dual Degree/Concurrent Program
- ☐ Certificate
- ☐ Diploma
- ☒ Graduate Certificate
- ☐ Graduate Diploma
- ☐ Ph.D. Program
- ☐ Doctorate Program (Other than Ph.D.)
- ☐ Private Program
- ☐ Off-Campus Program
- ☐ Distance Education Program (By Correspondence)
- ☐ Other:

Please specify

5.2 Category

- ☐ Faculty Program (FP)
- ☐ Major
- ☐ Joint Major
- ☐ Major Concentration (CON)
- ☐ Minor
- ☐ Minor Concentration (CON)
- ☐ Honours (HON)
- ☐ Joint Honours Component (HC)
- ☐ Internship/Co-op
- ☐ Thesis (T)
- ☐ Non-Thesis (N)
- ☐ Other:

Please specify

5.3 Level

- ☐ Undergraduate
- ☐ Dentistry/Law/Medicine
- ☐ Continuing Studies (Non-Credits)
- ☒ Masters & Grad Dip & Certs
- ☐ Doctorate
- ☐ Post-Graduate Medicine/ Dentistry
- ☐ Graduate Qualifying
- ☐ Postdoctoral Fellows

5.4 FQRSC (Research) Indicator (For GPS)

☐ Yes ☒ No

5.5 Requires Resources (financial, personnel, space)

☐ Yes ☒ No

6.0 Total Credits

15

7.0 Consultation with

Related Units	☒ Yes	☐ No
Financial Consult	☒ Yes	☐ No

Attach list of consultations.

8.0 Program Description (Maximum 150 words)

The Graduate Certificate in Regenerative Medicine focuses on biology of stem cells, their uses in diagnostic and therapeutic applications, the practicalities of generating them, and using and modifying them for clinical translation. Exploration of the combination of stem cell-based model systems for drug discovery and disease modelling as well as the ethical implications of their use.

9.0 List of proposed program for the New Program/Major or Minor/Concentration

If new concentration (option) of existing Major/Minor (program), please attach a program layout (list of courses) of existing Major/Minor.

Proposed program (list course as follow: Subj Code/Crse Num, Title, Credit weight, under the heading of: Required Courses, Complementary Courses, and Elective Courses).

Graduate Certificate in Regenerative Medicine (15 credits)

Required Courses (9 credits)

FMED 525 Foundations of Translational Science (3 credits)
HGEN 675 Stem Cell Biology (3 credits)
PHAR 508 Drug Discovery and Development 3 (3 credits)

Complementary Courses (6 credits)

6 credits from the following:
CHEE 512 Stem Cell Bioprocess Engineering (3 credits)
EXMD 501 Clinical Applications of Regenerative Medicine (3 credits)
EXMD 505 Directed Readings in Regenerative Medicine (3 credits)
HGEN 660 Genetics and Bioethics (3 credits)

10.0 Approvals

Routing Sequence	Name	Signature	Date

Routing Sequence	Name	Signature	Date
Department	Anne-Marie Lauzon		September 24th, 2018
Curric/Acad Committee	DAVID RAGSDALE	for D.R	29 Oct, 2018
Faculty 1	Aimee Ryan		29 Oct 2018
Faculty 2			
Faculty 3			
CGPS		CGPS APPROVAL	December 17, 2018
SCTP			JAN. 10, 2019
APC		APC	Feb 14, 2019
Senate		Senate	Feb 20, 2019

SCTP APPROVED

Submitted By

Name	Marylin Linhares	To be completed by ARR:
Phone	514 934-1934, ext: 34699	CIP Code
Email	experimental.medicine@mcgill.ca	
Submission Date	September 24, 2018	

We recently united more than 100 researchers involved in Stem Cell Research and Regenerative Medicine, creating the McGill Regenerative Medicine Network. Open to all McGill scientists, this network positions Regenerative Medicine (RM) into the Strategic Research Plans of the Faculty of Medicine and the University. Our own strategic research plan was the result of a broad survey of key stakeholders at McGill University. Written by a small group of diverse researchers from across McGill institutions, the plan identified five major consensus commitments to move McGill Regenerative Medicine (MRM) science forward.

Commitment 1- To expand our footprint from McGill to the world (Establishing and promoting the MRM network from seminars to conferences, media releases, and international scientific outreach).

Commitment 2- To understand and to translate RM biology (Encouraging and financing basic infrastructure, and fundamental research programs of MRM across McGill and affiliated institutions).

Commitment 3- To develop and implement MRM clinical pipelines (Supporting diverse clinical pipelines and sustaining translational research from Phase 1 to Phase 3 trials at our hospitals and research institutes).

Commitment 4- To foster the next generation of transdisciplinary RM personnel (Building and implementing a graduate training program to expand mentorships and interest in RM).

Commitment 5- To develop and sustain impactful actions in clinical applications, ethical, legal and social implications of RM research (Assisting McGill researchers to change and update ethical guidelines, and RM knowledge and applications to the public.

From stem cells to "disease in a dish" models and 3D printing of synthetic tissues, RM is expanding dramatically and will comprise a great portion of future biomedical advances and applications. Remarkably, through this process, we noted that McGill researchers and their collective infrastructure represent tremendous academic and clinical activity in RM in Canada. Moreover, recent recruits to McGill have brought significant new RM expertise but need engagement from stakeholders to thrive both locally and internationally. The MRM network is a clear sign that researchers in RM at McGill want to build on fertile ground for such activities. Our ultimate aim is that during this five-year strategic research plan, we will work toward *the creation of a comprehensive and competitive international MRM Institute.*

Among the major endeavors of MRM are several ongoing research activities: developing patient and population-derived induced Pluripotent Stem Cell (iPSC) banks; improving novel methods to produce and expand autologous as well as universal donor tissues; and optimizing large-scale technologies for expanding non-autologous stem cells and graftable organoids for clinical applications.

