SENATE

NOTICE OF MEETING

February 10, 2023

Please be advised that the next regular meeting of Senate of Concordia University will be held on Friday, February 17, 2023, at 2 p.m., in the Norman D. Hébert, LLD Meeting Room (Room EV 2.260) on the SGW Campus.

The Agenda and documents for the Open Session meeting are now posted on the Senate webpage.

Please note that there is no Closed Session for this meeting. The Senate meeting will start with the Open Session at 2:00 p.m., and all members of the University community who wish to view the Open Session meeting will be admitted at this time.

Karan Singh
Secretary of Senate

UNIVERSITÉ Concordia UNIVERSITY

AGENDA OF THE OPEN SESSION
OF THE MEETING OF SENATE

Friday, February 17, 2023, at 2 p.m
in the Norman D. Hébert, LLD Meeting Room
(Room EV 2.260) on the SGW Campus
and via Zoom video conferencing

Item		Presenter(s)	Action
1.	Call to order	G. Carr	
	1.1 Approval of the Agenda	G. Carr	Approval
	1.2 Adoption of Minutes from the Open Session meeting of December 16, 2022	G. Carr	Approval
2.	Business arising from the Minutes not included on the Agenda	G. Carr	
3.	President's remarks	G. Carr	Information
4.	Academic update (Document US-2023-1-D1)	A. Whitelaw	Information
CONSENT AGENDA			
5.	Tribunal Pool/Committee Appointments (Document US-2023-1-D2)		Approval
6.	Research Committee Report (Document US-2023-1-D3)		Information

REGULAR AGENDA

7.	Academic Programs Committee – Report and recommendation – Microprogram in Indigenous Land-Based Education (Document US-2023-1-D4)	A. Whitelaw/ C. Richardson	Approval
8.	Academic Programs Committee – Report and recommendation - B. Eng in Chemical Engineering (Document US-2023-1-D5)	A. Whitelaw/ M. Debbabi	Approval
9.	Research Data Management Strategic Plan (Document US-2023-1-D6)	A. Whitelaw/ P. Riva / D. Dennie	Approval
10.	Question period (*maximum 15 minutes*)		
11.	Other business		
12.	Adjournment	G. Carr	

US-2022-7

MINUTES OF THE OPEN SESSION
OF THE MEETING OF SENATE

Friday, December 16, 2022
following the meeting of the Closed Session
in the Norman D. Hébert, LLD Meeting Room
(Room EV 2.260) on the SGW Campus
and via Zoom video conferencing

PRESENT

Voting Members: Graham Carr (Chair), Mohamad Abdallah, Nagendra Sri Anurag Appala, Leslie Barker, Matthew Barker, Sabine Bergler, Dominique Bérubé, Beverley Best, Catherine Bolton, Adam Bouguila, Sally Cooke, Anne-Marie Croteau, Fabienne Cyrius, Selvadurai Dayanandan, Mourad Debbabi, Larry Deck, William Dickson, Mary Esteve, Mehdi Farashahi (attended remotely), Annie Gérin, Marina Ghali (attended remotely), Fawaz Halloum, Steve Henle (attended remotely), Asli Isaaq, Jordan Jerome-Pitre, Michael Lecchino, Sofia Lipari-Couture, Peter Morden (attended remotely), David Morris, Catherine Mulligan, Fuzhan Nasiri (attended remotely), Xavier Ottenwaelder (attended remotely), Mireille Paquet (attended remotely), Peter Pawelek (attended remotely on behalf of Effrosyni Diamantoudi), Thenmozhie Rajan, Ian Rakita, Nachiketh R. Ravindra, Rosemary Reilly (attended remotely), Pat Riva (attended remotely), Pascale Sicotte, Sofiane Tahar (attended remotely), Kelly Thompson (attended remotely), Craig Townsend, Guylaine Vaillancourt (attended remotely), Deeva Wazir, Anne Whitelaw (attended remotely), Radu Grigore Zmeureanu (attended remotely)

Non-voting members: Philippe Beauregard (attended remotely), Paul Chesser, Denis Cossette (attended remotely), Stéphanie de Celles, Michael Di Grappa (attended remotely), Tom Hughes, Frederica Jacobs, Emilie Martel (attended remotely), Stefana Nita

Also attending: William Cheaib, Richard Courtemanche (attended remotely), Saba Din, Sandra Gabriele, Martin Lefebvre (attended remotely), Lisa Ostiguy (attended remotely), Melodie Sullivan (attended remotely)

ABSENT

Voting members: Alexandra Dawson, Samreet Kaur, Moshe Lander, Christopher Moore, Emilie Rosenthal-Bustamante, Ahmadou Sakho

<u>Non-voting members:</u> Isabel Dunnigan, Nadia Hardy

1. Call to order

The President called the meeting to order at 2:24 p.m.

1.1 **Approval of the Agenda**

R-2022-7-3 Upon motion duly moved and seconded, it was unanimously resolved that the revised Agenda of the Open Session be approved.

1.2 **Adoption of November 11, 2022 Minutes**

R-2022-7-4 Upon motion duly moved and seconded, it was unanimously resolved that the Minutes of the Open Session meeting of November 11, 2022, be adopted.

2. Business arising from the Minutes not included on the Agenda

There was no business arising from the Minutes not included on the Agenda.

- **President's Remarks**

The President's remarks are summarized as follows:

- G. Carr expressed that it has been heartening to have students on campus and again seeing so many activities on campus. The University is winding down for the end of term and will be closed starting at end-of-day Friday, December 23rd, and re-opening on January 9th. The only event scheduled during the break was the annual Molson School MBA International Case Competition, scheduled for January 2nd to 6th.

- He reminded Senators that a request was sent out with the document package to donate to the Student Emergency Fund.

- On Wednesday, December 14th, Maimunah Mohd Sharif, the Executive Director of UN Habitat was on campus with colleagues from her organization for a two-hour meeting hosted by NextGen Cities Institute. UN Habitat announced at COP27 that they will be opening an office in Montréal in 2023 with a focus on applying AI to address challenges of smart, sustainable urban growth. Concordia was one of the main supporters of this initiative.

- The University also hosted the launch of the Canadian office of the Canada-Asia Business council at the John Molson School of Business building. The Council promotes trade and other forms of exchanges between Canada and the ASEAN countries, which include Vietnam, Cambodia, Malaysia, Indonesia, Singapore and Brunei. The event saw over 100 attendees from international organizations, industry, NGOs and diplomatic corps, including Jean Charest (honorary Chair), Louis Vachon (co-chair), and Minster Pierre Fitzgibbon and the Assistant Deputy Minister of Global Affairs Canada. Board member Francis Baillet was also present along with Michael Novak. G. Carr thanked A.-M. Croteau for making space at the JMSB available for this event.

- G. Carr ended by wishing everyone a safe and restful holiday season.

3. Academic update (Document US-2022-7-D1)

There was nothing to add in addition to the written report.

CONSENT

4. Tribunal Pool/Committee Nominations (Document US-2022-7-D2)

R-2022-7-5 Upon motion duly moved and seconded, it was unanimously resolved that the Tribunal Pool and Committee appointments be approved.

5. Academic Programs Committee – Report and recommendations (Document US-2022-7-D3)

R-2022-7-6 Upon motion duly moved and seconded, it was unanimously resolved that the Academic Programs Committee - Report and recommendations (Document US-2022-7-D3) be approved.

REGULAR

6. Academic Programs Committee – Report and recommendation – Alternative Entry (OOTR-OOTR-5138; GCS-GCS-101; UNVSKIL-UNVSKIL-5141) (Document US-2022-7-D4)

A. Whitelaw presented the item as the first bridging program, which would support access to engineering programs for Indigenous students.

R-2022-7-7 Upon motion duly moved and seconded, it was unanimously resolved that, following recommendation of the Academic Programs Committee, the Senate approve changes (New Kaié:ri Nikawerà:ke Indigenous Bridging Program and Alternative Entry changes) - OOTR-OOTR-5138;GCS-GCS-101;UNVSKIL-UNVSKIL-5141 as detailed in the attached document (Document US-2022-7-D4).

7. Academic Programs Committee – Report and recommendation – Microprogram in Fundamentals of Digital Filmmaking under the Mel Hoppenheim School of Cinema (FA-CINE-4461) (Document US-2022-7- D5)

A. Gerin presented the item and spoke to making more programs available to respond to the growing cinema industry in Quebec.

R-2022-7-8 Upon motion duly moved and seconded, it was unanimously resolved that, following recommendation of the Academic Programs Committee, the Senate approve the microprogram in Fundamentals of Digital Filmmaking under the Mel Hoppenheim School of Cinema (FA-CINE-4461) as detailed in the attached Document (Document US-2022-7-D5).

8. Centraide Campaign (Document US-2022-7-D6)

P. Beauregard presented the item, informing Senate that the campaign raised more than $206,000 in donations. With many in-person events, this year's campaign was a success and will support the needs of the community of Montreal, where more than 600,000 people are in need of support with food costs.

This item was presented for information only.

9. Question period

There were no questions asked during the question period.

10. Other business

There was no other business to bring before the Open Session.

11. Adjournment

The meeting was adjourned at 2:42 p.m.

K. Singh
Karan Singh
Secretary of Senate

Internal Memorandum

To: Members of Senate
From: Anne Whitelaw, Provost and Vice-President, Academic
Date: February 8, 2023
Re: Academic Update

This month's Academic Update to Senate is the first of 2023 and it's shaping up to be a busy year for Concordia faculty, staff and students. Here is an overview of some of the things happening at the university.

The John Molson Chartered Professional Accountancy (CPA) Program continues to have a strong Common Final Examination pass rate and the school is proud of its 2022 capstone cohort. Ninety students successfully passed the 2022 Common Final Examination (CFE), with one of our students, Jaeanne Bayucot, being recognized on the Honor Roll.

The Mel Hoppenheim School of Cinema is now recruiting for its new 9-credit undergraduate Microprogram in the Fundamentals of Digital Filmmaking. This program, to be offered each Summer, brings 15 students though the process of producing a short movie; teaching them how to express their distinct creative voice, develop artistic skills and apply aesthetic judgment.

The John Molson School of Business is now a full member of the European Foundation for Management Development (EFMD), an international, not-for-profit, membership organization of business schools and corporations. This means that the school now has voting rights in the EFMD Global Network Annual General Platforms. But, most importantly this full membership status is a requirement for accreditation. Becoming a full member is a path to becoming an EQUIS-accredited institution.

Concordia University is now the site of the newly inaugurated Canadian office of the Canada-ASEAN Business Council (CABC) in the John Molson School of Business. Celebrating its 10th anniversary this year, CABC looks forward to pursuing its advocacy, networking, and education efforts in the Canada and Southeast Asian Nations economic corridor. For Concordia, hosting the organization is the latest step in a rich collaboration between the two organizations and places ASEAN at the heart of Concordia's internationalization strategy. The new partnership comes in the wake of announcements of the new Canada and Quebec Indo-Pacific Strategies. The ASEAN region was established in 1967 and is comprised of 10 nations: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam.

The Mel Hoppenheim School of Cinema and Kiuna College, an Indigenous CEGEP situated in Odanak, have signed an agreement that facilitates and encourages transition to university by recognising equivalent credentials. The agreement is for the BFA in Film Production and the BFA in Animation.

The Faculty of Fine Arts has joined a pan-Canadian network, led by with OCAD University, to implement the Mindful Campus Initiative. Funded by the Public Health Agency of Canada, this pilot develops a suite of mindfulness training, resources and activities tailored specifically to art and design students. OCAD will be developing the program in collaboration with the Centre for Mindfulness Studies. The program will be offered at Concordia in Fall 2023 and Winter 2024.

Concordia's John Molson Sustainable Enterprise Committee and the Concordia Precious Plastic Project (CP3) has been preselected to participate in the Global Dialogue: Sustainable Campus & Communities launched by ENLIGHT, a European University Alliance formed by comprehensive, research-intensive universities from nine European countries (Belgium, Estonia, France, Germany, Ireland, Netherlands, Slovakia, Spain, Sweden).

The John Molson School of Business undergraduate student delegation reached the podium again at this year's prestigious Jeux du Commerce case competition. The students were coached during the entire fall term and their efforts yielded 10 podium finishes in seven different academic disciplines. They placed third overall at the event, which took place in-person from January 6 to 9 and was hosted by HEC Montréal. Participating in the Jeux du Commerce requires students to take the COMM 499 seminar course, which is taught by Nora Baronian, BSc 99, MBA 06, director of the case competition program and a senior lecturer in the Department of Management. To qualify for the course, students try out for the team in the spring. An average of 300 students apply, but less than a third are selected. Fourteen universities across Quebec and the east of Canada take part at this competition. This year's final John Molson representatives consisted of 86 delegates: 40 in academic, four in debate, 18 in sports, 11 in participation, four in social, six internals, two coordinators and one program director/faculty advisor.

The Department of Mathematics and Statistics named five winners for its inaugural video contest, Math and Stats: 1:01. The aim of the contest was twofold: to supply undergraduate and graduate students with new tools for communication that can be useful in their future careers; and to encourage students to create videos related to their research. Entries had to be accessible to a general audience and demonstrate creativity and strong video production.

The Kaié:ri Nikawerà:ke Indigenous Bridging Program, originally developed within the Indigenous Directions Office, has transitioned operations into the Student Success Centre within Student Services. The program has officially launched and recruitment for the program is now taking place to welcome our first cohort of students in fall 2023, who will ultimately bridge into the Gina Cody School of Engineering and Computer Science. Development of the next iteration of the program, which will include welcoming bridging students into additional Concordia faculties, is underway to be launched in fall 2024.

For winter 2023 Orientation, which took place over 4 phases, Services for New Students (Student Success Centre) saw approximately 5,500 instances of student attendance at events or student interactions at our different pop-up kiosks on campus. That's an increase of just over 300% from last winter. Highlights included a 2-day sugar shack on the Hall Mezzanine, which was a big hit with the large international student winter cohort who appreciated the welcome to Quebec.

FutureBound (Student Success Centre) launched a new skill module on Financial Literacy. The goal is to support students to be able to plan, decide and reflect about their financial lives knowledgeably and proactively. The new module will provide undergraduate students with hands-on and practical financial literacy tools and workshops. Find the winter 2023 financial literacy offerings.

Student Learning Services (Student Success Centre) offers in-depth exam preparation sessions for basic math, accounting, ECON and ESL classes every fall and winter. 1553 students attended these sessions in December 2022.

Student Learning Services' on-the-spot-study help launched in fall 2022, providing 8 hours of weekly drop-in time for students to meet with a Learning Specialist to get help with time management, study strategies and problem-solving. In fall 2022, 25% of students who dropped by were new to Learning Services support, and 50% of them went on to make use of other services like tutoring and study groups. To make this service even more accessible, winter 2023 sessions are now offered both online and in-person, and on both campuses.

The Homeroom program (Dean of Students Office) has expanded its internal partnerships beyond Black Perspectives Office, the Department of Psychology and the Faculty of Fine Arts to include two new pods this term. One is in partnership with the Beat the Odds (BTO) internship program where a former BTO and Homeroom participant facilitates a pod of current BTO interns to complement their internship experience. The other new pod is a Graduate student pod, also facilitated by a former Homeroom participant.

The Library is pleased to launch the new Black Studies Subject Guide. This guide brings together information about diverse resources - including journals, databases, and archival materials - that support research in Black Studies at Concordia. This guide is interdisciplinary and was designed to support research in this area broadly. Importantly, this guide is iterative and will evolve as new resources are created and made available either through the Library's collection or other publicly accessible avenues. The Black Studies Subject Guide is accessible to members of the Concordia community and the general public. It was created at the request of and in collaboration with the Subcommittee for Faculty Development, Research, Library and Supports of the President's Task Force on Anti-Black Racism.

If you are intrigued by the buzz about ChatGPT, the Library's Quick Thing for Digital Knowledge about generative AI—including ChatGPT is a short explainer to help you learn more about emerging new tools, their promise, and their pitfalls. Other topics on the Quick Things platform include Web 3.0 and the metaverse, data visualization, security and privacy, and more. For students, the Library piloted informal discussion events earlier this month to allow students to learn from each other (one in person and one online). The Centre for Teaching and Learning (CTL) has also created a list of resources on AI tools and their use in the classroom.

In Fall 2022, the Library launched a new Leisure and Wellness collection and dedicated spaces for our students to help them decompress and recharge. At Vanier and Webster, our students can now find a small collection of leisure reading books, and a growing collection of board games, puzzles, and colouring books. The book collection consists of 119 titles and there are available for loan. There is also a collection board games, puzzles, and colouring books that are available for in-library use. There is also an accompanying Leisure Reading Guide developed by the Library team. This is a pilot project funded by the Library Services Fund. The Library Services Fund was established in 2010 in an agreement between the Concordia Student Union (CSU) and the Library for the purpose of providing additional and improved library resources at the Webster and Vanier Libraries. Undergraduates contributed $1 per credit to Fund.

John Molson is proud to remain a 2022 parity certified organization. Le Gouvernance au Feminin has recognized the school for its valorization of gender parity and renewed our certification at the Silver level for another year.

Mel Hoppenheim School of Cinema professor Luigi Allemano's work *The Flying Sailor* is nominated for "Best Animated Short Film" at the 95th Oscars. *The Flying Sailor* is inspired by the true story of a sailor who was propelled two kilometres in the air by the 1917 Halifax Explosion, the largest accidental non-nuclear explosion of all time. Allemano contributed the music and sound composition.

Studio Arts Associate Professor, Nadia Myre, and two Concordia alumni, Marc Séguin et Jocelyne Alloucherie have been chosen to design three of the five new stations that will be added to the STM metro blue line.

Dayna Danger (MFA, 2017), Louis-Charles Dionne (BFA, 2017) and Laïla Mestari (BFA, 2017), members of Concordia's Art Volt Collection (launched in 2022) had works acquired by the Canada Council for the Arts' Art Bank.

Department of Theatre professor Menka Nagrani was one of 114 Order of Canada inductees appointed in 2020, honouring her decades of work to create a safer space for artists with disabilities. Nagrani was finally able to attend her investiture ceremony on November 3, 2022.

Dajana Vuckovic has won the prestigious 2023 Fred Beamish Award presented by the Analytical Chemistry Division of the Canadian Society for Chemistry. Vuckovic, associate professor of chemistry and biochemistry and director of the Centre for Biological Applications of Mass Spectrometry, is the first Concordia professor to receive the award. She was recognized for her many important contributions to the field of analytical chemistry. The award is presented every year to junior researchers who demonstrate innovation and whose research is anticipated to have significant potential for practical applications.

Gideon Abagna Azunre's doctoral research on sustainability in sub-Saharan African cities led him to win December's Prix Relève étoile Paul-Gérin-Lajoie from the Fonds de recherche du Québec – Société et culture (FRQSC). Azunre's research paper evaluated the role of urban informalities in sustainable city development in sub-Saharan Africa. Urban informalities refer to everyday economic, social or spatial activities not recognized by formal regulations. He is currently pursuing his PhD in geography, urban and environmental studies at Concordia.

Research Infosource has released its 2022 results (referencing 2021 fiscal year) and with a total of $75.782M, Concordia placed 25th among Canada's Top 50 Research Universities. This is one spot higher than last year. Further, the year-over-year growth in sponsored research income of +25.2% was the highest among comprehensive universities.

Québec Science named direct sound printing as one of the most significant scientific breakthroughs of 2022. The research team was led by Muthu Packirisamy (Mechanical, Industrial and Aerospace Engineering) and introduced the technology in an article in Nature Communications in April.

In a new paper published in Facets journal, a team of Concordia researchers led by Department of Biology's Dylan Fraser in collaboration with the Cree Nation of Mistissini discusses understandings they were able to gain by bringing Indigenous Ecological Knowledge (IEK) and Western Science (WS) together. They looked at three fish species: walleye, lake trout and northern pike, measuring factors such as size, colour, genetic difference and the number of fish in specific lake areas. Fraser and his team say this work offers valuable insight into how similarities and complementary differences between knowledge types can help Indigenous communities optimize their decision-making regarding the natural resources they are stewards of.

A Concordia project cataloguing the diversity of the urban forest in a Montreal residential neighbourhood is now complete, and the researchers behind it say the results highlight the importance of a diverse city tree population. MSc student Kayleigh Hutt-Taylor co-led the project with assistant professor of biology Carly Ziter.

Public Scholar and PhD candidate in communication studies Scott DeJong is investigating how media literacy games can effectively be used to tackle online disinformation. He explored why many educational games "fall flat," as he says, and how to make them better as part of a week-long symposium, Bad Game Arcade, at Concordia's 4TH SPACE from January 23 to 27. The public was invited to take part in Bad Game Arcade, where they can try out educational games in the public arcade, watch roundtable discussions in person or online and listen to live interviews with game developers.

The Canadian Institutes of Health Research (CIHR) has awarded $592,000 in funding to a new Concordia-led preventive-health initiative spearheaded by Simon Bacon, professor in the Department of Health, Kinesiology and Applied Physiology. The pan-Canadian platform has received an additional $1.3 million in funding from partners, bringing its total to $1.8 million. The funding will create a training platform that focuses on the development and testing of behavioural change interventions to address high-risk human behaviours linked to chronic diseases.

Concordia professors of English Mikhail Iossel and Josip Novakovich bring literary workshops to Kenya to support up-and-coming writers. The inaugural International Literary Seminars (ILS) Kenya took place in Nairobi and on the island of Lamu in Kenya from December 6 to 20. They brought together an impressive array of writers, editors and industry people from around the world for the sake of the craft. Participants were invited to the program based on the strength of their manuscripts, with three Kenyan writers receiving full scholarships to cover their expenses.

Concordia's SHIFT Centre for Social Transformation hosted their second lunch & learn event on December 6, 2022 as part of the SHIFT Learning Community Showcase series. This series occurs on the first Tuesday of every month and creates opportunities for staff, students, faculty and community members to learn more about the socially transformative initiatives that SHIFT is supporting. At the December event, members of the Black Healing Centre and Community Healing Days teams spoke about their work creating supportive, culturally sensitive, community-based opportunities to promote health and wellness.

This year, the 41st edition of the MBA International Case Competition took place from January 1 to 6, 2023 at the Hotel Bonaventure in downtown Montreal. The student-run event hosted 36 schools from 15 different countries, which saw over 1,000 people, including 200 coaches and participants, participate in a full week of events.

On January 16, renowned Canadian visual artist and performer, Shary Boyle, was the invited guest for FoFA's Wild Talks lecture series. Speaking to a sold-out theatre, Boyle discussed her career and work, addressing themes of collaboration, community and alternative education.

Concordia's Centre for Teaching and Learning (CTL) is holding its annual Teaching and Learning Winter Festival on the theme Contemplative Pedagogy Practices to Promote Well-being, Deep Learning and Community Building on February 15, 16 and 17, 2003**.** The 3-day online conference offers a series of short talks, panels and workshops for faculty and educational developers on the conceptual framework of contemplative pedagogy, simple practices that can be easily adopted in the classroom, and reflections on the impact of contemplative practices on faculty and students. Registration is now open.

The library's researcher-in-residence, Stéphanie Hornstein has curated an exhibition titled Journey Through the Stacks: Illustrated Travelogues and the Orientalist Imagination. Since the inception of photography in the 1830s, the medium has been entwined with histories of writing and travel. It was not until the 1880s, however, that photographs could be viably reproduced in books thanks to the implementation of the halftone printing process. Featuring historical material from Concordia, McGill, and the Université de Montréal's library collections, this exhibition explores the impact of this printing technology on travelogues that describe the so-called Orient. The exhibition will be on display in the Webster Library vitrines on LB-2 until March 22nd.

Dec. 16, 2022 marked the final event (110 total) of the Fall 2022 season at 4th Space with a documentary film screening and discussion relevant to COP15, co-organized with Concordia International and the Consulate General of Chile in Montreal.

Since the start of 2023, 4th Space has been activated by numerous collaborative ventures including a community conversation on youth homelessness spearheaded by the Garnet Key Society, the launch of a multilingual web project centred on migration experiences of local Arabic speakers, presented by the Leonard & Bina Ellen Art Gallery, and a week-long residency focused on educational games stemming from public scholar, Scott DeJong's research, that brought in numerous local school groups, international experts, and local industry partners.

Eight events are in development for Black History Month, including a series of activities, focused on Grenada, but broadly speaking to community pedagogy and Black knowledges, and an in-depth examination of housing in the Global South, chaired by PhD student and Public Scholar Hone Mandefro.

The Library's Researcher-in-Residence program began in January 2017 and Concordia has since welcomed six researchers whose presence have enriched the Library and university community. The upcoming residency period is from September 1, 2023 to August 31, 2024. The call for the 2023-2024 Concordia Library Researcher-in-Residence closes on March 17. The program was created to promote conducting research in the library and the use of research by practitioners. The program offers the opportunity for librarians, archivists, scholars, or doctoral students to focus on an area of inquiry in a supportive and enriching environment, and to interact with Concordia Library staff and resources.

US-2023-1-D2

Université Concordia University

SENATE
OPEN SESSION
Meeting of February 17, 2023

AGENDA ITEM: Tribunal Pool/Committee Nominations

ACTION REQUIRED: For approval

SUMMARY: Senate is being asked to approve the following Committee and Tribunal Pool appointments:

Committee	**Appointee**	**Term**
Distinguished Professor Emeriti and Distinguished Librarian Emeriti	Bryan Barbieri (JMSB)	2023-26
Appointments requiring Senate ratification	**Appointee**	**Term**
Student Tribunal Pool	Jamieson Sparling (CSU)	2022-24

DRAFT MOTION:

That the Committee and Tribunal Pool appointments be approved.

PREPARED BY:

Name: Karan Singh
Date: February 9, 2023

RESEARCH COMMITTEE
REPORT TO SENATE
Dr. Dominique Bérubé (Chair)
February 17, 2022

Meeting of December 16, 2022

1. Research Data Management (RDM) Strategy – consultation

   The Research Committee was consulted (by P. Riva, D. Dennie, R. Johal - Library) for comments and feedback on the Research Data Management Strategy document that was prepared by the Research Data Management project team. The invitees began by providing some background information about the Tri-agency's Research Data Management Policy while also explaining the importance of research data and research data management, and the current support available at Concordia. A roadmap was also presented on how the University is working towards adopting data management best practices. A productive discussion ensued with committee members providing their comments and suggestions.

2. Strategic Research Plan 2023-2028 – *for review and approval*

   The Chair informed Committee members that it was time to update Concordia's Strategic Research Plan, and that a team in the OVPRGS had put together a draft document after having initial consultations with the Associate Deans Research from each Faculty. The Chair and members of her team presented the draft Strategic Research Plan (2023-2028) (which had been circulated to Research Committee members in advance), and committee members were informed that the next step was to send the document out for wider consultation. Committee members were given the opportunity to provide feedback and suggestions, and with the agreed modifications incorporated, approved to launch the wider Strategic Research Plan consultation.

SENATE
OPEN SESSION
Meeting of February 17, 2023

AGENDA ITEM: Academic Programs Committee – Report and Recommendation – Microprogram in Indigenous Land-Based Education (AS-SCPA-5222; APC-2023-1-D1)

ACTION REQUIRED: For approval

SUMMARY: Senate is being asked to approve a new Microprogram in Indigenous Land-Based Education (AS-SCPA-5222; APC-2023-1-D1)

BACKGROUND:

The proposed Microprogram in Indigenous Land-Based Education (MILBE) comes out of a collaborative partnership between the Chamandy Foundation, Concordia University, the School of Community and Public Affairs (SCPA)/First Peoples Studies Program (FPST) and the Ionhntionhhéhkwen Wilderness Skills located in the Kanien'kehá:ka community of Kahnawake. This 12-credit microprogram will be housed in the SCPA and will complement the BA in First Peoples Studies. While the program will serve as a standalone credential, students will also be able to transfer credits from the program towards completion of the BA in First Peoples Studies. The aim of the program is to equip students with the kinds of skills, knowledge, and attitudes that are uniquely available in land-based programs, as learning from the land is such a crucial element of Indigenous epistemology.

Given that the University is located on the traditional Kanien'kehá:ka Nation Territory, it is essential to acknowledge and reflect the local Kanien'kehá:ka perspective in the curriculum while providing students with diverse Indigenous knowledge systems as well. As such, Kanien'kehá:ka epistemologies will serve as the foundational theoretical and experiential base of teaching and learning while broadening and including other Indigenous nations' theories and practices.

Further details of the program are provided in the attached document.

DRAFT MOTION: Following recommendation of the Academic Programs Committee, the Senate approve a new Microprogram in Indigenous Land-Based Education (AS-SCPA-5222; APC-2023-1-D1), as detailed in the attached document.

PREPARED BY:

Name: Karan Singh
Date: February 9, 2023

ACADEMIC PROGRAMS COMMITTEE
REPORT TO SENATE
Sandra Gabriele, PhD
February 17, 2023

The Academic Programs Committee requests that Senate consider the following changes for the Academic Calendar.

Following approval of the Faculty Councils, APC members reviewed the curriculum submissions listed below. As a result of discussions, APC resolved that the following curriculum proposal be forwarded to Senate for approval:

Undergraduate Curriculum Proposals (Changes for the 2023-24 Calendar)

Faculty of Arts and Science
School of Community and Public Affairs
AS-SCPA-5222; **APC-2023-1-D1** (For May 2023 Implementation)

- New Program: Microprogram in Indigenous Land-Based Education

Gina Cody School of Engineering and Computer Science
Department of Chemical and Materials Engineering
GCS-CME-4421**; APC-2023-1-D2** (Implementation pending MES Approval)

- New Program: BEng in Chemical Engineering

Sandra Gabriele, PhD
Vice-Provost, Innovation in Teaching and Learning January 27, 2023

New Undergraduate Program (Regular Process) - AS-SCPA-5222 - VERSION : 3

Summary of Committee Discussion: Faculty Council Approval

For Submission to:

Sandra Gabriele, Vice-Provost, Innovation in Teaching and Learning,
Academic Programs Committee, 17 Jan 2023

Approved by:

Pascale Sicotte, Dean, Faculty of Arts and Science,
Arts and Science Faculty Council, 25 Nov 2022

The following proposal was presented under ASFC-2022-7M-A and approved at the Arts and Science Faculty Council meeting on November 25th, 2022. Anna Sheftel, Principal, and Louellyn White, Associate Professor in First Peoples Studies (FPST), School of Community and Public Affairs, were invited to introduce the proposed Microprogram in Land-Based Education and outcomes of the pilot project. The committee was very supportive of this initiative and posed questions relative to target audiences and the program.

We request that it be reviewed at the Academic Programs Committee meeting of January 17, 2023 for implementation in the 2023-24 Undergraduate Calendar.

<u>Summary of Committee Discussion: Faculty Curriculum Approval (FCC/FAPC)</u>

For Submission to:

Pascale Sicotte, Dean, Faculty of Arts and Science,
Arts and Science Faculty Council, 25 Nov 2022

Approved by:

Richard Courtemanche, Associate Dean,
Faculty Curriculum Committee, 03 Oct 2022

The Faculty Curriculum Committee (FCC) supports the proposed new *Microprogram in Land-Based Education* and recommends that it be reviewed at the next meeting of Arts and Science Faculty Council.

Summary of Committee Discussion: Department approval

For Submission to:

DR. RICHARD COURTEMANCHE, ASSOCIATE DEAN, ACADEMIC PROGRAMS,
FACULTY CURRICULUM COMMITTEE,

Approved by:

DR. ANNA SHEFTEL, PRINCIPAL, SCHOOL OF COMMUNITY AND PUBLIC AFFAIRS (SCPA),
SCPA Council, 22 Sep 2022

This proposal was passed unanimously by our school council, with enthusiastic support, on September 22, 2022.

Program Requirements

Microprogram in Indigenous Land-Based Education (12 credits)

12 credits:

FPST 210	Haudenosaunee Peoples (3.00)
ILBE 301	Indigenous Land-Based Field Studies Part I (3.00)
ILBE 302	Indigenous Land-Based Field Studies Part II (3.00)
ILBE 403	Integrative Seminar on Indigenous Sustainability and Self-Determination (3.00)

Concordia University

Faculty of Arts and Science

School of Community and Public Affairs

Microprogram in Indigenous Land-Based Education

September 19, 2022
Revised:
December 22, 2022
January 26, 2023

Contents

Executive Summary

The proposed **Microprogram in Indigenous Land-Based Education** (MILBE) comes out of a collaborative partnership between the Chamandy Foundation, Concordia University, the School of Community and Public Affairs (SCPA)/First Peoples Studies Program (FPST) and the Ionhntionhhéhkwen Wilderness Skills located in the Kanien'kehá:ka community of Kahnawake. This 12 -credit microprogram will be housed in the SCPA primarily as a stand-alone undergraduate program to complement the BA in First Peoples Studies.

The aim of the program is to equip students with the kinds of skills, knowledge, and attitudes that are uniquely available in land-based programs, as learning from the land is such a crucial element of Indigenous epistemology. This is achieved by: 1) examining the theoretical underpinnings of Indigenous-led, land-based pedagogies, 2) surveying sustainable Indigenous theoretical frameworks and practices that promote economic self-sufficiency, and 3) developing land literacy and building awareness of the learners' relationships with the land. The microprogram will use the land both as a fundamental source of knowledge and as a learning space capable of reconnecting Indigenous students specifically, as well as non-Indigenous students in general, to the social relationships, culture, language, knowledge, and experiences that arise from the land. The primary aim is to reconnect and ground Indigenous students in Kanien'kehá:ka and other diverse Indigenous epistemologies, promote health and mental well-being, strengthen cultural identity, kinship, and community responsibilities.

Given that the university is located on the traditional Kanien'kehá:ka Nation Territory, it is essential to acknowledge and reflect the local Kanien'kehá:ka perspective in the curriculum while providing students with diverse Indigenous knowledge systems as well. As such, Kanien'kehá:ka epistemologies will serve as the foundational theoretical and experiential base of teaching and learning while broadening and including other Indigenous nations' theories and practices.

The program will blend face-to-face courses, online cultural workshops, in-person field trips and community land-based experiences. In these different modalities and delivery formats, accessibility and inclusivity will be considered. The program will be offered over the fall and winter terms of each academic year as it relies on intensive community, land-based field/experiential activities that take place during the fall, winter and spring seasons. In the long term, this microprogram is a possible component of future stackable programs both within and beyond FPST and SCPA, such as microprograms in FOFA.

The proposed 12 - credit **Microprogram in Indigenous Land-Based Education** (MILBE) will be comprised of four courses (i.e., one existing FPST course and three new courses) to be completed over the Fall and Winter terms.

In the Fall term, students will be introduced to Rotinonhsión:ni history, culture and societal structure in FPST 210: Haudenosaunee Peoples. At the same time, in ILBE 301: Indigenous Land-Based Field Studies Part I, students will explore how the re-emergence of Indigenous land-based education systems provides opportunities for transformative learning that foster community resurgence and sustainability. Students will be introduced to diverse research on

Indigenous-led, land-based models combined with immersive, hands-on, land-based survival skills in the local community of Kahnawake.

In the Winter term, students in ILBE 302: Indigenous Land-Based Field Studies Part II, will continue to participate in immersive land-based activities to further cultivate an integrated understanding of environmental, social, and economic issues. Finally, students registered in ILBE 403: Integrative Seminar on Indigenous Sustainability and Self-Determination, will connect their learning to issues that include food security, food sovereignty, and models of Indigenous economic self-sufficiency and sustainability practices. As part of the two new land-based courses offered in the Winter term, students will develop a community-based project proposal reflecting both their own interests and the broader needs of Indigenous communities. This community-based proposal will serve as the program's capstone project to help students synthesize and demonstrate what they have learned through the entire program.

The *Truth and Reconciliation of Canada* Calls to Action (2015) (https://nctr.ca/records/reports/#trc-reports) calls upon all Canadian educational institutions to address institutional racism by decolonizing and Indigenizing their educational systems in ways that open up institutional spaces, elevate and re-center Indigenous epistemologies, and acknowledge Indigenous histories and perspectives. As an institution, Concordia University could substantially contribute to the education of Indigenous students by launching a targeted program that aligns the principles stemming from the *Truth and Reconciliation Commission* with the learning needs of Indigenous students as well as with the skills in-demand by Indigenous communities. The MILBE will be perfectly situated to advance Indigenous epistemologies and will provide opportunities for both Indigenous and non-Indigenous students to develop their own unique connection with the land and become stewards of the land.

In May 2021, Concordia University received funding designed to support the creation of the **MILBE**, from the Chamandy Foundation. Spread over three years, this $471,033 donation was made "to support the development and implementation of the program benefiting Indigenous students based at Concordia University and Kahnawake".