A key strategy of the MRM SRP is building learning opportunities into our platforms and providing training across them. We will continue to provide appropriate training in research methodology at all career stages from research student to principal investigator. We will identify key professional and employment skills inherent in our MRM courses. Our trainees will be afforded opportunities for funded exchanges and internships. We will encourage crosscutting research experiences at McGill. MRM activities are across the depth and breadth of RM research in five faculties, and across all research environments: basic, clinical, translational, ethical and legal involving training of undergraduate and graduate students and professional programs in medicine, nursing, and law. We will enhance graduate offerings with cross-faculty programming in courses that increase the breadth of understanding of stem cell biology and clinical translation.

The Graduate Certificate in Regenerative Medicine lays the groundwork for such an institute by creating an expandable educational platform that fills a key gap in the training McGill currently offers. There are many courses that touch on stem cell biology but none have a defined focused on translating this into regenerative medicine applications. We think we fill an unmet curricular need.

A new graduate program in RM

The MRM partnered with the graduate program in Experimental Medicine to develop a graduate certificate in RM, based largely on existing courses taught at McGill. However, we also have two new courses on track to be approved, EXMD 501 (Clinical Applications of Regenerative Medicine) and EXMD 505 (Directed Readings in Regenerative Medicine), specifically designed for the Graduate Certificate Program. The MRM graduate certificate aims to prepare trainees for the domains of stem cell biology and RM. It will explore the combination of stem cell-based model systems for designing more effective screens and therapies for disease that can capture both disease progression and therapeutic success and lead to clinical translation. Our graduate concentration initially provides a 15-credit focus on the biology of stem cells, their uses in diagnostic and therapeutic applications, the practicalities of generating them, their ethical usage and clinical translation. This initial offering will benefit trainees across many biomedical departments and help forge links to different sites and platforms. Ultimately, we envisage a larger graduate program in stem cell biology and clinical translation that is driven by our research and clinical pipelines.

Consultations

We have consulted with all the course directors of the relevant courses and they have given us their blessing to allow for the increased enrollment in individual courses. Further, we have consulted with all the chairs of the departments where these courses are run and they too have consented to be part of our program.

Expected Enrollment

It is difficult to say how many students the program will have initially, but the interest in the subject is substantial and the professional opportunities important. We would initially except up to 20 students per year. Eventually, this program could transition into something larger and more formal if the demand is there.

Similar programs outside McGill University that highlight our own needs

Training Program in Regenerative Medicine
University of Toronto

Trainees spend one year with a view to obtain an MSc, PhD, and/or combined Health Professional degree under the auspices of a degree-conferring graduate department, or as post-doctoral fellows in the discipline of Regenerative Medicine.

Participating universities and departments will confer degree status on program trainees from within existing graduate programs (e.g. the University of Toronto's Departments of Immunology and Laboratory Medicine, and its Institute for Medical Science). Each student accepted to the program will be supervised by a member of the Regenerative Medicine Training Program faculty who also has a faculty appointment in a graduate degree-granting department at one of the participating universities.

Curriculum

The Program will consist of several components, which will employ a variety of approaches to teaching and learning, including innovative information technologies.

Online Courses
Stem Cell Therapeutics
Link: http://geneticscertificate.stanford.edu/courses/stem-cells-therapeutics.php
Offered by: Stanford University
Description: Stem cells provide enormous potential for the field of regenerative medicine. Their ability to become any type of cell-blood, heart, brain, bones, skin, muscles, etc.- offers hope for effective treatments, or perhaps even reversal of, a disease.

This course will advance your understanding of cell-based therapies and show you what it is being done today to develop and deliver them. Discover new ways to restore organ and tissue function for the treatment of chronic diseases, genetic disorders and serious injuries. Get a glimpse inside the laboratory of medical researchers who are pioneering

stem cell therapeutics.

Stem Cell and Regenerative Biology
Link: http://online-learning.harvard.edu/course/stem-cell-and-regenerative-biology
Offered by: Harvard University
Description: We are entering a new era in which a fundamental understanding of developmental biology and regeneration will play a critical role. In this course, embryonic and adult stem cells in different organisms are examined in terms of their molecular, cellular, and potential therapeutic properties. Genetic reprogramming and cloning of animals are critically evaluated. Ethical and political considerations are also considered.

Epigenetic Regulation of Stem Cells
Link: http://ocw.mit.edu/courses/biology/7-347-epigenetic-regulation-of-stem-cells-spring-2014/
Offered by: MIT
Description: During development a single totipotent cell gives rise to the vast array of cell types present in the adult human body, yet each cell has essentially the same DNA sequence. As cells differentiate, distinct sets of genes must be coordinately activated and repressed, ultimately leading to a cell-type specific pattern of gene expression and a particular cell fate. In eukaryotic organisms, DNA is packaged in a complex protein super structure known as chromatin. Modification and reorganization of chromatin play a critical role in coordinating the cell-type specific gene expression programs that are required as a cell transitions from a pluripotent stem cell to a fully differentiated cell type. Epigenetics refers to such heritable changes that occur in chromatin without altering the primary DNA sequence. This class will focus on the role of epigenetic regulation with respect to developmental fate and also consider the fact that the epigenetic mechanisms discussed have broad implications, including how seemingly normal cells can be transformed into cancerous cells.

Stem Cells: A Cure or Disease?
Link: http://ocw.mit.edu/courses/biology/7-349-stem-cells-a-cure-or-disease-spring-2011/
Offered by: MIT
Description: Have you ever considered going to a pharmacy to order some new cardiomyocytes (heart muscle cells) for your ailing heart? It might sound crazy, but recent developments in stem cell science have made this concept not so futuristic. In this course, we will explore the underlying biology behind the idea of using stem cells to treat disease, specifically analyzing the mechanisms that enable a single genome to encode multiple cell states ranging from neurons to fibroblasts to T cells. Overall, we hope to provide a comprehensive overview of this exciting new field of research and its clinical relevance.

Pluripotent Stem Cells and Genome Engineering for Modeling Human Diseases
Link: http://ocw.mit.edu/courses/biology/7-342-pluripotent-stem-cells-and-genome-engineering-for-modeling-human-diseases-spring-2015/

Offered by: MIT

Description: One of the major priorities in biomedical research is understanding the molecular events that establish the complex processes involved in human development and the relationships of these processes to human disease and disease progression. In this class, we will explore stem cell biology and the way in which it has developed and shaped our ability to study complex human disease. We will introduce the field of stem cell biology and genome engineering through critical reading of both the classical and newest primary research literature. In addition, this course will discuss specific disease model systems and their benefits and limitations for understanding disease and treating human patients.