Section 1 – Program Identification

1.1 Program title, degree title and level

Degree Type: Microprogram
Program Title: Indigenous Land-Based Education
Level: Undergraduate
Streams, Options or Concentrations: n/a
Total credits: 12 credits

1.2 Administrative location

Department(s): School of Community and Public Affairs
Faculty: Faculty of Arts and Science
Campus: SGW
Building: CI

Section 2 – Program Description

2.1 Rationale

Provide a brief description of the program, its rationale and general academic objectives.

The proposed **Microprogram in Indigenous Land-Based Education** (MILBE) comes out of a collaborative partnership between the Chamandy Foundation, Concordia University, the School of Community and Public Affairs (SCPA)/First Peoples Studies Program (FPST) and the Ionhntionhhéhkwen Wilderness Skills located in the Kanien'kehá:ka community of Kahnawake. This 12 - credit microprogram will be housed in the SCPA primarily as a stand-alone undergraduate program to complement the BA in First Peoples Studies.

The aim of the program is to equip students with the kinds of skills, knowledge, and attitudes that are uniquely available in land-based programs, as learning from the land is such a crucial element of Indigenous epistemology. This is achieved by: 1) examining the theoretical underpinnings of Indigenous-led, land-based pedagogies, 2) surveying sustainable Indigenous theoretical frameworks and practices that promote economic-self-sufficiency, and 3) developing land literacy and building awareness of the learners' relationships with the land. The microprogram will use the land both as a fundamental source of knowledge and as a learning space capable of reconnecting Indigenous students specifically, as well as non-Indigenous students in general, to the social relationships, culture, language, knowledge, and experiences that arise from the land. The primary aim is to reconnect and ground Indigenous students in Rotinonhsión:ni and other diverse Indigenous epistemologies, promote health and mental well-being, strengthen cultural identity, kinship, and community responsibilities.

Given that the university is located on the traditional Kanien'kehá:ka Nation Territory, it is essential to acknowledge and reflect the local Rotinonhsión:ni and more specifically Kanien'kehá:ka perspectives in the curriculum while providing students with diverse Indigenous knowledge systems as well. As such, Rotinonhsión:ni epistemologies will serve as the foundational theoretical and experiential base of teaching and learning while broadening and including other Indigenous nations' theories and practices. The Kanien'kehá:ka are one of the original five nations of the Rotinonhsión:ni Confederacy (the other nations are the Oneida, Onondaga, Cayuga, and Seneca) whose territories spread across the boundaries of the U.S. and Canada.

The program will blend face-to-face courses, online cultural workshops, in-person field trips and community land-based experiences. In these different modalities and delivery formats, accessibility and inclusivity will be considered. The program will be offered over the fall and winter terms of each academic year as it partly relies on intensive community, land-based field/experiential activities that take place during the fall, winter and spring seasons. In the long term, this microprogram is an ideal possible component of future stackable programs both within and beyond FPST and the SCPA.

The proposed 12-credit **Microprogram in Indigenous Land-Based Education** (MILBE) will utilize one existing course—FPST 210: Haudenosaunee Peoples—to give students an academic background in Rotinonhsión:ni culture, practices and beliefs. Three new courses will be created for the Microprogram: ILBE 301: Indigenous Land-Based Field Studies Part I, ILBE 302: Indigenous Land-Based Field Studies Part II, and ILBE 403: Integrative Seminar on Indigenous Sustainability and Self-Determination. ILBE 301 and ILBE 302 will introduce and immerse students into land-based learning. In these courses, students will alternate time in the classroom learning about the theoretical and epistemological approaches to land-based education, with time on the land in Kahnawake in which they will put these ideas into practice. ILBE 403 is an integrative seminar that will connect their land-based learning to broader issues of Indigenous practices, sustainability and justice, and which will allow students to synthesize the experiences they have had in the field.

In the Fall term, students will be introduced to Rotinonhsión:ni history, culture and societal structure. In addition, students will explore how the re-emergence of Indigenous land-based education systems provides opportunities for transformative learning that foster community resurgence and sustainability. Students will be introduced to diverse research on Indigenous-led, land-based models combined with immersive, hands-on, land-based survival skills in the local community of Kahnawake.

In the Winter term, students will continue to participate in immersive land-based activities in order to further cultivate an integrated understanding of environmental, social, and economic issues. Topics will include food security, food sovereignty, and models of Indigenous economic self-sufficiency and sustainability practices. As part of the two new land-based courses offered in the Winter term, students will develop a community-based project proposal reflecting both their own interests and the broader needs of Indigenous communities. This community-based proposal will serve as the program's capstone project to help students synthesize and demonstrate what they have learned through the entire program.

In alignment with an institutional-wide strategy to move Concordia towards Universal Design for Learning (UDL) (https://www.concordia.ca/students/accessibility/faculty-information/universal-design-for-learning.html), this microprogram will apply UDL principles to assessments[1]. Students will be provided with flexible opportunities to demonstrate knowledge in an ongoing manner that reflect the learning outcomes of the program. Evaluations can include assignments such as contributing to discussions, reflective journal writing, reading responses, oral presentations of individual or group work using digital technologies, completion and mastery of land-based learning activities, mid-term projects, creative final projects– painting, graphic novel, short story, infographic, and similar, as well as a mixture of individual and group work.

The Truth and Reconciliation of Canada Calls to Action (2015) (https://nctr.ca/records/reports/#trc-reports) calls upon all Canadian educational institutions to address institutional racism by decolonizing and Indigenizing their educational systems in ways that open up institutional spaces, elevate and re-center Indigenous epistemologies, and acknowledge Indigenous histories and perspectives. As an institution, Concordia University could substantially contribute to the education of Indigenous students by launching a targeted program that aligns the principles

[1] UDL on Campus: This resource provides a brief overview of Universal Design for Learning (UDL) and assessment in postsecondary settings

stemming from the Truth and Reconciliation Commission with the learning needs of Indigenous students as well as with the skills in-demand by Indigenous communities. The MILBE will be perfectly situated to advance Indigenous epistemologies and will provide opportunities for both Indigenous and non-Indigenous students to develop their own unique connection with the land and become stewards of the land.

In May 2021, Concordia University received funding designed to support the creation of the **MILBE**, from the Chamandy Foundation. Spread over three years, this $471,033 donation was made "to support the development and implementation of the program benefiting Indigenous students based at Concordia University and Kahnawake".

2.2 Target audience, and admission requirements and targets

Provide an overview of the target audience including the following:

- *characteristics of potential students who would be likely to apply to the program*
- *an explanation of how the admission requirements are aligned with the target audience*
- *admission and enrolment targets*

While anyone who is interested in this program will be welcome to apply, there are nevertheless several target audiences:

The primary target audience for this program is Indigenous adult learners. For example, former graduates of the Ratiwennahni:rats Adult Language Immersion program, located in the Kanien'kehá:ka community of Kahnawake may want to pursue a micro-credential in Indigenous land-based education to become land-based facilitators/educators employed in the Kahnawake school system, enabling them to transfer cultural knowledge and land-based survival skills to local elementary and high school students. This program comes out of significant outreach and consultation with stakeholders in Kahnawake, and it is through these same relationships and networks that recruitment efforts will be able to regularly reach these potential students.

A second possible target audience is local Kahnawakeró:no teachers/educators who may seek to further their professional development by enrolling in the program. Obtaining a credential specifically based in Indigenous land-based education would allow them to build Indigenous land-based activities into the Kahnawake Education system (e.g., elementary through high school).

In addition, two external seats will be reserved for mentorship training with Ionhntionhhéhkwen land-based facilitators for Kahnawake Youth (18 years and over and not enrolled at Concordia) who express an interest in training as mentees with our land-based facilitators. These two seats will be funded by the Chamandy Foundation for three years. The rationale is to encourage Kahnawake youth, adults and lifelong learners who want to leverage a pathway to further their post-secondary education after completion of the program.

A future aim of the program, following consultations with MES, will be to attract Indigenous students already enrolled at Concordia University in various academic disciplines including Fine Arts, Applied Human Sciences, Education, History, Communication and Media, Sciences, Engineering, and Business. Given the uniqueness of this program which combines Indigenous theories with hands-on, Indigenous-led land-based experiences, many Indigenous students will have the opportunity to immerse and participate in the culture, language, knowledge, and experiences that arise from the land. Such experiences don't exist in any other program at Concordia.

When the mechanism to do so is eventually in place, this program will also appeal to non-Indigenous Concordia students who are interested in the history of Canada's relationship with Indigenous peoples and desire to explore a connection to and learn from the Land. Students could potentially enroll in this microprogram as part of their undergraduate degree, like they would enroll in a minor.

We anticipate this microprogram will also contribute to the growth of the FPST BA program by providing an intensive on-the-land learning experience that encourages a diverse range of Indigenous applicants who are from local Indigenous communities and may not be enrolled in a post-secondary program but wish to join a university community (including those with disabilities, care-giving or family commitments, those employed but wishing to upgrade skills through an online/blended learning format, and those coming to the program with varied levels of academic experience). This microprogram would also provide a broader pathway into the *BA Major in First Peoples Studies* by allowing students who successfully complete the program, and once the university-level mechanisms are in place, to apply to the BA program, if they meet the BA admission requirements. It will also help to further connect Indigenous students already at Concordia University to the FPST program and will therefore increase its visibility both within the university and outside of it. Finally, FPST students may want to do the microprogram alongside their major, or after graduation, once the university-level mechanisms are in place.

The creation of this microprogram also aligns with the university's strategy to introduce stackable certificate curriculum pathways to students, enhancing accessibility as well as interdisciplinarity.

In terms of Admissions requirements, considering the principal audience imagined for the microprogram, it is expected that most applicants will be mature students, and that admission to this microprogram will be based on Concordia's Mature Entry admission requirements (https://www.concordia.ca/admissions/undergraduate/requirements/mature-entry.html) according to applicants' age, experience and academic potential. Younger applicants coming from CEGEP or high schools who meet the regular admissions criteria will be able to apply through Concordia's standard process. See section 7.4 for admission requirements.

Nevertheless, because this is an experiential program that involves spending large amounts of time in Kahnawake learning from Elders, knowledge keepers and community facilitators, the admissions process will require a CV, a letter of intent explaining the prospective student's motivations, experiences with Indigenous communities, and related knowledge and skills, as well as a short interview. The goal is to make sure students have sufficient background experience and sensitivity to be immersed in an Indigenous learning context and to behave respectfully while on the land.

Section 3- Curriculum

3.1 Program objectives and learning outcomes

Describe the overall program objectives, as well as a description of the specific learning outcomes of the degree (knowledge, expertise, and skills that students will have acquired upon completion of the program including discipline-specific knowledge and competencies, as well as broader competencies and skills such as intellectual or methodological competencies, communication, planning, critical thinking, citizenship, etc.)

The program's objectives are threefold: 1) to provide Indigenous students with a culturally relevant curriculum and meaningful learning experiences that connect them to their community, to the past, and to the present, and to introduce non-Indigenous students to these experiences; 2) to instill a sense of cultural pride among students and develop in them an appreciation of the land and diverse Indigenous pedagogies specific to and grounded in the land; and 3) to expose students to research led by Indigenous scholars on sustainable practices that promote economic self-sufficiency, and equip them with practical skills relevant to addressing the realities and challenges impacting both local Indigenous communities and society in general.

The program's learning outcomes are listed below. By the end of the microprogram, each student will be able to:

1. Examine the history, culture and structure of Rotinonhsión:ni society. Specific emphasis will be placed on the Kanien'kehá:ka nation of Kahnawake and discussion of Rotinonhsión:ni socio-cultural, political, and economic perspectives, as well as their relationship to the land.

2. Examine and discuss land as learning space and Indigenous research and theories related to land-based education.

3. Apply a variety of practical land-based survival skills. These include fire and shelter-making, harvesting, animal tracking, and other land-based activities grounded in Rotinonhsión:ni epistemological perspectives that promote physical self-reliance, collective well-being and self-sufficiency.

4. Discuss issues related to land, water, environmental challenges, and Indigenous sustainability existing within Rotinonhsión:ni communities, drawing on diverse Indigenous epistemologies and land-based experiences.

3.2 Detailed curriculum

Describe in detail the curriculum of the program, including how students are expected to progress through the program. If the program is designed to be a pathway program (e.g., stacked degrees), please outline what other curricular changes beyond this proposal are needed to support this objective. Provide a description of how students will be assessed, such as through the completion of written assignments, hands on projects, or exams.

FPST 210 - Haudenosaunee Peoples

Topics:
This existing FPST course introduces students to the history, culture, and diverse practices of the Haudenosaunee Confederacy, with a focus on the Kanien'keha:ka of Quebec. The purpose of this course within the microprogram is to give students the academic background to contextualize their focus on land-based learning, and to understand the basics of Haudenosaunee philosophies and worldviews that underpin these epistemological approaches.

Assessments:
Assessments for this course have varied over the years, but may include: reflective learning narrative writing assignments; digital storytelling projects; small group Pecha Kucha oral presentation style using images to reflect a topic of the course; active online discussions and mini assignments using Moodle.

ILBE 301 – Indigenous Land-Based Field Studies Part I

Topics and Activities:
Students will begin the course with the Ohén:ton Karihwátehkwen, welcoming them into the program through this expression of gratitude and connection. Students will introduce themselves in a sharing circle where we will discuss the course, expectations, and work toward cultivating a safe space for all. Land-based facilitators from Kahnawake will introduce themselves, explain some of the land-based activities, and discuss community protocols for visitors on the land. Subsequent class sessions include topics such as the Rotinonhsión:ni Creation Story which provides students with a grounding in foundations of Roninonhsión:ni epistemologies in relation to Earth and all creation. Students will have a tour of the community of Kahnawake highlighting points of land, history, and contemporary lives. Students will spend significant time on the land learning about medicine plants, wild edibles, the St. Lawrence Seaway and aquatic life. Additional topics include Celestial teachings of the Skyworld and the beginnings of Creation for Rotinonhsión:ni people as well as the cultural significance of the stars, moon, and other celestial bodies. Land-based facilitators will instruct students in basic wilderness survival skills where they will learn to make small ground fires using natural materials, learn to tie various knots useful in survival situations, and will spend a significant amount of time creating shelters made from tree branches and other natural materials.

Assessments:
Students will complete weekly reflective journal assignments with prompts by the instructor. They will create their own personalized Ohénton Karihwatehkwen or Thanksgiving Address that is reflective of course content and lessons learned. They will present this as a creative project to share with the class. Students will create a Star Map based on their research extending the learning from the topic on Celestial Teachings. In this assignment, students will create their own personal representations integrating course knowledge. They will share this with the class as well. A two-part component of this course is the Personal Learning Plan in which students will first outline their learning goals for the course and secondly reflect on whether they accomplished their goals, their contributions and achievements, and how they benefited from the teachings on the land. Students will also be assessed for participation by successfully engaging

with the course material, activities, classmates, and instructors. Additionally, they will contribute to their participation grade by demonstrating land-based skills.

ILBE 302 – Indigenous Land-Based Field Studies Part II

Topics and activities:
In part II, students will build upon prior knowledge and land-based skills acquired. They will also expand their understanding by exploring other models of land-based education. Land-based survival skills and activities will reflect the seasonal cycle with focus on winter skills such as building snow shelters and expanding knowledge of fire making by creating their own tinder for winter survival. They will be introduced to outdoor knives and knife safety, as well as tracking animals in the snow and developing an understanding of behavior patterns. Students will learn to identify maple trees, tap trees for maple water, and learn the cultural significance of various tree species in the region. They will observe and identify various bird species, study migration patterns and cultural significance.

Assessments:
Students will complete weekly journal reflections in which they build upon the first course by deepening their understanding of relationality and connections to land, place, and community. They will complete a wellness project as a group in which they explore how land-based activities and skills acquired have influences themselves in relation to land and how this can promote collective well-being and self-sufficiency. In this course, students will expand their knowledge of land-based education models by completing a research paper drawing connections between different models and applying their model to a context of their choosing. Students will create a Personal Learning Plan that builds upon the fall course plan they completed. They will create new goals for the course and in part two of the assignment, will submit a reflection paper on their achievements. Students will receive a participation grade based on their engagement with the course material, activities, classmates, and instructors as well as demonstrating land-based skills.

ILBE 403 – Integrative Seminar on Indigenous Sustainability and Self-Determination

Topics and activities:
The final capstone course is one in which students will reach a greater level of understanding of land-based learning by expanding knowledge of Indigenous sovereignty, land rights, and community health. They will explore land dispossession by way of discussing the impacts the building of the St. Lawrence Seaway had on the community of Kahnawake. They will explore sustainability and Indigenous ecological knowledge. Students will learn about climate change and Indigenous responses. This course will have an emphasis on food sovereignty including learning about traditional diets and the impacts of western foods on Indigenous people's health. Students will visit community gardens and seed banks to gain an understanding of traditional agricultural practices. They will learn about traditional food preparations like smoking fish and making traditional corn soup. Finally, students will develop an understanding of wild game, hunting practices, and traditional hide tanning.

Assessments:

In this final course, students will continue their weekly reflective journaling to deepen their understandings and connections to land and place. They will complete an assignment in which they choose an environmental issue within a Roinonhsión:ni community, research its impacts and address community responses. They will then share their findings through a creative representation. In this course, students will partake in group work to develop deeper connections to one another. The first assignment is to create a Group Poster depicting an Indigenous territory, land rights, and how dispossession of lands has impacted community health. Students will also create an Annotated Bibliography responding to Indigenous people's responses to climate change. A Mindmap assignment will reflect Indigenous food systems. The final project that encompasses the entire land-based education program, is a group service-learning project in which students will develop relationships with organizations and implement a service-learning project that addresses a real community need and that has the potential to support Indigenous connectedness to land and the natural world. Each group will develop a proposal first and finally submit a group portfolio of the project. As in all of the courses, participation by engaging with materials, activities, classmates and instructors will be assessed.

See Appendix I: Overview of Program Structure Curriculum Map.

3.3 Innovative or distinguishing features

Describe the innovative or distinguishing features adopted in the design, delivery and pedagogy of the program (e.g., ties to future skills development, online/flipped components, experiential learning opportunities, flexibility in design through stacked certificates, etc.).

The program will include several innovative elements and opportunities: 1) the co-design and co-teaching of the program courses by Concordia Indigenous faculty members, Indigenous cultural knowledge experts, and land-based survival skills facilitators, 2) mentorship; 3) experiential learning; 4) flexible modules and land-based learning opportunities; and 4) practical survival skills development.

In addition, the proposed 12-credit microprogram builds a pathway to post-secondary education for 18-plus- year-old, community-based Indigenous learners not enrolled in the post-secondary system, such as former graduates from Kahnawake’s Ratiwennahni:rats Adult Language immersion program and the First Nations Regional Adult Education Centre. It serves as a form of outreach to the local Indigenous community, as students who complete and enjoy the program may be interested in enrolling for an undergraduate degree, provided that they meet admission requirements.

3.4 Curriculum map

The program's learning outcomes are listed below. By the end of the microprogram, each student will be able to:

1. Examine the history, culture and structure of Rotinonhsión:ni society. Specific emphasis will be placed on the Kanien'kehá:ka nation of Kahnawake and discussion of Rotinonhsión:ni socio-cultural, political and economic perspectives as well as their relationship to the land.
2. Examine land as a learning space, Indigenous research and theories related to Indigenous land-based education.
3. Apply a variety of experiential hands-on land-based survival skills such as methods of fire-making, building different types of shelters based on different seasonal weather (fall and winter), knot making for shelters using cordage and natural fiber (from wood) grounded in Rotinonhsión:ni epistemologies and pedagogies that promote individual and collective well-being and self-sufficiency.
4. Critically evaluate issues related to climate change, sustainability, water, environmental challenges impacting Indigenous communities specifically and society in general, integrating diverse Indigenous approaches to sustainability, self-determination and economic self-sufficiency.

Fall Term (6 credits)

Course code and Number	Course Title	Number of credits	Pre-requisites	Learning Outcomes
FPST 210	Haudenosaunee Peoples	3		1
ILBE 301	Indigenous Land-Based Field Studies Part I	3		1,2,3

Winter Term (6 credits)

Course Code and Number	Course Title	Number of credits	Pre-requisites	Learning Outcomes
ILBE 302	Indigenous Land-Based Field Studies Part II	3	FPST 210 ILBE 301	2,3
ILBE 403	Integrative Seminar on Indigenous Sustainability and Self-Determination	3	FPST 210 ILBE 301	2,3,4

Section 4 – Demand and Societal Need

4.1 Overview of the discipline

Provide an overview of the discipline including relevant history, theoretical foundations and recent developments in the field.

Overview
Prior to European colonization, Indigenous nations had and continue to have, their own educational systems. These were and continue to be grounded in Indigenous epistemologies and ontological pedagogical practices (such as land-based survival skills) that equipped learners with the knowledge and skills needed to survive and strengthen their relationships, responsibilities, and connections to land, family and community. The impact of colonization, specifically Canada's colonial-settler education policies and practices based on cultural and linguistic genocide was designed to assimilate Indigenous children into the 'white man's image.
The 1996 Royal Commission on Aboriginal Peoples report, and the 2015 Truth and Reconciliation Report highlighted the need for provincial and federal governments, alongside civil society, and educational institutions, to address institutional racism and inequities in western-based education by re-centering on culturally relevant curriculum reflective of the educational needs of Indigenous students. Canadian educational systems and Indigenous community-based schools and organizations have responded by developing programs in partnership with Indigenous communities, with a focus on Indigenous land-based education to better serve Indigenous students and communities.

The microprogram in Indigenous Land-Based Education Program positions Concordia university as a committed and willing participant in the drive to value and re-center Indigenous knowledge in its degree programs.

Theoretical Foundations
The proposed curriculum framework is based on Rotinonhnsíon:ni epistemological (Indigenous ways of knowing) and ontological (Indigenous ways of doing) foundations that draw upon the Ohénton Karihwatéhkwen (the words before all else, or thanksgiving address to the natural world) which itself underscores the Rotinonhnsíon:ni worldview. The Ohénton Karihwatéhkwen reminds humans to be thankful for all of creation and reaffirms the spiritual relationship we have with the natural world. In the words of Kanien'kehá:ka scholar Kahtehron:ni Stacey, "our Rotinonhnsíon:ni worldview and spirituality is conveyed through the Ohénton Karihwatéhkwen, as those words carry the intellectual and scientific knowledge of our ancestors passed on from generation to generation" (2016: 29).

In addition to recognizing Indigenous worldviews, this program also draws upon decolonization theory. As Wildcat et al. (2014:2) succinctly state: "if colonization is fundamentally about dispossessing Indigenous people from land, decolonization must involve forms of education that reconnect Indigenous peoples to land and the social relations, knowledge and languages that arise from the land."

Combining Indigenous knowledge and decolonial theories allows students to reframe their experiences, learn new ways of thinking, develop the tools needed to exercise self-sufficiency, and promotes health and well-being on both individual and community levels. (Wilson, 2018; Alfred, T., 2014; Simpson L., & Coulthard, G., 2014; Cornstassel, J., 2012).

Indigenous pedagogical theory also allows students to understand the significance of their relationship to the land, the responsibilities that comes with it, and helps them gain a better understanding of ecosystems and the changes brought on by global warming (Goodleaf, 2021).

Anishnabeg scholar Leanne Betasamosake Simpson, in her article Learning from the Land: Indigenous Land Based Pedagogy and Decolonization (2014), succinctly elucidates that if we are serious about decolonizing education and educating people within frameworks of Indigenous intelligence, we must find ways of reinserting people into relationships with and on the land as a mode of education (p. 15).

Recent Developments in the Field
Many Canadian academic institutions (including the University of Saskatchewan, the University of British Columbia, the University of Alberta, Red River College, and Algoma University) are working in partnership with Indigenous communities and educators (such as the Dechinta Institute for Research and Learning) to create Indigenous-led, land-based education systems. These partnerships require students to spend time out on the land and participate in various land-based activities. The Microprogram in Indigenous Land-Based Education will make Concordia the leading university in Quebec in this process by creating a culturally responsive program that uses Indigenous land-based pedagogies, is framed within an Indigenous paradigm, and is taught primarily by Indigenous faculty, community Elders, Kanien'kehá:ka land-based educators, and community-based cultural knowledge experts. This program will both motivate and meet the learning needs of Indigenous students as they see themselves, their histories, voices, and lived experiences reflected in the program curriculum.

4.2 Value of the program to society

Describe how this program will address current or future societal needs, emerging trends in research and/or higher education.

Indigenous Students' Educational Needs
According to ***Land as Teacher: Understanding Land-based Education*** (2021), a recent UNESCO report, land-based education has positive implications for science, culture, politics, language, environmental stewardship, land rights, reconciliation, and the future of the planet. Land-based education can also offer significant benefits to Indigenous students by providing safe and culturally responsive learning experiences, and creating learning opportunities that promote the transfer of intergenerational Indigenous knowledge from Elders to Indigenous youth. Finally, land-based education can increase awareness regarding biodiversity loss, climate change, environmental degradation, as well as help students learn the importance of promoting environmental stewardship.

In March 2021, the *Ionhntionhékwen* Land-Based Wilderness Program partnered with Concordia University to conduct a pilot study providing Indigenous Concordia students with land-based learning experiences on the land in the local community of Kahnawake. A total of eight (undergraduate and graduate) students and one Concordia Indigenous faculty member participated. The combination of the program's design with the use of land as a learning platform resulted in and overwhelming positive feedback. Indigenous students felt that the program offered an inclusive and culturally responsive learning experience that fulfilled their learning needs, strengthened their cultural identity, and increased their intrinsic motivation towards learning in general. The pilot program made it clear that the creation of an Indigenous land-based education program that centers Indigenous land-based experiences is both possible and desirable.

In First Peoples' Storytelling Exchange research (https://fppse.net/), their results also speak to the need for the creation of Indigenous land-based education programs focusing on Indigenous value systems. They place particular importance on learning from the land and emphasize that programs that embrace these ideals will attract Indigenous students to post-secondary education, improve retention, and encourage graduate education, often with the goal of developing more land-based and healing opportunities in the home communities that graduates return to.

Emerging Trends in Research. Indigenous land-based education programs have increasingly become a priority within Indigenous communities across all levels of education. Culturally-responsive education curricula for Indigenous students have become particularly important given the recent impact of climate change and the COVID-19 pandemic on Indigenous communities and Canadian society in general. The concept of Indigenous land-based education is multidimensional in definition, theory, pedagogy and practice and responds to the urgencies of our times. It is context-specific and takes into account various Indigenous territory or community land-based learning concepts (Krill, S, Wilson, A., & Crawford, T., 2021). Indigenous land-based learning is an immersive, embodied and practice-based approach that offers students unique opportunities to address current issues by being physically present on the land and engaging in land-based activities.

As well, an Indigenous land-based education program must also cultivate in students the ability for critical discourse and analysis about the history of colonization, loss of land and disconnection to land and community for many Indigenous nations across Turtle Island (Wilson, 2018; Alfred, T., 2014; Simpson L., & Coulthard, G., 2014; Cornstassel, J., 2012). This is necessary, in order to unlearn and reframe new ways of thinking and develop the tools needed to exercise self-sufficiency and promote health and well-being on an individual and community level. As Kathy Abolson (2020) comments: "we have a responsibility to learn about colonization and its impact and to unlearn colonial ideas. We then have to relearn our own Indigenous philosophies and learn in an Indigenous way. We have a responsibility to restore land-based programming and education" (p. 96). To strengthen and promote land-based learning opportunities for Indigenous youth, current research (Fast E., et al., 2021, Wilson A., & Laing, M., 2019; Dechinta, 2020) highlights the importance of creating land-based education programs that are supportive, inclusive, accessible and provide culturally safe spaces for Indigenous two-spirit, non-binary, LGBTQUIA+ students, as well as students with various forms of disabilities.

Furthermore, Tuck et al. (2014) highlight the importance of curricula that examine the intersections of land and land-based pedagogies and makes note of: "the urban experience as storied Indigenous lands in (re)storying Chicago as Indigenous land through urban Indigenous land-based pedagogies" (p. 10). This perspective provides another critical lens for creating Indigenous land-based programs that explore pedagogy of land within the frameworks of both rural and urban contexts (Styres et al., 2013).

Given the critical consensus represented by the research cited above, it is essential that the proposed program contribute to and expand knowledge of Indigenous land-based education, research, and experiential learning while being firmly grounded in Rotinonhnsion:ni worldviews. The proposed microprogram will also expand the breadth of benefits and positive outcomes unique to Indigenous land-based education available to Indigenous Youth, life-long learners, and non-Indigenous students in Quebec. Finally, it will increase students' understanding and appreciation of the cross-cutting issues impacting both local Indigenous communities and the wider Canadian society.

4.3 Demand

Describe the type of students the program is expected to attract (e.g., lifelong learners, local, international students, etc.), drawing on evidence from a market analysis.

Provide a rationale for how there is demonstrable student interest in, demand for and capacity to support the program (e.g., feeder programs at other institutions like cégeps or within Concordia; data indicating hiring trends or areas of growth in industries; data indicating the emergence of an important research field).

Type of Students the program will attract

This program will attract Indigenous adult learners, youth, mid-career professionals, and lifelong learners from both Kanien'kehá:ka and other Indigenous communities (e.g., Cree, Inuit and Algonquin) in Quebec who, based on this unique first experience at Concordia, may decide to enroll in the university for a full degree afterwards. They would do so by applying for admissions like any other student, and some credits from the MILBE may be transferrable to the major in FPST. In addition, this microprogram will attract students from various disciplines, who share an interest in the topic and approach, and who may wish to take a 12-credit land-based microprogram eventually as part of a stackable degree when more microprograms exist, or as a complement to their major as a minor would be, when that becomes technically possible. In the meantime, they may decide to take the microprogram as a complement to their studies after graduation. International students are not currently eligible given the small number of credits. Finally, this microprogram will hopefully also attract local Indigenous teachers and educators currently employed in the community-based school system to pursue a microprogram in Indigenous land-based education as part of their professional development. This mix of students will make for fruitful cohorts that combine academic and cultural experience, and which allow for many opportunities for interdisciplinary peer learning and exchanges.

Rationale for student interest

To evaluate interest, in April 2021, we sent an online survey to students, Indigenous and non-Indigenous, enrolled in different undergraduate programs (including in First Peoples Studies, Education, Applied Human Sciences, and Sociology and Anthropology) at Concordia University. A total of 45 students participated in this survey. Overall, over 90% of students (inclusive of Indigenous and non-Indigenous students) expressed an interest in taking Indigenous land-based courses at Concordia.

More evidence comes from within the Concordia community itself. SCPA/FPST Associate Professor Louellyn White and AHSC Associate Professor Elizabeth Fast have previously incorporated land-based activities into their courses and have received positive feedback from their students. Both have received requests for more offerings that focus on experiential Indigenous-led, land-based learning opportunities. In response to these demands, Professor Fast further developed and implemented a graduate-level course on Indigenous land-based pedagogies as part of a Concordia Summer Institute 2021. She noted: "Indigenous students, in particular, are excited and hopeful for land-based learning as evidenced by the overwhelming interest in the Concordia Summer Institute 2021, which is an intensive week on the land with a focus on fishing and fish preparation. The course was full within two days of registration being opened, with over 80% of applicants being Indigenous students. These students were a mix of undergraduate and graduate Concordia students with a few coming from CEGEP program and other universities".

More recently, Professor White co-organized, with Dr. Donna Goodleaf, the Director of Decolonizing Curriculum and Pedagogy, one-day land-based classes as part of the FPST Proseminar series: *FPST 297 – Indigenous Ways of Knowing (Fall 2021 – 13 students); FPST 397 - Ethics and First Peoples (Winter 2022 – 11 students); FPST 497 – Oral Tradition as Methodology (Winter 2022 – 12 students)*. Each course had Indigenous and non-Indigenous students who were FPST majors participating. Student feedback included many comments on the various land-based survival skills they learned (such as how to make fire and shelters using natural elements from the land), that participating in immersive land-based experiences also improved their mental health and well-being and that a land-based program was much needed at Concordia. Finally, they wanted to participate in more land-based activities.

The following is a brief summary of Concordia student testimonials who have participated in land-based activities via the FPST Proseminar courses:

New skills and knowledge learned:
"The most important knowledge I learned was how quickly a shelter can be built with teamwork. Each member of my group played their part in getting wood, shoveling snow, gathering the material used for the base and making the fire. Teamwork is vital when on the land because there is power in numbers. Land-based education means utilizing the elements in nature that can serve a purpose, as a shelter for survival."

"I learned so much from animal tracking! To be honest, I mostly learned that there is so much to observe and to know. I mainly remember an approach, an attitude, a way of relating to the surroundings, specifically *about* animal tracking. I remember the way rabbits cut small branches at a clean 45-degree angle to eat them, the way we can spot underground tunnels from above the melting snow, and that we can picture the size of certain animals by the distance between 2 or 3 of their prints".

Re-connection to land, increased mental health and well-being:
“It has helped me connect to the land in so many ways. Being far away from my homelands, this day meant the world to me…learning traditional survival skills made me feel happy and grounded. It has helped my mental health greatly that week, by feeling less sad and doomed in the city. It helped me feel like my body is useful, using every muscle to create a shelter. This land-based experience was beautiful in so many ways and so important”.

“It made me miss home and want to go back to learn more about the land. I want to learn about the animals and medicine surrounding the Naskapi territory”.

Apply land experiences to self and educational journey*:*
“I intend to apply what I have learned from the land in my educational journey as I understand that land is the ultimate teacher. I will remember everyone has unique strengths and so many skills can be learned from doing land-based activities. School can be stressful because of exams and assignments, but experiences on the land remind me to be present. This will help me to manage my stress by focusing on the present moment and being aware of the environment”.

“I am hoping to complete a master’s in social work after my undergraduate degree, I hope to incorporate more land-based knowledge in my studies and efforts on improving mental health within certain communities such as women and/or youth. This experience was empowering, fulfilling and overall, extremely educative that a lot of individuals can benefit from”.

Note: Currently, we are running a pilot version of the land-based education courses as special topics in FPST. The first course, which began this fall, reached full enrollment with a waiting list before the start of term.

4.4 Review of similar and related programs

Provide an overview of related programs within Quebec, Canada, North America and internationally as applicable, indicating the innovative features of the proposed program at Concordia and its competitive advantage.

Similar programs in land-based education are detailed in Appendix I. To summarize, Canadian universities are increasingly turning towards land-based learning in collaboration and partnership with local Indigenous communities. Locally, *McGill University* offers a land-based field course (which was suspended during the pandemic); however, it is one course, whereas the goal here is to create a coherent program that does not only send students out onto the land, but which also helps them explore the epistemology, practices and political potential in engaging in this kind of learning.

Elsewhere in Canada, the *Dechinta Centre for Research and Learning*, a leading organization in land-based learning with Northern Indigenous communities, has a partnership with the *University of British Columbia* for a *Certificate in Community and Land-Based Research*, which consists of 5 courses, given by Dechinta but accredited by UBC. The *University of Saskatchewan* as a *Master of Indigenous Land-Based Education*, which is unique for offering this material at the graduate level, while the *University of Manitoba* has an Indigenous Land-Based education program which is project-based but does not lead to any particular degree or certificate.

Across the country, there are one-off courses and initiatives that bring land-based education into the university, however what is clear is that there is a lack of coherent, sustained programming on the topic. Per our research, there is no undergraduate level program, housed within a university and taught by university professors, that does land-based education in Canada.

There is, therefore, a tremendous opportunity in the microprogram, to become a leader in land-based education in Québec and in Canada. While there is tremendous enthusiasm for this approach across the country, there is a lack of coherent, well-thought-out programming that blends academic theory and teaching with field experiences and practice, a gap which this program intends to fill.

4.5 Career opportunities

Include a description of career opportunities for students who complete the program, based on evidence from a market analysis.

Students who complete this microprogram as a standalone program will be attractive candidates for degree programs in First Peoples Studies, Environmental and Sustainability programs, Education, Fine Arts, Geography, Planning and Environment, Law, Applied Human Sciences, Economics, Business Management, Center for Engineering and Society, History, Political Sciences, and Concordia's new School of Public Health program, with a specific focus on Indigenous Community Health and Well-being.

Students who complete this microprogram before or after a BA degree in Education will be attractive to educational institutions looking for teachers with experience in Indigenous land-based education and culturally responsive teaching techniques, Education, local Indigenous governance and Law, Indigenous Health, social work, Indigenous environmental agencies and Indigenous community development. As you can see in our letter of support from the English Montreal School Board (EMSB), there is growing interest in hiring people with this training within the educational sector.