McGill

New Program/Major or Minor/Concentration Proposal Form

(2017)

1.0 Degree Title
Please specify the two degrees for concurrent degree programs

M.Eng.

1.1 Major (Legacy= Subject)(30-char. max.)

Sustainability in Engineering and Design

1.2 Concentration (Legacy = Concentration/Option)
If applicable to Majors only (30 char. max.)

Non-Thesis

1.3 Minor (with Concentration, if Applicable) (30 char. max.)

2.0 Administering Faculty/Unit

Graduate and Postdoctoral Studies

Offering Faculty/Department

Engineering / TISED

3.0 Effective Term of Implementation
(Ex. Sept. 2004 = 200409)
Term

201909

4.0 Rationale and Admission Requirements for New Proposal

SEE P1-2

5.0 Program Information
Please check appropriate box(es)

5.1 Program Type

- Bachelor's Program
- → **Master's**
- M.Sc. (Applied) Program
- Dual Degree/Concurrent Program
- Certificate
- Diploma
- Graduate Certificate
- Graduate Diploma
- Ph.D. Program
- Doctorate Program
- (Other than Ph.D.)
- Self-Funded/Private Program
- Off-Campus Program
- Distance Education Program
- (By Correspondence)
- Other (Please specify)

5.2 Category

- Faculty Program (FP)
- Major
- Joint Major
- Major Concentration (CON)
- Minor
- Minor Concentration (CON)
- Honours (HON)
- Joint Honours Component (HC)
- Internship/Co-op
- Thesis (T)
- → **Non-Thesis** (N)
- Other
- Please specify

5.3 Level

- Undergraduate
- Dentistry/Law/Medicine
- Continuing Studies (Non-Credit)
- Collegial
- → **Masters & Grad Dips & Certs**
- Doctorate
- Post-Graduate Medicine/Dentistry
- Graduate Qualifying
- Postdoctoral Fellows

5.4 FQRSC (Research) Indicator

(for GPS) Yes ___ **No X**

5.5 Requires Resources

Yes X No ___

6.0 Total Credits

45

7.0 Consultation with

Related Units	→ **Yes**	No
Financial Consult	→ **Yes**	No

Attach list of consultations.

8.0 Program Description (Maximum 150 words)

The Master of Engineering in Sustainability in Engineering and Design; Non-Thesis, focuses on the critical sustainability challenges of the 21st century. The program provides students with the opportunity to apply systems-based frameworks and sustainability metrics to analyze problems and design solutions for sustainability in engineering and design. It provides an interdisciplinary working environment for those working on sustainability.

9.0 List of proposed program for the New Program/Major or Minor/Concentration.

If new concentration (option) of existing Major/Minor (program), please attach a program layout (list of all courses) of existing Major/Minor.

Proposed program (list courses as follows: Subj Code/Crse Num, Title, Credit weight under the headings of: Required Courses, Complementary Courses, Elective Courses)

Master of Engineering (M.Eng.) in Sustainability in Engineering and Design; Non-Thesis *(45 credits)*

Required Courses (27 credits)

SEAD 500 Foundations of Sustainability for Engineering and Design (3)
SEAD 510 Energy Analysis (4)
SEAD 520 Life Cycle-based Environmental Footprinting (3)
SEAD 530 Economics for Sustainability in Engineering and Design (3)
SEAD 540 Industrial Ecology and Systems (3)
SEAD 550 Decision-Making for Sustainability in Engineering & Design (3)
SEAD 660 Strategies for Sustainability (3)
SEAD 670 Collaborative Design for Sustainability (5)

Complementary Courses (18 credits)

Students will take 12 to 18 credits from courses in one or two streams:

Stream 1 - Sustainable Processes and Manufacturing

CHEE 511 Catalysis for Sustainable Fuels and Chemicals (3)
CHEE 521 Nanomaterials and the Aquatic Environment + (3)
CIVE 521 Nanomaterials and the Aquatic Environment + (3)
CIVE 663 Environmental Fate of Organic Chemicals (4)
CIVE 677 Water-Energy Sustainability (4)
MECH 534 Air Pollution Engineering (3)
MECH 560 Eco-design and Product Life Cycle Assessment (3)
MIME 511 Advanced Subsurface Ventilation and Air Conditioning (3)
MIME 588 Reliability Analysis of Mining Systems (3)
URBP 506 Environmental Policy and Planning (3)

+ Students can take only one of CHEE 521 or CIVE 521

Stream 2 - Renewable Energy and Energy Efficiency

CHEE 511 Catalysis for Sustainable Fuels and Chemicals (3)
CIVE 677 Water-Energy Sustainability (4)
ECSE 562 Low-Carbon Power Generation Engineering (4)
MECH 534 Air Pollution Engineering (3)

Attach extra page(s) as needed

Stream 3 - Sustainable Urban Development

ARCH 515 Sustainable Design (3)
ARCH 517 Sustainable Residential Development (3)
ARCH 564 Design for Development (3)
MECH 534 Air Pollution Engineering (3)
URBP 504 Planning for Active Transportation (3)
URBP 551 Urban Design and Planning (3)
URBP 620 Transportation Economics (3)
URBP 651 Redesigning Suburban Space (3)

Stream 4 - Sustainable Infrastructure

ARCH 515 Sustainable Design (3)
ARCH 564 Design for Development (3)
CIVE 540 Urban Transportation Planning (3)
CIVE 621 Sustainable Design of Municipal Systems (4)
CIVE 623 Durability of Construction Materials (4)
CIVE 629 Sustainable Design: Water and Wastewater Facilities (4)
CIVE 652 Bioprocesses for Wastewater Resource Recovery (4)
SEAD 515 Climate Change Adaptation and Engineering Infrastructure (3)
URBP 620 Transportation Economics (3)
URBP 651 Redesigning Suburban Space (3)

Up to 6 credits from the following:

BIEN 520 High Throughput Bioanalytical Devices (3)
BREE 518 Ecological Engineering (3)
BREE 520 Food, Fibre and Fuel Elements (3)
CHEE 541 Electrochemical Engineering (3)
CHEE 543 Plasma Engineering (3)
CIVE 550 Water Resources Management (3)
ECSE 507 Optimization and Optimal Control (3)
MECH 535 Turbomachinery and Propulsion (3)
MECH 559 Engineering Systems Optimization (3)
MIME 556 Sustainable Materials Processing (3)
SEAD 600 Sustainability Research 1 (3)"
SEAD 602 Sustainability Research 2 (3)"
URBP 619 Land Use and Transportation Planning (3)

NOTE: " Students must find a supervisor from a McGill engineering, urban planning or architecture program before registering for SEAD 600 and 602, subject to approval by the program director.
NOTE: Other unlisted 500 level or higher courses taught at McGill may be permitted, subject to approval by the program director.

PROGRAM RATIONALE

A critical need

Industrial and urban development of the last century has been built on notions of an unlimited supply of natural resources (Davidson et al. 2010). While the world has experienced tremendous societal advances, including a global increase in living standards, we are becoming more and more aware of the unsustainable rates at which development patterns are consuming natural resources and producing waste (Anastas and Zimmerman, 2006). Phenomena such as water scarcity, desertification, deforestation, reduced fish stocks and agricultural productivity, are all being increasingly experienced and present tangible effects of overharvesting the earth's natural resources. In addition, steadily increasing levels of greenhouse gas emissions in the earth's atmosphere contribute to rising global environmental and climate changes and point to the acute need to rethink our consumption patterns (IPCC, 2014). Each of the last three decades has been successively warmer at the earth's surface than any preceding decade since 1850 (IPCC, 2014). This global trend has already started to effect climate patterns, contribute to rising sea levels and the occurrence of disaster events (IPCC, 2014). Engineers and designers play a significant role in developing and maintaining the projects, infrastructure and systems society uses. Thus, addressing the challenges of sustainability requires a specially trained group of engineers and designers who can lead the charge for sustainability thinking in their profession and in collective efforts to move society towards a future sustainable economy.

Sustainability as a wicked problem

Engineers and designers of the 21st century are tasked with devising creative new solutions that consider the constraints of our earth's carrying capacity while continuing to address the needs of a growing population used to an increasing standard of living (Davidson et al. 2007). There is an increasing acknowledgment that challenges such as climate change, resource scarcity, and environmental degradation should be recognized as *wicked problems* or problems that are not immediately solvable (Seager et al. 2012). Problems such as global pollution and resource extraction are tied to complex systems at varying scales, it is not likely that they are solvable with one solution but, rather, multiple approaches will be required (Seager et al. 2012). One of the fundamental problems with current approaches to address sustainability questions in most disciplines is that the methods and frameworks of their respective bodies of knowledge continue to be applied and very rarely are sustainability questions framed in wicked terms (Seager et al. 2012).

Training engineers and designers to address sustainability problems

Most accredited Engineering and Design programs in North America do not specifically teach students to operate in a "wicked milieu" (Seager et al. 2012). Tackling complex sustainability problems asks for different ways of forming problems. Seager et al. argue that a fundamental shift needs to occur to understand wicked problems as conditions to be governed, as opposed to problems to be solved (Seager et al. 2012). Students will need to be equipped to recognize and grapple with the ethical, adaptive, and cross-disciplinary challenges embedded in their practice development programs (Wiek et al. 2010). Davidson et al. elaborate further on the skills necessary for engineers and designers of the future. (1) They must be familiar with the concepts, language, and sources of information related to natural and social sciences. While not always expected to be experts in these domains, they should be comfortable and fluent in dealing with such experts. (2) Engineers must also have an awareness of major dilemmas that are best addressed by other disciplines. (3) In addition, they must be able to develop first-order predictions about potential outcomes and changes to environmental, economic, and social systems that result from engineering and design decisions (Davidson et al. 2010). Wiek et al. go further to propose a framework of five interrelated competencies that are seen as critical to tackling complex problems of sustainability in engineering and design. These include systems thinking, the ability to anticipate, the ability to strategize, normative competence strategies, and interpersonal abilities (Wiek et al. 2011). The goal of the proposed program is to train engineers and designers who can make progress on complex problems, primarily because it provides them with interdisciplinary and multi-faceted training.

DEFINITION OF THE BODY OF KNOWLEDGE

Defining sustainability in engineering and design

The concept of sustainability was initially popularized by the "Our Common Future" report, which addresses the term in the context of industrial and urban development as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). This broad definition has, over the years, been interpreted in many ways from different disciplinary perspectives. The National Association for Environmental Management defines sustainability as "a term that describes a company's strategies for acting as a responsible corporate citizen, ensuring its operations are financially sustainable and minimizing its environmental footprint" (US Dept. Labour, 2012). Engineers Canada has defined the term as "the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs, through the balanced application of integrated planning and the combination of environmental, social, and economic decision-making processes" (2016). The American Society of Civil Engineers defines sustainability as "a set of economic, environmental and social conditions in which all of society has the capacity and opportunity to maintain and improve its quality of life indefinitely without degrading the quantity, quality or the availability of economic, environmental and social resources" (ASCE, 2018). The American Institute of Architects has defined the term as "the ability to provide healthy and safe environments for people and the preservation of the earth's capability of sustaining a shared high quality of life" (COTE, 2018).