These degree-combination options will be possible once the appropriate University-level mechanisms are in place.

Section 5 - Institutional Relevance

5.1 Institutional fit

Provide an explanation of how the proposed program fits within the Faculty and University at large. Demonstrate how the program contributes to the strategic growth or revitalization of the unit and the university.

This Indigenous land-based program fits within the Faculty of Arts and Science and University at large in the following ways:

The proposed **Microprogram in Indigenous Land-Based Education** program is guided by Concordia University's mission to be innovative, creative and promote excellence in education, research and build community partnerships; Concordia's salus – 'well-being through harmony'; and the institution's nine strategic directions that embrace diversity. Furthermore, the creation of an Indigenous Land-based program is in alignment with the Concordia University's *Indigenous Directions Action Plan (specifically recommendation 2.7*: *"New Indigenous land-based programs are researched, developed and offered in partnership with Indigenous communities and on campus" (p.18).*

This program is also in alignment with Concordia's Sustainability Action plan regarding the key stream areas: food, waste, climate, research and curriculum. It also aligns with the goals of the Equity, Diversity and Inclusion Working Group of the university to see underrepresented members of its community not reflected, but welcomed, included and supported to make contributions in all areas of university life (see: https://www.concordia.ca/provost/initiatives/working-toward-equity-diversity-inclusion.html).

As well, this program aligns with the Office of Experiential Learning key goals by providing students opportunities to enrich and apply their learning experiences through participation in various land-based activities in partnership with local Indigenous community organizations. In addition, this program aligns and supports the Next Generation Cities Institute key initiatives that address societal challenges such as climate change, ecological environmental systems, waterways, impacting urban development through examination of Indigenous sustainable practices.

As such, the development of an Indigenous land-based program grounded in Rotinonhsión:ni epistemological frameworks and pedagogical practices would demonstrate Concordia's commitment and actions in decolonizing and Indigenizing curriculum and pedagogy through the offering of an Indigenous land-based program that would benefit all students at the university.

Faculty Context. In addition to full time FPST Indigenous faculty members and those who have cross-appointments with other academic units in the Faculty of Arts and Science, this program could also draw upon various expertise and faculty members from other departments and faculties [including Art History, Studio Arts, Sculpture, Design and Computational Arts, History, Centre for Oral History and Digital Storytelling, Applied Human Sciences, Education, Center for Engineering and Society, Media and Communication, Journalism and the decolonizing STEM curriculum committee within the Centre for Engineering and Society (CES)]. For example, faculty members could speak on the role of media and its impacts on Indigenous issues related to land; faculty from the CES can speak on the impacts of sciences, technology and development on Indigenous communities today.

5.2 Program alignment with unit

Provide a rationale for how the program aligns with your unit, indicating how the new program represents an area of growth and/or an area of strength.

List the existing programs in your unit and indicate how the new program will affect these programs. Indicate what, if any, programs or courses will be closed in its place, or how programs will be consolidated or re-packaged (for instance, why is a new program necessary, rather than revising an existing program?)

Include an overview of all current full-time faculty in the unit and their relevant research and teaching expertise, and identify directions for future hires as needed.

The SCPA offers interdisciplinary education to undergraduate and graduate students in First Peoples Studies, public policy analysis and advocacy, immigration studies, and community economic development. It contains the following programs:

Bachelor of Arts (BA)

- *Major in First Peoples Studies (45 credits)*
- *Minor in First Peoples Studies (24 credits)*
- *Major in Community, Public Affairs and Policy Studies (42 credits)*
- *Certificate in Immigration Studies (30 credits)*
- *Minor in Immigration Studies (24 credits)*

Graduate Diploma in Community Economic Development (30 credits)

The microprogram in Indigenous Land-Based Education complements the *BA Major in First Peoples Studies* as a standalone program with the potential to also serve as a component of future stackable programs. The goal is to offer intentional learning opportunities designed to address the learning needs of Indigenous students. This would also increase students' flexibility in selecting courses and diversify their degree program, once the proper university-level stacking capacity mechanisms are in place. The microprogram complements the *Minor in First Peoples Studies* in similar ways, by making space for Indigenous epistemologies and building on our existing courses and methods while adding a novel approach.

The microprogram fits well into the SCPA as a whole, furthering interests in the intersection of theory, practice, and community engagement. The new microprogram will enhance and enrich the FPST program and the SCPA because it draws upon existing FPST courses and offers a hands-on, experiential land-based program that takes place in partnership with the local Kanien'kehá:ka community of Kahnawake. As a standalone microprogram, it will attract non-traditional learners from the community who may wish to continue at Concordia for a further degree afterwards, by applying through the regular admissions process. For students who pursue the Major in FPST afterwards, INLB courses could be transferred towards the Major. FPST 210, which is already part of both programs, would be an "in program" course, while the others could be credited as electives. This will make for diverse and engaging cohorts of learners bringing different kinds of cultural and academic experience to the BA Major and Minor programs.

The overall richness of the unit's coursework will also benefit. FPST courses could potentially be strengthened by the pedagogy developed in this microprogram through research and pedagogical practices grounded in Rotinonhsión:ni epistemological frameworks under the guidance of local Kanien'kehá:ka community experts and cultural knowledge holders. This bodes well for the reinforcement and development of academic opportunities grounded in land-based education. For example, SCPA/FPST Associate Professor Dr. Louellyn White, a Kanien'kehá:ka from Akwesasne has taken a leadership role in bridging FPST and the proposed program as she already employs land-based experiential learning in the development of existing coursework. There are also faculty members in other academic units such as Professor Monika Gagnon, Chair of Communications, Professor Tanya Tajmel, Centre for Engineering and Society, Professor Arseli Documaci, Canada Research Chair in Critical Disabilities Studies, Media and Technology interested in these approaches, and this could help with furthering enhanced interdisciplinary links. The BA Major in FPST already has served to recruit faculty members and teachers from Indigenous communities for teaching, research, and service, and this work would be strengthened by the community links facilitated by this microprogram. Finally, developing a land-based pedagogy program is a priority for the SCPA and its FPST-related faculty members, as it is part of the commitment and momentum towards decolonization, by centering on the Indigenous epistemologies as well as creating more opportunities for students to become immersed in them.

There would be no programs or courses closed for this program. This microprogram builds on our existing courses and programs, but it does not require eliminating anything, nor would it draw students away from our Major or Minor.

Section 6 - Consultation and Collaboration

6.1 Consultation with stakeholders

Describe the consultation processes that have been undertaken with academic units and/or other stakeholders that will be impacted by the introduction of this program.

The consultations undertaken include discussions and information gathering within the Concordia University community (including its students), as well as with local Indigenous communities:

Concordia University

- Met with the Indigenous Directions Leadership Council and received approval to move forward as this is in line with meeting recommended action: 2.7, as noted above.
- Met with the Program Director of the BA Major in First Peoples Studies, Dr. Catherine Richardson, who has approved and expressed support for this program.
- Met with the Principal of the School of Community and Public Affairs (Dr. Anna Sheftel), as well as the SCPA Departmental Assembly, including faculty and student associations, all of whom have expressed support for this program. The Principal and Director of the First Peoples Studies have collaborated on the creation of this document.
- Met with Associate Dean, Academic Programs and Pedagogy, Faculty of Fine Arts (Dr. Elaine Cheasley Paterson), who has expressed support and interest in the program.
- Met with the Chair of the Department of Communications Studies (Dr. Monika Kin Gagnon), who has expressed an interest and support for the program.
- Met with members of the Decolonizing STEM Curriculum and have expressed interest to collaborate and co-design a course on water issues impacting Indigenous communities.
- Met with the Canada Research Chair in Critical Disability Studies and Media Technologies, and the director of Access in the Making Lab, Dr. Arseli Dokumaci, and she has expressed an interest and support for the program (see letter of support).

Local Indigenous Community: Kahnawake

- **Iontionhnhékwen Wilderness Skills Land-Based facilitators -** established a partnership with the Iontionhnhékwen Wilderness land-based facilitators in co-constructing the curriculum framework that outlines various experiential, hands-on, and land-based activities to take place in the local Kanien'kehá:ka community of Kahnawake.
- **Kahnawake Education Centre (KEC)** – communicated the proposal with the Director of the KEC. The Director expressed support for the new program as it supports post-secondary students enrolled at Concordia University as well as fits well for current KEC teachers intending to pursue professional development via a microprogram in **Kanien'kehá:ka** land-based education. The KEC Board of Directors approved the proposed microprogram at their August meeting. (See letter of support).
- **Kahnawake School Diabetes Prevention Project (KSDPP)** – discussed the program proposal with Alex McComber the Community Advisor & Researcher for the *Kahnawake Schools Diabetes Prevention Project* who is also the Director of *Quebec Indigenous*

Mentorship Network and Assistant Professor in the Department of Family Medicine at McGill University. The Director expressed support and an interest to be a partner in this program from a community-based context. Also, met with the KSDPP Community Board, who approved the proposed microprogram at their August meeting. (See letter of support).

- **First Nations Regional Adult Education Centre Kahnawake (FNRAEC)** – met with the Executive Director of FNRAEC and its instructors to communicate the proposal. They expressed support and interest for this program as they are also in a process of developing their own land-based courses for their students; they welcome the collaboration and partnership with this program (see letter of support).

Concordia Students

- As members of the IDLC, both graduate and undergraduate Indigenous student representatives expressed overwhelming support for this program proposal.
- An online survey that went out in April 2021 to the KEC's post-secondary students at the time enrolled at Concordia University, the Otsénhakta Student Centre and to all students enrolled in the BA Major in First Peoples Studies program. Findings from the online survey indicate that over 90% of students (inclusive of Indigenous and non-Indigenous students) expressed an interest in taking Indigenous land-based courses at Concordia University.

6.2 Impacts on other existing programs

Describe the impact the new program will have on other, existing programs.

There is currently no program like this one offered at Concordia University. It will not take students away from other programs but may aid in the recruitment of Indigenous students across programs, due to the increased visibility it will give Concordia in local Indigenous communities, as well as non-traditional students who may develop a new interest in pursuing higher education. This new Indigenous land-based program will provide opportunities for other existing programs across the University to form collaborative relationships and work to realign their curricular program objectives to advance and center Indigenous epistemological frameworks and pedagogical practices. We expect that this microprogram will raise the profile of our existing Major and Minor by introducing new students to SCPA and FPST, and perhaps draw new students into these programs after a positive experience in the microprogram. The microprogram will strengthen and add to our existing course offer, but have no direct impact on the Major and the Minor, which will remain as is, and require no modifications.

It could also serve as an opportunity for the development of similarly inspired coursework in the FAS and university. For example, this program serving as a model, other units might wish to propose further experiential courses, working with Donna Goodleaf, the Director of Decolonizing Curriculum and Pedagogy, and other Indigenous leaders. Such new courses could center on Indigenous theoretical frameworks and perspectives, in ways that would complement and address themes such as water rights, sustainability, environmental issues, access to land, health, food security and food sovereignty, related to Indigenous land-based education.

6.3 Collaborations

Describe what collaborations or partnerships have been developed or will be developed to support the program (for example with other complementary programs, departments, universities, cégeps, community groups, governments, corporations, etc.)

Future collaborations will be essential, and at times necessary, for Concordia University to continue building and sustaining trustful and meaningful relationships with local Indigenous communities, Elders, and community organizations who have an interest in this proposed program. In addition, possible future collaborations could be with other Rotinonhsión:ni communities such as Kanehsatake and Akwesasne; Cree, Inuit and Algonkian communities and other universities who offer Indigenous land-based programs and/or courses such as the *University of Saskatchewan*, *McGill University*, and the *University of Manitoba*.

6.4 Consultation with the School of Graduate Studies

If this is a graduate program, describe what consultations have been undertaken with the School of Graduate Studies.

N/A

Section 7 – Program Requirements

7.1 Admission requirements

Provide an overview of admission requirements for the program.

It is expected that most prospective students will be mature students. The program will welcome candidates with non-traditional academic background and career paths or those who do not necessarily possess a university or college degree. Applicants will be required to submit:

- Curriculum vitae (CV) or resumé
- A letter of intent explaining:
    - Describe their knowledge of, experience in, and/or connection to Indigenous communities.
    - Why have they chosen to study at university at this time? Outline the reasons for their choice of program and their personal and educational goals and/or aspirations.
    - Describe any experience, knowledge, or skills which they have acquired that would assist them in their studies (i.e., any prior academic and/or lived experiences in Indigenous land-based field activities or study).
- Transcripts.
- A short interview by FPST faculty for shortlisted candidates.

The Director of the Microprogram will oversee admissions, with a centralized process to be planned for future years.

Required documents

Applicants are required to submit the following documents along with the online admissions application:

Required Prerequisite(s)

The prerequisite for this program is either academic or lived experience of Indigenous communities. However, where a student is a promising candidate for the program but has no experience or prior knowledge of Indigenous communities, they may be required to take FPST 201: Introduction to First Peoples Studies course in addition to the above requirements prior to enrolling in the program or concurrently in their first term.

7.2 Residence requirements

Provide an overview of the residence requirements.

Based on the partnership between Concordia University and the Ionhntionhhéhkwen Wilderness Skills located in the Kanien’kehá:ka community of Kahnawake, 100% of the credits of this microprogram must be taken at Concordia, with some structured, seasonal land-based activities that will take place in the Kanien’kehá:ka community of Kahnawake as well.

7.3 Program procedures

Provide a description of the administrative structures and procedures of the program, including the following, as applicable:

Concordia's acceptable standing, conditional standing and failed standing performance requirements do not apply to the microprogram, given that it is intended to be completed in two consecutive terms. Students will be considered eligible to graduate from this program if they have passed all four required courses.

If students do not successfully complete any of the required courses within the standard two consecutive terms for program completion, they must return in the fall term or winter term of the following year to complete the courses that they missed. Students who have not registered for a course for four consecutive terms or more will have a lapsed notation entered on their student record.

Graduation Requirement:
Students enrolled in this microprogram are not required to submit an application for graduation but will graduate following completion of their program requirements.

- ***Grading and assessment of projects and experiential learning components*** - Grading and assessment of projects and experiential learning components
    - Students will be graded and assessed according to fulfilment of all class assignments, projects and experiential land-based learning activities.

- ***Graduate supervision***
    - n/a

7.4 Degree requirements

Provide a breakdown of required courses for the degree, including a table to indicate the typical trajectory of students through the program, indicating courses to be taken in the first, second and third years of the program. Clearly identifying the core and elective courses, as well as any streams or concentrations within the program.

Students accepted into the microprogram in Indigenous Land-Based Education must complete all required 12 credits one existing FPST courses and three new courses) and follow a pre-determined sequence, shown in the table below, that would lead to graduation.

Fall Term (6 credits)

Course Code and Number	Course Title	Number of Credits	Prerequisites
FPST 210	Haudenosaunee Peoples	3	Registration in the program
ILBE 301	Indigenous Land-Based Field Studies Part I	3	Registration in the program

Winter Term (6 credits)

Course Code and Number	Course Title	Number of Credits	Prerequisites
ILBE 302	Indigenous Land-based Field Studies Part II	3	Registration in program FPST 210, INLB 301
ILBE 403	Integrative Seminar on Indigenous Sustainability and Self-Determination	3	Registration in program FPST 210, INLB 301

In the rare case where a student enrolled in the BA program in First Peoples Studies has already successfully completed FPST 210 prior to their enrollment in the **Microprogram in Indigenous Land-Based Education,** they will be required to replace this course by taking an alternative determined by SCPA in consultation with the FPST program's director. This is to avoid redundancy and "double-dipping" towards two different credentials. Consultation with the director will ensure that the substitute course fits within the program goals and learning outcomes of the microprogram.

7.5 Co-op, internship and experiential learning options

Provide a description of any Co-op, internship and experiential learning options available to students as applicable. Provide details regarding administrative processes, including placement processes for internships or the proposal submission process for experiential projects. Clearly indicate the number of hours of work expected from students, how students will be assessed, and identify the responsibilities and expectations of any external organizations involved. When significant collaborations with external bodies for the delivery of a program component, and MOU will be required as an appendix.

In the two experiential courses, ILBE 301 Indigenous Land-based Field Studies Part I and ILBE 302 Indigenous Land-Based Field Studies Part II, students will be immersed in land-based activities on the land in the community of Kahnawake with land-based facilitators from Iontionhnhékwen as well as with other Indigenous knowledge holders. As is described elsewhere in the proposal, these two classes will alternate more theoretical and epistemological discussions in the classroom with these facilitated hands-on experiences on the land, to be able to tie together the theory and practice of land-based learning. The facilitators will be paid by the program and will work with the course's professors to design each land-based session. Students will be graded for the coursework they produce which reflects on what they learned from these experiential sessions, and not for their actual success at completing these tasks on the land.

As an example, the following table represent the curricular framework for Iontionhnhékwen experiential and survival skills land-based activities, the duration of the activities, and the method of delivery.

***Note**: The various activities described below will take into account ways of how to accommodate students with disabilities.*

Land-Based Curricular framework: Prepared by Ionhntionhnhékwen Wilderness Skills Instructors

Topic	Activity Description	Learning Outcomes	Duration of Activity	Method of Delivery
Introduction: Sensing PLACE in the Natural World	Students will be introduced to breathing tools & visualization based on traditional Kanien'kehàka worldview and practices. These will be conducted with physical connection to the land surrounded by the natural beings and elements that support the health and well-being of the physical, mental and emotional bodies. These can increase awareness of students' inner landscape, the unique place they hold in creation and strengthen their sacred relationships to the natural world as is traditionally recognized by Indigenous peoples worldwide. "All our Relations" are known to heal, restore and bring balance to body, mind and emotions.	Using a variety of conscious breathing and visualization techniques students will have versatile practical tools to use at anytime. With practice this will enable them: • To recognize the sacredness of themselves and their place in relation to the natural world. • To have an experience of their inner physical, emotional and mental landscapes. • To identify what self- care they may need from natural elements.	Two 20 minutes guided sessions each day. In addition, a variety of supportive reminders, available to group and one on one, will be provided to heighten awareness and connection throughout each land- based exercise.	In person session Location: Kahnawake community
Introduction to Fire making. All Seasons.	Students will learn the basics of fire making and fire safety. Students will learn how to harvest natural materials from the land and build a sustainable and efficient fire	• Identify different trees. • Identify different plants. • How to make proper tinder bundles • How to prepare weather appropriate fire structures. • How to use ferro Rods in various techniques. • Fire safety. • Fire management.	4 hours	In person session. Location: Kahnawake community
Knife, Axe and Saw safety. All Seasons.	Students will learn how to safely use a knife, axe, and saw and apply their skills on the landscape.	• Learn and apply proper safety rules. • Identify different types of axes, knives, and saws and their uses. • Build confidence in using tools. • Learn about different woods and how they apply to the tools.	3 hours	In person session. Location: Kahnawake community

Introduction to Types of Shelters and Shelter making. All Seasons.	Students will learn how to construct 3 minimalist and emergency shelters using tarps and lines. Students will learn about various knots and rigging techniques.	• Learn to tie various safety knots. • Identify safe shelter locations. • Identify shelter hazards. • Building a weather appropriate shelter. • Build and manage a base camp.	4 hours	In person session. Location: Kahnawake community
Introduction to Water and Water Safety. All Seasons.	Students will learn how to safely gather and prepare potable water from the landscape. Students will learn about the dangers of unclean water and how to remedy with modern and primitive water filters.	• Identify safe drinking water sources. • Examine dehydration and its effects. • Examine water borne pathogens and viruses. • Examine sanitization techniques. • Identify different primitive boiling techniques. • Examine different teas on the landscape.	4 hours	In person session Location:
Foraging and Wild Edibles. Summer.	Students will learn how to identify and prepare various wild edibles from the landscape.	• Learn about plant anatomy. • How to safely harvest plants. • How to sustainably harvest plants. • Introduce forest gardens. • How to prepare and cook various plants and berries. • Examine health benefits of wild foods. • Identify Sustainable practices.	4 hours	In person session Location: Kahnawake community
Introduction to Animal Tracking. All Seasons.	Students will be introduced to sign and clear print ID tracking. Students will examine gait patterns and foot morphology of common animals.	• Identify common gait patterns. • Identify common animal tracks. • Study animal movement. • Learn to identify animal trails. • Learn to catalogue and ID prints.	4 hours	In person session Location: Kahnawake community

7.6 Accreditation

Indicate any requirements associated with accreditation processes, as applicable.

There are no accreditation requirements for this program.

7.7 Course descriptions

Include descriptions for existing and new courses, and a summary of changes to existing courses.

Course Descriptions

Existing Course

FPST 210 – Haudenosaunee Peoples (3 credits)
Prerequisite:
From a Rotinonhsión:ni perspective, this course traces the history of the Haudenosaunee (Iroquois) from the period of the founding of the Confederacy to the present. With particular focus on the Kanien'kehaka (Mohawk) of Quebec, it includes discussion on the culture, language, and structure of Haudenosaunee society, the formation of the Haudenosaunee Confederacy, traditional philosophies such as the Kaienerekowa (Great Law of Peace) symbolism, as well as contemporary issues, including the impact of Euro-Canadian government policies and practices.

Proposed New Courses

ILBE 301 – Indigenous Land-Based Field Studies Part I (3 credits)
In this experiential course, students engage in seasonal immersive land-based activities in the community of Kahnawake, as well as classroom-based discussions via sharing circles, presentations by Indigenous knowledge holders, and other experiential classroom methods. Students build awareness and reconnection to the land drawing from Rotinonhsión:ni knowledge systems such as the Creation Story and the Ohénton Karihwatehkwken. Students examine land as learning space and examine how fostering land-based pedagogies can promote collective well-being and self-sufficiency.

ILBE 302 – Indigenous Land-Based Field Studies Part II (3 credits)
The following courses must be completed previously: FPST 210; ILBE 301. If prerequisites are not satisfied, permission of the School is required.
In this experiential course, students engage in seasonal immersive land-based activities in the community of Kahnawake as well as classroom-based discussions via sharing circles, presentations by Indigenous knowledge holders, and other experiential classroom methods. Students build awareness and reconnection to the land drawing from Rotinonhsión:ni knowledge systems such as the Creation Story and the Ohénton Karihwatehkwken and other Indigenous epistemologies as they relate to Indigenous land-based education. Students examine land as learning space, variations of Indigenous land-based systems, and examine how fostering land-based pedagogies can promote collective well-being and self-sufficiency.

ILBE 403 – Integrative Seminar on Indigenous Sustainability and Self-Determination (3 credits)

The following courses must be completed previously: FPST 210; ILBE 301. If prerequisites are not satisfied, permission of the School is required.

This course aims to expand students' knowledge and understanding about diverse Indigenous land-based practices through guest lectures, seminars and/or workshops offered by Indigenous community based cultural knowledge experts, and other Indigenous scholars across Turtle Island. Students critically examine what sustainability means from Indigenous perspectives and its linkages to self-determination. As well, students explore topics on Indigenous traditional food systems, food security and food sovereignty, models of Indigenous economic self-sufficiency, and Indigenous health systems.

Section 8 – Resource Implications

8.1 Enrolment forecast

Provide Application, Acceptance, and Registration (AAR) forecasts, with justification and explanations, projected for a 5-year period.

Example: Enrolment Forecast Table 1 (AARs)

Year	Applied	Accepted	Registered
2022-23	30	20	15
2023-24	35	25	20
2024-25	40	30	24
2025-26	40	30	24
2026-27	40	30	24
2027-28	40	30	24

These numbers are forecasted based on interest the program has already received from potential and current students. The pilot courses were capped at 15 students and the one that has already been run had a waiting list of 5 students. The expectation is that we will be able to accept the majority of applicants, as this program does not have a high barrier to entry and is likely to attract very specific types of students, however the Admissions process still needs to ensure that students come in with some knowledge or background of Indigenous communities, and with a respectful approach to the subject matter. The goal is to grow slowly but eventually reach 24 students per cohort, the maximum number that would allow for land-based field days to run smoothly and to facilitate a sense of cohort-based learning.

8.2 Human resources required and available

8.2.1 Faculty presently available

Indicate the number of full-time faculty available and qualified to teach in the program.

One full-time faculty member in FPST will teach in the program. Louellyn White, Associate Professor, FPST, is a Kanien'kehá:ka scholar who has been teaching in FPST at Concordia since 2010, where she assisted in program and curriculum development. She has taught FPST 210, which will be part of the microprogram, 4 times. During the 2021-2022 academic year, she collaborated with Donna Goodleaf and Ionhntionhékwen, piloting land-based learning through the proseminars offered in FPST: FPST 297, 397, and 497. Each course was taught both online and in Kahnawake where students were taught land-based skills facilitated by staff from Ionhntionhékwen. FPST also has a current LTA, Emily Charmaine Coon, who has expertise in this area and will be a potential instructor. She is currently teaching FPST 210.

8.2.2 New faculty required, with specialization

Indicate specific faculty hiring needs required for the launch of the program.

The Ionhntionhékwen survival skills land-based facilitators will be hired for the on the land elements of the courses, as local Indigenous community-based cultural knowledge experts associated with the program. Additional knowledge holders, elders, and experts will be hired for specific topics and activities as necessary. However, these courses will be otherwise taught by existing full and part-time faculty.

8.2.3 Present and future faculty workloads

Provide a breakdown of present and future faculty members, a list of courses and the faculty members available to teach the courses.

Example Table: Available Faculty Members for Core and Elective Courses

Course Code	Course Title	Credits	Full-time Faculty Member
ILBE 301 Fall	Indigenous Land-based Field Studies – Part I	3	Louellyn White
ILBE 302 Winter	Indigenous Land-based Field Studies – Part II	3	Louellyn White
ILBE 403 Winter	Integrative Seminar on Indigenous Sustainability and Self-Determination	3	LTA
FPST 210	Haudenosaunee Peoples	3	LTA

8.2.4 Additional section allocations and part-time instructors

Provide a breakdown of additional course sections that would need to be taught by part-time faculty, according to the enrolment projections.

This program would add three new sections to FPST annually; it would also add a 4^{th} section every three years, as currently FPST 210 is offered two years on, one year off. With full-time faculty and LTA teaching partly in this program, some of their previous FPST sections would go to part-time faculty.

8.2.5 Course remissions

Indicate any course remissions required for administrative oversight of the program.

The Director of the microprogram would receive a three-credit course remission to assist in administering the program. Their responsibilities will include:

- Develop curricula and teach at least two of the four program courses; manage students, cultivate sense of community, cultural safety, Moodle management, create and grade assignments, respond to student needs.
- Oversee other faculty teaching within the Micro-program
- Admissions process development and implementation
- Recruitment
- Screen students for admission
- Respond to program inquiries

- Organize land activities; scheduling, invite guests, location logistics, rent space as necessary, process payments
- Organize transportation; booking, payments
- Develop and maintain community relationships and engagement
- Budget development and management
- Meet regularly with community stakeholders and advisors
- Manage any behavioural issues that may emerge when students are out on the land
- Develop and distribute promotional materials
- Webpage development

8.2.6 Teaching Assistantships

Provide a breakdown of additional teaching assistant hours required for any new courses or additional sections required for existing courses.

There are no teaching assistant needs.

8.2.7 Accreditation costs

Indicate any initial or ongoing costs associated with accreditation, as applicable.
N/A

8.2.8 Technical staff

Provide an overview of the capacity of current technical staff, and identify any need for additional technical staff as applicable.
N/A

8.2.9 Administrative support staff

Provide an overview of the capacity of current administrative support staff, and identify any need for additional administrative support staff as applicable.

There is a need for some administrative support to help with admissions, enrollment, and logistics for the land-based field days. This would not require full-time support, therefore we propose creating a work-study position for a graduate student to assist with the administration of the program.

8.3 Material Resources, Required and Available

8.3.1 Library facilities and holdings

Provide an overview of library facilities and holdings, and any costs related to the acquisition of additional holdings as applicable, based on findings from the Library Report.

The Concordia Library has improved over the last few years with the creation of online Indigenous education resources link dedicated to serve Concordia faculty and students at: https://www.concordia.ca/library/guides/indigenous-fac-res.html.

There are no additional costs for acquisition of additional holdings. This is detailed in the Library Report attached in Appendix V.

8.3.2 Computing facilities

Provide an overview of existing computing facilities and identify any need for upgrades, renovations, or additional computing facilities needed, as applicable.

Currently, FPST relies on the university-wide computing facilities. There is no need for any additional resources for this program.

8.3.3 Teaching space

Provide an overview of existing teaching space, such as laboratories, studios and classrooms, and identify any need for upgrades, renovations, or additional facilities, as applicable.

This program would generally be offered on the Loyola campus, so it would require classroom space there. There are no other space needs.

8.3.4 Research space

Provide an overview of existing research space and identify any need for upgrades, renovations, or additional facilities, as applicable.

This program does not require additional research space.

8.3.5 Equipment

Provide an overview of existing equipment and identify any need for upgrades, or new equipment such as laboratory equipment or audio-visual equipment, as well as any ongoing costs such as licensing and equipment maintenance.

This program does not require additional equipment.

8.3.6 Administrative office space

Provide an overview of existing administrative office space and identify any need for upgrades, renovations, or additional facilities, as applicable.

There is no need for extra office space.

8.3.7 Funding for graduate students

Provide a breakdown of funding available to support students in graduate programs, if applicable.

This is not a graduate program.

8.4 Itemized Summary of Resource Implications

The program's resource implications are as follows:

- 3-credit course release for program director
- 3 new sections (plus a 4th for FPST 210 every three years, as it is generally offered two years on, one year off)
- Part-time administrative support in the form of work-study contracts (approximately $6000 per year)

There are also expenses related to community partnerships and the time the students will spend in the field:

- Youth and Elder Advisory Board: $4000 per year for gifts and honoraria, transportation and food, for two meetings per year
- Land-Based Facilitator Salaries:
  - $80 per hour for 8 hours per day x 4 facilitators = $2560 per day
    INLB 301: Indigenous Land-Base Field Studies Part I - 5 land days
    INLB 302: Indigenous Land-Base Field Studies Part II - 4 land days
    INLB 403: Integrative Seminar on Indigenous Sustainability and Self-Determination - 3 land days
    Total: 12 land days x 2560 per day: $30720 per year

Youth Mentees:

- Stipends to enable two youths from the community to participate in the program: $2000 per stipend = $4000 per year

Cultural Knowledge holders and classroom honoraria:

- Budget to invite cultural knowledge holders and other guest speakers into the classroom, at $500 per speaker:
  4 guest speakers per course for 4 courses = 16 x $500 = $8000

Course materials, per supplies requested by land-based facilitators:

- $1991.04 per year ($82.96 per student x 24 students)

Cultural Protocol Supplies:

- Miscellaneous gifts and offerings for elders and knowledge keepers: $1200 per year

Program Evaluation:

- $3100 per year to pay for an Indigenous consultant to conduct a yearly program evaluation in collaboration with the program director.

Rental fees:

- Venue rental space: $500 per land day to rent commercial land or compensate for private land use x 12 land days = $6000 per year
- Canoes: $300 per year
- Bus rentals, to and from Concordia: $12 000 per year

- Rental for portable toilets for field days: $200 per day x 12 land days = $2400
- Kahnawake Community Hall, for year end feast: $1600 per year
- Catering for year-end community feast: $3000 per year

8.5 Cost/Revenue Projection

Provide an overview of the cost/revenue projection based on the figures calculated in the approved LOI budget and demonstrate how the program will be financially sustainable.

Currently the program benefits from funding from the Chamandy Foundation, which helps to pay for the land-based facilitation and logistics. Initially conceived for three years, the Foundation is willing to extend the duration of the funding as the current budget projections are much lower than the initial amount we had anticipated we would need yearly. After this money runs out, we are asking the university to commit to seeking continued funding for the program, whether it is internal or external.

Summary and Rationale for Changes

It is my great pleasure to present to you this new program proposal for a 12-credit microprogram in Indigenous Land-Based Education, to be housed within the First Peoples Studies Program in the School of Community and Public Affairs. This proposal was passed unanimously by our school council, with enthusiastic support, on September 22, 2022.

The program comes out of a year and a half of collaboration between members of our School and Dr. Donna Goodleaf, Director, Decolonizing Curriculum and Pedagogy, as well as consultation and partnership with various Indigenous stakeholders at Concordia and in Kahnawake. You can see the community engagement for the program in the attached letters of support. It is in line with the university's priorities in decolonization and Indigenization of our pedagogy and practices, and proposes a really cutting edge but also deeply culturally rooted curriculum that brings students out into the land to learn through Indigenous epistemologies and methodologies, and then brings them back into the classroom to reflect on, analyze, and integrate their knowledge, making connections between the experiences they have on the land with wider issues of social and political concern. This program fits in very well to our school's focus on community-engaged scholarship, and the intersection of theory and practice, and while there are land-based programs popping up across the country, this one is quite unique for how integrated and comprehensive it is within a university structure. All of this is discussed in more detail in the proposal itself.

Currently, all the new courses that we want to create in this proposal are being piloted as slot courses in the FPST program. The reaction to them has been tremendous; our fall course filled up quickly, and had a waiting list. It has been clear to us that the demand is there, and this was without being able to do any official advertising of the courses, and without getting any kind of credential at the end.

Students have been thrilled to engage in a learning space that takes them out of the classroom and into the community, and have benefited from instruction from Elders and land-based facilitators. This has been a unique opportunity for some students to learn while connecting with their heritage, and for others to learn from the stewards of this land. I think it is a model of what decolonized education can and should look like, and we are excited at the prospect of formally launching the program once it passes the various levels of review.

I thank you for your thoughtful review of our proposal.

Summary of Changes (New Undergraduate Program (Regular Process))

Course Changes:

	Subject Code Change	Catalogue Number Change	Title Change	Description Code Change	Prerequisite Change	Note Change (any change to any of the items under "Notes")	Credit Value Change	Component Change	Mode of Instruction Change	Cross-listed Course Change
ILBE 301 Indigenous Land-Based Field Studies Part I New	X	X	X	X	X		X	X	X	
ILBE 302 Indigenous Land-Based Field Studies Part II New	X	X	X	X	X		X	X	X	
ILBE 403 Integrative Seminar on Indigenous Sustainability and Self-Determination New	X	X	X	X	X		X	X	X	

Regulation Changes:

- Notes New

PROGRAM CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: Land-based Education Microprogram

Calendar Section Name: Microprogram in Indigenous Land-Based Education
Calendar Section Type: Program
Description of Change: Microprogram in Indigenous Land-Based Education New

Proposed: Undergraduate Curriculum Changes

Faculty/School: Faculty of Arts and Science

Department: School of Community and Public Affairs
Program Name: Microprogram in Indigenous Land-Based Education
Program Type: Micro Program
Degree: Micro Program

Calendar publication date: 2023/2024/Summer
Planning and Promotion: 01 Jan 0001
Effective/Push to SIS date: 01 Jan 0001
Implementation/Start date: 01 Jan 0001

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 31 Faculty of Arts and Science > Faculty of Arts and Science > Section 31.540 School of Community and Public Affairs > School of Community and Public Affairs Programs > Indigenous Land-based Education > Microprogram in Indigenous Land-based Education > Program Requirements

Type of Change: New Program

Present Text (from 2021) calendar	Proposed Text	
credits	**12 credits**	Microprogram in Indigenous Land-Based Education
0	~~0~~	12 credits: FPST 210 Haudenosaunee Peoples (3) ILBE 301 Indigenous Land-Based Field Studies Part I (3) ILBE 302 Indigenous Land-Based Field Studies Part II (3) ILBE 403 Integrative Seminar on Indigenous Sustainability and Self-Determination (3)

Rationale:
See program proposal.

Resource Implications:
See program proposal.

REGULATIONS CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: Land-based Education Microprogram

Calendar Section Name: Notes
Calendar Section Type: Regulation
Description of Change: Notes New

Proposed: Undergraduate Curriculum Changes

Faculty/School: Faculty of Arts and Science

Department: School of Community and Public Affairs

Calendar publication date: 2023/2024/Summer
Type of change: New Regulation

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 31 Faculty of Arts and Science > Faculty of Arts and Science > Section 31.540 School of Community and Public Affairs > School of Community and Public Affairs Programs > Indigenous Land-based Education > Microprogram in Indigenous Land-based Education > Program Requirements > Microprogram in Indigenous Land-Based Education

Present Text (from 2021) calendar	Proposed Text
	Notes - Students enrolled in this microprogram who have not registered for a course for four consecutive terms or more will have a lapsed notation entered on their student record.