Drawing from all of these definitions, sustainability in engineering and design typically refers to the sustainable (re)design of products, systems and services and includes some form of environmental and social performance in the evaluation of designs (Allen et al. 2009). While simple in the abstract, reducing this concept to quantitative tools and performance metrics, from which engineers can precisely define questions and solve problems, is much more difficult and oftentimes not possible (Allenby et al. 2007; Davidson et al. 2010). The definitions above point to an

expanded need for sustainable engineering and design to address more than technical solutions to wicked problems, and must also address social, economic, and environmental considerations (Lubichenco. 1998; Hokanson et al. 2007; Beddoe et al. 2009 Seager et al. 2012).This calls for a need to develop new frameworks, which teach engineers to designers to operate in inter-disciplinary and collaborative contexts, to allow for more complex problem solving (Seager et al. 2012). A nationwide benchmarking study conducted by the Center for Sustainable Engineering, identified four critical competencies for future engineers tackling problems for sustainability. They include, (1) an ability to appreciate complex "wicked" problems and design for multiple objectives, (2) the ability to analyze problems with systems-based frameworks such life-cycle analysis, sustainable design, industrial ecology and the circular economy, (3) the ability to collaboratively work with other disciplines in a interdisciplinary setting and finally, (4) the ability to understand and design engineering solutions at multiple scales (Allen et al. 2009). The diagram represented in Figure 1.0 below interprets these competencies and is used as a pedagogical concept map to help guide the development of the proposed master's program.

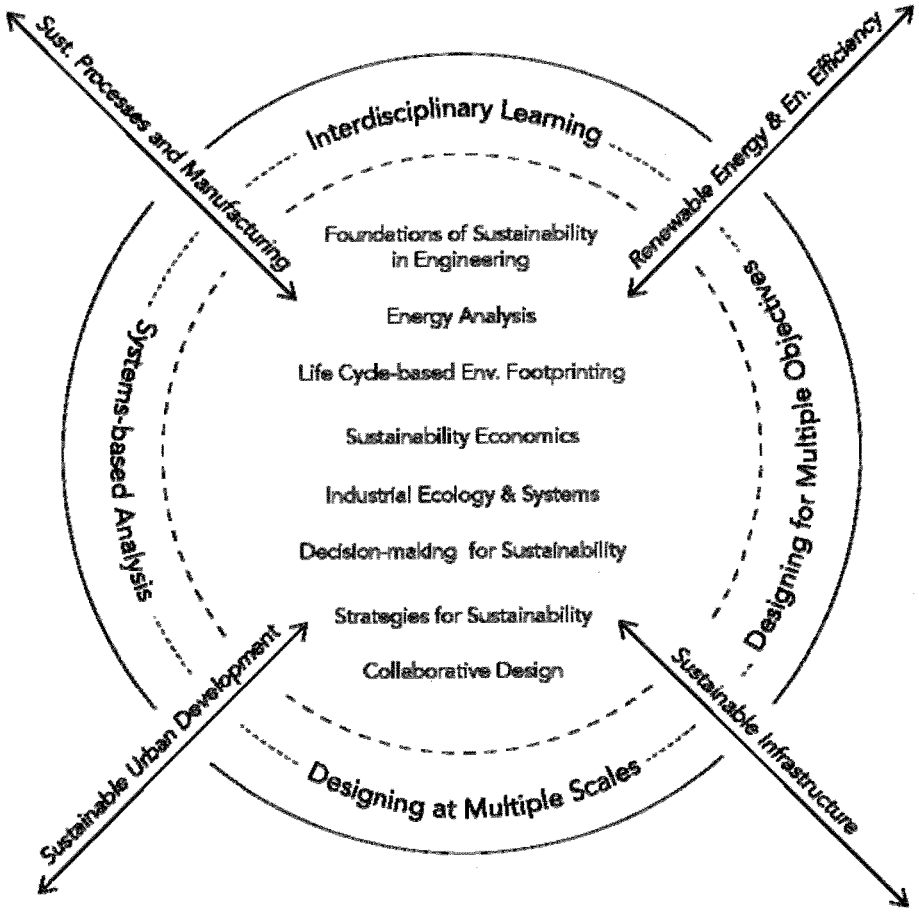

Figure 1
Concept map, adapted from key competencies outlined in *Incorporating Sustainability into Chemical Engineering Education* (Allen et al, 2009).

ORIGINALITY OF THE PROPOSAL

Sustainability in engineering and design in higher education

The proposed Master of Engineering in Sustainability in Engineering and Design; Non-Thesis will be the first M.Eng. program in Canada to offer a broad approach to teaching sustainability in engineering and design. Students will be trained with critical skills in sustainability in engineering and design while also being able to specialize in the engineering field of their choice. With the exception of a select few institutions, such as Carnegie Mellon University and Cambridge University, there remain very few schools that address sustainability in engineering and design in broad terms. If interdisciplinarity remains one of the critical tenants of sustainability thinking, there is a need to move beyond what Seager et al. call the "single treatment approach" (2012) and to introduce broader programs that integrate sustainability throughout the curriculum (Seager et al. 2012).

Over the past decade, several schools of engineering and design have begun to embrace the need to include sustainability content in education (Rowe, 2007). In recent years, several new masters and Ph.D. programs in sustainability in engineering and design have emerged, most of which have specialized on very focused disciplinary fields, such as sustainable water systems (U of Michigan) or sustainable design and construction (Stanford University). It has been noted that this trend is not surprising as new programs, not grounded in traditional core disciplines, make some people — and educational institutions — wary. This narrow focus may, in fact, be working against some of the

interdisciplinary objectives implicit in sustainable thinking (Mascarelli, 2013). Christ et al. have also expressed a need to exert caution regarding discipline-specific program transformations, "due to the well-founded desire to retain a foundation in a core discipline" (Christ et al. 2015).

Industry demand

Both local and global trends suggest a growing desire in industry for professionals who are adept in applying sustainability concepts to a diverse range of practical problems. A recent survey with industry professionals from nine prominent Quebec-based corporations revealed a need for sustainability experts in engineering and design and a 15.4% increase in employment of sustainability managers over the past ten years (MBCG study, 2015). A strong demand also exists nationally. In 2013, there were over 730,000 environmental professionals in Canada, which accounted for just over 4% of the country's labour force (Barbier, 2016). A recent study looking at Canada's cleantech sector (which includes technology related to recycling, energy information, green transportation, electric motors, green chemistry, lighting, and greywater) identified 856 companies which provide 55,200 jobs throughout Canada (SDTC, 2017). This has increased by 5% since 2012 (SDTC, 2012). Globally, research also suggests that sustainability is becoming an increasingly important priority for businesses worldwide. In a survey of 2,711 global corporations, undertaken by McKinsey and Co, 70% of respondents claim that their organizations have some form of governance for sustainability in place, an increase of 56% since 2014 (McKinsey & Co, 2017). These statistics are further reinforced by the most recent UN Global Compact report, which suggests that strategies for sustainable development are monitored at the CEO level in 69% of businesses surveyed, up 4% since 2008, and that 70% of companies are reporting publicly about specific sustainability targets (UN Compact, 2017).

Student interest

By conducting an in-depth needs analysis, TISED was able to gauge demand from prospective students, alumni, and employers, with very positive results. Student demand was assessed through a survey of 591 respondents, where the sample included current undergraduate and graduate students, as well as undergraduate and graduate alumni. 31% of respondents expressed an interest in applying to the program, the most enthusiastic segment coming from undergraduate alumni. The second most interested group were current undergraduate students (TISED Survey, 2015).

McGILL, SUSTAINABILITY AND THE TISED MASTER'S PROGRAM

Vision 2020: Climate and Sustainability Action Plan
link: https://www.mcgill.ca/sustainability/sustainability-strategy
The proposed Master of Engineering in Sustainability in Engineering and Design; Non-Thesis contributes to the university's long-term target of attaining the university AASHE platinum rating by 2030. With the introduction of this program, TISED has created over 14 new course, and 9 course revisions, which directly advance sustainability teaching throughout the Faculty of Engineering and that will provide credits toward this platinum classification. The program also contributes to Research, Education, and Connectivity on campus, three critical themes of the university's Vision 2020 strategic plan.

Guiding principals of the Faculty of Engineering
link: http://www.mcgill.ca/engineering/about/guiding-principles
As a program designed around interdisciplinary learning, and advancing state-of-the-art concepts for thinking on engineering and design for sustainability, the program addresses all five of the guiding principles of the Faculty of Engineering: Collaboration and Networking, New Approaches, Sustainability, Personal Development, and Environmental Scanning.

RELEVANCE TO THE UNIVERSITY NETWORK

A review of all of McGill's existing graduate-level programs was undertaken to determine whether the university may offer a similar program outside of the Faculty of Engineering. The findings did not identify any programs with considerable overlap. The results are listed below.

M.Sc. Bioresource Engineering (46 credits)
Offered by the dept. of Bioresource Engineering (Faculty of Agricultural and Environmental Sciences)

Comments: The water resource management and waste management components of this degree may overlap slightly with a few complementary courses offered in the Sustainable Infrastructure stream of the proposed Master of Engineering in Sustainability in Engineering and Design; Non-Thesis; however the content in the bioresource program is not specifically discussed in the context of sustainability.

M.Sc. Geography / Environment (Thesis) (45 credits)
Offered by dept. of Geography (Faculty of Science)

Comments: The similarities between this program and the proposed Master of Engineering in Sustainability in Engineering and Design; Non-Thesis, lie mainly in the approach to advancing interdisciplinary learning through seminar-based courses that receive students from various departments. There is very little content overlap, and the geography/environment degree does not focus on engineering content. It should however be noted that this program provides significant training of undergraduate and graduates through research and other co-curricular activities.

COMPARABLE M.ENG. PROGRAMS IN SUSTAINABILITY IN ENGINEERING & DESIGN

A scan was undertaken of similar M.Eng. programs offered at both national and international institutions. Several programs were found to address sustainability in engineering and design within very specific fields, such as renewable energy or sustainable infrastructure. Very few offered a program with comparable breadth as the proposed Master of Engineering in Sustainability in Engineering and Design; Non-Thesis. Table 1 summarizes the findings of the study. It compares the similarities and differences between 14 different master's programs. The results of this analysis underscore a pressing need for a leading post-secondary institution to provide a comprehensive interdisciplinary program in sustainability in engineering and design. The proposed Master of Engineering in Sustainability in Engineering and Design; Non-Thesis addresses this need with a broad curriculum that allows students a high degree of freedom to specialize in the area of their interest.

			Required Core			Stream or Concentration					
	University	Title	Analysis	Social Sciences	Design	Energy	Processes & Manuf.	Urban Design	Research	Intern	Credit
Canada – Quebec	McGill	M.Eng Sustainability in Engineering and Design	X	X	X	X	X	X	X	0%	45
	Polytechnique Mtl	M.Eng in Chem. Engineering - Energy and Sust Dev	X	X	-	X	-	-	-	33%	45
	Polytechnique Mtl	M.Eng in Industrial Engineering - Organizational Resilience	X	X	-	-	X	-	-	33%	45
Canada	U of British Columbia	M.Eng Energy Leadership in Clean Energy Engineering	X	X	-	X	-	-	-	0%	30
	U of Calgary	M.Eng Interdis spec. in Energy and Environment	X	-	-	X	-	-	-	0%	30
	U of Ottawa	M.Sc Environmental Sustainability	-	X	-	-	-	-	X	19%	31.5
	Queens University	M.Eng in Applied Sustainability (CMAS)	-	X	-	X	X	-	X	0%	30
	U of Toronto	M.Eng in Civil Engineering - Sust Urban Systems	X	-	-	X	-	X	X	0%	30
International	Arizona State U	MSc in Eng: Sustainable Engineering	X	X	-	X	-	X	-	0%	30
	U of Cambridge	MPhil in Engineering for Sustainable Development	X	X	X	X	-	X	X	0%	30
	Carnegie Mellon U	M.Sc in Civil and Env. Engineering - Env.Eng, Sust & Sc	X	X	X	X	X	X	X	0%	32
	U of Colorado Denver	M.Eng Environmental and Sustainability Engineering	-	X	-	-	-	X	-	0%	30
	U of Michigan	M.Sc Sust Systems & M.Sc in Civil Engineering	-	X	X	X	X	-	-	0%	54
	Rochester Tech	M Sc in Sustainable Systems	-	X	X	X	X	X	-	0%	30
	Stanford U	M.Sc in Civil and Env Engineering in Sust Design and Construction -Sustainable Urban Systems	-	X	X	-	-	X	-	0%	30

Table 1
A comparison of 14 different master's programs in engineering and design.