Rationale:
A standard note regarding lapsed standing is added to the program notes, in alignment with standard process for microprograms at Concordia.

Resource Implications:
None.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: Land-based Education Microprogram

Calendar Section Name: ILBE 301
Calendar Section Type: Course
Description of Change: ILBE 301 Indigenous Land-Based Field Studies Part I New

Proposed: Undergraduate Curriculum Changes

Faculty/School: Faculty of Arts and Science

Department: School of Community and Public Affairs

Calendar publication date: 2023/2024/Summer
Planning and Promotion: 01 Jan 0001
Effective/Push to SIS date: 01 Jan 0001
Implementation/Start date: 01 Jan 0001

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 31 Faculty of Arts and Science > Faculty of Arts and Science > Section 31.540 School of Community and Public Affairs > School of Community and Public Affairs Courses > Land-based Education Courses

Type of Change: New Course

Present Text (from 2021) calendar	**Proposed Text**
	ILBE 301 Indigenous Land-Based Field Studies Part I (3 credits)
Prerequisites:	*Prerequisites:*
	Enrolment in the Microprogram in Indigenous Land-Based Education is required. If prerequisites are not satisfied, permission of the School is required.
Description :	*Description :*
	In this experiential course, students engage in seasonal immersive land-based activities in the community of Kahnawake, as well as classroom-based discussions via sharing circles, presentations by Indigenous knowledge holders, and other experiential classroom methods. Students build awareness and reconnection to the land drawing from Rotinonhsión:ni knowledge systems such as the Creation Story and the Ohénton Karihwatehkwken. Students examine land as learning space and examine how fostering land-based pedagogies can promote collective well-being and self-sufficiency.
Component(s):	*Component(s):*
	Field Studies
Notes :	*Notes :*

Rationale:
See program proposal.

Resource Implications:
See program proposal.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: Land-based Education Microprogram

Calendar Section Name: ILBE 302
Calendar Section Type: Course
Description of Change: ILBE 302 Indigenous Land-Based Field Studies Part II New

Proposed: Undergraduate Curriculum Changes

Faculty/School: Faculty of Arts and Science

Department: School of Community and Public Affairs

Calendar publication date: 2023/2024/Summer
Planning and Promotion: 01 Jan 0001
Effective/Push to SIS date: 01 Jan 0001
Implementation/Start date: 01 Jan 0001

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 31 Faculty of Arts and Science > Faculty of Arts and Science > Section 31.540 School of Community and Public Affairs > School of Community and Public Affairs Courses > Land-based Education Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	ILBE 302 Indigenous Land-Based Field Studies Part II (3 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: FPST 210 ; ILBE 301 . Enrolment in the Microprogram in Indigenous Land-Based Education is required. If prerequisites are not satisfied, permission of the School is required.
Description :	*Description :*
	In this experiential course, students engage in seasonal immersive land-based activities in the community of Kahnawake as well as classroom-based discussions via sharing circles, presentations by Indigenous knowledge holders, and other experiential classroom methods. Students build awareness and reconnection to the land drawing from Rotinonhsión:ni knowledge systems such as the Creation Story and the Ohénton Karihwatehkwken and other Indigenous epistemologies as they relate to Indigenous land-based education. Students examine land as learning space, variations of Indigenous land-based systems, and examine how fostering land-based pedagogies can promote collective well-being and self-sufficiency.
Component(s):	*Component(s):*
	Field Studies
Notes :	*Notes :*

Rationale:
See program proposal.

Resource Implications:
See program proposal.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: Land-based Education Microprogram

Calendar Section Name: ILBE 403
Calendar Section Type: Course
Description of Change: ILBE 403 Integrative Seminar on Indigenous Sustainability and Self-Determination New

Proposed: Undergraduate Curriculum Changes

Faculty/School: Faculty of Arts and Science

Department: School of Community and Public Affairs

Calendar publication date: 2023/2024/Summer
Planning and Promotion: 01 Jan 0001
Effective/Push to SIS date: 01 Jan 0001
Implementation/Start date: 01 Jan 0001

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 31 Faculty of Arts and Science > Faculty of Arts and Science > Section 31.540 School of Community and Public Affairs > School of Community and Public Affairs Courses > Land-based Education Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	ILBE 403 Integrative Seminar on Indigenous Sustainability and Self-Determination (3 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: FPST 210 ; ILBE 301 . Enrolment in the Microprogram in Indigenous Land-Based Education is required. If prerequisites are not satisfied, permission of the School is required.
Description :	*Description :*
	This course aims to expand students' knowledge and understanding about diverse Indigenous land-based practices through guest lectures, seminars and/or workshops offered by Indigenous community based cultural knowledge experts, and other Indigenous scholars across Turtle Island. Students critically examine what sustainability means from Indigenous perspectives and its linkages to self-determination. As well, students explore topics on Indigenous traditional food systems, food security and food sovereignty, models of Indigenous economic self-sufficiency, and Indigenous health systems.
Component(s):	*Component(s):*
	Seminar
Notes :	*Notes :*

Rationale:
See program proposal.

Resource Implications:
See program proposal.

Impact Report

Programs

Microprogram in Indigenous Land-Based Education New

Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 31 Faculty of Arts and Science -> Faculty of Arts and Science -> Section 31.540 School of Community and Public Affairs -> School of Community and Public Affairs Programs -> Indigenous Land-based Education -> Microprogram in Indigenous Land-based Education -> Program Requirements

Source of Impact

Courses

ILBE 301 Indigenous Land-Based Field Studies Part I New

Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 31 Faculty of Arts and Science -> Faculty of Arts and Science -> Section 31.540 School of Community and Public Affairs -> School of Community and Public Affairs Courses -> Land-based Education Courses

Source of Impact

ILBE 302 Indigenous Land-Based Field Studies Part II New

Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 31 Faculty of Arts and Science -> Faculty of Arts and Science -> Section 31.540 School of Community and Public Affairs -> School of Community and Public Affairs Courses -> Land-based Education Courses

Source of Impact

ILBE 403 Integrative Seminar on Indigenous Sustainability and Self-Determination New

Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 31 Faculty of Arts and Science -> Faculty of Arts and Science -> Section 31.540 School of Community and Public Affairs -> School of Community and Public Affairs Courses -> Land-based Education Courses

Source of Impact

MEMO

DATE: April 11, 2022

TO: Dr. Richard Courtemanche, Associate Dean, Academic Programs, FAS

FROM: Sandra Gabriele, Vice-Provost, Innovation in Teaching & Learning

SUBJECT: Letter of Intent: Land-Based Education Microcertificate

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I am writing on behalf of Provost Whitelaw to confirm our support of the 15-cr Land-Based Education Microprogram (LBEM) at the undergraduate level, to be hosted in the School of Community & Public Affairs (SCPA), offered through the First People's Studies program (FPST). The program will make significant inroads in our commitment to Indigenize the curriculum at Concordia and will advance our commitment to decolonize the university. We also note that this is the first major addition to the FPST since its inception and believe, coupled with the first Program Review underway, the new program will also mark an important milestone for the Program itself.

We want to especially congratulate the curriculum team for working so closely with the Kanien'kehá: ka community and land-based education facilitators in preparing this Letter of Intent (LOI). We find the opportunity to build a program with the Kanien'kehá: ka community is an important step in reaching our commitments as laid out in the Indigenous Action Plan to bring land-based education to Concordia. We wish to acknowledge the work of Dr. Kahérakwas Donna Goodleaf of the Centre for Teaching and Learning for securing the funds from the Chamandy Foundation to kick off this work and for shepherding the relationship-building with the Kanien'kehá: ka community.

The following comments are offered for the Program to consider as the remaining work on the full program proposal continues. Some of the comments and suggestions are oriented toward the curriculum, while some issues related to the resources will require adjustment when the budget is submitted with the proposal.

Curriculum
We believe that the curriculum will provide a balanced mix of historical insights, hands-on learning derived from Indigenous ways of knowing, and a taste of academic life at Concordia.

Admissions
In terms of the anticipated market for this program, we welcome the desire to attract new

Indigenous students to our University, but would assert that a path for current and future FPST students (majors and minors) must be more clearly outlined in the full program proposal. We believe this is an important way to serve the Program needs and to enrich the curriculum of the Program. It is important to consider this alongside the program proposal because, depending on the path forward, additional curriculum changes should be submitted at the same time as the current proposal so that current FPST students may easily access the program when it is offered. Julie Johnston, the University Curriculum Administrator, can suggest pathways forward, but in the meanwhile, here are some aspects to consider: would the Program be open to allowing Major students to add this microcertificate to their degree? Is there a way to recognize completion of these courses within the Major and the Minor?

We would also recommend that the community-based seats are not reserved exclusively for mentees of the land-based facilitators. Language indicating that "preference will be given to community members who wish to become mentees" may be added in order to achieve this objective without necessarily deterring some community members from applying who may not be ready or fully understand what is implied by becoming a mentee. This can certainly be reviewed once the program has been running for a few years.

Curriculum – Prerequisites

The final point we wish to raise in relationship to INLB 20X* is that it is not clear why the course is not made into a 3-cr offering with more focus on traditional Indigenous ways of knowing. That is, the distinction between the aims of FPST 297, Proseminar Indigenous Ways of Knowing and INLB 20X*, "Introduction to Land-Based Education" is not clear. We wondered if there would be greater simplicity in the curriculum and greater coherence if some of the content of FPST 297 is simply added to INLB 20X*, "Introduction to Land-Based Education," which would then increase in credit value to 3-cr. There may be other reasons for organizing the curriculum in the proposed fashion; should the program proposers wish to keep the current structure, the curriculum map should indicate how each course will meet the program outcomes.

Future Orientations – Indigenous Action Plan, Action 2.7

Before proceeding to a full proposal, we want to ask that the First People's Studies Program pauses to consider where LBE can and will go into the future. Recognizing that this program emerges from Action 2.7 to "Develop comprehensive land-based education programs," we believe this micro-program can be the beginning of other LBE microcertificates, that could be delivered in partnership with other Indigenous communities and scholars. We believe this path would be advisable as it will allow us to build partnerships in knowledge-making with several Indigenous communities through short programs for a time, until we have sufficient experience and trust built to move onwards to other kinds of programming, if there is a desire to do so.

If the Program, and other stakeholders, believe there is a future for LBE using the proposed program as the foundation, we would then recommend that the course description for INLB 20X*, “Introduction to Land-Based Education” reflect more of the outcomes of land-based education overall, without specific references to a location or peoples (Path 1), ***or*** be named differently to reflect the specific offering on and with the Kanien’kehá: ka peoples (Path 2).

If Path 1 is preferred, we would recommend that a sentence be added that would reference that, depending on where and with whom the LBE program would be hosted, the curriculum would shift to address the knowledge systems, history of relations, etc, of each host community. The general title of “Introduction to Land-Based Education” would then serve as an introductory course that would introduce students to the intellectual, historical, spiritual and cultural interventions that LBE makes, in addition to introducing students to the host community and peoples and their histories. The advantage of this approach is that there would be little need to make curriculum changes into the future. If there were two programs running in different communities, the sections could be separated with letters (e.g., INLB 20Xa and INLB 20Xb) and each section would have a different syllabus.

If Path 2 is selected, we would recommend that with each LB offering, a new course would be added to reflect the community and specifics of the offering as new microprograms are developed. In this case, the course should be renamed to something like INLB 20X*, Introduction to Land-Based Education, Kanien’kehá: ka Lands”. When another program is established with another community, a new course code and description could be added that would then reflect the specific lands and peoples who would host the program. This path would necessitate additional curriculum changes into the future.

This recommendation is thus offered to: 1. Occasion reflection on the future orientation of the program and land-based education in the longer-term; and 2. Revisit the course description which contains information that should not appear in the calendar and does not significantly focus on course learning objectives. We ask that all courses be reviewed to provide concise calendar descriptions that name outcomes as much as possible, and not specifics of the course organization which are more appropriately described on a website and syllabus.

Requirements

Given the listed program outcomes (pages 3-4), we suggest the program promoters consider if it is necessary to require some students to take FPST 202 in order to gain access to FPST 302. This requirement will delay completion of the microprogram, while not being strictly necessary according to the learning outcomes of this program (which do not specify research skills as an outcome). Further, if different rules regarding the prerequisites for FPST 302 will be applied to different learners, clearly outlined policies should be established that will indicate under what conditions the current two prerequisites will be waived, for whom and for what reasons. The full program proposal should outline the rationale for any differences in terms of recognition of existing knowledge and skill sets (for example with Indigenous community-based learners) or why the prerequisite is required to fill in knowledge and/or skills sets.

Related to the curriculum, we wish to reiterate Concordia policy around hiring will determine who can teach in the program. We vigorously affirm our commitment to recruit as many Indigenous instructors as possible to teach in this program, while respecting our current legal obligations under our various Collective Agreements.

Budget

Though it is not customary to include a budget at the LOI stage, we appreciate the effort to cost the program. Though we do not expect every program to be revenue-generating, we also recognize a need for all programs to be mindful of how program delivery affects program costing. As such, we offer the following comments on the budget for consideration by the School and the Faculty:

- We concur with your observation, Richard, that the budget does not match the LOI in terms of anticipated enrolments. The revenue table indicates 7.5 students in year 1, 10 in year 2, and 12 in each subsequent year. Yet the LOI notes an expected enrolment of 24 by year 3 (page 12), without specifying what the early anticipated enrolments would be. This discrepancy needs to be clarified.
- Course sections: the need to add sections for the 3 identified FPST courses is not justified with an anticipated intake of 10-12 additional students (again, see the point above about the lack of clarity around admissions). If the program succeeds in reaching 24 students, certainly the need for an additional section should be considered. Given the additional credits that are dedicated to this program alone, and its sequencing, we believe a cohort can be nurtured through these new courses, without necessarily providing additional sections for the FPST courses if the intake is less than 20 students. If the program promoters feel differently, a clearer argument must be presented in the Program proposal explaining their reasons.
- Course remission: we do not offer course remissions for program development, particularly when two existing staff positions and a requested third position is dedicated to building and supporting the program.
- Admin support: please provide a fuller justification for the need for this staff position when the full proposal and budget are submitted in the next phase of the program development process. In particular, we wish to understand if this brings a current FPST staff position to full-time hours, or if this would necessitate the creation of a new position.
- Land-based facilitators & other costs: it is essential that a clearly articulated understanding of the capacity and needs for land-based facilitator contracts are outlined in the proposal and budget to be presented at the next approval step. In particular, please articulate the student-facilitator ratio, the cost per session and its duration, and the costs of the incidentals mentioned in the proposal (facilities rental, supplies, etc). This will be important for us to assess, as we consider incurring those costs on a longer-term basis beyond the funding provided by the Chamandy Foundation.

We are very excited to see this initiative come to Concordia. We are particularly pleased at the prospect of welcoming new community members to our Concordia classrooms, while also expanding what our campus can include through the invitation of our neighbours, the Kanien'kehá: ka community.

We want to reiterate our support for this program and the curriculum team. We look forward to seeing the full program proposal in due course.

cc: Dr. Anne Whitelaw, Provost & Vice-President, Academic
Dr. Pascale Sicotte, Dean, Faculty of Arts & Science
Dr. Anna Scheftel, Principal, School of Community & Public Affairs
Dr. Cathy Richardson, Associate Professor & Program Director, First People's Studies
Ms. Julie Johnston, University Curriculum Administrator
Mr. Graham Maisonneuve, Director, Finance & Budgets, Office of the Provost

UNIVERSITÉ Concordia UNIVERSITY

March 3rd, 2022

Dr. Sandra Gabriele
Vice-Provost, Innovation, Teaching and Learning
Concordia University

RE: LOI for a Microprogram in Land-Based Education

Dear Vice-Provost Gabriele:

I am forwarding to you this LOI for a new *Microprogram in Land-Based Education*, coming from the *School of Community and Public Affairs,* developed in collaboration with Donna Kahérakwas Goodleaf (Director, Decolonizing Curriculum and Pedagogy), from the Office of the Provost. This is an interesting proposal, and I have reviewed it with Dean Sicotte. We both see great value in the purpose of the program, in its alignment with university initiatives and with faculty-level values; we also duly acknowledge the potential benefits to the student population it is intended to attract and serve. While we still have some questions particularly with the proposed budget, we support the Land-Based Education concept as exemplified in the LOI: its strategic goals are important considerations, and it should further progress within the university. Although our programs are all publicly funded, this is also a rare program initiative to get the extra benefit from external donor funding to accomplish its goals, in this case from generous consideration from the Chamandy Foundation (> 471 K$). The leaders of this initiative should be commended for securing this support.

This LOI has many good things going for it: this initiative fits well with the university's decolonization and sustainable development plans. It allows an immersion in community. It also provides a potential bridge for indigenous students to join Concordia. The program also touches a bit on health, a theme that has received renewed focus in our institution. As it is the case for many interdisciplinary programs, the development process for this LOI has partially served to optimize the issues of expertise and effective communication, and in creating best processes for inter-unit coordination. This is good institutional development. On a personal level, it has been valuable to participate in preparatory discussions with Dr. Goodleaf and the Provost' Office, as well as to engage with the School's Principal, Dr. Sheftel and with the Undergraduate Program Director of the *BA in First Peoples' Studies*, Dr. Richardson, in optimizing the LOI.

The context of this program has also been progressively refined with helpful gathering of information. It should be noted that certain course elements of the program have been carefully piloted, in a collaboration with the *Ionhtionhékwen Land-Based Wilderness Program*, leading to very favorable conclusions. Finally, the extensive consultation should also be noted, within and outside the university, in surveys and discussions. The networking was partly provided by the *Indigenous Directions Leadership Committee* (IDLC), but also in sensibly reaching out to key communities. This includes discussions with many faculty members and academic unit heads from various units, but also with multiple local indigenous communities, and even samples of Concordia students.

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Program Overview
The proposed 15-credit, two-semester microprogram is geared towards the understanding of the theoretical underpinnings of Indigenous-led land-based pedagogies, in providing students with sustainable Indigenous theoretical frameworks to support economic self-sufficiency, and in developing their land literacy. One of its mandates is to serve as a bridge for non-traditional learners to come to Concordia, in doing so offering a path that can enhance personal and community success. For some students, this will potentially lead to further knowledge exploration and maybe even further university studies. The microprogram has been voluntarily paced as to be done over two semesters, a schedule chosen to be well-adapted to the intended clientele, who might find it best to come engage with the university part-time.

Basic program development and basic budget
This LOI has seen many drafts initially prepared by Donna Goodleaf and coordinated within the Provost' Office. These have also been progressively and intently discussed with the SCPA. Overall, the justification for the land-based educational approach is well laid-out in the LOI, with useful academic references. It is also valuable to have been provided with the international and national perspectives, as many reflections have surfaced from governmental and non-governmental commissions. These are important accounts from resource-defining bodies as well as from expert bodies in Indigenous perspectives. Some descriptions of curricular initiatives at other Canadian universities are also given in Appendix C. Overall, this contextual information gives added weight to this initiative, and in its capacity in building bridges.

The resource needs as currently itemized are:

- Three new INLB courses (so 1 section for each – total 3 sections)
- One additional section for each of the FPST courses used (total 3 sections)
- One part-time administrative staff as coordinator.
- A yet-to-be-determined number of land-based facilitators.

A preliminary budget has been provided ("*LOI Budget Chart Land-based microprogram Nov 23 JJ.xlsx*") by Julie Johnston, University Curriculum Administrator, and the unit. The revenues include the Government grant as well as the donation from the Chamandy Foundation. This sets a favorable context. However, we have a few questions as to the intended use of the funding from the Foundation, and other elements of the budget.

1- The number of students in the LOI (up to 24 students by year 3) and the proposed budget (student numbers set at yearly totals of 7.5-10-12-12-12) do not match. There is a need to clarify the actual numbers. We would agree that a higher number of students would justify better the request for a coordinator and would make for a stronger cohort feeling, as discussed in the LOI document. We thus agree with the text in the LOI and suggest a scheme with a growing student cohort of about 24 by year #3 (8-16-24-24-24).

2- From a first read, the LOI summary page shows that the program costs are quite high for the Faculty (FAS deficit of >356 K$ over the 6 years). This is a major concern.

3- In relation to point 2, the donation from the Chamandy Foundation is covering expenses for facilitators, facility rentals, community costs. The itemization for these expenses does not appear in the current budget.

We also have identified a few questions that we suggest could be useful to consider in the work towards the formal proposal:

- From a domain perspective, the survival skills land-based activities provided in Appendix B show a series of learning outcomes directly related to experiential learning that could be better articulated with program- or course-level learning outcomes. While the skills themselves are the tools supporting the learning, the inner reflection gains could be further highlighted.
- The structure of two-semester courses could be made more flexible by having a part I and part II to each course. For example, the two-credit course INLB 20X Introduction to Indigenous… could be split into 2*1-cr courses. This would help the credit accounting per term, as well.
- The proposal should address more directly the interdisciplinary connections that are innovative features from the program design. For example, there is a component that touches on the Economics aspect. Could this aspect connect with general economic notions? Other connections with applied human sciences, psychology, philosophy, languages, art history, health and religion could be highlighted where appropriate.
- The relationship between the *BA Major in FPST* and the *Microprogram* is hinted in terms of the use of common infrastructure, the positioning of the clienteles is also mostly clarified. However, could the components of the Microprogram also constitute parts of a Minor for students already at Concordia? This would need to be addressed directly, as we imagine that this will be a question that would surface quickly in the student population.
- The tasks and the profile of the land-based facilitators should be developed, as well as the parameters for the renumeration. We did notice a synergy in terms of the training for and by facilitators, within the structure of the SCPA. Should the facilitators be interested in further studies, it might be advantageous to consider their integration in a Certificate, BA or MA program. It would also be useful to get a clearer understanding of the reserved seats, for mentorship training in the *Microprogram*, paid for by the Chamandy Foundation.
- Would it be useful to consider providing a bilingual course description for the INLB courses – English and Ratiwennahni:rats Language - to better resonate with students interested in the area?

We hope these considerations will be helpful in the crafting of the formal program proposal.

Thank you very much for your consideration.

Sincerely,

Richard Courtemanche
Associate Dean, Academic Programs
Faculty of Arts and Science

Documentation (see attached)

- *LOI document, made into pdf (version Dec 2021)*
- *e-mail from Principal*
- *Initial budget*

Cc: Pascale Sicotte, Dean, *Faculty of Arts and Science*
Anna Sheftel, Principal, *School of Community and Public Affairs*

APPENDICES

Appendix I	Curriculum Documents
Appendix II	Related Programs (detailed descriptions, calendar excerpts)
Appendix III	Enrolment Surveys and Indicators of Student Demand
Appendix IV	Market Analysis
Appendix V	Library Report
Appendix VI	Abridged Curricula Vitae of Current Faculty Members
Appendix VII	Letters of Support and List of Persons Consulted
Appendix VIII	Assessment of Facilities and Equipment Costs

APPENDIX I: Curriculum Documents

Curriculum Framework Map

Courses	Course description	Learning objectives	Content	Activities	Assessment	Skills acquired
FPST 210 Haudenosaunee Peoples	Introduction to the history, political philosophy, worldview, culture and lived experiences of the Rotinonhsión:ni (Haudenosaunee) Confederacy from a historical and contemporary context.	1. Provide students with an overview and understanding of Rotinonhsión:ni Peoples' oral histories, culture, worldviews and experiences from an historical and contemporary context. 2.Develop in students critical analysis, understanding and make connections about historical and current issues impacting Rotiononhsión:ni society today. 3. Examine the function and role of Rotinonhsión:ni wampum belts, treaties and its political/cultural and constitutional significance from historical and contemporary context.	1.Rotinonhsión:ni Creation Story 2.Political Philosophy The Great Law of Peace 3.Function and Meaning of Rotinonhsión:ni Wampum Belts and Treaties 4.Doctrine of Discovery, Colonialism, 5.Colonial-settler education systems, 6.Gender, sexuality and settler-colonialism, 7.Indigenous resurgence and self-determination, 8.Rotinonhsión:ni Literature and the Arts.	1.small group discussions and activities on class materials. 2. oral presentations. 3. homework assignments 4. reflective writing assignments.	1. Reflective Learning narrative writing assignments. 2. Digital storytelling projects. 3. Small group Pecha Kucha oral presentation style using images to reflect a topic of the course. 4. active online using moodle to engage and respond to mini class assignments posted on moodle.	1.Students have awareness, sensitivity and understanding about the Rotionh-sión:ni Peoples' Oral history, culture, worldview. 2. Students have abilities to read, write and engage in critical discourse and analysis based on course materials. 3. Students have abilities to communicate using digital forms of technology in as tools to convey and express their knowledge and understanding of issues impacting Rotinonhsión:ni society today.
ILBE 301 Indigenous Land-Based Field Studies **Part 1 Fall**	In Part 1 of this experiential course, students will engage in seasonal immersive land-based activities in the community of Kahnawake, as well as classroom-based discussions via sharing circles, presentations by Indigenous knowledge holders, and other experiential classroom methods. Students will build awareness and reconnection to the land drawing from Rotinonhsión:ni knowledge systems such as the Creation Story and the Ohénton Karihwatehkwken. Students will examine land as learning space and will examine how fostering land-based pedagogies can promote collective well-being and self-sufficiency.	1.Demonstrate how Rotinonhsión:ni worldview (Creation Story & Ohénton Karihwatehkwen) is used as a philosophical framework to guide our relationship to others and the natural world including the cosmos. 2. Make connections to 'self' in relationship to land. 3.Discuss land as a learning space. 4.Demonstrate practical land-based survival skills. 5.Demonstrate how land-based activities and survival skills can promote collective-wellbeing and self-sufficiency.	1.Ohénton Karihwahtehkwen. 2.Kahanwake community-based cultural protocols. 3. Rotinonhsión:ni Creation Story. 4.Rotinonhsión:ni ecosystem or the natural world ie., medicines, plants, water, fish life, etc.,impacts of the St. Lawrence Seaway on Kahnawake community. 5. Rotinonhsión:ni astronomy or sciences related to land and place. 6. Land-based survival skills.	1.Sharing circles 2. Kahnawake community tour of land, water and ecosystems. 3. Individual and group work. 4. journaling 5. Oral presentations on creative project using digital tools. 6. Experiential Land-based survival skills ie. Making fire and shelters.	1.Weekly reflective journal assignments. 2.Creative project 3.Star Map project 4.Personal Learning plan 5.Oral presentations 6. Participation	1.Students demonstrate understanding about Rotinonhsión:ni epistemo logies and make connections to land, place and community. 2. Students can apply hands-on experiential land-based survival skills in various activities. 3. Students can identify local plant life for medicinal and foraging purposes from the land. 4. Students can critically think, read, write and integrate Rotinonhsión:ni theoretical concepts, land-based learning with hands on experiential land-based activities.
ILBE 302 Indigenous Land-Based Field Studies **Part 2 Winter**	As an extension of the Fall course, FPST 398 Part I Indigenous Land Based Field Studies Course students will expand their learning while gaining a better understanding of what land-based learning is through examining other Indigenous land-based education models. The course combines oral traditions/storytelling and sharing circles with students immersed in experiential land-based activities in the winter located in the community of Kahnawake as well as classroom time. Students will also apply a	1.Demonstrate how Rotinonhsión:ni worldview (Creation Story & Ohénton Karihwahtehkwen) is used as a philosophical framework to guide our relationship to others and the natural world including the cosmos. 2. Make connections to 'self' in relationship to land. 3.Discuss land as a learning space.	1. Ohénton Karihwahtehkwen. 2. Rotinonhsión:ni Creation Story. 3. Diverse Indigenous Land-based education platforms/programs (community-based, urban, partnerships with universities, courses). 4.Rotinonhsión:ni ecosystem with emphasis on local diverse trees (ie., pine, cedar and black ash trees) animals, winged ones (birds).	1.Sharing circles 2. Individual and group work. 3. critical self-reflective journaling 4. Oral presentations on creative project using digital tools. 5. Experiential Land-based survival skills ie. Buildng winter shelters and various types of fires.	1. weekly journals reflecting on new learnings and describe what 'relationality' of self to land. 2. Oral presentations on Creative expression assignment utilizing digital technologies, art, writing to convey deeper meaning, experiences and relationship to land. 3. Research paper on land-based education model/s highlighting similarities/differences / challenges.	1.Students demonstrate understanding about Rotinonhsión:ni epistemo logies and make connections to land, place and community. 2. Students can apply various hands-on experiential land-based survival skills activities in winter. 3. Students can identify local tress and explain the cultural meaning of

	variety of practical land-based survival skills while on the land. These include building winter shelters, expanding fire building skills, tracking four-legged relatives, observing and identifying winged relatives, and learning maple syrup tapping as a Rotinonhsión:ni land-based survival skill.	4.Demonstrate practical land-based survival skills. 5.Demonstrate how land-based activities and survival skills can promote individual and collective-wellbeing and self-sufficiency. 6. Describe existing variations of Indigenous land-based education platforms.	5. Rotinonhsion:ni Cultural meaning on Whata (or tapping of Maple trees). 6. Land-based survival skills in winter ie., winter shelter making, diverse complex methods of fire making, tinder bundles, making knots for shelter using cordage and natural fiber (wood).		4. Personal Learning Plan Part 2. 5. Participation	Whata (tapping maple trees) means to the Rotinonhsión:ni peoples. 4. Students can critically think, read, write and integrate Rotinonhsión:ni theoretical concepts related to land-based learning theories with hands on experiential land-based activities.
ILBE 403 Integrative Seminar on Indigenous Sustainability and Self-Determination	This course aims to expand students' knowledge and understanding about diverse Indigenous land-based practices through guest lectures, seminars and/or workshops offered by Indigenous community based cultural knowledge experts, and other Indigenous scholars across Turtle Island. Students will critically examine what sustainability means from Indigenous perspectives and its linkages to self-determination. As well, students will explore topics on Indigenous traditional food systems, food security and food sovereignty, models of Indigenous economic self-sufficiency, and Indigenous health systems.	1.Using the lens of the Ohén:ton Karihwátehkwen, explain how historical and current socio-economic and environmental issues such as water pollution/loss and land dispossession impacts the relationship between Haudenosaunee Peoples and the natural world. 2.Explain the relationship between Indigenous sustainability and traditional Indigenous food systems and practices. 3.Discuss the linkages between Indigenous sovereignty, land rights and community health. 4.Explain the relationship between climate change and Indigenous ecological sustainable practices.	1.Indigenous sovereignty, land rights and community health. 2.Land dispossession. 3.Indigenous sustainability and ecological practices. 4. Climate change 5. Food and seed sovereignty and security - Rotinonhsión:ni and other Indigenous community perspectives. 6.Hide tanning 7. Gathering and preparation of traditional Indigenous food practices.	1. Sharing Circles 2. Oral presentations 3. In-class discussions on course materials. 4. Experiential land-based activities. 5. Group posters 6. Research and prepare annotated bibliography on Indigenous approaches to address climate change. 7. eportfolio project.	1.journal 2.Oral presentations 3. Demonstrate land-based survival skills 4. Oral presentation 5. Group Poster 6. Annotated Bibliography 7. eportfolio project	1. Students learn traditional Indigenous land-based practices related to planting, seeds, food systems, hide tanning. 2. Students can think critically about issues related to climate change and make connections to Indigenous sustainability, food sovereignty and security with Indigenous economic self-sufficiency and health systems. 3. Students can read, write and. Express themselves orally with clarity and accuracy on data gleaned from the research. 4. Students are aware of the local and national issues on climate change and have the tools to help mitigate the effects of climate change impacting Indigenous communities and society in general.

ILBE 301 *(3 credits)*
INDIGENOUS LAND BASED FIELD STUDIES - PART I
Short course outline

Loyola (CJ 1.129 LOY): 10:00 – 1:00
Kahnawake Land Days: 9:30 – 3:30
(See schedule for further details.)

INSTRUCTOR	Louellyn White
OFFICE	**CI 304**
CONTACT	**Louellyn.white@concordia.ca**
OFFICE HOURS	**TBA**
COURSE WEBSITE	Available through the myconcordia.ca portal, using "Moodle".

CALENDAR DESCRIPTION.

In this experiential course, students will engage in seasonal immersive land-based activities in the community of Kahnawake, as well as classroom-based discussions via sharing circles, presentations by Indigenous knowledge holders, and other experiential classroom methods. Students will build awareness and reconnection to the land drawing from Rotinonhsión:ni knowledge systems such as the Creation Story and the Ohénton Karihwatehkwken. Students will examine land as learning space and will examine how fostering land-based pedagogies can promote collective well-being and self-sufficiency.

COURSE DESCRIPTION

The course combines oral traditions/storytelling and sharing circles with students immersed in seasonal, experiential land-based activities in the community of Kahnawake as well as classroom time. Students will examine the theoretical underpinnings of Indigenous-led, land-based pedagogies, develop land literacy, and build their awareness of their relationships with the land. Kanien'kehá:ka epistemologies grounded in traditional teachings including the Creation Story serve as the foundational theoretical and experiential base of teaching and learning. Values of relationality, respect, reciprocity, reverence, humility, and responsibility are embodied throughout the teachings. The Ohén:ton Karihwátehkwen also known as the Words That Come Before All Else or the Thanksgiving Address, serves as a reminder to give gratitude toward all living things in recognition of the interconnectedness between and among humans and the natural world. The natural world and our relationships embedded within the Ohén:ton Karihwátehkwen such as plants, fish, fire, water, celestial bodies, and others will serve as a curricular framework.

Students will also apply a variety of practical land-based survival skills while on the land. These include making fire and shelters, developing an understanding of medicinal and edible plants, and other land-based activities grounded in Rotinonhsión:ni epistemology.

COURSE GOALS AND LEARNING OUTCOMES (LO)

The main goal of this course is to provide an in-depth understanding of the role of Indigenous land-based education in promoting self-sufficiency and collective well-being.

1. Demonstrate how Rotinonhsión:ni worldview – How the Creation Story and the **Ohén:ton Karihwátehkwen** is used as a philosophical framework to guide our relationship to others and the natural world including the Cosmos.
2. Make connections of 'self' in relationship to land.
3. Discuss land as a learning space.
4. Demonstrate practical land-based survival skills.
5. Demonstrate how land-based activities and survival skills can promote collective well-being and self-sufficiency.

REQUIRED TEXTBOOKS*:* *(See Follett Textbook link on course Moodle page.)*

1. Porter, T. S., (2008). *"And Grandma Said…Iroquois teachings as passed down through Oral Tradition*." Xlibris Corp.
2. Stokes, J., Thompson, D.R., (1996). "*Thanksgiving Address: Greetings to the natural world*." Six Nations Indian Museum and The Tracking Project.

REQUIRED READING LIST: *(See online course material linked on course Moodle page.)*

Bartlett, Cheryl & Marshall, Murdena & Marshall, Albert. (2012). Two-Eyed Seeing and other lessons learned within a co-learning journey of bringing together indigenous and mainstream knowledges and ways of knowing. Journal of Environmental Studies and Sciences.

Deborah McGregor (2002) Traditional ecological knowledge and the Two—Row wampum, Biodiversity, 3:3, 8-9.

Hill R.W., Sr., Coleman D. (2019). The Two Row Wampum-Covenant Chain Tradition as a Guide for Indigenous-University Research Partnerships. Cultural Studies: Critical Methodologies. 19(5):339-359.

Hill, R.W., Sr. Geonda'sho'oh Ge:ido (Trees) Is the Celestial Tree a Tree of Life or a Deadly Plant: https://www.snpolytechnic.com/sites/default/files/docs/resource/2_trees-min.pdf

Mohawk, J. (2005). Iroquois creation story. Buffalo, NY: Mohawk Publications.

Rotinonhsión:ni Star knowledge:
https://www.snpolytechnic.com/sites/default/files/docs/resource/starknowledge.pdf

Simpson, L. B. (2014). Land as pedagogy: Nishnaabeg intelligence and rebellious transformation. *Decolonization: Indigeneity, Education & Society*, *3*(3).

Stokes, J., Benedict, D.K., Thompson, D. Thanksgiving Address: Greetings to the Natural World.

Styres, S., et al. (2013). Towards a pedagogy of land: The urban context. Canadian Journal of Education. 36. 34-67.

Wilson. A, (2021). Land As teacher: Understanding land as land-based education: https://en.ccunesco.ca/idealab/indigenous-land-based-education

COURSE SCHEDULE

*Attending and participating in the land-based activities is a *compulsory* part of this course.

Week	Topics	Location	Time	Assignment Due	LO
Sept 9	**Opening:** • Ohén:ton Karihwátehkwen • Territorial Acknowledgement and what it means for land-based learning • Sharing circle/ Introductions	Loyola	3hrs 10 -1		#1 #2
Sept 16	**Land as Learning Space:** • Introduction to Land based facilitators • Community protocols	Loyola	3 hrs 10-1	• Weekly Journal Entry check - ongoing with prompts	#1
Sept 23	**Creation:** • The Creation Story will be shared around a fire by knowledge holders in the context of making connections to course and students • Getting to know Kahnawake via community tour	Kahnawake	6 h 9:30-3:30	• Personal learning plan (Part I) – outline course goals	#1 #3
Sept. 30	**Plant Relatives:** • Identifying and understanding cultural significance of Medicine plants • Students partake in identifying wild edibles while foraging on the land	Kahnawake	6 h 9:30-3:30	• Weekly Journal Entry check - ongoing with prompts	#4 #2
Oct. 14	**Water/Fish Relatives:** • Discussions and visits to St. Lawrence seaway to foster and understanding of water and its cultural relevance	Kahnawake	6 h 9:30 - 3:30		#4
Oct. 28	**Celestial Teachings:** • Delve deeper into understanding the Rotinonhsión:ni Creation Story and its origins in the Skyworld	Kahnawake	6 h 9:30 - 3:30		#1 #2

	• Discuss the connections with Earth and Sky • Explore intersections of Indigenous knowledges and western sciences in relation to celestial bodies • Learn about star knowledge as predictors of seasonal changes • Discuss impacts of light pollution on transmission of Indigenous knowledges of the Cosmos				
Nov. 18	**Basic Survival Skills:** • Land facilitators instruct and demonstrate survival skills in a cultural context • Students create shelters using branches and other natural material suitable for Fall weather • Students learn how to make small ground fires using natural fiber • Learn various knot tying and cordage making techniques for use in survival settings	Kahnawake	6 h 9:30 - 3:30	• Weekly Journal entry check – Final entry • Star Map – research, create, and share representations of the night sky and share visual representation.	#4
Nov. 25	**Closing:** • Ohén:ton Karihwátehkwen • Debrief semester • Share Creative Project	Loyola	3 h 10-1:00	• Creative Project – reflect on understanding and integration of the Ohénton Karihwatehkwken by choosing an element to researching and share via creative expression. • Review personal learning plan (Part II) – Reflect on course goals, contributions, achievements, and understanding.	#1 #2 #5

ASSESSMENT AND GRADE BREAKDOWN

Assignment	Individual Grade (%)	Due
Weekly Journal Assignment: Ongoing weekly reflections via personal journal on overall course theme: • Reflect on self in relation to elements of the Ohénton Karihwatehkwken • Develop understanding of relationality	25%	Every week throughout the course
Creative Project: A reflective project focused on students understanding and integration of the Ohénton Karihwatehkwken • Students choose an element of the Ohénton Karihwatehkwken to research and share. • Creative project (video, collage, poem, journal entry, beadwork, etc.) • Submit 1-2 page contextualization paper • 5 mins sharing	25% (20% completion; 5% sharing)	Nov 25 - Last day of class
Star Map Project: Students research, create, and share representations of the night sky based on own cultural, familial, ancestral, and/or personal backgrounds. • Students should appropriately integrate knowledge gained during the course lectures, readings, videos, etc.). • Students create a visual representation through art, story, prose, video, music, or written form. • If choosing visual art, submit 1-2 contextualization paper • 5 mins sharing	25% (20% completion; 5% sharing)	Nov 18
Personal Learning Plan **Part 1:** Students will be asked to create a learning plan outlining their goals in this course. **Part 2: Reflection Paper**: Students will be asked: • To what extent did I successfully accomplish the goals I set for myself? • Reflect on your contributions to the course and achievements. • To what extent did I benefit from the teachings from the land?	Part I – 10% Part II – 5%	Sept 23 Nov 25
Participation • Actively engaging with course material, activities, classmates, instructor, guests, etc. • Demonstrate land-based survival skills	10%	Ongoing
TOTAL	100%	

FINAL GRADING SCALE

According to the Faculty of Arts and Sciences policy, a total of 100 marks will be earned for this course and final grades will be computed as follows:

90-100 %	A+	4.3	Outstanding
85-89 %	A	4.0	
80-84 %	A-	3.7	
77-79 %	B+	3.3	Very Good
73-76 %	B	3.0	
70-72 %	B-	2.7	
65-69 %	C+	2.3	Satisfactory
60-64 %	C	2.0	
57-59 %	C-	1.7	
55-56 %	D+	1.3	Marginal Pass
53-54 %	D	1.0	
50-52 %	D-	0.7	
35- 49%	F, FNS (poor failure)	0	Poor - Failure
0	R (very poor failure)	0	
	NR (Grade not reported)	0	

ILBE 302 (*3 credits*)

INDIGENOUS LAND BASED FIELD STUDIES - PART II

Loyola (CJ 1.125 LOY): 10:00 – 1:00
Kahnawake Land Days: 9:30 – 3:30
(See schedule for further details.)

INSTRUCTOR	Louellyn White
OFFICE	**CI 304**
CONTACT	**Louellyn.white@concordia.ca**
OFFICE HOURS	**TBA**
COURSE WEBSITE	Available through the myconcordia.ca portal, using “Moodle”.

CALENDAR DESCRIPTION

Prerequisite: FPST 201, INLB 301

In this experiential course, students will engage in seasonal immersive land-based activities in the community of Kahnawake as well as classroom-based discussions via sharing circles, presentations by Indigenous knowledge holders, and other experiential classroom methods. Students will build awareness and reconnection to the land drawing from Rotinonhsión:ni knowledge systems such as the Creation Story and the Ohénton Karihwatehkwken and **other Indigenous epistemologies as they relate to Indigenous land-based education.** Students will examine land as learning space, variations of Indigenous land-based systems, and will examine how fostering land-based pedagogies can promote collective well-being and self-sufficiency.

COURSE DESCRIPTION

As an extension of the Fall course, FPST 398 Part I Indigenous Land Based Field Studies Course (encouraged but not required), students will expand their learning while gaining a better understanding of what land-based learning is through examining other Indigenous land-based education models.

The course combines oral traditions/storytelling and sharing circles with students immersed in seasonal, experiential land-based activities in the community of Kahnawake as well as classroom time. Kanien'kehá:ka epistemologies grounded in traditional teachings including the Creation Story serve as the foundational theoretical and experiential base of teaching and learning. Values of relationality, respect, reciprocity, reverence, humility, and responsibility are embodied throughout the teachings. The Ohén:ton Karihwátehkwen also known as the Words That Come Before All Else or the Thanksgiving Address, serves as a reminder to give gratitude toward all living things in recognition of the interconnectedness among humans and the natural world. The relationships with our relatives such as winged beings, four-legged beings, various tree species, and others will serve as a curricular framework.

Students will also apply a variety of practical land-based traditional survival skills while on the land. These include building winter shelters, expanding fire building skills, tracking four-legged relatives, observing and identifying winged relatives, and learning maple syrup tapping as a traditional land-based skill.

COURSE GOALS AND LEARNING OUTCOMES (LO)
The main goal of this course is to provide an in-depth understanding of the role of Indigenous land-based education in promoting self-sufficiency and collective well-being.

6. Demonstrate how Rotinonhsión:ni worldview – How the Creation Story and the Ohén:ton Karihwátehkwen is used as a philosophical framework to guide our relationship to others and the natural world including the Cosmos.
7. Make connections of 'self' in relationship to land.
8. Discuss land as a learning space.
9. Demonstrate practical land-based survival skills.
10. Demonstrate how land-based activities and survival skills can promote collective well-being and self-sufficiency.
11. Describe existing variations of what Indigenous land-based learning means.

REQUIRED TEXTBOOKS: *(See Follett Textbook link on course Moodle page.)*

Kimmerer, Robbin Wall. (2013). Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants. Milkweed Editions.

REQUIRED READING LIST: *(See online course material linked on course Moodle page.)*
Fast, L., et al. (2021). Restoring our roots: Land-based community by and for Indigenous youth. International Journal of Indigenous Health. Vol 16 No 2. https://jps.library.utoronto.ca/index.php/ijih/article/view/33932

Land-based Education Success Pathways: https://www.nccie.ca/resource-library/

Tuck, E., et al., (2014). Land education: Indigenous, post-colonial, and decolonizing perspectives on place and environmental education research, Environmental Education Research, 20:1, 1-23, DOI: 10.1080/13504622.2013.877708

The Whitefeather Forest Initiative: https://www.whitefeatherforest.ca/

Wildcat, M., et al (2014). Learning from the land: Indigenous land-based pedagogy and decolonization. Decolonization: Indigeneity, Education & Society, 3(3).

COURSE SCHEDULE

**Attending and participating in the land-based activities is a compulsory part of this course.*

Week	Topics	Location	Time	Assignment Due	LO
Jan 13	**Opening:** • Ohén:ton Karihwátehkwen • Sharing circle/Introductions	Loyola	3 h 10-1		#1
Jan 27	**Land as a learning space:** • Introduction of diverse Indigenous land-based education systems • Introduction to land-based facilitators/community protocols	Loyola	3 h 10-1	• Personal learning plan (Part I) – outline course goals	#1 #3 #5 #6
Feb. 10	**Advanced Survival Skills for Winter:** • Students create snow shelters • Expand on prior knowledge of fire making by creating own tinder boxes for winter survival • Learn how to use outdoor knives safely	Kahnawake	6 h 9:30-3:30	• Weekly Journal Entry check - ongoing with prompts	#1 #2 #4 #5
Feb. 24	**Four-legged Relatives**: • Students learn about various animal tracks • Identify tracks and behavior patterns • Students make own tracks and identify patterns	Kahnawake	6 h 9:30-3:30		#1 #2 #4
March 10	**Trees Relatives:** • Students learn to identify maple trees for tapping (Wahta) • Learn techniques for tapping and how to process maple water • Learn of the cultural/historical significance of white pine trees • Identify the Black Ash tree and explore the art of basket making	Kahnawake	6 h 9:30-3:30	• In-class Sharing: Discuss how land-based activities/skills can promote collective well-being and self-sufficiency. (Share findings via sharing in class and/or creative expression.) • Weekly Journal Entry check - ongoing with prompts	#1 #2 #3 #4 #5

March 24	**Winged Relatives:** • Students observe and learn to identify various bird species by physical description and vocalization • Explore cultural significance of winged relatives • Explore migration patterns and disruptions	Kahnawake	6 h 9:30-3:30	• Weekly Journal Entry check - ongoing with prompts	#1 #4
March 31	**Closing:** • Ohén:ton Karihwátehkwen • Debrief semester • Final group share	Loyola	3 h 10-1	• Research and share land-based education model • Review Personal Learning Plan (Part II) – Reflect on course goals, contributions, achievements, and understanding.	#1 #2 #3 #5 #6

ASSESSMENT AND GRADE BREAKDOWN

Assignment	Individual Grade (%)	Due
In-class Sharing/Creative Expression: • Discuss how land-based activities/skills can promote collective well-being and self-sufficiency. • Share findings via sharing in class and/or creative expression – art, digital technologies, writing • Convey deeper meaning to land	20%	March 10
Research paper-Land-based education Model: • Students should be able to draw connections among different models • Highlight/list similarities and differences • Justify their decision for choosing one model • Propose ways to personalize and employ the model in a different	30%	March 31

community (ie. closely related to their community/neighborhood)		
Personal Learning Plan **Part 1**: Students will be asked to create a learning plan outlining their goals in this course. **Part 2:** Reflection Paper: Students will be asked: • To what extent did I successfully accomplish the goals I set for myself? • Reflect on your contributions to the course and achievements. • To what extent did I benefit from the teachings from the land?	Part I – 10% Part II – 5%	Jan 27 March 31
Participation: • Actively engaging with course material, activities, classmates, instructor, guests, etc. • Demonstrate land-based survival skills	10%	Ongoing
TOTAL	100%	

FINAL GRADING SCALE

According to the Faculty of Arts and Sciences policy, a total of 100 marks will be earned for this course and final grades will be computed as follows:

90-100 %	A+	4.3	Outstanding
85-89 %	A	4.0	
80-84 %	A-	3.7	
77-79 %	B+	3.3	Very Good
73-76 %	B	3.0	
70-72 %	B-	2.7	
65-69 %	C+	2.3	Satisfactory
60-64 %	C	2.0	
57-59 %	C-	1.7	
55-56 %	D+	1.3	Marginal Pass
53-54 %	D	1.0	
50-52 %	D-	0.7	
35- 49%	F, FNS (poor failure)	0	Poor - Failure
0	R (very poor failure)	0	
	NR (Grade not reported)	0	

ILBE 403
INTEGRATIVE SEMINAR ON INDIGENOUS SUSTAINABILITY AND SELF-DETERMINATION

Loyola (CJ 1.125 LOY): 10:00 – 1:00
Kahnawake Land Days: 9:30 – 3:30
(See schedule for further details.)

INSTRUCTOR	Louellyn White
OFFICE	**CI 304**
CONTACT	**Louellyn.white@concordia.ca**
OFFICE HOURS	**TBA**
COURSE WEBSITE	Available through the myconcordia.ca portal, using "Moodle".

CALENDAR DESCRIPTION

Prerequisite: Permission from instructor. **Although not required, students are encouraged to also register for FPST 398 Part I and II, offered in the Fall and Winter semester.*

This course aims to expand students' knowledge and understanding about diverse Indigenous land-based practices through guest lectures, seminars and/or workshops offered by Indigenous community based cultural knowledge experts, and other Indigenous scholars across Turtle Island. Students will critically examine what sustainability means from Indigenous perspectives and its linkages to self-determination. As well, students will explore topics on Indigenous traditional food systems, food security and food sovereignty, models of Indigenous economic self-sufficiency, and Indigenous health systems.

COURSE DESCRIPTION

In the Winter semester, students will continue to participate in immersive land-based activities in order to further cultivate an integrated understanding of environmental, social, and economic issues. Topics will include food security, food sovereignty, and models of Indigenous economic self-sufficiency and sustainability practices. Students will develop a community-based service-learning project proposal reflecting both their own interests and the broader needs of Indigenous communities. This community-based proposal will serve as the program's capstone project to help students synthesize and demonstrate what they have learned through the entire program.

COURSE GOALS AND LEARNING OUTCOMES (LO)

1. Using the lens of the Ohén:ton Karihwátehkwen, explain how historical and current socio-economic and environmental issues such as water pollution/loss and land dispossession impacts the relationship between Haudenosaunee Peoples and the natural world.
2. Explain the relationship between Indigenous sustainability and traditional Indigenous food systems and practices.
3. Discuss the linkages between Indigenous sovereignty, land rights and community health.

4. Explain the relationship between climate change and Indigenous ecological practices.

REQUIRED TEXTBOOKS: *(See Follett Textbook link on course Moodle page.)*

Nelson, M. and Dan Shilling (Eds.) (2021). *Traditional Ecological Knowledge: Learning from Indigenous Practices for Environmental Sustainability.* Cambridge Univ. Press.

REQUIRED READING LIST: *(See online course material linked on course Moodle page.)*

Cote, Charlotte. (2016). "Indigenizing" Food Sovereignty. Revitalizing Indigenous Food Practices and Ecological Knowledges in Canada and the United States. *Humanities*. 5. 57. 10.3390/h5030057.

Redvers. N., Celidwen. Y., Schultz, C., Horn. O., et al. (2022). The determinants of planetary health: an Indigenous consensus perspective. *Lancet Planetary Health*, 6, 56-63.

Lines, L. & Jardine, C. (2019). Connection to the land as a youth-identified social determinant of Indigenous Peoples' health. *BMC Public Health*. 19. 10.1186/s12889-018-6383-8.

Delormier, K., Marquis, K. (2019). Building Healthy Community Relationships Through Food Security and Food Sovereignty, *Current Developments in Nutrition*, Volume 3, Issue Supplement_2, Pages 25–31, https://doi.org/10.1093/cdn/nzy088

Ngapo, et al. (2021). "Historical Indigenous Food Preparation Using Produce of the Three Sisters Intercropping System" *Foods* 10, no. 3: 524. https://doi.org/10.3390/foods10030524

Pawlowska-Mainville, A. and Pierreroy, Y. (2020) Duni zuz 'utilnilh, 'tanning moose-hide': weaving Dakelh (Indigenous) intangible cultural heritage transmission with academia. *The International Journal of Intangible Heritage*, 15. pp. 90-101. ISSN 1975-3586. https://www.ijih.org/volumes/article/945

COURSE SCHEDULE

*Attending and participating in the land-based activities is a *compulsory* part of this course.

Week	Topics	Location	Time	Assignment Due	LO
Jan 10	**Opening:** • Ohén:ton Karihwátehkwen • Sharing circle/Introductions	Loyola	3hrs 10-1		#1
Jan 17	**Indigenous sovereignty:** • Students explore Indigenous inherent rights to land • Examine relationship to land, sovereignty	Loyola	3hrs 10-1	• Weekly Journal Entry check - ongoing with prompts	#1 #3

	and community health				
Jan 31	**Land dispossession:** • Discuss impacts of the St. Lawrence Seaway on the Kahnawake community	Loyola	3hrs 10-1	• Group service-learning proposal	#1
Feb 14	**Indigenous Sustainability:** • Explore Indigenous ecological knowledges and practices	Loyola	3hrs 10-1	• Weekly Journal Entry check - ongoing with prompts • Oral Presentation	#1 #2 #4
Feb 21	**Climate Change:** • Students learn about discuss Indigenous responses to climate change	Loyola	3hrs 10-1		#4
Mar 14	**Indigenous Food Sovereignty:** • Explore Indigenous sovereignty in relation foods • Learn about traditional diets, introduction of western foods, and impacts throughout history on Indigenous health	Loyola	3hrs 10-1	• Weekly Journal Entry check - ongoing with prompts	#1 #3
Mar 21	**Rotinonhsión:ni Agriculture:** • Students visit a community garden to learn about the Three Sisters (Corn, Beans, Squash) and agricultural practices • Learn about traditional heirloom seeds and their importance to sustainability, cultural continuity and seed sovereignty	Kahnawake	6 h 9:30- 3:30	• Annotated Bibliography	#1 #2 #3

Mar 28	**Traditional Foods:** • Visit fishing sites and learn about types of fish • Learn traditional fishing practices and techniques and how to catch fish • Learn to smoke fish • Students learn traditional cooking recipes of fish, corn soup • Students partake in a small feast with foods they've prepared	Kahnawake	6 h 9:30- 3:30	• Group Poster	#1 #2 #3
Apr 4	**Traditional Hunting Practices:** • Students develop understanding of deer and moose hunting and other wild game • Learn how animal hides are tanned using traditional techniques • Students are actively engaged in tanning hides	Kahnawake	6 h 9:30- 3:30	• Weekly Journal Entry check - ongoing with prompts • Creative Mind Map	#1 #2 #3 #4
Apr 11	**Closing:** • Ohén:ton Karihwátehkwen • Debrief semester • Final group share	Loyola	3hrs 10-1	• E-Portfolio/Service-Learning Project	#1 #2 #3 #4

ASSESSMENT AND GRADE BREAKDOWN

Assignment	Individual Grade (%)	Due
Weekly Journal Assignment: Ongoing weekly reflections via personal journal on overall course theme: • Reflect on self in relation to elements of the Ohénton Karihwatehkwken • Deepen understanding of relationality	15%	Every week throughout the course

Oral Presentation: Research and share about a contemporary environmental issue and its impact and implications for a specific Haudenosaunee community.	15%	Feb. 14
Group Poster: In small groups, identify food practices and how they've changed over time for Indigenous Peoples in Canada	15%	Mar. 14
Annotated Bibliography: Respond to the topic of Indigenous Peoples ecological practices as part of the solution to climate change.	10%	Mar. 21
Mindmap: Create a visual representation (e.g., artifact), a mindmap, or a written vision towards a healthy, resilient, and sustainable food system based on Indigenous Peoples traditional food systems and practices.	15%	Apr. 4
E-Portfolio for Service Project: Design a proposal and implement a service-learning project that directly address an Indigenous community need and has the potential to support Indigenous connectedness with land and the natural world.	25% (5% proposal)	Apr. 11
Participation Actively engaging with course material, activities, classmates, instructor, guests, etc.	5%	Ongoing
TOTAL	100%	

FINAL GRADING SCALE
According to the Faculty of Arts and Sciences policy, a total of 100 marks will be earned for this course and final grades will be computed as follows:

90-100 %	A+	4.3	Outstanding
85-89 %	A	4.0	
80-84 %	A-	3.7	
77-79 %	B+	3.3	Very Good
73-76 %	B	3.0	
70-72 %	B-	2.7	
65-69 %	C+	2.3	Satisfactory
60-64 %	C	2.0	
57-59 %	C-	1.7	
55-56 %	D+	1.3	Marginal Pass
53-54 %	D	1.0	
50-52 %	D-	0.7	
35- 49%	F, FNS (poor failure)	0	Poor - Failure
0	R (very poor failure)	0	
	NR (Grade not reported)	0	

APPENDIX II: Related Programs

Many Canadian academic institutions are working in partnership with Indigenous communities and educators to create Indigenous-led, land-based education programs at the post-secondary level.

- **McGill University – Land-based Education Field Course** was offered for the first time in 2018 (INDG 450) through the Indigenous Studies Program. Offered for *only two years* before COVID disrupted land-based learning, the course was taught by faculty lecturer Kanienkeha:ka Gabrielle Iakotennikonhrare Doreen, as an introduction to land-based learning rooted in Rotinonhson:nih worldview and was offered during an intensive summer session. Doreen was a graduate of the University of Saskatchewan's Masters program in Indigenous Land-based Education. (Doreen is also a current research assistant with Concordia's FPST faculty member, Dr. Louellyn White.) https://www.mcgill.ca/indigenous/channels/news/first-landbased-education-field-course-mcgill-287165

- **Dechinta *(Bush)* Centre for Research and Learning** – Unique in its undertaking, Dechinta evolved from a research project with Northern Indigenous communities to address gaps in post-secondary education accessibility by delivering accredited courses entirely on-the-land. Dechinta is "dedicated to creating a future of Indigenous cultural revitalization through a reconnection with the land." Recognized as a leading *organization* in Indigenous land-based education, programs are led by Indigenous academics, elders, and community experts. Skill building and practices on the land is prioritized throughout the curricula. Through a blended model of academics and Indigenous knowledge, programs focus on harvesting medicines, drying fish, tanning hides. Cohorts are 10-12 students with terms spanning 12-week terms. Courses are accredited through the *Faculty of Native Studies at the University of Alberta.* Courses such as INLB 252 "Introduction to Gender Justice and Indigenous Communities;" INLB 201a "Narrating the Land: Indigenous Storytelling;" INLB 301 "Land and Indigenous Self-determination: Advanced Theoretical Perspectives," can be applied toward undergraduate degrees.

  Furthermore, Dechitna offers in partnership with *UBC,* the *Dechinta Certificate in Community and Land- Based Research.* Students can complete this certificate over a longer period of time, or during one of the 12-week Dechinta terms. To receive this university certificate, *students must complete 5 of the courses* offered by Dechinta that are accredited by the *University of British Columbia.*

  Dechinta also offers *short, intensive*, university level programming that is delivered in specific regional contexts responding to the needs of each area. Sessions on governance, sustainable development, Indigenous language, Indigenous arts, and community-based participatory research methodology are offered. Dechinta faculty and staff also offer specialized training and custom designed courses developed as graduate courses, master classes, professional development and training, and workshops. All courses are co-taught with Indigenous academics, community leaders and Elders. Courses are *1-2 weeks* in length and are offered seasonally. https://www.dechinta.ca

- **The University of Saskatchewan – Master of Indigenous Land-Based Education (MILBE)** is a 30-credit *graduate l*evel degree that offers intellectual and experiential

learning opportunities with a blended model of online courses and on-the-land learning through field-based courses that are hosted by Indigenous communities. Course offerings range from ILBE 869.3 "Queer Land-Based Pedagogy and Praxis"; ILBE 991.3 "Indigenous Land-Based Capstone"; to additional courses in other programs in the *College of Education and Graduate and Postdoc Studies* such as: EFDT 817.3 "Trends and Issues in Foundations of Education" and GPS 960 "Introduction to Ethics and Integrity".
https://grad.usask.ca/programs/indigenous-land-based-education.php#Program

- **The University of Manitoba – Land and Water: Indigenous Land-Based Education** is held within Community-Engaged Learning (CEL) which focuses on *projects and initiatives,* rather than degree or certificate programs. The year-round program brings together Indigenous, and other students, community members, knowledge holders, and elders to partake in *urban land-based experiences* (weekends) and online workshops (evening). The program is different every year and has an annual theme including "Climate Change and Land-Based Ways of Life" and "Queering Land-Based Education." The program is offered free of charge to everyone.

https://umanitoba.ca/community-engaged-learning/land-and-water

- **University of Calgary -Werklund School of Learning** offers land-based opportunities by way of *field trips for pre-services* teachers facilitated by Indigenous Elders, leaders, and communities. Field trips are spread over a semester and focus on "how land-based understandings, holistic understanding, and Indigenous pedagogical practices connect."

https://werklund.ucalgary.ca/undergraduate-programs/student-opportunities/land-based

- **The University of British Columbia** – Vancouver campus offers courses in Indigenous Land-Based (INLB) studies through the Institute for Critical Indigenous Studies. These courses are meant to complement existing curriculum and learning within the Institute. *Students are not able to pursue a major or minor in INLB.* https://www.calendar.ubc.ca/vancouver/index.cfm?tree=12,197,282,1651

- **The University of British Columbia** – Vancouver campus also offers field *courses* in INLB through the Faculty of Land and Food Systems who partners with the Squamish First Nations to offer community-based experiential learning in *food security*. https://aboriginal.landfood.ubc.ca/place-based-learning/

- **The University of Alberta – Kule Institute for Advanced Study** offers land-based learning through **research partnerships** with local Indigenous communities. In the past they have offered bush camps for youth through the Native Studies department. https://www.ualberta.ca/kule-institute/projects.html?details=land-based-learning-in-teetl-it-zheh

The programs outlined above either offer only individual courses in ILBE; are sporadic in nature due to their affiliation with grant funded research projects; are set in a urban context; and are graduate level programs; and therefore do not offer a full certificate or microprogram or undergraduate degree. Dechinta offers a certificate in ILBE, but it is conferred through other accredited institutions. **There appear to be no undergraduate level programs specifically geared to ILBE at an accredited post-secondary institution**.

The Truth and Reconciliation of Canada Calls to Action (2015) (https://nctr.ca/records/reports/#trc-reports) calls upon all Canadian educational institutions to address institutional racism by decolonizing and Indigenizing their educational systems in ways that open up institutional spaces, elevate and re-center Indigenous epistemologies, and acknowledge Indigenous histories and perspectives. As an institution, Concordia University could substantially contribute to the education of Indigenous students by launching a targeted program that aligns the principles stemming from the Truth and Reconciliation Commission with the learning needs of Indigenous students as well as with the skills in-demand by Indigenous communities. The MILBE will be perfectly situated to advance Indigenous epistemologies and will provide opportunities for both Indigenous and non-Indigenous students to develop their own unique connection with the land and become stewards of the land.

The Microprogram in Kanien'kehá:ka Indigenous Land-Based Education will make Concordia the leading university in Quebec in this process by creating a culturally responsive program that uses Indigenous land-based pedagogies, is framed within an Indigenous paradigm, and is taught primarily by Indigenous faculty, community Elders, and cultural knowledge experts. This program will both motivate and meet the learning needs of Indigenous students as they see themselves, their histories, voices, and lived experiences reflected in the program curriculum.

APPENDIX III: Enrolment Surveys and Indicators of Student Demand

Currently the first semester of pilot land-based education courses are full, with a waiting list. This is without an official program or promise of a diploma at the end.

With the piloting of the land-based program as part of two FPST Proseminar courses last fall 2021, and winter semester 2022, the student enrolment in these courses consisted a total of thirty-seven (37) students. Currently, FPST has a total of fifteen (15) students max enrolled in this semester's academic year Indigenous land-based pilot program with a waiting list of students eager to get into the program.

APPENDIX IV: Market Analysis

Land-based learning is emerging as a professional and academic field. There is therefore no existing market analysis of this field, however recent trends in education, commitment to the TRC's Calls to Action, and Indigenizing pedagogical approaches, all articulate a need for land-based education in universities.

APPENDIX V: Library Report

Library Report
For the Proposed

Microprogram in Indigenous Land-Based Education
Michelle Lake, Reference & Subject Librarian, First Peoples Studies, the School of Community and Public Affairs, Political Science and Government Publications

Created: Monday, September 19, 2022

Purpose

The purpose of this report is to assess the adequacy of available library resources to support the proposed Microprogram in Indigenous Land-Based Education at Concordia University. The report identifies resources and funding required to support the program.

Summary

The Library can adequately support this new program within its current collections budget.

Concordia programs and comparators

Currently the Faculty of Arts & Sciences offers a BA major and minor in First Peoples Studies. Other related programs in the Faculty include a BSc in Ecology, a BSc in Environmental and Sustainability Science, and a BSc in Environmental Geography, Minor in Sustainability Studies. Concordia Library has collections to support all of these academic programs.

The Steering Committee identified comparator programs at McGill University, University of Manitoba, University of Saskatchewan, University of Calgary and University of British Columbia. These universities' collections will be used as comparators for this report.

Collections Assessment

Required readings for the proposed courses were examined. Concordia University Library's collections already include 100% of the fee-based resources listed.

To assess the relative strength of Concordia University Library's monograph collection in terms of ongoing research needs of the proposed microprogram, collection size for each comparator university was measured for a sample of relevant Library of Congress Subject Headings. The results are presented in Table 1.

The subject headings are grouped into 6 themes, aligned with the curriculum from the proposed courses for the microprogram; Education, Environmental and traditional knowledge, Food, Haudenosaunee culture, Field guides and Health. Each theme contains several subject headings, which are counted together, to account for differences in vocabulary and updates in subject heading language, especially as it pertains to Indigenous terminology. "Indians of North America" is still the main subject heading for Indigenous materials; however, some libraries are making the transition to "Indigenous Peoples". A range of 5 years (2018-2022) was applied to the subject headings in the Education, Environmental and Traditional knowledge, Food and Health categories, to retrieve the most recent titles only, while all dates were searched for Haudenosaunee culture and Field guides to show the breadth of materials in these categories.

The Quebec Network category refers to the Partnenariat des bibliothèques universitaires du Québec, a joint initiative between 18 university libraries in Quebec, providing a shared catalogue and network loans of print books. The 18 libraries include both Concordia and McGill University. This category only includes print books, as ebooks are not available to be borrowed across institutions.

LC Subject Heading Group	Concordia	Quebec Network	Manitoba	Calgary	Saskatchewan	UBC
Education: Culturally relevant pedagogy, Environmental education curricula, Indigenous Peoples Education North America, Place-based education	66	141	223	184	32	420
Environmental & traditional knowledge: Climatic changes Canada, Environmental ethics, Environmental justice, Ethnoecology, Ethnoscience, Human-plant relationships, Indian philosophy North America, Sustainability Canada, Traditional ecological knowledge	342	400	973	828	562	1619
Food: Indians of North America Food, Food Security, Food Sovereignty	231	70	438	423	153	1088
Haudenosaunee culture: Iroquois Indians Folklore, Iroquois Indians Rites and ceremonies, Iroquois Indians Social life and customs, Kahnawake Indian Reserve (Quebec) History, Mohawk Indians Social life and customs	80	170	44	51	73	199
Field Guides: Birds Canada, Botany Canada, Mammals North America Identification, Medicinal plants Canada, Wildlife Management North America, Wild plants, edible Canada identification, Trees Canada identification	485	1238	459	443	269	675
Health: Indians of North America Health and Hygiene, Indigenous Peoples Health and hygiene, Indigenous peoples **Health** and **hygiene** Canada	60	24	76	35	72	587

Concordia's monograph collection in the areas measured is smaller than that of most of the comparator universities. However, if the numbers from the Quebec network are added to the collection total for Concordia, it increases the materials available to be numbers comparable to the other universities in the chart. University of British Columbia is the outlier, with a much larger number of libraries, including the Xwi7xwa Library, which focuses solely on Indigenous collections. University of Manitoba, Calgary, Saskatchewan and UBC all have agriculture and food sciences programs, which Concordia does not, which would account for the difference in the titles for the Food category.

The monograph budget allocation for First Peoples Studies has been consistent for the past 5 years.

Year	First Peoples Studies
2018-2019	$6000
2019-2020	$6000
2020-2021	$5000
2021-2022	$5500
2022-2023	$5000

Despite the slight reduction in monograph funds over the years, the Concordia Library has been able to acquire several electronic book collections using some centralized (non-subject specific) funds. Electronic book collections bought using these funds include Springer Ebooks, ScienceDirect, and UPCC eBooks on Project Muse. These collections (normally updated each year with new titles) include monographs relevant to land-based education, Indigenous topics, environmental studies, sustainability, ecology and health.

Databases

The Concordia University Library's current collection of relevant databases for the field of First Peoples Studies is on par with other universities that offer similar programs.
In Concordia's collection, the three most important databases for First Peoples Studies—providing access to indexed abstracts—are the following:

Academic Search Complete - A scholarly, multi-disciplinary full-text database on the EBSCO platform, with more than 8,800 full-text periodicals, including more than 7,600 peer-reviewed journals. In addition to full text, this database offers indexing and abstracts for an additional 9,200 journals. Includes full-text for another 1,000 full-text documents (monographs, reports, conference proceedings, etc). The database features PDF content going back as far as 1887, with the majority of full text titles in searchable PDF format.

Bibliography of Indigenous Peoples in North America - articles covering all aspects of Indigenous North American culture, history, and life: archaeology, multicultural relations, gaming, governance, legend, and literacy. Earliest indexed publication is from 1890; some coverage throughout 20th century; majority of the collection was published after 1990.

ProQuest Combined Canadian - Interdisciplinary resource, includes academic, magazine and news articles and more. Databases include: Canadian Newsstream (full text access to Canadian daily newspapers with local and regional coverage -- formerly "Canadian Newsstand"); Canadian Business & Current Affairs (CBCA). Databases of reference and current events (which cover: Business; Health & Medicine; History; Literature & Language; Science & Technology; Social Sciences; The Arts).

Other databases in the library's collection that provide access to literature relevant for First Peoples Studies, land-based education, sustainability and environmental topics include:

Environment Complete - Offers extensive coverage in the areas of agriculture, ecosystem ecology, energy, and affiliated areas of study. Offering full text and indexing for journals, books and monographs, Documents indexed: Books, Journal Articles.

Geobase (on Engineering Village platform) Citations with abstracts to literature in physical and human geography, geology, mineralogy, ecology and development studies.

GreenFILE - A multidisciplinary database covering many aspects of sustainability and environmental sciences from the perspective of disciplines such as education, law, health and engineering and geography and biology. The database indexes academic journals, magazines, trade publications and monographs.

JSTOR Sustainability – a wide range of journals, ebooks and more than 5400 Open Access research reports in the field of sustainability. The subjects of resilience and sustainability are explored broadly, covering research on environmental stresses and their impact on society.

Project Muse - Provides access to the fulltext of more than 600 scholarly journals in the arts and humanities, social sciences, and mathematics via Project MUSE's integrated ebook/journal platform.

Scopus - Large, comprehensive and up-to-date multidisciplinary article abstract database. Includes both scientific and social aspects of sustainability. Offers citation searching. 19,000 titles from more than 5,000 international publishers.

Web of Science - A large, multidisciplinary, article abstract database, covering the journal literature of the Sciences, Social Sciences and Arts & Humanities Citation Indexes. This database can be searched simultaneously with BIOSIS, a large, life science abstract database. Web of Science allows for citation searching.

Primary Sources

Concordia University Library has several primary source databases related to Indigenous topics and peoples. In 2019 and 2021 the library was provided with additional funding to purchase one-time collections of Indigenous related materials and several of the following databases were purchased at that time.

- Indigenous Peoples of North America: History, Culture & Law (HeinOnline)
- McIntyre Media – Indigenous Studies playlist

- CBC - Indigenous films collection
- NFB - Indigenous Cinema collection
- American Indian Newspapers, 1828-2016 (Adam Matthew)
- Indigenous Peoples of North America [19^{th} -20^{th} centuries], & Indigenous Peoples of North America Part II: Indian Rights Association, 1882-1986 (Gale Primary Sources)
- Early Encounters in North America [1534-1850] (Alexander Street Press)
- North American Indian Thought and Culture (Alexander Street Press)
- Frontier Life: Borderlands, Settlement and Colonial Encounters (Adam Matthew)
- North American Indian Drama (Alexander Street Press)

Journals

The Library has a substantial collection of electronic journals, which are usually acquired in bundles, either from the publisher or an aggregator. These subscription bundles, generally managed on a national or provincial level by the CRKN consortium of academic libraries or the BCI Sous-comité des bibliothèques in Quebec, include journals relevant to First Peoples Studies. These electronic subscriptions have largely displaced the print journal collections and are available to Concordia researchers on- and off-campus. The relevant subscription bundles for First People Studies include (but are not limited to): Cambridge University Press, Elsevier (ScienceDirect), Oxford University Press, Sage, Taylor & Francis, and Wiley-Blackwell.