PROGRAM STRUCTURE

The proposed Master of Engineering in Sustainability in Engineering and Design; Non-Thesis will be a course-based master's program of 45 credits, taken over a minimum of three academic terms. All courses are a minimum of three credits and each provides a minimum of 39 total contact hours. McGill uses a semester system, with three semesters per Academic Year: Fall (September – December), Winter (January – April) and Summer (May – August). The majority of classes will be offered in the Fall and Winter semesters. The program structure is summarized in Figure 2.

Sixty percent (27 credits) of the program curriculum consists of required core courses. The remaining forty percent (18 credits) consist of complementary courses, which offer students the flexibility of focusing their studies on their interests. The complementary courses have been arranged into four program streams to provide a framework to help students focus on the particular areas of (1) Sustainable Processes and Manufacturing, (2) Renewable Energy and Energy Efficiency, (3) Sustainable Urban Development and (4) Sustainable Infrastructure. Additional advanced courses are also listed. All stream courses address sustainability content and complement the skills being taught in the core classes. Stream courses are also designed to be accessible to the breadth of engineers, architects and planners entering the program. The list of complementary courses includes courses which teach sustainability concepts and skills at advanced levels for students who come into the program with advanced knowledge of a particular field. Students may also take up to 6 credits of unlisted courses offered at McGill which directly relate to the program and its training goals. The list also includes research courses which allow students to undertake a self-directed research project in collaboration with a professor of engineering, urban planning or architecture at McGill.

Required Core Courses (27 credits)

The program's (required) core courses are designed to equip students with the necessary concepts, skills and tools in the context of interdisciplinarity, and to devise solutions from holistic strategies, using quantitative sustainability metrics. Learning Objectives for the core training include:

1. Understanding multiple concepts and paradigms for sustainability from different disciplines and stakeholders.
2. An appreciation of the complexity of sustainability problems and an understanding that engineering solutions must address multiple solutions at varying scales.

3. Apply systems based frameworks such as life cycle analysis, environmental foot printing, ecological economics, industrial ecology and social and political ecology, and the ability to apply these frameworks to analyze complex problems, and create systems based solutions.
4. Evaluate and formulate sustainability metrics to the analysis of proposed solutions for engineering and design.
5. An understanding of the professional roles and obligations of engineers and designers in addressing sustainability challenges.
6. Apply skills and competencies of collaboratively working in an interdisciplinary setting.

Core courses are designed to be delivered in a sequence. In the first semester, students will take SEAD 500 Foundations for Sustainability in Engineering, SEAD 510 Energy Analysis, and SEAD 520 Life Cycle-based Environmental Footprinting. These courses introduce students to the theoretical understandings of sustainability in engineering and design, as well as equip them with critical analytical tools that will be used throughout the remainder of the program. Over the second semester, students are asked to explore engineering problems, through interdisciplinary perspectives, which often fall outside a typical engineering education. Courses include SEAD 530 Economics for Sustainability in Engineering and Design, SEAD 540 Industrial Ecology and Systems, and SEAD 550 Decision-Making for Sustainability in Engineering & Design. Two advanced-level courses are taught in the third semester and require students to synthesize and apply their knowledge towards problem solving in a management/governance context (in SEAD 660 Strategies for Sustainability), and towards the design (or redesign) of products, buildings, or infrastructure (in SEAD 670 Collaborative Design for Sustainability).

TERM 1

Course	Credits	Prerequisites / notes
SEAD 500 *Foundations of Sustainability for Engineering and Design*	3	
SEAD 510 *Energy Analysis*	4	
SEAD 520 *Life Cycle-based Environmental Footprinting*	3	
Complementary	3	select from Stream Courses or List A
Complementary	3	select from Stream Courses or List A
	16	

TERM 2

Course	Credits	Prerequisites / notes
SEAD 530 *Economics for Sustainability in Engineering and Design*	3	
SEAD 540 *Industrial Ecology and Systems*	3	
SEAD 550 *Decision-Making for Sustainability in Engineering & Design*	3	
Complementary	3	select from Stream Courses or List A
Complementary	3	select from Stream Courses or List A or List B*
	15	

TERM 3

Course	Credits	Prerequisites / notes
SEAD 660 *Strategies for Sustainability*	3	min 9 SEAD credits
SEAD 670 *Collaborative Design for Sustainability*	5	min 9 SEAD credits
Complementary	3	select from Stream Courses or List A
Complementary	3	select from Stream Courses or List A or List B*
	14	

Summary	Credits
Required Courses	27
Complementary (Stream Courses, List A, List B)	18
	45

*approval from an academic advisor is required to take courses from list B

Figure 2
Proposed Curriculum for M.Eng. in Sustainability in Engineering and Design

Complementary Courses (18 credits)
Complementary courses are divided into four streams, which focus on specific themes, as well as some additional courses. Students will have to choose from up to two streams. It is anticipated that more courses will be added to this list in the future as new courses related to sustainability are introduced across the faculty.

Stream 1 - Sustainable Processes and Manufacturing (SPM): Aimed at teaching leading approaches in manufacturing and industry to reduce energy use, water, materials and resource use, and environmental impacts, with particular emphasis on prospective or consequential life-cycle assessments of products and processes. Courses in this stream also relate to assessments of the impact of industrial chemicals and nanomaterials on the environment. Policies and institutions for implementing sustainable solutions are also covered.

Stream 2 - Renewable Energy and Energy Efficiency (REEE): Focused on generation and distribution of low-/no-carbon energy and its relation to storage and energy-carrier systems. The stream will train students on technology assessment for sustainable energy supply and use, and the nexus between energy systems and water resources. The synthesis of renewable fuels from biomass, waste and carbon dioxide will be covered. This stream includes the impact of power-generation systems and combustion processes on the environment.

Stream 3 - Sustainable Urban Development (SUD): Explores the design and re-engineering of urban environments to reduce natural resource consumption, waste generation, and energy use, in the context of urban growth and development in the local and global context. Adapting cities to climate change pressures towards resilient and low environmental footprint urban systems, reduced energy consumption in construction methods, residential development, public urban spaces, and densification strategies are covered.