Collections Recommendation Summary

The Library can adequately support this new program within its current collections budget.

Additional Library services

The interlibrary loans service provides faculty and students with the ability to request materials that are not available in the Concordia Library collection, including electronic delivery of journal articles.

The shared catalogue and network loans of the Partnenariat des bibliothèques universitaires du Québec allows students and faculty to borrow books at other academic libraries in Quebec.

Academic Support

The subject librarian is available to conduct course-specific library workshops, as requested by faculty, and provides help with library research on an individual basis for all students and faculty in the Department. A team of professional librarians and trained staff help Concordia students and faculty with their basic information and research questions at the Ask Us Desks, as well as via e-mail and chat.

Conclusion

A careful assessment was made of the library’s current monograph holdings and journal subscriptions to determine the adequacy of available library resources to support the proposed Microprogram in Indigenous Land-Based Education at Concordia University. It was determined that the Library can adequately support this new program within its current collections budget.

APPENDIX VI: Abridged Curricula Vitae of Current Faculty Members

CURRICULUM VITAE

Louellyn White

biographical information

Nation	Kanienkeha:ka (Mohawk Nation) of Akwesasne
Home Address	7315 Chester Montreal, Quebec, Canada H4V 1M1
Office Address	School of Community and Public Affairs/First Peoples Studies Program 1455 de Maisonneuve blvd. West Montreal, Quebec H3G 1M8
Phone	Office: (514) 848-2424, ext. 2584 Home: (514) 217-1625
Email	Louellyn.white@concordia.ca

Academic Background

- Associate Professor, First Peoples Studies Program, Concordia University, Montreal, Quebec, 2010 - present
- Postdoctoral Fellow, The University of Illinois, Champaign-Urbana, 2010, American Indian Studies
- Ph.D., The University of Arizona, 2009, American Indian Studies

research

Peer Reviewed Publications

Books – Authored

White, L. (2015). *Free to be Mohawk: Indigenous Education at the Akwesasne Freedom School.* The University of Oklahoma Press.

Books – Chapters

White, L. (2021). "The goddam white man took everything, but he can't take away your education': A Kanienkeha:ka woman's journey." American Indian Graduates book project. Blair, M. and Tippeconnic-Fox, M.J. (eds). University of Arizona Press.

White, L. (2016). "White power and performing assimilation: Lincoln Institute and Carlisle Indian School," in *Carlisle Indian School: Site of Indigenous Histories, Memories, and Reclamations*, Fear-Segal, J. and Rose, S. (eds). Lincoln: The University of Nebraska Press.

Journal Articles

White, L. (2022). "Momma, today we were Indian Chiefs!" Pathways to Kan'nikonhrí:io through Indigenous Holistic Education. *Curriculum, Instruction, and Pedagogy, Front. Educ. - Assessment, Testing and Applied Measurement*. Ed by Stefinee Pinnegar.

Patton, O.C.; Ibarra-Lemay, A.; **White, L**. (2021). Ohén:ton Karihwatéhkwen and Kanien'kehá:ka: Teachings of Gratitude and Connection. *Genealogy*, *5*, 81.

Salzman, I., **White, L**., Goodleaf, D., Tajmel, T. (In press, 2020). *Decolonizing Light: A Project Exploring Ways to Decolonize Physics.* Physics in Canada. Special Issue on "Inclusive Excellence."

McCarty, T., Nicholas, S., White, L., et al. (September 2017). *Hear Our Languages, Hear Our Voices: Stories of Resilience and Justice in Indigenous Language Reclamation*. Daedalus. Special Issue on "The American Indian: Obstacles and Opportunities."

White, L. (March 2018). *Who Gets to Tell the Stories? The Carlisle Indian School and Descendant Voices.* The Journal of American Indian Education. Special Issue on American Indian Boarding Schools.

Non-Peer Reviewed Publications

Newspapers (Op Ed, Freelance Submissions)

White, L. (September 30, 2021). A mother's prayer: Carlisle Indian School and the Lincoln Institution's buried children." *Indian Country Today Media Network*.

White, L. (September 30, 2021). Are your ancestors on this list? Carlisle Indian School and the Lincoln Institution's buried children. *Indian Country Today Media Network*.

Conferences, Panels and Presentations

Taylor, M., **White, L.,** Lajimodiere, D., Soldier Wolf, Y. (June 14, 2021). *Boarding School Stories: Interdisciplinary Approaches to Community-Centered Scholarship*. Native American and Indigenous Studies Association online annual meeting. Pre-recorded session.

White, L., (October 20, 2020). *Don't Get Carried Away with the House: Shifting Focus to Find Relevance.* Preservation Pennsylvania. Webinar Panelist.

White, L., (June 15, 2021). Time Talks Podcast guest: *on Education, Carlisle Indian School, Akwesasne Freedom School, Self-Determination, and Language Revitalization*.

White, L., (June 11, 2021)."*Decolonizing Light: centering Indigenous concerns in science.*" 4th Space, Concordia University. Webinar Presenter.

Rethinking Columbus: On Symbolic Reparations and Indigenous Histories. Webinar. Coalition of International Sites of Conscience. October, 2019.

Who Gets to Tell the Stories? Presentation. Carlisle Journeys, Carlisle, Pennsylvania, October, 2018.

Carlisle Indian School Outing Burials. Panel Presentation. National Native American Boarding School Healing Coalition, Carlisle, Pennsylvania, October, 2018.

Carlisle Indian School Archives and Indigenous Data Sovereignty. Panel Presentation. Natives in Philanthropy Institute, Santa Ana Pueblo, New Mexico, June 2018.

Reclaiming Indigenous Languages—New Research and Praxis. Panel Presentation (by Voice Thread). Sociolinguistics Symposium 22, Auckland, New Zealand, June 2018.

White Power and Performing Assimilation at the Carlisle Indian Industrial School. First Voices Week faculty lecture. January, 2017.

Funding

- Primary Investigator. *Deaths and Burials of Indigenous Children at the Lincoln Institute.* Seed (Individual) Grant, Faculty of Arts and Science, Concordia University, $6,695; 2019 – 2021.

- Co-applicant. *Decolonizing Light – Tracing and countering colonialism in contemporary physics*. New Frontiers in Research Fund – Exploration, $163,567; 2019 – 2021.
- Co-researcher. *Chaire-réseau Jeunesse : Les parcours vers l'autonomie et l'épanouissement des jeunes dans une société en transformation* (Youth Network Chair: Pathways toward youth autonomy and fulfilment in a transforming society). *Volet Jeunes issus des Premières Nations et jeunes Inuits (Youth Component, First Nations and Inuit Youth).* Fonds de recherche du Québec – Société et Culture (FRQSC) and the Secrétariat à la Jeunesse de Québec. $1,115,440; 2018 – 2023.
- *Co-investigator. "The Land as our Teacher: Land based pedagogy for and by Indigenous youth". SSHRC Insight Grant funded project $330,000; 2019-2024.*
- Principal Investigator. *Carlisle Indian School: Beyond School Walls*. Fonds de recherche du Québec – Société et culture (FQRSC). $39,526; 2014 – 2017.

teaching activities

Courses Developed and Taught at Concordia University

2010 – present

Remote:

FPST 302: First Peoples Education x1
FPST 402: Contemporary Issues in First Peoples Studies x1
FPST 397: Pro-Seminar II x2
FPST 497: Pro-Seminar III x2
FPST 498 x1
FPST 202: Research Strategies in First Peoples Studies x2
FPST 297: Pro-seminar I x2

In-person:

FPST 498: Advanced Topics in First Peoples Studies x2
FPST 297: Pro-seminar I x4
FPST 302: First Peoples Education x9
FPST 202: Research Strategies in First Peoples Studies x11
FPST 397: Pro-Seminar II x4
FPST 497: Pro-Seminar III x4
FPST 402: Contemporary Issues in First Peoples Studies x6
FPST 498A: Independent Reading Course x1
FPST 498 B: Independent Reading Course x1
FPST 498C: Independent Reading Course x1
RELI 639P: First Peoples Education Reading Course x1
INDI 620: Individualized Graduate Reading Course x1
FPST 201: Introduction to First Peoples Studies x9
FPST 498B: First Peoples Advanced Research Methodologies x2
FPST 210: Haudenosaunee Peoples x8

Graduate Student Supervision

Graduate Student Supervisor

- Brook Rice, MA, Individualized Program, Concordia University 2022 -
- Larissa States, MA, Individualized Program, Concordia University 2021 -
- Shiann Whitebean, MA, Individualized Program, Concordia University, 2016 – 2019

Graduate Student Committee Member

- Daniella Birlain D'Amico, PhD Candidate, Education, McGill University, 2020 –
- Alicia Ibarra-Lemay, MA, Individualized Program, Concordia University, 2022 -
- Daniella Birlain D'Amico, PhD, Education, McGill University, 2021-
- Chloe Boone, MA, Individualized Program, Concordia University, 2019

Research Supervision/Mentoring

- Daniella Birlain D'Amico, PhD Candidate, McGill University, Research Assistant, 2020 – present
- Salma El Hankouri, PhD Candidate, Concordia University, Teaching Assistant, 2020-2022
- Amanda Shawanamish, MA student, Concordia University, Research Assistant, 2020-2021

service

Concordia University Service

- Interim Director, FPST, July 2022 – Dec. 2022
- Member, Indigenous Land-Based Education development committee - Administrative duties, program/curriculum/proposal development, 2021 -
- Member, Hiring Committee for Limited Term Appointment position, Winter 2022.
- Member, Hiring Committee for Canada Research Chair position, 2018
- Member, Hiring Committee, Assistant Professor position in First Peoples Studies, 2018 - 2020
- Chair, Hiring Committee, Director position in First Peoples Studies, 2018 – 2019
- Member, Department Personnel Committee, School of Community and Public Affairs, 2018 –
- Member, Department Tenure Committee, School of Community and Public Affairs, 2018
- Indigenous Directions Leadership Group, member, Fall, 2017 - 2019

Outside Service

- Collaborator/consultant - English Montreal School Board, 2021 – present. Consultant for Territorial Acknowledge creation, textbook selection. Collaborated to bring inaugural Indigenous Peoples Celebration to local elementary school.
- Co-founder and Spokesperson, Carlisle Indian Industrial School Farmhouse Coalition, 2011-present. Advocate for historic preservation. *Successfully applied and received recognition with*: International Sites of Consciousness, Preservation Pennsylvania at Risk, Cumberland County Historic Sites. *Developed collaborations with*: Cumberland County Historical Society, Preservation Pennsylvania, Carlisle Barracks, National Native American Boarding School Healing Coalition, Bosque Redondo Historic Site, Carlisle Indian School descendants, relatives, and friends. *Manage donations:* including personal contributions and ($3,000) from the Nell Newman Foundation (2019).
- Social Science and Humanities Council review committee – member, 2020
- Founding Board Member, Healing and Reconciliation Institute, Monterey, California, 2018 - 2021
- National Native American Boarding School Healing Coalition, Conference Committee Member, 2018
- Committee member, Carlisle Journey's Symposium, 2017 – 2020

Scholarly Consultant / Media

- *KZFR Community Radio*, Peace and Justice, Chico, California. Interview. October 8, 2021.
- *First Voices Radio Program*. Interview. October 13, 2021.
- Pember, Mary Annette, *Indian Country Today Media Network.* "We won't forget about the children." Interviewed. June 6, 2021.
- *Time Talks: History, Politics, Music, and Art, Podcast. Interview*. "Carlisle Indian School, Akwesasne Freedom School, Self-determination, and Language Revitalization. June 15, 2021.
- Little, B., *History Stories*, History Channel. "Why Grave Robbers Won't Leave Native American Burial Sites Alone." Interviewed. March 4, 2019.
- *Center for Diversity and the Environment*. Board Training on Decolonization. Tucson, Arizona. January, 2019.
- Cress, J., *Cumberlink*, "Indian School: Legacy of Carlisle Indian School presents a conflicted point of view" Carlisle, Pennsylvania. Interviewed, August 31, 2018.
- Gammage, J., *The Philadelphia Inquirer*, Philadelphia, Pennsylvania. Research with Carlisle Indian School and Indigenous remains highlighted, June 2018.

Professional Development and Memberships

- Spencer Foundation Indigenous Education Initiative, Virtual Convening on Indigenous Futures in Education. Chosen as one of forty global leaders in Indigenous education to envision the future of Indigenous education, November 2021
- Member, National Native American Boarding School Healing Coalition, Denver, Colorado, April 2016 – present
- Member, Native American and Indigenous Studies Association, 2009 - present

Emily Charmaine Coon

Kanien'keha:ka • Haudenosaunee • Kenhte:ke

Educational Training

2020 **Master of Arts**
University of Victoria, Child and Youth Care
Thesis: *Oh nisa'taro:ten? Learning how to sken:nen as a contemporary Haudenosaunee woman*

2014 **Bachelor of Arts**
University of Waterloo, Honours Psychology

Academic Teaching Experience

Lecturer, Limited-Term Appointment

First Peoples Studies, Concordia University

Fall 2022
FPST 210: Haudenosaunee PeoplesFPST 302: First Peoples Education
FPST 397: Pro-Seminar 2 – Ethics and First Peoples
FPST 402: First Peoples Contemporary Social Issues

Sessional Instructor

School of Child and Youth Care, University of Victoria

Winter 2022
Winter 2022
Fall 2021
Fall 2021
Winter 2021
Fall 2020
Fall 2020
Winter 2020

CYC 430 A01: Research Practice in Indigenous Contexts
CYC 250 A01: Law, Indigenous Peoples & the TRC Calls to ActionCYC 382 A01: Early Years Program Approaches
CYC 250 A02: Law, Indigenous Peoples & the TRC Calls to Action CYC 171 A01: Introduction to Families: Issues, Patterns & ProcessesCYC 250 A02: Law, Indigenous Peoples & the TRC Calls to Action CYC 250 A03: Law, Indigenous Peoples & the TRC Calls to Action CYC 430 A01: Research Practice in Indigenous Contexts

Indigenous Studies Program, University of Victoria

Winter 2022
Fall 2021
Fall 2021
Spring 2021
Winter 2021

IS 101 A03: Indigenous Studies Foundations
IS 201 A02: Introduction to Indigenous StudiesIS 101 A03: Indigenous Studies Foundations
IS 101 A01: Indigenous Studies FoundationsIS 101 A03: Indigenous Studies Foundations

	Gender Studies Program, University of Victoria
Winter 2022	GNDR 209: Families, Intimacies & Nationhood
	Early Learning and Care Program, Camosun College
Winter 2021	ELC 130/160: Early Childhood Profession & Community Observations
Winter 2021	ELC 170: Working with Families and Communities

Curriculum Development

Fall 2021	CYC 382: Early Years Program Approaches
Winter 2021	ELC 170: Working with Families and Communities
Fall 2020	CYC 250: Law, Indigenous Peoples & the TRC Calls to Action
Winter 2018	CYC 230: Introduction to Child and Youth Care in Indigenous Contexts

Teaching Assistant

School of Child and Youth Care, University of Victoria

Fall 2020
Fall 2019
Fall 2018
Spring 2018
Fall 2017

CYC 250: Law, Indigenous Peoples & the TRC Calls to Action CYC 250: Law, Indigenous Peoples & the TRC Calls to Action CYC 250: Law, Indigenous Peoples & the TRC Calls to Action CYC 230: Introduction to CYC Practice in Indigenous ContextsCYC 250: Law, Indigenous Peoples & the TRC Calls to Action

Winter 2020 *Indigenous Studies, University of Toronto*
INS 205H: Indigenous Worldviews, Spiritual and Healing Traditions

Fall 2015 *Indigenous Studies Program, University of Victoria*
IS 101: Indigenous Studies Foundation

Academic Presentations

Guest Lectures and Invited Presentations

Coon, E. (2022). *The Kanehsata:ke Resistance: Leadership of Kanien'keha:ka women*. In FRAN 336: Québec and Francophone Cinema. French Department, University of Victoria. Invited by Dr. Sada Niang

Coon, E. (2019). *Indigenous lands & environments*. In CLD 111: Curriculum 1: Environments. School of Childhood Studies, Ryerson University. Invited byDr. Nicole Land.

Coon, E. (2016). *Haudenosaunee ethics*. In CYC 552: Ethics in CYC practice. Schoolof Child and Youth Care, University of Victoria. Invited by Dr. Jennifer White.

Coon, E. (2016). *Introduction to Indigenous land knowledges*. In EDUC 144: Theoretical Perspectives. Early Childhood Care & Education, Capilano University. Invited by Dr. Vanessa Clark.

Land, N., Coon, E., & Nelson, N. (2015). *Risky/ing sensing in early childhood education: Licked sound, hearing cold, lumpy vision*. In CYC 541: Historicaland Contemporary Theoretical Perspectives in Child and Youth Care.
School of Child and Youth Care, University of Victoria. Invited by Dr.Veronica Pacini-Ketchabaw.

Coon, E. (2015). *Indigenous lands & knowledges*. In CYC 280: Creating Programsand Environments for Young Children. School of Child and Youth Care, University of Victoria. Invited by Dr. Nicole Land.

de Finney, S., & Coon, E. (2015). *Drum-work and Indigenous practices*. In CYC 100B: Introduction to Professional CYC Practice. School of Child and YouthCare, University of Victoria. Invited by Dr. Jim Anglin.

Coon, E. (2015). *Haudenosaunee perspectives on qualitative research*. In CYC 424: Qualitative & Quantitative Analysis in CYC. School of Child and Youth Care,University of Victoria. Invited by Dr. Nicole Land.

Refereed Presentations

Coon, E. (2019, March). *Tracing the rhythmic gestures of my grandmother's hands: Patchworking my contemporary Haudenosaunee identity and the futurities of peacemaking.* Accepted [unable to attend] at Rising Up 2019 Conference. Winnipeg, MB.

Coon, E. (2018, November). *Moving through Dish with One Spoon treaty territories: Contemporary treaty relationships, realities and responsibilities*.Presentation at Queen's University 20th annual Indigenous Knowledge symposium: Understanding treaties & treaty-making: Kingston, ON

Coon, E., Gulamhusein, S., & Scott, A. (2017, April). *Enacting transdisciplinary conversations in child and youth care.* Workshop at the Child & Youth Carein Action V: Embracing Challenge conference: Victoria, BC.

Coon, E., Richardson, C., Land, N., Smith, J., & Kouri, S. (2016, May). *Decolonizing and desettlering conversations in practice.* Panelist at the Dignity 2016: The Centre for Response-Based Practice Conference: Duncan, BC.

Coon, E. (2016, May). *Following in the footsteps of Sky Woman: Reimagining our early childhood practices*. Keynote address at the Early Childhood Educators of British Columbia 45th annual conference: Richmond, BC.

Land, N., Coon, E., & Nelson, N. (2015, October). *Risky/ing sensing in early childhood education: Licked sound, hearing cold, and lumpy vision*. Workshop at the Reconceptualizing Early Childhood Education conference: Dublin, Ireland.

Academic Publications

Non-Blind Peer-Reviewed Publications

Coon, E. (2015, December 14). tewahtatowi: We carry ourselves [peer-reviewedblog post]. *International Journal of Children, Youth, and Family Studies Review.*

Peer-Reviewed Publications

Coon, E., & Land, N. (2019). iMessaging flesh, friendships and futurities. *Imaginations: Journal of Cross-Cultural Studies, 10*(1).

Land, N., Gulamhusein, S., Scott, A., & Coon, E. (2018). Transdisciplinary conversations in child and youth care. *World Futures: The Journal of New Paradigm Research, 74*(7-8), 572-594.

Nelson, N., Coon, E., & Chadwick, A. (2015). Engaging with the messiness of placein early childhood education and art therapy: Exploring animal relations, traditional hide and Drum. *Canadian Children, 40*(2), 43-56.

Community Involvement and Outreach

2016 – 2020 **Haudenosaunee Cultural Advisor**

Riel Cultural Consulting

- Produced and facilitated arts-based and culturally-appropriate workshops for diverse settler and international audiences, introducing participants to Indigenous pedagogies, with an emphasis on Kanien'keha:ka knowledges

2016 – 2018 **Board Member**

Indigenous Health Council, Kingston Community Health Centres

- Attended monthly board meetings, offered input on the Indigenous programming being delivered at various community health centres across the Kingston region, and ran cultural workshops on the Two Row wampum

2016 – 2017 **Intern**

City of Kingston: Cultural Services & Better Beginnings for Kingston Children

- Designed, developed and delivered a series of workshops for frontline early childhood workers; topics included the history of settler colonialismin Canada, Indigenous terminology, privilege, allyship and decolonization

2016 – 2017 **Vice-Chair & Founding Member**

Kingston Thunder Women, Ontario Native Women's Association Affiliate

- Advocated for the safety and rights of Indigenous women, children, Two Spirit and trans folk in the community, developed cultural programming for children rooted in the Kanien'keha language, and assisted in organizingevents such as Prisoner's Justice Day and National Indigenous Peoples Day

2014 – 2015 **Indigenous Research Partner**

University of Victoria Child Care Services

- Collaborated with toddlers, pedagogists and early childhood educators to explore and document curiosities of Indigenous drum-sounds, stories and songs in Haro Woods on unceded Lekwungen territories

Academic Awards and Funding

2021	Grant Funded Research Assistant ($500)
2016	University of Victoria Graduate Award ($2000)
2015	Agnes Shahariw Memorial Scholarship ($1500)
2015	University of Victoria Graduate Studies International Travel Grant ($900)
2015	Reconceptualizing Early Childhood Education Travel Award ($300)
2014	University of Victoria Graduate Award ($500)

APPENDIX VII: Letters of Support and List of Persons Consulted

Please see attached letters of support.

Access in the making Lab
Concordia University

Located on unceded lands of
the Kanien’kehá:ka Nation

September 1st, 2022

Dear Review Committee,

I undersigned Arseli Dokumaci, in my quality as Canada Research Chair in Critical Disability Studies and Media Technologies (CRC) at Concordia University and as the director of Access in the Making (AIM) Lab, commit to support the Micro-certificate in Indigenous Land-Based Education Program that has been developed by Donna Kahérakwas Goodleaf, the director of Decolonizing Curriculum and Pedagogy at Concordia University. This is a long-needed, vital and extremely relevant program that centers Rotinonhsión:ni decolonial pedagogical principles and experiential land-based survival skills, cosmologies, ways of living and learning.

AIM Lab brings together faculty members, graduate students, non-student researchers, local artists and community members working on issues of access and disability justice. Rather than reducing access to codes and checklists, the AIM Lab approaches access critically and creatively. At the AIM Lab, we consider access as an inherently intersectional issue that requires decolonial, anti-racist, anti-sexist approaches and a commitment to a broad social justice framework. Centering research and research-creation, we produce films, podcasts and other types of creative media works related to disability and social justice. Given our diverse expertise in disability and access issues, we also provide guidance and promising practices on access to various stakeholders (for further information, please see https://accessinthemaking.ca/).

We are delighted and honored to work with the Directors of Decolonizing Curriculum and Pedagogy and First Peoples Studies Program regarding the micro-certificate in Indigenous Land-Based Education Program, and support them in increasing the accessibility of the program to differently disabled students, educators and facilitators.

As the director of the Lab, I confirm that we will work with the directors of the Certificate program and,

a. conduct a pilot study of the program in the Fall 2022 and/or Spring 2023, where differently disabled AIM members would visit the teaching sites, take part in the educational activities, and identify various barriers where access can be improved in the future iterations of the program;
b. give guidance and do consultations sessions with the directors of the program in order to improve accessibility;
c. provide audiovisual (taking photographs, filming, editing) support to the Program as per its needs and requests;
d. make the AIM lab space and its equipment available for the needs of the Program;
e. help with other issues of access as they arise.

As the director of the AIM Lab, I confirm that I will provide Research Assistantship support for the above listed activities, and students and AIM community members will be reimbursed for their time through my CRC funds.

If I can be of any further assistance, please do not hesitate to contact me.

Yours sincerely,

Arseli Dokumaci
Assistant Professor, Communication Studies Department
Concordia University
Canada Research Chair in Critical Disability Studies and Media Technologies

KAHNAWAKE SCHOOLS DIABETES PREVENTION PROJECT
Center for Research & Training in Diabetes Prevention
P.O. Box 989, Kahnawake Mohawk Territory
Quebec, Canada J0L 1B0
Tel: (450) 635-4374
Fax: (450) 635-7279

" Daily Physical Activity, Healthy Eating Habits & a Positive Attitude Can Prevent Diabetes"

August 26, 2021

Kahérakwas Donna Goodleaf, Ed.D.
Director Decolonizing Curriculum and Pedagogy
Center for Teaching and Learning
Concordia University, Montreal, Quebec

Kwe Kahérakwas,

Re: Support Letter for Concordia University Proposed Certificate in Kanien'kehá:ka Land-Based Education Program

It is our pleasure to provide you with this support letter for the "Proposed Concordia University Certificate in Kanien'kehá:ka Land-Based Education Program". The Kahnawake Schools Diabetes Prevention Program (KSDPP) Community Advisory Board made this decision at their duly convened meeting on Tuesday, August 17, 2021.

KSDPP is governed by their Community Advisory Board (CAB) which consists of grass-roots community members and community organizational representatives who oversee KSDPP's administrative and fiscal accountability. For KSDPP empowers the community to care for their personal and family health through continual improvement of our unique diabetes prevention model that is based on Kanien'kehá:ka (Mohawk) values.

Based upon our experience since 1994, as a Center for Research & Training in Diabetes Prevention & Healthy Lifestyles that services Indigenous communities, we can attest to the immense value of the Proposed Certificate Program in Kanien'kehá:ka Land-based Education Program's stated objectives to equip students with essential skills, knowledge, and attitudes that include their ability to 1) Examine theoretical underpinnings of Indigenous led, land-based pedagogies. 2) Survey sustainable Indigenous theoretical frameworks and practices to promote economic-self-sufficiency, and 3) Apply survival skills on land.

Furthermore, as an Indigenous organization, we recognize the value of using the land as a fundamental learning space that reconnects Indigenous students to social relations, culture language, knowledge, and experiences that arise from the land. All with the resolve for grounding Indigenous students in Indigenous epistemologies, promote health and mental well-being, strengthen cultural identity, kinship and community responsibilities and to promote the precious Kanien’kehá:ka language.

KSDPP shares these recognized values and resolve in our health promotion and diabetes prevention work for incorporating Indigenous knowledge, ways of knowing and understanding. We look forward to seeing this important Concordia University Certificate Program become a welcomed reality.

In Peace and Friendship

Alex M. McComber,

KSDPP Community Advisory Board member

Encl.

Cm

Kahnawake Schools Diabetes Prevention Program
Background Information

KSDPP: A RESEARCH AND TRAINING CENTER FOR DIABETES PREVENTION. KSDPP Recognizes the diabetes epidemic among Indigenous peoples in Canada, along with the need to mobilize communities to build diabetes prevention/healthy lifestyle programs that support community members who are at-risk and those who are living with this disease.

Since 1994. KSDPP has actively promoted healthy eating, physical activity and a positive attitude among Kahnawakehronon school children, their families and the community at large, with the ultimate goal of reducing overweight and obesity and lowering the incidence and prevalence of type 2 diabetes. The KSDPP model of community leadership and engagement to promote healthy lifestyles for the prevention of obesity and type 2 diabetes has been shared with several First Nations communities and regions since 2001.

KSDPP MISSION STATEMENT. The Kahnawake Schools Diabetes Prevention **Program** (KSDPP) prevents type 2 diabetes through the promotion of healthy eating, physical activity and **wholistic wellness** for present and future Kahnawakeró:non and for other **Indigenous** communities. This is achieved by designing and implementing school, family and community intervention activities. KSDPP conducts community based participatory research on these activities, trains community intervention workers and academic and community researchers. KSDPP is committed to report all research results first to the community, then to wider lay and scientific audiences.

Kahnawà:ke Combined Schools Committee
PO Box 1000
Kahnawà:ke, QC J0L 1B0
Tel: 450-632-8770
Fax: 450-632-8042
www.kec.edu.ca

Tuesday, August 24, 2021

Ms. Kahérakwas Donna Goodleaf, Ed. D.
Director Decolonizing Curriculum and Pedagogy
Centre for Teaching and Learning
Concordia University
donna.goodleaf@concordia.ca

Shé:kon Ms. Goodleaf,

SUBJECT: Proposed Certificate in Kanien'kehá:ka Land-Based Education Program

On behalf of the Kahnawà:ke Combined Schools Committee (KCSC), please accept this as an official letter of support for the creation of the proposed 15-credit Certificate in Kanien'kehá:ka Land-Based Education Program in partnership with one of our community-based entities, Iontionhnhékwen Wilderness Skills and Concordia University.

As the governing body of the Kahnawà:ke Education Center (KEC), the KCSC believe education is a critical component that helps our nations to continue to prosper. Offering this program to Indigenous students has come at such a pivotal time as it is becoming more and more evident that Indigenous students are yearning to use land as a fundamental learning space to connect to culture, language, knowledge, and social relations.

We want our students to thrive on any life path they choose for the next seven generations and beyond. It is vital that higher educational organizations provide rich, hands-on, culturally relevant learning experiences like the Kanien'kehá:ka Land-Based Education Program to our Indigenous students to help promote health and mental well-being, strengthen cultural identity, kinship, and community connection.

Should you have any questions regarding this letter, please do not hesitate to contact the undersigned.

In Peace and Friendship,

Chelsea Lahache
Secretary, KCSC
Chelsealahache@gmail.com

cc. KCSC

The First Nations Regional Adult Education Center

August 17, 2021

Donna Kaherakwas Goodleaf, Ed. D.
Director Decolonizing Curriculum and Pedagogy
Concordia University
Montreal, Quebec
donna.goodleaf@concordia.ca

OBJECT: LETTER OF SUPPORT

To Whom It May Concern,

It is with great pleasure to write a letter of support for the Kanien'keha:ka Land Based Education Certified Program being developed for Concordia University in Montreal by Donna Goodleaf Ed. D.

The Kanien'keha:ka Land Based Education Certified Program is comprehensive and culturally appropriate approach to providing an Indigenous learning perspective.

As part of this initiative, the First Nations Regional Adult Education Center location in Kahnawake will be available to the Kanien'keha:ka Land Based Education Certified Program for land based activities.

Sincerely,

Carina Deere

Carina Deere M., B.Ed
Director, First Nations Regional Adult Education Center
(450) 635-6352 Ex:225
cdeere@fnraec.com

Commission scolaire English-Montréal
English Montreal School Board

English Montreal School Board
6000 Fielding Avenue
Montreal, QC H3X 1T4

August 26, 2022

Concordia University
1455 Boul. De Maisonneuve Ouest
Montreal, QC H3G 1M8

To whom it may concern:

We were very excited to learn about the proposed Indigenous Land-Based Education program at Concordia University, School of Community and Public Affairs/First Peoples Studies Program. At the EMSB, we are committed to expanding opportunities for students to learn about Indigenous Peoples, as well as to supporting our students' well-being and connection to the larger community.

Over the past two years, working in close collaboration with members of Concordia's First Peoples Studies program, we've deepened our knowledge, commitment, and programing for students in relation to Indigenous Peoples. We are keen to continue to expand both the "what" and the "how" of what we teach students about Indigenous history, communities, culture, and knowledge.

The opportunity to engage students experientially through land-based education and exploration is an exciting prospect and one we have talked about with partners at Concordia's FPSP as a future goal. If there were a cohort of students who came out of this program equipped with the knowledge, skills, and experience to facilitate land-based programing for EMSB students, we would be very interested in working with them. This would be a tremendous opportunity for Indigenous and non-Indigenous students to spend time in nature and to learn more about Indigenous culture and ways of knowing, as well as to connect with and learn more about the community and land on which we live, Tiohtià:ke.

Thank you for your consideration and support of these wonderful initiatives.

Sincerely,

Danika Swanson
Consultant, Spiritual and Community Animation Service

APPENDIX VIII: Assessment of Facilities and Equipment Costs

As this program will take place in regular classrooms on campus, and on the land when off campus, it does not require any special facilities or equipment.

Requested amounts for the Department of: School of Community and Public Affairs
Program name: Kanien’kehá:ka Land-Based Education Certificate

Program Financial Viability

REVENUE	Year 0 Start-Up	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Tuition Fee							
Tuition (FTE)		$ 11,188	$ 16,782	$ 22,376	$ 22,376	$ 22,376	$ 95,098
Grants							
Teaching Grant (WFTE)		$ 21,561	$ 32,342	$ 43,122	$ 43,122	$ 43,122	$ 183,270
Support Grant (FTE)		$ 9,544	$ 14,316	$ 19,088	$ 19,088	$ 19,088	$ 81,124
Total grants		$ 31,105	$ 46,658	$ 62,210	$ 62,210	$ 62,210	$ 264,394
Additionnal Funding External	$ -	$ 151,911	$ 151,911	$ 151,911	$ -	$ -	$ 455,733
Total Revenue	**$ -**	**$ 194,204**	**$ 215,351**	**$ 236,497**	**$ 84,586**	**$ 84,586**	**$ 815,225**

EXPENSES	Year 0 Start-Up	Year 1	Year 2	Year 3	Year 4	Year 5	Total
TEACHING							
Tenure Track	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Extended Term Contrats	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Limited Term Contracts	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Lecturers	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Course remissions	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 75,000
Technical support	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Part Time Contracts	$ -	$ 37,500	$ 37,500	$ 37,500	$ 37,500	$ 37,500	$ 187,500
Teacher's Assistants	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Stipends	$ -	$ 49,820	$ 49,820	$ 49,820	$ 49,820	$ 49,820	$ 249,100
Other	$ -	$ -	$ -	$ -	$ -	$ -	$ -
ADMIN STAFF							
Administrative Staff	$ -	$ 7,578	$ 7,578	$ 7,578	$ 7,578	$ 7,578	$ 37,890
Total Payroll	**$ 12,500**	**$ 107,398**	**$ 107,398**	**$ 107,398**	**$ 107,398**	**$ 107,398**	**$ 549,490**
OTHER EXPENSES							
Total Other Expenses	**$ -**	**$ 28,491**	**$ 28,491**	**$ 28,491**	**$ 28,491**	**$ 28,491**	**$ 142,455**
Total Expenses	**$ 12,500**	**$ 135,889**	**$ 135,889**	**$ 135,889**	**$ 135,889**	**$ 135,889**	**$ 691,945**
CONCORDIA UNIVERSITY SURPLUS / (DEFICIT)	**$ (12,500)**	**$ 58,315**	**$ 79,462**	**$ 100,608**	**$ (51,303)**	**$ (51,303)**	**$ 123,279**

UNIVERSITÉ Concordia UNIVERSITY

SENATE
OPEN SESSION
Meeting of February 17, 2023

AGENDA ITEM: Academic Programs Committee – Report and Recommendation – New program: Bachelor of Engineering in Chemical Engineering GCS-CME-4421

ACTION REQUIRED: For approval

SUMMARY: Senate is being asked to approve a new program: Bachelor of Engineering in Chemical Engineering GCS-CME-4421

BACKGROUND: The Department of Chemical and Materials Engineering proposes to launch a Bachelor of Engineering (BEng) in Chemical Engineering. The chemical industry in Québec is projected to grow significantly within the next five years, and the program will contribute to training the required skilled workers. The Department has a strong research specialization in advanced materials and sustainability, and the program focuses on delivering skills to support the development of sustainable energy solutions.

The details of the proposed BEng in Chemical Engineering are provided in the attached documentation.

DRAFT MOTION: Following recommendation of the Academic Programs Committee, the Senate approve a new program: Bachelor of Engineering in Chemical Engineering GCS-CME-4421, as detailed in the attached document.

PREPARED BY:

Name: Karan Singh
Date: February 9, 2023

ACADEMIC PROGRAMS COMMITTEE
REPORT TO SENATE
Sandra Gabriele, PhD
February 17, 2023

The Academic Programs Committee requests that Senate consider the following changes for the Academic Calendar.

Following approval of the Faculty Councils, APC members reviewed the curriculum submissions listed below. As a result of discussions, APC resolved that the following curriculum proposal be forwarded to Senate for approval:

Undergraduate Curriculum Proposals (Changes for the 2023-24 Calendar)

Faculty of Arts and Science
School of Community and Public Affairs
AS-SCPA-5222; **APC-2023-1-D1** (For May 2023 Implementation)

- New Program: Microprogram in Indigenous Land-Based Education

Gina Cody School of Engineering and Computer Science
Department of Chemical and Materials Engineering
GCS-CME-4421**; APC-2023-1-D2** (Implementation pending MES Approval)

- New Program: BEng in Chemical Engineering

Sandra Gabriele, PhD
Vice-Provost, Innovation in Teaching and Learning January 27, 2023

New Undergraduate Program (Regular Process) - GCS-CME-4421 - VERSION : 2

Summary of Committee Discussion: Faculty Council Approval

For Submission to:

Sandra Gabriele, Vice- Provost, Innovation in Teaching and Learning,
APC, 17 Jan 2023

Approved by:

Mourad Debbabi, Dean, Gina Cody School of Engineering and Computer Science,
Council of the Gina Cody School of Engineering and Computer Science, 04 Nov 2022

Summary of Committee Discussion: Faculty Curriculum Approval (FCC/FAPC)

For Submission to:

Mourad Debbabi, Dean, Gina Cody School of Engineering and Computer Science,
Council of the Gina Cody School of Engineering and Computer Science, 04 Nov 2022

Approved by:

Ali Akgunduz, Associate Dean, Academic Programs and Undergraduate Studies,
Engineering and Computer Science Undergraduate Studies Committee, 18 Oct 2022

Summary of Committee Discussion: Department approval

For Submission to:

Ali Akgunduz, Associate Dean, Academic Programs and Undergraduate Studies,
Engineering and Computer Science Undergraduate Studies Committee, 18 Oct 2022

Approved by:

Alex De Visccher, Chair,
Chemical and Materials Engineering Department Council, 30 Sep 2022

New Program Proposal – Bachelor of Chemical Engineering

List of Figures

List of Tables

1. EXECUTIVE SUMMARY

The Department of Chemical and Materials Engineering currently has no accredited undergraduate program and wishes to start its first undergraduate program in Chemical Engineering. The Department of Chemical and Materials Engineering has a strong research specialization in advanced materials and sustainability.

The Department of Chemical and Materials Engineering proposes to launch a BEng program in Chemical Engineering. The rationale to propose this program is as follows:

- Chemical industry in Quebec employs over 2,000 chemical engineers, and over 10,000 in Canada, indicating that Quebec chemical engineers constitute roughly 20% of Canadian chemical engineers. The employment outlook for chemical engineers in Quebec has been rated as *good* for the next three years (2021-2023) by the Government of Canada[1]. Contributing factors to this good job prospect are employment growth, retirement of current workforce, and small numbers of unemployed workers with experience in this occupation. Only three out of the 13 provinces and territories are rated *good* (highest ranking) at the time of the writing.
- Quebec battery initiative is planning for 10,000 new jobs for the next five years with a total budget of $10B[2], this proposed program will contribute to training the required skilled workers in this field due to the program focus on advanced materials and materials processing
- The Department currently offers the Graduate Certificate, Graduate Diploma, MASc, and PhD programs in Chemical Engineering. These programs have graduated 11 students since the department was established in 2017.
- Concordia University is a leader in advanced materials and sustainability research. The Department of Chemical and Materials Engineering currently has 14 professors working on a broad range of chemical engineering research areas.
- The proposed program will enable students to study in the areas of Chemical Engineering and there are clear and significant needs from industry and society in this area.
- The Department of Chemical and Materials Engineering has the resources and expertise to operate this program at the highest level of quality to meet the demands from students, industry, and society.
- There is a current search to hire two new faculty members. Six new faculty members in priority areas will be hired in the short term.
- Many of the courses specified in the proposed program are currently offered by the Faculty (ENGR and ENCS courses), and the Department of Chemical and Materials Engineering has the expertise to offer the new courses. 49 new courses are proposed to create this BEng in Chemical Engineering, 22 of these are core chemical engineering courses in the program, 15 of these are existing graduate courses to be cross listed as undergraduate technical electives, and the remaining 12 are new technical electives to provide training specialized topics in advanced materials and materials processing, data science and engineering, and sustainability and sustainable process design.
- The implementation of the proposed program is feasible with the resources listed herein.
- The proposed program will generate revenue for the University after Year 5.
- This is the second BEng program in Chemical Engineering offered in the English language in Quebec, the first being at McGill University. This program differentiates itself from the program at McGill through a focus in advanced materials, sustainability, computer programming and machine learning, and having a Co-operative Education option.
- The proposed date to introduce the Chemical Engineering BEng program is September 2024.

[1] Chemical Engineer in Canada | Job prospects - Job Bank
[2] https://ici.radio-canada.ca/nouvelle/1948910/fitzgibbon-silicon-travailleurs-filiere-quebec-batterie-vehicules-voiture-electrique

2. PROGRAM IDENTIFICATION

2.1 Degree awarded: Bachelor of Engineering

2.2 Discipline: Chemical Engineering

2.3 Program Title: Bachelor's of Engineering in Chemical Engineering

2.4 Administrative location:

University:	Concordia University
Faculty:	Gina Cody School of Engineering and Computer Science (GCS)
Department:	Department of Chemical and Materials Engineering
Address:	1455 de Maisonneuve Blvd. W, Montreal, Québec, H3G 1M8, Canada

3. FIELD OF STUDY AND RELEVANCE

3.1 Field of study

Chemical Engineering is an engineering discipline that applies the principles of engineering and natural sciences to design and effectively operate industrial units to manufacture a broad range of chemical products. These products include bulk chemicals (e.g., oil refinery products, fertilizers, plastics), fine chemicals (e.g., pharmaceuticals), metals, industrial products derived from micro-organisms (e.g., fermentation, brewing), biofuels, nanomaterials and composites. Chemical engineers are responsible for the design and operation of safe and sustainable processes.

Chemical Engineering is one of the core engineering programs in many Canadian universities. Concordia University is one of the few universities without a Chemical Engineering undergraduate program in Canada. The Department of Chemical and Materials Engineering at Concordia University was established in 2017 with the mandate of developing undergraduate and graduate programs in Chemical Engineering. Adding Chemical Engineering undergraduate program to the portfolio of core engineering disciplines at Concordia University will increase Concordia's impact on overcoming emerging global challenges by training engineers who can:

- Develop effective ways to manufacture CO_2-based fuels and chemicals to replace oil-based counterparts.
- Design battery materials with higher energy density and stability at a lower cost.
- Create better ways to produce and recycle the raw materials needed to produce battery materials.
- Devise strategies to effectively recycle plastics to decrease plastic waste.
- Create solutions to close the global phosphorus cycle.
- Develop ways to reduce the environmental impact of aluminum production.

The proposed program is geared towards students with an interest in engineering and applied chemistry; it is complementary to the existing programs at Concordia University. The programs that are closely related to the proposed program are the Mechanical Engineering undergraduate program in the Department of Mechanical and Industrial Engineering, and the Environmental Engineering specialization in the Department of Building, Civil, and Environmental Engineering.

3.2 Areas(s) of expertise

The proposed program consists of 120 credits. The curriculum is developed to provide the students with theoretical knowledge and hands-on practice on Chemical Engineering principles. A variety of pedagogical approaches including work-integrated learning, blended learning, laboratory training will be used to foster student success. Beyond the core Chemical Engineering curriculum, students can choose elective courses from a variety of specialized technical tracks such as biochemical and food engineering, materials engineering, sustainable chemical engineering, advanced process design and control, biomolecular modelling and drug design. Refer to Section 7 for further details.

In terms of the focus of the program and its pedagogical features, the proposed program distinguishes itself from existing programs in various ways described below.

- Traditionally, sustainability has been under-emphasized in chemical engineering programs. We propose to build elements of sustainability into the program early on. The overarching goal of the program is to train engineers who understand the impact of their decisions not just on their own sector, but on society at large.
- Chemical engineering programs typically offer only one general course on materials science. Advanced materials are an emerging field, and an area of strength for Concordia University. The proposed program has a specialized track on materials engineering offering six courses on a range of topics including nanomaterials, metallurgical engineering, polymer engineering, advanced battery materials, and material characterization. Students who choose courses from this specialized track will have the necessary fundamental and practical knowledge to design novel materials.
- Chemical engineering processes produce large data sets. Programming and data science skills are integral to critically analyze and obtain a detailed understanding of these data sets. The proposed program has two core courses offered in the first year focusing entirely on programming for chemical engineers. Additionally, the fourth-year curriculum includes a programming course focusing on advanced data analysis and machine learning. In addition to these courses, programming assignments will be given in multiple core and elective courses throughout the program, further developing coding skills of the students. Typically, programming courses are offered as elective courses and are not part of the core engineering curriculum.
- Chemical engineering programs typically do not provide a comprehensive training in chemistry. The proposed degree program gives particular emphasis to chemistry education, more specifically in organic chemistry and computational chemistry. Graduates from the program will have the necessary knowledge to understand the properties of the chemicals they will manufacture in their prospective industrial positions.
- The chemical industry in the Province of Quebec consists largely of small and medium enterprises (SMEs). The program will address skills that engineers need to have in SMEs (e.g., basic IT skills in companies that cannot afford a separate IT department, basic mechanical design and machining skills, entrepreneurship). Graduates from the program will be pragmatic engineers and versatile problem solvers.
- Co-operative education, internships, and experiential learning opportunities are of tremendous importance for students to bridge the gap between academia and industry. The proposed program has a co-op option to provide the students with industrial work experience before graduation.
- Blended learning approaches will be integrated into a variety of core courses in which online modules will be developed in collaboration with KnowledgeOne. These modules will be accessible to the students throughout their entire program. Additionally, online laboratories focusing on dynamic chemical process simulations will be developed.

4. PROGRAM RATIONALE

4.1 Socio-economic and socio-cultural opportunities

4.1.1 Economic, social and cultural needs

Chemical engineers are considered highly-skilled workers and receive competitive salaries[3]. Chemical engineers usually earn between \$25.00/hour and \$76.44/hour with a median salary of \$43.27/hour in Canada and between \$25.00/hour to 64.90/hour with a median salary of \$39.56/hour in Quebec. More chemical engineers entering the workforce therefore serves to boost economic activity through both work and leisure activities in their regions. Many of the most well-paid careers[4] in engineering can be filled by chemical engineers, leveraging a strong technical and project- and systems-based education and background. With a background in chemical engineering providing a strong understanding of systems thinking, this also provides opportunities for success in many non-traditional fields such as sustainability consulting, start-up creation, new product/process development and others. The proposed chemical engineering program also provides a strong focus on sustainability, which offers many opportunities for chemical

[3] https://www.jobbank.gc.ca/marketreport/wages-occupation/2789/ca

[4] https://www.randstad.ca/job-seeker/career-resources/salary/9-top-paying-roles-in-engineering/

engineers to make meaningful contributions toward the energy and material transition required for a sustainable future. Leveraging the competitive advantages of low-carbon energy supply in Québec provides opportunities for start-ups and novel developments in chemical engineering processes and products. Research in chemical engineering is an additional avenue for value creation and societal benefit. Increasing chemical engineering education by adding the proposed undergraduate program will attract creative and skilled individuals internationally to contribute to the development of research at Concordia University, providing both global benefits from knowledge creation and direct links/implementation with local industry.

The major research strengths of Concordia University, as noted by the Strategic Plan[5], reference several areas strongly integrated within the Chemical and Materials engineering department. The proposed undergraduate program specifically targets cutting-edge and disruptive technologies such as Industrial Internet of Things (IIoT) toward Industry 4.0 and includes a strong emphasis on artificial intelligence (AI), machine learning, and advanced data analytics to provide the next generation of chemical engineers with advanced skills to excel in their careers and advance society (CHME 316 and technical electives). Advanced materials are also a strong point in Concordia's research portfolio, which has research elements in the department and has been integrated deeply within the undergraduate program. A strong fundamental education in materials is included in MIAE 221 and CHME 220, with advanced concepts included in CHME 320 and CHME 321, and further options available as technical electives. A potential consideration for the future of undergraduate education in the department is to develop an option in materials engineering or a related undergraduate program in this field. Finally, sustainability is included in the core of the curriculum (CHME 201, ENGR 202, CHME 352) with a focus toward sustainable chemical engineering offering an additional six courses as technical electives. Sustainability-focused elements also appear in conventional courses such as CHME 200, CHME 301, CHME 390 and CHME 490. These three target areas of research and societal impact for Concordia University are clearly echoed in the development of this undergraduate initiative, aiming to leverage the expertise and strengths of the department and university, with the goal of meeting societal needs through engineering science and education of young chemical engineers.

4.1.2 Enrollment in Chemical Engineering

Over the past decade, the enrollment of undergraduate students in Chemical Engineering has increased substantially. From 2010 to 2018, the total undergraduate enrollment in Chemical Engineering programs in Canada has increased from 5,163 to 6,451. During this time, the number of graduations in Chemical Engineering has increased from 1,148 to 1,660. In the Province of Québec, the enrollment in Chemical Engineering in 2018 was 1,070, whereas the number of graduations was 230 (Source: Engineers Canada). Due to the COVID-19 pandemic, data from 2020-2022 are not considered to be representative of long-term trends; therefore, this section primarily includes data prior to the pandemic.

It is remarkable that in the Province of Québec, the percentage of engineering students that is enrolled in Chemical Engineering programs (3.95 %) is currently still markedly less than the national average (7.22 %). Likewise, the number of graduating students in Chemical Engineering in Quebec as a percentage of the total number of graduating students (5.86 %) is markedly less than the national average (10.07 %). This may be due to the fact that the first and third largest engineering schools in the province, École de Technologie Supérieure (ÉTS) and Concordia University, do not offer undergraduate degrees in Chemical Engineering. This indicates a significant gap for an additional undergraduate Chemical Engineering program in the province. The short-term labour forecast (2021-2023) for chemical engineers in Quebec is Good [6], with opportunities specifically noted in several regions of the province [7].

The trends in the United States are similar to those in Canada. From 2010 to 2018, the enrollment in Chemical Engineering undergraduate programs in the US increased from 34,506 to 42,454. The number of graduations increased from 5,948 to 11,586 during that time (source: American Society of Engineering Education).

The program is expected to attract a very similar mix of students as other engineering programs at Concordia University,

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[5] https://www.concordia.ca/research/strategic-research-plan.html
[6] https://www.jobbank.gc.ca/marketreport/outlook-occupation/2789/ca
[7] https://www.jobbank.gc.ca/marketreport/outlook-occupation/2789/QC

i.e., primarily from the Greater Montreal Area. The same Cégeps that feed the other engineering programs are expected to be the main feeder schools for the Chemical Engineering program (e.g., John Abbott, Dawson).

The number of students registering in Bachelor's programs in Chemical Engineering has increased by 30% between 2011 and 2018 (from 5,000 to 6,451)[8]. The year-over-year growth in enrollment has been healthy. It declined following the crude oil plunge (2014-2015), it grew by 8.4% in 2018, and sharply decreased again in 2019 (see Table 1 and Figure 1). All schools experienced a decrease in enrollments in 2019 except UBC, which almost doubled its enrollments. Sherbrooke and Western suffered the largest decreases (-59% and -37% respectively). It is important to note that in 2019, total enrollments in Canadian engineering programs (all disciplines) decreased by 1%. Québec's enrollment in engineering decreased by 21%[9], by far the largest of all provinces.

Table 1. Undergraduate enrollments in Canada.

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Chemical Engineering	5,000	5,517	5,825	6,076	6,323	6,341	5,949	6,451	6,099
Total Engineering	65,468	69,549	72,448	77,204	82,374	83,302	82,472	89,242	88,273
% of ChE / Total Eng.	7.6	7.9	8.0	7.9	7.7	7.6	7.2	7.2	6.9
Growth (YOY) ChE		10.3	5.6	4.3	4.1	0.3	-6.2	8.4	-5.5
Growth (YOY) Eng		6.2	4.2	6.6	6.7	1.1	-1.0	8.2	-1.1

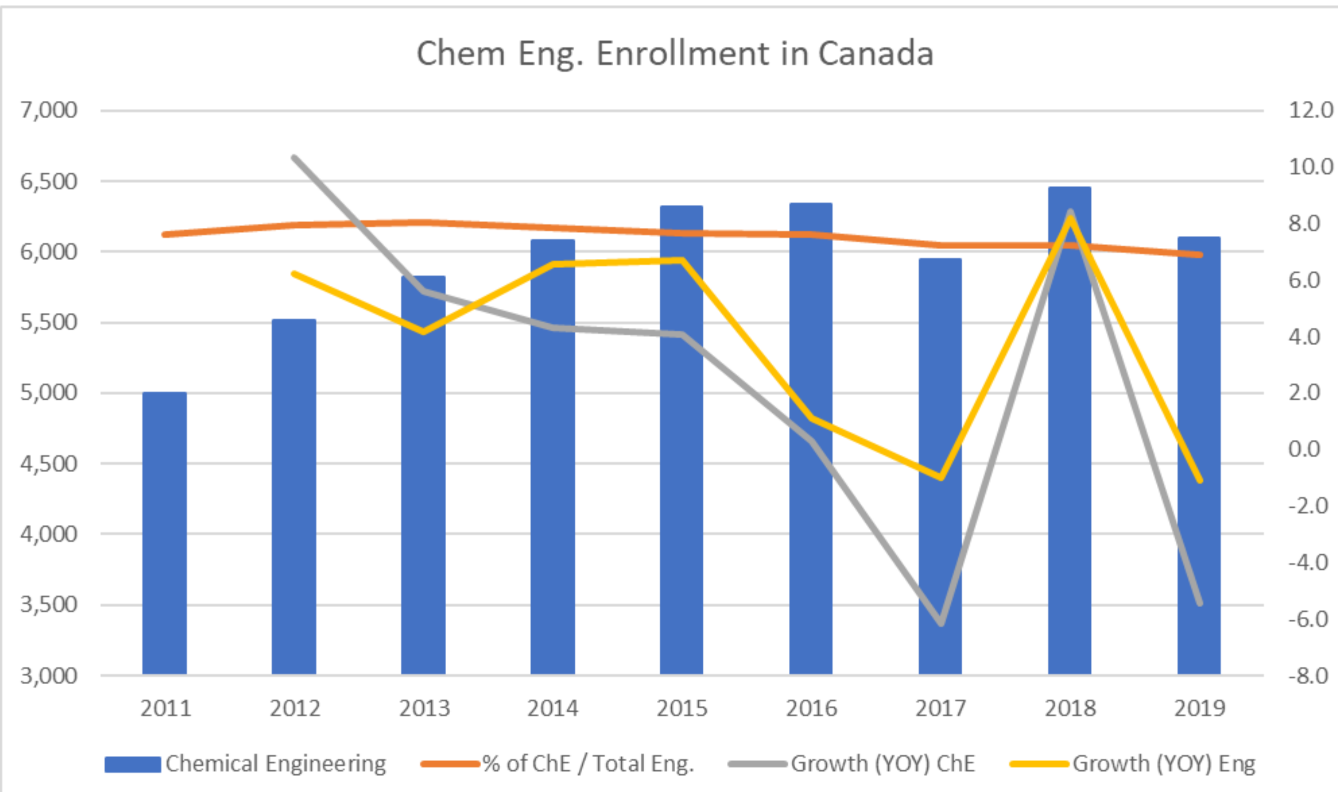

Figure 1. Undergraduate enrollments in Canada.

[8] 2012-2016: https://engineerscanada.ca/reports/canadian-engineers-for-tomorrow-2016#data-tabulations-engineering-enrolment-and-degrees-awarded
2015-2019: https://engineerscanada.ca/reports/canadian-engineers-for-tomorrow-2019#total-undergraduate-student-enrolment-by-discipline

[9] Table U2.1 https://engineerscanada.ca/sites/default/files/publications/Enrolment-Degrees-Report-2020/data/a1-undergraduate-enrolment-provincial.xlsx

Prior to 2019, Queen's, Western, and Dalhousie expanded their programs. Saskatchewan, Alberta, Laval, and McGill Schools experienced declines. The decrease in Saskatchewan and Alberta is most likely due to the regional focus on oil and gas production, which has experienced a decline in recent years.

Table 2. Enrollments in Chemical Engineering by institution.

	Enrollments in Chemical Engineering					YOY Growth			
Institution	2015	2016	2017	2018	2019	2016	2017	2018	2019
Alberta	603	533	467	508	421	-12%	-12%	9%	-17%
Calgary	350	330	365	508	496	-6%	11%	39%	-2%
Dalhousie	102	116	146	156	135	14%	26%	7%	-13%
Lakehead	102	124		125	119				
Laurentian	139	141	125	235	189	1%	-11%	88%	-19%
Laval	131	112	113	95	75	-15%	1%	-16%	-21%
McGill	385	381	316	301	284	-1%	-17%	-5%	-6%
McMaster	371	364	363	340	320	-2%	0%	-6%	-6%
Ottawa	495	424	396	384	351	-14%	-7%	-3%	-9%
Polytechnique	381	401	421	423	417	5%	5%	0%	-1%
Queen's	334	345	315	401	378	3%	-9%	27%	-6%
RMC	42	37	27	24	20	-12%	-27%	-11%	-17%
Ryerson	387	395	401	387	366	2%	2%	-4%	-5%
Saskatchewan	214	203	169	134	125	-5%	-17%	-20%	-7%
Sherbrooke	231	238	252	251	102	3%	6%	0%	-59%
Toronto	552	530	481	527	511	-4%	-9%	10%	-3%
UBC	198	244	236	246	485	23%	-3%	4%	97%
UNB	180	265	226	211	210	47%	-15%	-7%	-1%
UQTR	13	6	2	0	0	-	-	-	-
Waterloo	946	921	922	879	896	-3%	0%	-5%	2%
Western	194	234	206	317	200	21%	-12%	54%	-37%
Total	**8,365**	**8,360**	**7,966**	**8,469**	**8,118**	**0%**	**-5%**	**6%**	**-4%**

According to data from the American Society for Engineering Education (ASEE), the number of students graduating with a bachelor's degree in Chemical Engineering in the United States has doubled from 5,185 in 2009 to 11,148 in 2019[10]. The year-over-year growth (YOY) in enrollment in chemical engineering programs has outpaced that of the combined engineering programs since 2009 and until the fall in crude oil price in late 2014/early 2015 (gray versus yellow lines in Figure 2, Table 3). Although the enrollment in chemical engineering programs in the United States has decreased in the last few years, the job market for graduates remains strong as discussed in Section 4.2.

[10] Engineering by the Numbers, Engineering Statistics report. American Society for Engineering Education (ASEE). https://aseecmsprod.azureedge.net/aseecmsprod/asee/media/content/publications/pdf/2018-engineering-by-numbers-engineering-statistics-updated-15-july-2019.pdf, 2009-2018 data on page 39.
2019 report also from ASEE: Engineering and Engineering Technology by the Numbers. https://ira.asee.org/wp-content/uploads/2021/01/Binder1.pdf

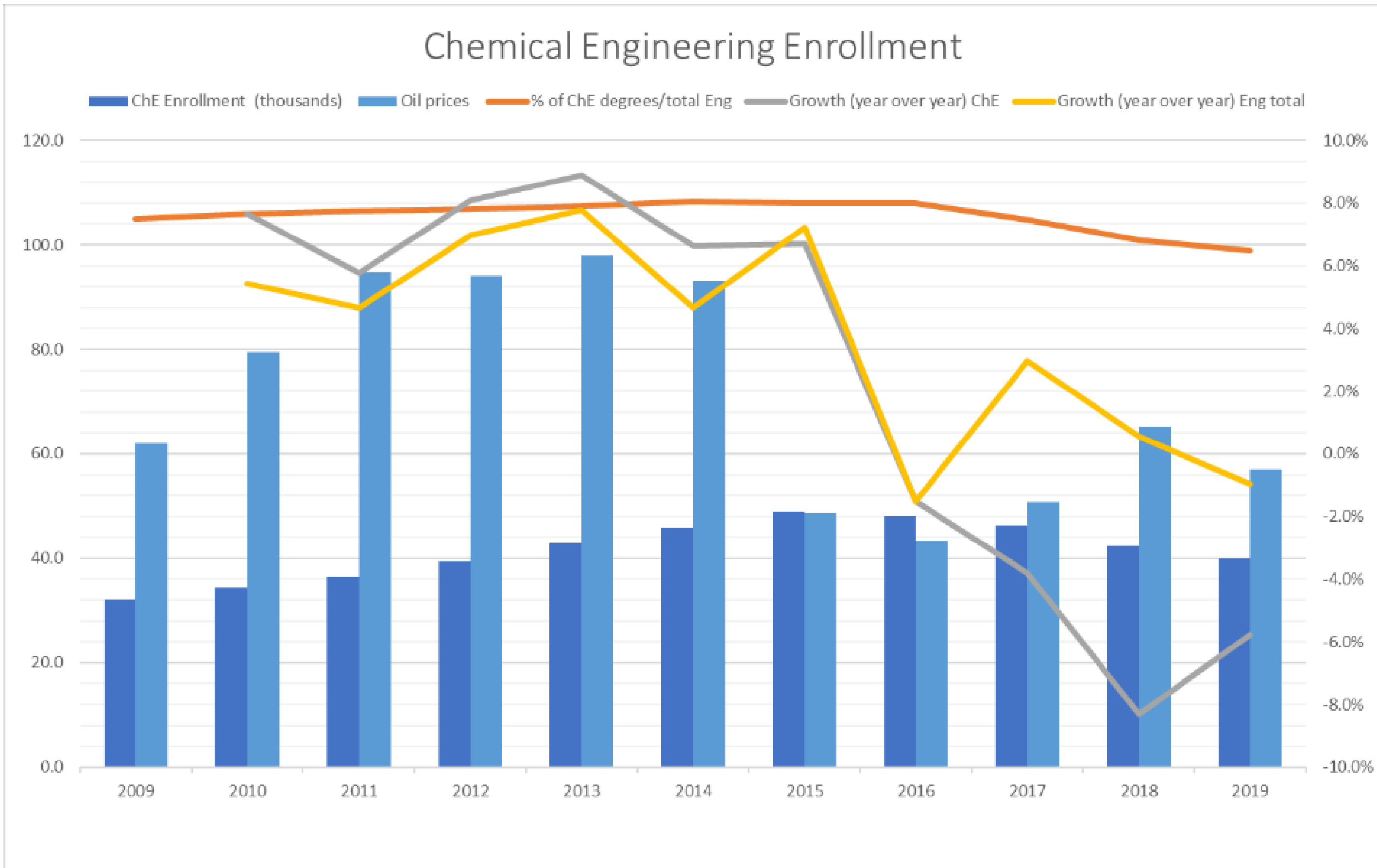

Figure 2. Undergraduate enrollment in the universities in the United States.

Table 3. Enrollment in the undergraduate programs in the United States.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
ChE Enrollment (thousands)	32.1	34.5	36.5	39.4	43.0	45.8	48.9	48.1	46.3	42.5	40.0
Oil price (USD/barrel)	62.0	79.5	94.9	94.1	98.0	93.2	48.7	43.3	50.8	65.2	57.0
% of ChE degrees/total Eng	7.5%	7.7%	7.7%	7.8%	7.9%	8.0%	8.0%	8.0%	7.5%	6.8%	6.5%
Growth (YOY) ChE		7.7%	5.8%	8.1%	8.9%	6.6%	6.7%	-1.5%	-3.8%	-8.3%	-5.8%
Growth (YOY) Eng total		5.4%	4.7%	7.0%	7.8%	4.7%	7.2%	-1.5%	3.0%	0.6%	-1.0%

In Canada, the number of graduations increased by 41% (from 1,161 to 1,636) from 2011 to 2019[11], before experiencing a drop in 2020, which may be related to the COVID-19 pandemic. The year-over-year growth of graduating chemical engineering students has been almost double that of graduating engineering students from 2016-2018 (gray and yellow lines in Figure 3, Table 4). Graduations dropped sharply in 2019, most likely due to the decrease in enrollments seen in 2016-2017. Perhaps another reason for the decrease is switching to other disciplines; graduations in Biosystems engineering, computer engineering and software engineering increased by 68%, 118% and 130%, respectively between 2016 and 2020[12] compared to 7%-8% of enrollments (Table 4), indicating a smaller attrition rate than other engineering disciplines.

[11] Engineers Canada, Canadian Engineers for Tomorrow, 2015, 2019. https://engineerscanada.ca/publications/canadian-engineers-for-tomorrow-2019#appendix-a

[12] Canadian Engineers for Tomorrow: Trends in Engineering Enrolment and Degrees Awarded 2016-2020. Engineers Canada. Available from: https://engineerscanada.ca/reports/canadian-engineers-for-tomorrow-2020

Table 4. Undergraduate degrees awarded by the universities in Canada.

	2011	2012	2013	2014	2015	2016	2017	2018	2019
ChE Degrees awarded	1,161	1,278	1,307	1,292	1,297	1,370	1,511	1,660	1,636
Eng Degrees awarded	11,761	12,382	13,363	13,808	14,557	14,905	15,782	16,497	17,866
% of ChE /total Eng	9.9%	10.3%	9.8%	9.4%	8.9%	9.2%	9.6%	10.1%	9.0%
Growth (YOY) ChE		10.1%	2.3%	-1.1%	0.4%	5.6%	10.3%	9.9%	-1.4%
Growth (YOY) Eng		5.3%	7.9%	3.3%	5.4%	2.4%	5.9%	4.5%	8.3%

* YOY: year-over-year

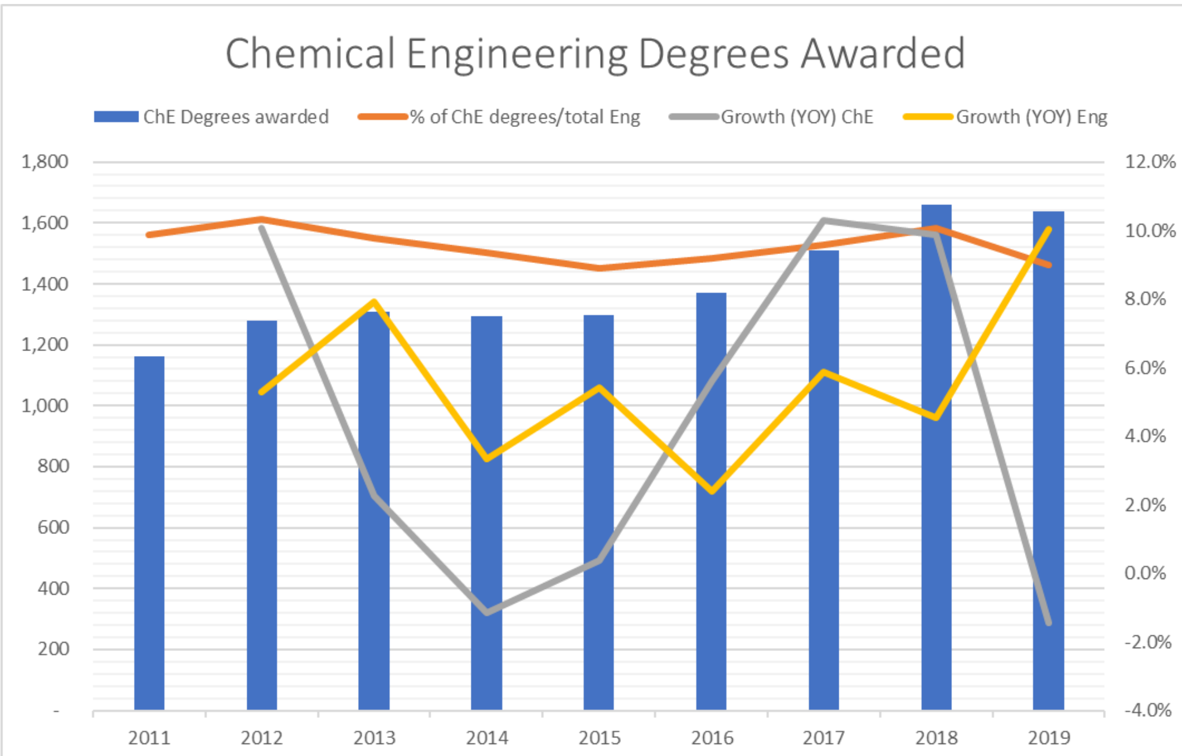

Figure 3. Undergraduate degrees awarded by the universities in Canada.

The information presented above suggests that Concordia should successfully attract students interested in the Chemical Engineering programs in Canada given the following:

- Positive job outlook for chemical engineers in North America, particularly when they are equipped to work in growing fields such as nanotechnology, alternative energy, biotechnology, IIoT, and AI.
- Chemical Engineering is currently underrepresented in the Province of Québec. Four universities in Québec offer chemical engineering programs, compared to ten in Ontario.
- Healthy YOY growth in enrollment in Canadian Chemical Engineering programs except in 2016, 2017, and 2019, which resemble the trend in engineering enrollments in total.
- Undergraduate enrollments in Chemical Engineering represent approximately 7%-8% of all engineering enrollments, and 9%-10% of all engineering degrees awarded.
- Offering IIoT, AI, pharmaceuticals, and food science, among other specializations, will attract students looking to work in Québec in emerging industries.

Table 5 shows the expected number of enrollments over a four year period.

Table 5. Forecast of enrollments.

	Time				
Students in Year	1	2	3	4	5
Year 1	50	75	100	125	125
Year 2		45	68	90	113
Year 3			41	61	81
Year 4				36	55
	50	120	209	312	374

Attrition: 10% per year, growth based on ramp up to 125 new enrollments per year.

4.1.3 Student Interest Survey

A student interest survey was administered to 3,875 undergraduates enrolled in the Winter 2022 term in Gina Cody School of Engineering and Computer Science as well as Chemistry and Biochemistry Departments of the Faculty of Arts and Science. A total of **381 students** completed the survey, yielding a response rate of 9.8%. The results showed that more than half (53.8%, 205/381) of the students surveyed were at least somewhat likely to prefer Chemical Engineering to their current program. Among those 205 students, 15.7% (60/205) indicated "Very likely" to have preferred the proposed program and 15% (57/205 counts) indicated "Likely".

Apart from the Likert scale question discussed above, responses to the last open-ended question on the questionnaire are also indicative of a strong interest in the program. Content analysis showed that 58% (32/55) of the 55 respondents who answered this question explicitly expressed support for the proposed program, 33% (18/55) offered suggestions and asked questions reflecting certain level of support and interest; and only 9% (5/55 respondents) were negative about the need for such a program.

The survey also solicited feedback from students about the curriculum design of the new program. The modern inclusions proposed for this program were well-received by the survey respondents, showing that materials engineering (45.7%, 174/381), data analytics (45.4%, 173/381), energy conversion (42.5%, 162/381), and sustainability (40.2%, 153/381) are the most interesting areas of expertise. This result to some extent validated the importance placed on these aspects in the core of the proposed program. Among the four specialized technical tracks, the one that received the most votes was Biochemical and Food Engineering (48.7%, 173/381), followed by Materials Engineering (45.9%, 163/381), Sustainable Chemical Engineering (41.7%, 148/381), and Advanced Process Design and Control (36.6%, 130/381). Student respondents also expressed their preference for the availability of experiential learning, with 70.3% (268/381) noting that a co-op option being available would improve the program.

The survey questionnaire, data, summary and analysis of results including open comments as well as consequential adjustments made to the program based on student feedback from the survey are provided in Appendix 3.

4.1.3 Future prospects for graduates

Chemical engineering, like all engineering programs at Concordia, will be accredited by Engineers Canada. The accreditation process includes evaluation by the Canadian Engineering Accreditation Board (CEAB) carried out at periodic intervals (currently every five years). Accreditation of an engineering program ensures that the necessary knowledge and skills are being acquired to safely and responsibly practice engineering in Canada. Although the accreditation requirements evolve, the principles of assuring competency in key areas remains consistent. The proposed chemical engineering program provides students with the graduate attributes required by Engineers Canada and exceeds the academic unit requirement in all categories, which is presented in Section 7.1.3.

Chemical engineers are typically trained to be designers of chemical processes; about a third work in design and technical services depending on the province[13]. They are also involved in operations, sales, safety, and technical

[13] https://www.jobbank.gc.ca/outlookreport/occupation/2789 (NAICS 5413, 5414, 5416-5419)

support. Because chemical engineers are excellent systemwide thinkers, they also find employment in sectors unrelated to chemical industry (management, banking, insurance, policy, etc.). Their training and skills often complement those of economists and managers.