Stream 4 - Sustainable Infrastructure (SI): Focuses on how critical infrastructure, such as buildings, bridges, transportation networks, water supply, waste disposal can be built and operated in a manner to reduce natural resource consumption, waste generation, and energy use. Considerations for adapting infrastructure for climate change through future climate scenario-informed design criteria, materials use and operation strategies. Opportunities and technologies for resource and energy recovery from waste is examined.

In addition to the 32 complementary courses discussed above, students are also eligible to take classes from a list of 11 advanced-level courses and 2 research courses. The advanced-level courses all directly address sustainability but require an advanced level of knowledge from a particular field of engineering, urban planning or architecture and may not be immediately accessible to all of the diverse sets of backgrounds coming into the program. The advanced-level courses on this list provide additional options for students who have specialized expertise in a particular field that they would like to further pursue. Students may also take up to 6 credits of other unlisted graduate courses taught at McGill. Unlisted graduate courses must directly relate to the program and its training goals, and are subject to approval by the program director. The research courses SEAD 600 and SEAD 602 provide an opportunity for students to explore issues of sustainability within their respective field of engineering, urban planning, or architecture. Students must find a supervisor in a McGill engineering, urban planning or architecture program before registering for these research courses, subject to approval by the program director, and are required to complete a written report and a presentation before the end of the semester. Research projects should address and include perspectives from the social sciences.

ADMISSION REQUIREMENTS

Applicants to this M.Eng. (Non-Thesis) program must hold an undergraduate degree in Engineering, Urban Planning, or Architecture (or equivalent) with a minimum CGPA equivalent to 3.0 on a scale of 4.0. Alternatively, an equivalent grade point average of 3.2 over the last two years of the program will be accepted. For non-native speakers of English, or who have not completed a degree in English, students must demonstrate English proficiency in one of the following ways.

- Achieved a minimum TOEFL score on the iBT (internet based test) of 86 overall and no less than 20 in each of the four component areas, or;
- Achieve a minimum band score of 6.5 or greater (Academic module) and no less than 6.0 for each of listening, reading, writing and speaking, for the IELTS (International English Language Testing System)

Two letters of reference are required, both of which should attest to the candidate's interest in Sustainability in Engineering and Design. Applicants must submit a copy of their most recent curriculum vitae and a 1 page personal statement describing their background, research interests and/or streams of interest, and reasons for wishing to undertake the proposed program. Satisfaction of these minimum requirements does not guarantee admission.

SOURCES

2017 United Nations Global Compact Progress Report: Business Solutions to Sustainable Development. Un Compact, 2017, pp. 1–51, 2017 United Nations Global Compact Progress Report: Business Solutions to Sustainable Development.

Allen, David T., et al. "Incorporating sustainability into chemical engineering education." Chemical Engineering Progress 105.1 (2009): 47-53.

Allenby, Brad, David Allen, and Cliff Davidson. "Sustainable engineering: From myth to mechanism." Environmental Quality Management 17.1 (2007): 17-26.

Anastas, P. T., and J. B. Zimmerman. "The twelve principles of green engineering as a foundation for sustainability." Sustainability Science and Engineering. Vol. 1. Elsevier, 2006. 11-32.

Aurandt, Jennifer L., and Elizabeth C. Butler. "Sustainability education: Approaches for incorporating sustainability into the undergraduate curriculum." Journal of Professional Issues in Engineering Education and Practice 137.2 (2011): 102-106.

Barbier, Edward B. "Building the green economy." Canadian Public Policy 42.s1 (2016): S1-S9.

Brundtland, Gro H. Report of the World Commission on Environment and Development: "our Common Future.". New York: United Nations, 1987. Print.

"COTE - Committee on the environment an AIA knowledge community" American Institute of Architects (AIA), 2018, https://network.aia.org/committeeontheenvironment/home

Cowan, David Jan, et al. "Sustainability and Education: The Need for New Degree Options." Earth and Space 2010: Engineering, Science, Construction, and Operations in Challenging Environments. 2010. 3821-3832.

Davidson, Cliff I., et al. "Adding sustainability to the engineer's toolbox: a challenge for engineering educators." (2007): 4847-4849.

Davidson, Cliff I., et al. "Preparing future engineers for challenges of the 21st century: Sustainable engineering." Journal of cleaner production 18.7 (2010): 698-701.

Engineers Canada "National Guideline on Environment and Sustainability.", 2016, pp. 1–12.

Hamilton, James. "Is a Sustainability Career on Your Green Horizon?." US Department of Labor, Bureau of Labor Statistics downloaded at http://www. bls. gov/green/sustainability/sustainability. htm (2012).

Rowe, D. "Sustainability: Education for a Sustainable Future." Science, vol. 317, no. 5836, 2007, pp. 323–324., doi:10.1126/science.1143552.

Mascarelli, Amanda. "Sustainability: Environmental puzzle solvers." Nature 494.7438 (2013): 507-509.

American Society of Civil Engineers (ASCE), "Sustainability" 2018, www.asce.org/sustainability/.

Sustainable Development Technology Canada. 2017, pp. 1–33, 2016/2017 Annual Report.

"Sustainability's Deepening Imprint." McKinsey & Company, Dec. 2017, www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/sustainabilitys-deepening-imprint.

10.0 Approvals

Routing Sequence	Name	Signature	Date
Department	Subhasis Ghoshal	S.Ghoshal	18 Apr 2018
Curric/Acad Committee	Laurent Mydlarski	L. Mydlarski	02 May 2018
Faculty 1	Laurent Mydlarski	L. Mydlarski	17 May 2018
Faculty 2			
Faculty 3			
CGPS	SCTP APPROVED	CGPS APPROVAL	September 17, 2018
SCTP			JAN. 10, 2019
APC		APC	Feb 14, 2019
Senate		SENATE	FEB 20, 2019

Submitted by

Name	
Phone	
Email	
Submission Date	

To be completed by ARR:

CIP Code