Chemical engineers are closely related to materials engineers. However, whereas the materials engineer is mainly focused on the *product and its properties*, the chemical engineer is mainly focused on the *process*. The proximity of the fields of chemical and materials engineering provides opportunities for cross-fertilization. The proposed program will train chemical engineers with a solid grasp of the materials aspects of their profession. This will expand the opportunities for graduates, particularly in Quebec, where advanced materials are a growing industry accounting for $10 billion in annual sales in 2017[14].

In both traditional and emerging sectors, graduates of Canadian chemical engineering programs benefit from high-quality education across the country, ensured to some extent by the required accreditation. Chemical engineering at Concordia will be subject to these same requirements but will also benefit from Concordia's unique positioning regarding AI and sustainability, both of which will be included in the program and will therefore provide uniquely qualified graduates with highly marketable skills. The depth and polyvalent nature of the proposed program also provides many opportunities for research globally, with many cutting-edge developments leveraging novel computational techniques and data science, and increasingly being driven toward sustainable solutions. These contemporary skills and perspectives also provide increased professional mobility for graduates between economic sectors and job categories.

Future prospects for graduates in traditional sectors

The Government of Canada estimates an overall surplus of chemical engineers looking for jobs in Canada for the 2019-2028[15] period (3,600 job openings and 5,500 job seekers), although some provinces have a better outlook than others. The outlook for Québec is good[16]. However, this outlook narrowly links employment to industries that have traditionally employed chemical engineers, such as oil & gas, chemicals, plastics, pulp & paper, and mining; however, these industries are not expected to grow. Conversely, emerging industries are growing rapidly (green energy, advanced materials, Industry 4.0, etc.) and will employ many chemical engineers. This is especially true for the acceleration phase toward sustainable industry and the energy transition. Chemical engineers have a critical role in research, design, and operation of the necessities for such a future. This is discussed further in Section 4.3.

According to Engineers Canada[17], the top three industries for chemical engineers are professional, scientific, and technical services[18], chemical manufacturing, and natural resources[19], shown in Figure 4.

http://imt.emploiquebec.gouv.qc.ca/mtg/inter/noncache/contenu/asp/mtg122_princsect_01.asp?PT4=53&lang=FRAN&Porte=1&cregn=QC&PT1=2&prov=pje&PT3=10&pro=2134&PT2=21&cregncmp2=QC

[14] https://www.prima.ca/wp-content/uploads/2020/03/advanced_materials_prima_quebec_-june_2018.pdf
[15] https://www.jobbank.gc.ca/marketreport/outlook-occupation/2789/ca
[16] https://www.jobbank.gc.ca/marketreport/outlook-occupation/2789/QC
[17] Engineering Labour Market in Canada: Projections to 2025, Table 6.2. https://engineerscanada.ca/reports/engineering-labour-market-report
[18] North American Industry Classification System included: NAICS 5413, 5414,5416, and 5419
[19] To simplify the chart, the following industries were grouped into natural resources: conventional oil, oil sands, petroleum and coal products manufacturing, and support activities for mining and oil & gas extractions. Also, the same industry from difference provinces were combined and normalized.

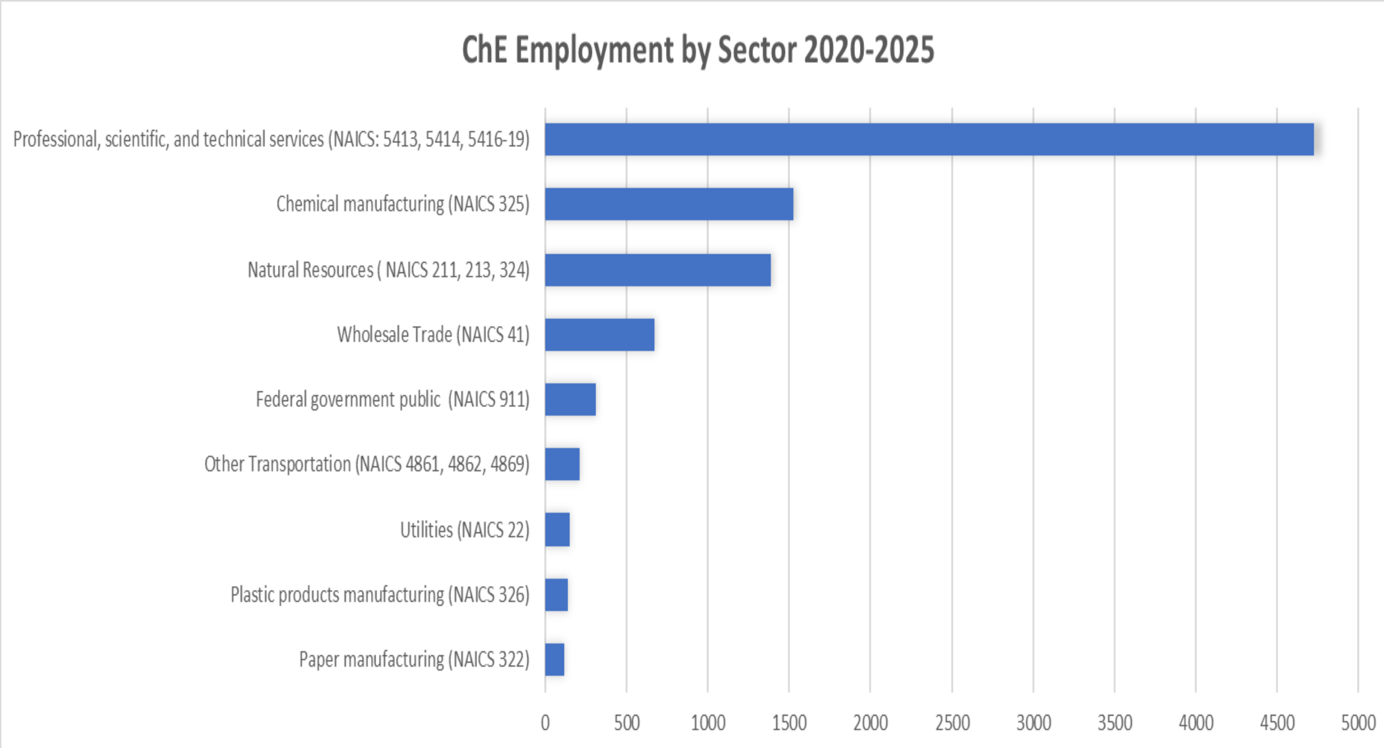

Figure 4. Top industries for Chemical Engineers in Canada (average number of jobs for the period).

The traditional sectors where chemical engineers work represents approximately CAD $345 billion (2019 GDP[20]), or approximately 17% of the total GDP (CAD $1.98 trillion). The sectors included[21] are shown in Table 6.

In the province of Québec, the government recently launched the Plan for the Development of Critical and Strategic Materials 2020-2025[22]. According to the 2020 survey prepared by PwC for the Comité Sectoriel de Main-D'œuvre de l'Industrie des Mines[23], the mining sector will need to fill 13,703 positions in Québec from 2019 to 2028. Although, a large majority of these positions are for operators and technicians, chemical engineers will be required during the design and construction, and operation of the mines.

In Québec, the provincial government periodically collects data regarding employment statistics and employer satisfaction. Between 2012 and 2019, several new categories have been added to the employer satisfaction survey, including two regarding informatic proficiency. This indicates that employers in Québec are increasingly requiring these skills from recent graduates and this trend is likely to continue. By creating a new program in chemical engineering at Concordia, these skills are integrated directly into the program to reflect the modern need for proficiency with state-of-the-art tools, methods and software. The results of the survey showed that employers are currently satisfied (94.9% satisfied or very satisfied) with the skills of recent graduates[24]; however, expectations and requirements will continue to increase. It is therefore one of the goals of the proposed program to provide highly qualified chemical engineers with these relevant skills for the modern workplace. It is anticipated that the graduates of the program will therefore be highly qualified and in demand globally.

[20] https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610043406.

[21] Industries where chemical engineers are typically not employed are excluded (e.g. meat production was removed from food sector)

[22] https://cdn-contenu.quebec.ca/cdn-contenu/ressources-naturelles/Documents/PL_critical_strategic_minerals.pdf?1604003187

[23] https://www.explorelesmines.com/images/pdf/Section_corporative/Publications/Etudes_sectorielles/Diagnostic_sectoriel_VF_INTERACTIVE_PDF_r%C3%A9vis%C3%A9.pdf

[24] La formation universitaire - point de vue des employeurs. pp 50 http://www.education.gouv.qc.ca/fileadmin/administration/librairies/documents/Ministere/acces_info/Statistiques/Enquetes_Relance/Universite_Bac_Maitrise/Relance_universite_Sondage_2019.pdf

Table 6. Size of the sectors for traditional work for Chemical Engineers in Canada (GDP in billions).

	Billions (CAD)
Oil &gas extraction and manufacturing (NAICS 211, 213, 324)	137,027
Manufacturing	76,515
Food (NAICS 311)	12,792
Beverages (NAICS 312)	7,013
Paper (NAICS 322)	6,676
Chemicals (NAICS 325)	20,909
Plastic & Rubber (NAICS 326)	11,315
Non-metallic minerals (NAICS 327)	6,991
Primary Metals (NAICS 331)	10,819
Professional scientific, and technical services (5413, 5414, 5416-19)	54,079
Utilities (NAICS 22)	42,997
Mining and quarrying (except oil and gas) [212]	34,556
Total	**345,174**

The outlook in the United States is more positive (Table 7, Figure 5). The chemical manufacturing industry, which employs close to 40% of chemical engineers in the United States[25] had positive growth since 2012 except in 2020, most likely due to the ongoing COVID-19 pandemic.

Table 7. Top 5 employment industries for Chemical Engineers in the United States.

Industry (SOC: Standard Occupational Classification code)	Employment Number	% of Total
Chemical Manufacturing (325000)	11260	38.1%
Research and Development in the Physical, Engineering, and Life Sciences (541710)	3090	10.4%
Engineering Services (541330)	2840	9.6%
Petroleum and Coal Products Manufacturing (324000)	1730	5.9%
Sector 42 - Wholesale Trade (42--43)	1370	4.6%
		69%

[25] U.S. Bureau of Labor Statistics (chem engineers) https://data.bls.gov/oes/#/occInd/One%20occupation%20for%20multiple%20industries

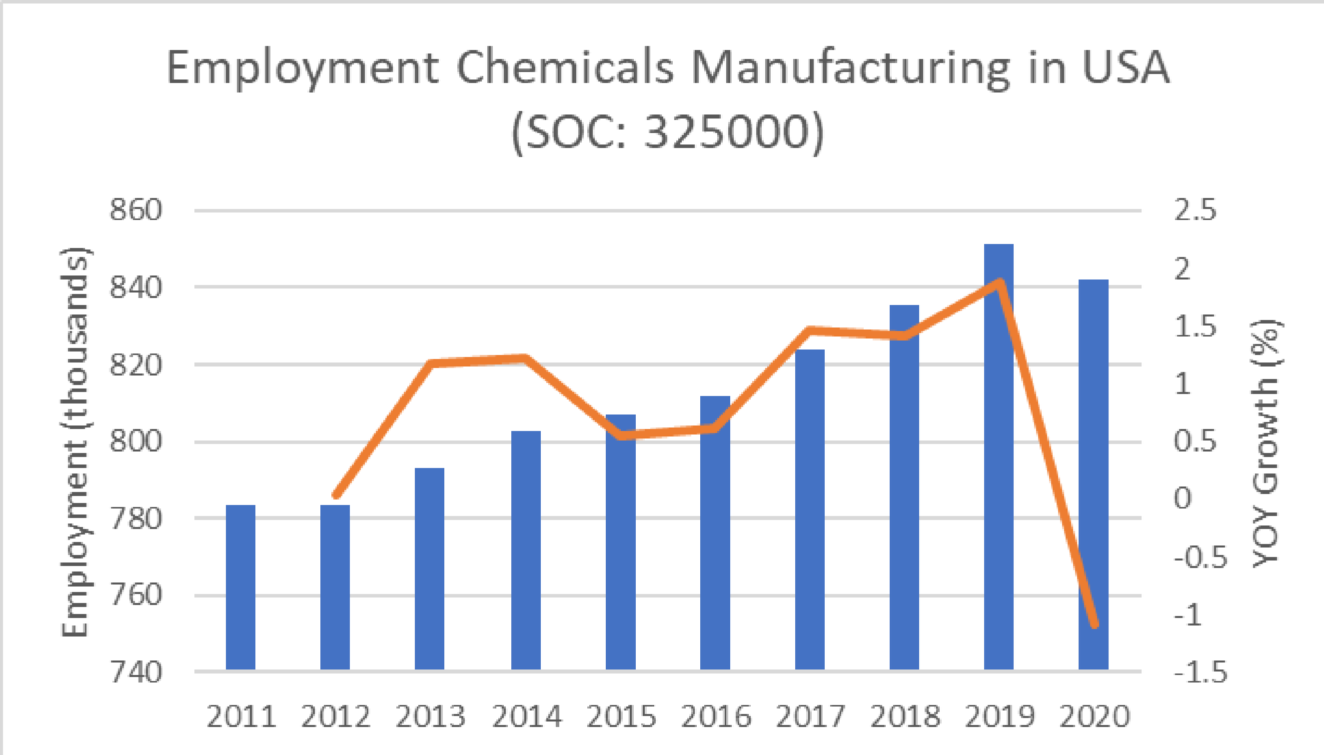

Figure 5. Chemical Engineers working in chemical manufacturing & YOY growth.

The US Bureau of Labor Statistics estimates employment to grow 14% for the 2021-2031 period. Its forecast includes a continuing migration of Chemical Engineers into dynamic fields, such as nanotechnology, alternative energy, and biotechnology[26].

Future prospects for graduates in emerging sectors

Chemical Engineers are uniquely positioned to play a key role in bringing IIoT, and AI into industrial processes. Implementing these technologies safely and efficiently requires knowledge of the technology as well as intimate understanding of chemical processes and their behaviour. These two technologies will create enormous opportunities. Accenture[27] foresees that IIoT products and services will contribute $10-$14 trillion to the global GDP by 2030. PwC estimates that AI will increase North America's GDP by US $3.7 trillion (14.5% GDP) by 2030[28]. Chemical Engineering programs in Canada are not currently addressing these technologies. Given that Montreal is a global AI hub, Concordia can make IIoT and AI an integral part of its chemical engineering program.

Other opportunities for chemical engineers, albeit smaller than those created by IIoT and AI, are being created by Covid-19. The pandemic exposed the risks of relying on international suppliers for pharmaceuticals, antibiotics, antiseptics, personal protective equipment, and food. The renewed interest in manufacturing these products locally will create opportunities for chemical engineers. Biologics Manufacturing Centre, Dorma filtration, CAE, Glycovax Pharma, Biodextris, and Phenomena are examples of investment from the Federal government in Montreal companies to help fight Covid-19[29].

[26] https://www.bls.gov/ooh/architecture-and-engineering/chemical-engineers.htm#tab-6

[27] https://www.accenture.com/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Dualpub_18/Accenture-Industrial-Internet-Things-Growth-Game-Changer.pdf

[28] https://www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf

[29] https://nrc.canada.ca/en/covid-19-response-personal-protective-equipment-sterilization
https://nrc.canada.ca/en/covid-19-response-canadian-companies-forefront
https://nrc.canada.ca/en/covid-19-response-vaccines-therapeutics
https://www.newswire.ca/news-releases/prime-minister-announces-funding-to-advance-the-development-of-canadian-covid-19-vaccine-technologies-852977593.html

Furthermore, renewable energy is a critical sector of the economy, according to the IEA World Energy Outlook 2020, renewables will become the largest source of electricity generation, surpassing coal by 2025[30]. Chemical engineers will play a key role in renewable energy from biomass and municipal solid waste, biorefinery development, as well as advanced materials for wind and solar energy. Chemical engineers play a critical role in solving societal "wicked problems" for sustainable material and energy conversion for the energy transition and will therefore be in high demand in the future.

The addition of Chemical Engineering to Concordia's offering of undergraduate engineering programs provides an additional opportunity compared to conventional and existing Chemical Engineering programs across Canada. Concordia has a strong focus on sustainability and has incorporated many aspects into its identity. This is a unique opportunity to develop a Chemical Engineering program with an integrated focus on sustainability, which is a novel development in this field.

4.2 Systemic Relevance and Opportunity

Canada currently offers Chemical Engineering programs at 20 universities (18 at the graduate level) with 6,451 students enrolled. The programs are very similar, often with a common first year, and followed by chemical engineering courses starting in year 2. Technical elective courses are offered in years 3 and 4 to allow students to develop expertise in a domain of interest and facilitate finding a job in a desired industry. Technical elective courses at Concordia University will be offered in several cutting-edge disciplines, including biochemical and food engineering, materials engineering, Sustainable chemical engineering, and advanced process design and control. These areas reflect the uniqueness of Concordia's offering by providing advanced topics in sustainability, IIoT for industry 4.0, and advanced materials. These areas give competitive advantage for Concordia students by advancing their knowledge in key strategic areas for the future of chemical engineering, and are rare or unique specialty tracks in other Canadian universities.

Four universities (McGill University, École Polytechnique, Université Laval and Université de Sherbrooke) offer Chemical Engineering programs in the Province of Québec. As a comparison, Ontario offers Chemical Engineering programs at ten universities (eight at the graduate level). Hence, in terms of the number of universities, Chemical Engineering is currently underrepresented in the Province of Québec.

Three Canadian universities ranked in the top 50 in QS Top University rankings in chemical engineering programs[31]: University of Toronto (28th), McGill University (tie at 49th), and University of British Columbia (tie at 54th). Polytechnique ranked in the 101-150 group and Université de Laval in the 251-300. Université de Sherbrooke ranked in the range of 401-410.

Academic reputation, research quality and number of citations, and faculty to student ratio represent 80% of the evaluation criteria[32]. Table 8 shows the ratings, number of research chairs, number of faculty, and students in the Chemical Engineering programs in Canada. Although the proposed program will not be constructed around these criteria, it is important to take them into consideration in the design of the program. For example, the program will maintain a student/faculty ratio between 15-20. Furthermore, excellence in academics and research are part of the selection criteria for new the faculty, and is one the program's design principles. Concordia's CME department is currently preparing to submit a nomination to a Canada Research Chair with the Department of Physics.

[30] https://webstore.iea.org/download/direct/4234
[31] https://www.topuniversities.com/university-rankings/university-subject-rankings/2022/chemical-engineering
[32] https://www.topuniversities.com/qs-world-university-rankings/methodology

Table 8. The number of research chairs and the faculty/student ratio in Chemical Engineering programs in Canada.

	QS Ratings	CR Chairs	Faculty	Enrollment*	Student/Faculty
Toronto	28	2	43	506	12
McGill	49	3	17	300	18
UBC	54	1	37	322	9
Alberta	51-100	2	50	465	9
Waterloo	51-100	3	36	899	25
McMaster	101-150	4	35	341	10
Polytechnique	101-150	2	38	420	11
Calgary	101-150	1	48	456	10
Queen's	151-200	1	23	364	16
Ottawa	151-200	1	18	377	21
Western	151-200	0	28	241	9
Laval	251-300	1	14	94	7
Saskatchewan	301-350	1	15	143	10
Lakehead	Not ranked	2	6	122	20
Laurentian	Not ranked	1	19	183	10
UNB	Not ranked	1	13	216	17
Sherbrooke	Not ranked	0	16	202	13

4.2.1 Chemical Engineering Specializations in Canada

For universities, specializations are one of the ways faculties can differentiate and attract students. Figure 6 and Table 9 show the specializations offered in Canadian universities.

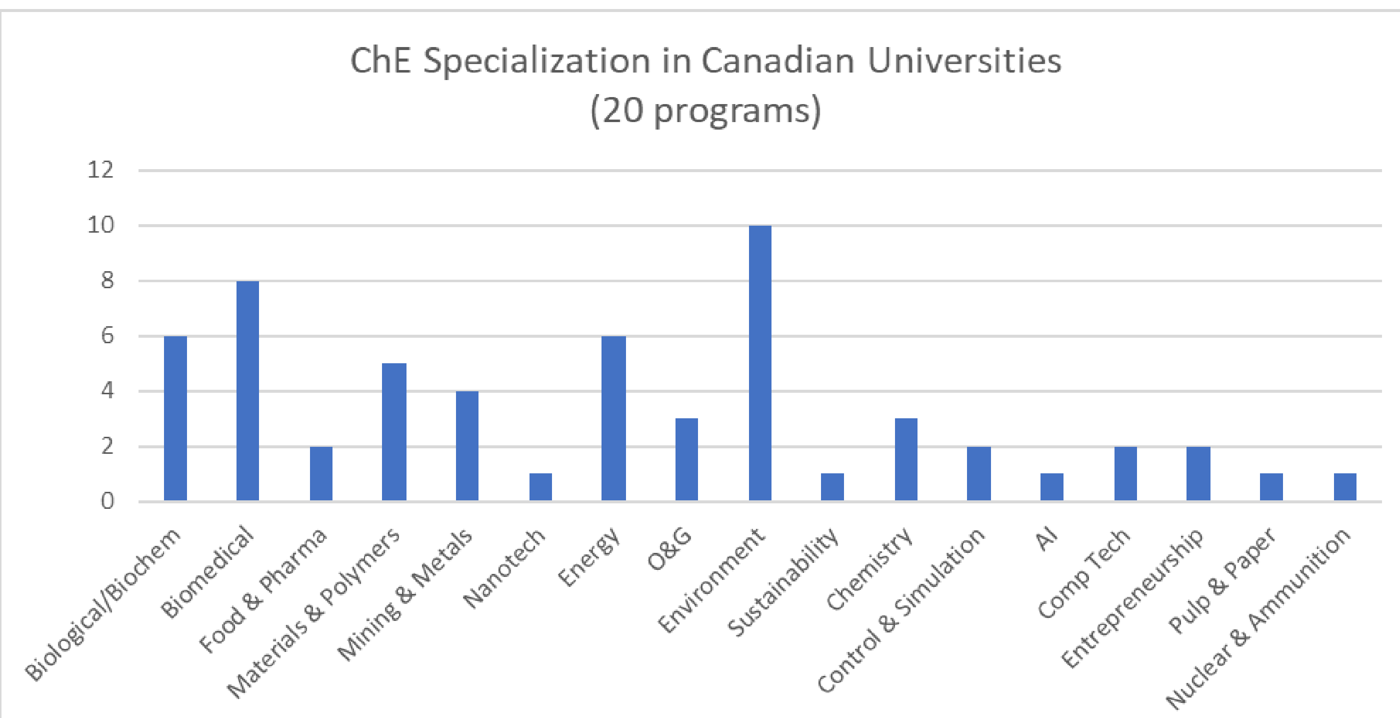

Figure 6. Specializations offered by Canadian universities.

Table 9. Specialization options offered in the Chemical Engineering programs in Canada.

	Chem Engineering	Biological/Biochem	Biomedical	Food & Pharma	Materials & Polymers	Mining & Metals	Nanotech	Energy	Oil & Gas	Environment.	Sustainability	Chemistry	Control & Simulation	AI	Comp Tech	Entrepreneurship	Pulp & Paper	Nuclear& Ammunition	Co-Op Program
Alberta	1		1		1				1										Y
Calgary	1		1					1	1	1					1				Y
Dalhousie	1			1															Y
Lakehead	1																		Y
Laurentian	1					1				1									Y
Laval	1	1								1									Y
McGill	1	1	1		1	1	1			1		1			1	1			N
McMaster	1		1		1			1											Y
New Brunswick	1		1					1											Y
Ottawa	1		1							1					1	1			Y
Polytechnique	1			1	1	1		1		1	1		1			1			N
Queen's	1	1	1		1	1		1		1		1	1						N
RMC	1									1		1						1	N
Ryerson's	1																		Y
Saskatchewan	1	1				1			1										Y
Sherbrooke	1																		Y
Toronto	1	1	1		1			1		1		1					1		Y
UBC	1	1																	Y
Waterloo	1		1							1				1					Y
Western Ontario	1	1								1									N
Total	**20**	**7**	**9**	**2**	**6**	**5**	**1**	**6**	**3**	**11**	**1**	**4**	**2**	**1**	**3**	**3**	**1**	**1**	

Environmental and biomedical are the most common specializations, followed by biological/biochemical, energy, and materials. IIoT, AI, Sustainability, and Food Science are underserved. No faculty offers IIoT as an option, and only Waterloo offers AI. Dalhousie offers a minor in food science, and Polytechnique food and pharmaceuticals, and sustainability specializations. Concordia's new program will fill the gap and meet the demand in these emerging industries (see section 7.1).

4.2.2 Similar Programs in Québec

In Québec, undergraduate degrees are offered at McGill University, École Polytechnique, Université Laval, and Université de Sherbrooke.

1. McGill University offers a general program, although it gives courses in a wide range of topics. The undergraduate curriculum includes only one materials science course and two related to data analytics and programming. Sustainability concepts are available from a list of technical electives but are not included in the core of the curriculum[33]. McGill is the only university in Québec to offer a chemical engineering program with English as the instructional language.

[33] https://www.mcgill.ca/chemeng/undergrad/programcourses

2. The École Polytechnique offers many specializations, some unique such as food & pharmaceuticals, simulation, sustainability, and entrepreneurship[34]. The core of the program shows an emphasis on sustainability with three courses covering aspects related to sustainability and its metrics. Software, informatics and data analytics are included with an introduction to programming in Python complemented by one course in numerical modeling and a separate project course to implement these concepts. Advanced analytics, machine learning and AI, IIoT, and industry 4.0 are not found in the courses currently offered. Materials engineering is covered by an introductory course and a specific chemical engineering course exploring polymer materials.
3. L'Université Laval is the second smallest program in Canada with only 75 students enrolled 2019. It offers biochemical and environmental engineering specializations. The core curriculum includes an introductory materials science course and a deeper exploration of corrosion with other materials options available as electives, including material selection, cellulose materials, and plastics. Sustainability is offered in a single course in the core curriculum through the Faculty of Philosophy, with a specialization possible in environmental engineering, though outside of the core curriculum. However, environmental aspects are included in the design capstone project and several technical electives are available to include sustainability concepts in the foundational education. Programming and informatics are introduced to aspiring chemical engineers through courses on introductory programming and numerical analysis/methods with an elective offering on introductory Python. Advanced data analytics and advanced concepts for industrial digitalization are not found elsewhere in their offering[35].
4. L'Université de Sherbrooke offers a program in chemical engineering[36] and one in biotechnology engineering[37]. The chemical engineering includes an introductory informatics course and a mathematical modeling course in the core, with an elective covering optimization techniques. Additional data analytics and advanced industrial digitalization do not appear in the course offerings. Material engineering are introduced in the core curriculum through a single course with technical electives offered in material characterization techniques, polymer engineering and material degradation. Sustainability and life-cycle assessment are included in the core of the chemical engineering program through three courses, also contributing toward sustainability considerations in the capstone project. The biotechnology engineering program is structed similarly to chemical engineering, with several courses overlapping between the two. The principle differences are found in the inclusion of biological systems within the core courses, e.g., including biomaterials, bio-reactors, and bio-process design in the core curriculum compared to material engineering, reaction engineering and process engineering in the chemical engineering program, respectively.

The proposed program will be complementary to the existing programs because it will have a stronger focus on materials engineering, not as a separate area but deeply embedded in chemical engineering. Some of the existing strengths at Concordia University in this area were discussed in sections 3.2, 4.1 and 4.2. In addition, a fourth-year course in machine learning and artificial intelligence (AI) and some technical elective courses related to Industry 4.0 (AI, IoT, cybersecurity) will offer a unique program to students looking to work in this emerging area. Food, Sustainability, and Entrepreneurship are offered at Polytechnique, by also offering these, Concordia would remove Polytechnique uniqueness in these areas, and provide an opportunity for potential collaboration.

Concordia has several advantages in the development of a new undergraduate program, integrating modern skill capacity development for an evolving job market. This provides a competitive advantage for Concordia in attracting undergraduate students. Programming skills and familiarity with scripting languages and various software platforms is increasingly relevant in many chemical engineering careers. In addition to the introductory programming course (CHME 215), the proposed undergraduate degree includes advanced programming for chemical engineers (CHME 216), which provides advances on the basic concepts and includes sections on the internet of things (IoT). Further advanced topics such as artificial intelligence and machine learning are included in CHME 316 – Advanced Data Analysis and machine learning. This group of courses provides a modern update to chemical engineering to be in line with current employer demands and Industry 4.0 concepts. Another competitive advantage of the proposed undergraduate chemical engineering program is a strong focus on sustainability. These concepts are core to Concordia's identity and are a strong focus in the core of the proposal. An introductory course on innovative, sustainable, and safe manufacturing in chemical industry (CHME 201) complements the engineering core course of sustainable development and environmental

[34] https://www.polymtl.ca/programmes/programmes/baccalaureat-en-genie-chimique
[35] https://www.fsg.ulaval.ca/etudes/programmes-detudes/baccalaureat-en-genie-chimique
[36] https://www.usherbrooke.ca/admission/programme/212/baccalaureat-en-genie-chimique#structure/
[37] https://www.usherbrooke.ca/admission/programme/272/baccalaureat-en-genie-biotechnologique#structure/

stewardship (ENGR 202). Interested students are encouraged to further specialize in this domain with a large selection of courses in the Sustainable chemical engineering specialty, featuring several technical electives such as Sustainable Process Design (CHME 401), Lifecycle Assessment (CHME 405), Sustainable Industrial and Engineering Chemistry (CHME 400), and Clean Energy Science and Technology (CHME404). Additional specialty tracks are available to directly address needs in the local Montréal area, focusing on biochemical and food engineering and materials engineering.

4.2.3 Partnerships and Collaborations

Foreseeable links to related programs; potential collaborations between professors in the new program and related ones in other institutions. The proximity of McGill University and École Polytechnique to Concordia University creates favourable conditions for collaborations with professors in these institutions. Furthermore, there is a history of collaboration between engineering professors at these three universities. Special areas of interest for collaboration are nanotechnology with McGill, and Sustainability, Simulation, Food engineering, and polymers with Polytechnique.

The newly created Department of Chemical and Materials Engineering was incubated in the Department of Mechanical and Industrial Engineering, and a substantial amount of collaboration is anticipated with this department. Research groups of particular interest are:

- Dr. M. Medraj (phase behaviour of materials), Dr. C. Moreau (thermal coating techniques), Dr. M. Packirisamy (MEMS, microfluidics), as well as others.
- Research groups of potential interest in the Department of Building, Civil, and Environmental Engineering include Dr. A. Athienitis (solar energy engineering), and Dr. Mulligan (bioenergy, sustainability), a chemical engineer and director of the Concordia Institute of Water, Energy and Sustainable Systems.
- Collaboration with Dr. A. Youssef and Dr. M. Ghafouri in the area of Cybersecurity, and with Dr. Y-G. Guéhéneuc in AI and IoT.
- At the Centre for Engineering in Society, Dr. K. Schmitt (public policy) is a faculty member of interest.
- At the Centre for Research in Molecular Modeling, collaboration with Dr. G. Peslherbe is ongoing and collaboration with others at the Centre is anticipated.

Outside the Faculty of Engineering and Computer Science, collaborations are anticipated with:

- The Department of Chemistry and Biochemistry. The past Department Chair, Dr. C. DeWolf, has degrees in Chemical Engineering. To foster these collaborations, the new department has been given space in the Loyola campus within the Applied Science Hub, which is shared with faculty members from the Department of Chemistry and Biochemistry.
- Dr. V. Martin at the Centre for Applied Synthetic Biology on biofuels and CO_2 conversion.
- District 3 Center for Innovation and Entrepreneurship's BioHub on commercializing faculty-student research.

The discipline of Chemical Engineering is well established in Québec and Canada, with 20 academic programs in Canada, and 4 in Québec.

At present, one international ranking lists Chemical Engineering at Concordia University: the National Taiwan University Ranking (NTU Ranking). In the 2020 ranking, Concordia is ranked number 271 worldwide in Chemical Engineering, out of 501 entries. Within Canada, Concordia ranks number 9 out of 17 ranked universities in Chemical Engineering. This indicates that the Department of Chemical and Materials Engineering has already established a sizable international reputation and visibility and is ready to translate this into a strong and competitive undergraduate program.

4.3 Institutional Relevance and Opportunity

Concordia University has defined nine strategic directions for a next-generation academic institution, four of which come through strongly in the creation of the proposed program:

- **Teach for tomorrow** – Integrating software tools and skills in the proposed program, as well as the availability of online learning modules provides students with multiple opportunities to learn and interact with their education. This provides the skills, knowledge and tools for graduates to adapt to a variety of working, learning and creating environments.

- **Get your hands dirty** – Engineering programs, in general, have a rich history of experiential learning, typically linked to local industries. Typical careers in chemical engineering are especially linked to existing enterprises, stemming from industrial need for chemical engineers but also related to the capital-intensive nature of chemical industry. Large enterprises often have strong links to universities for recruiting the next generation of employees and therefore provide enriching and fulfilling opportunities in experiential learning. Concordia enjoys a strong and robust experiential learning office, which will expand to meet the needs of the chemical engineering undergraduates and thus provide fulfilling opportunities for hand-on learning.
- **Grow smartly** – Based on the current lack of chemical engineering education opportunities in Québec, enrolment in chemical engineering is expected to quickly increase to match the levels seen elsewhere in Canada. The projected enrollment found in Section 4.1 shows a rapid increase from 50 students initially, to a mature annual enrollment of 125 students.
- **Embrace the city, embrace the world** – The proposed undergraduate program has a strong sustainability focus, enabling interdisciplinary connections and outreach to exhibit novel approaches and solutions for contemporary problems. Focused around a sustainable future, chemical engineering students will re-think the current systems and provide expertise to the local communities regarding climate change mitigation, the energy transition and transformation of industry toward a sustainable future and a symbiotic relationship with society.

The program will be complementary to existing programs at Concordia University. The programs most closely related to the proposed BEng in Chemical Engineering are the BEng in Mechanical Engineering, the BEng in Industrial Engineering, and the BEng in Civil Engineering. The overlap with these programs will be roughly one year (30 credits). Discussions with other departments will be held and courses will be shared with these programs whenever this makes sense.

Currently, faculty members in the Department of Chemical and Materials Engineering are already contributing to other BEng programs in Engineering, particularly by teaching the courses Thermodynamics I (ENGR 251) and Materials Science (MIAE 221). Additional contributions are anticipated, for instance by teaching courses such as Probability and Statistics in Engineering (ENGR 371).

Students who graduate from the proposed BEng program will be able to apply to programs in other departments. Examples are the MEng in Environmental Engineering and the MASc in Nanotechnology. A graduate program in Synthetic Biology is currently in preparation and this program is likely to attract BEng graduates from the Chemical Engineering program. Likewise, should the university develop a graduate program in Health Studies or in Biomedical Engineering, this is also likely to attract graduates from the Chemical Engineering program.

Because the department is newly created, its standing is the standing of the academics hired or transferred to the department. At the time of writing, the fourteen faculty members of the Department of Chemical and Materials Engineering have an average citation score of about 3572 citations according to Google Scholar, and an average h index of 26.1. These metrics are very similar to the average scores of McGill University (3300 citations, h = 27) and Ecole Polytechnique (3900 citations, h = 28), and considering that McGill University has a larger proportion of mid-career faculty members, and Ecole Polytechnique has a larger proportion of senior faculty members, the numbers are very congruent at the three universities in Montreal.

Chemical Engineering is the only major engineering discipline that is currently missing in the Engineering program offerings at Concordia University. Hence, the development of Chemical Engineering programs fits in Concordia University's objective to become a more comprehensive university. Nearly all Engineering programs at Concordia University have grown rapidly in recent years. The number of full-time graduate students at Concordia University in all engineering fields combined increased from 1677 in 2012 to 2184 in 2016. Of these, full-time enrollments increased from 355 to 514 in Civil Engineering, and from 295 to 371 in Mechanical Engineering (not including Industrial Engineering). The demand exceeds the enrollments, so it is anticipated that the addition of Chemical Engineering programs will not affect the enrollments in other programs. The student interest survey results discussed in Section 4.1 also revealed that a portion of students who are currently enrolled in MIAE would have been interested to enroll in chemical engineering or to transfer into it. With a current excess of applicants for MIAE, creation of the proposed chemical engineering program is likely to alleviate some pressure in the enrollments and admissions processes across the faculty.

5. PROGRAM OBJECTIVES

5.1 Output Profile

The Canadian Engineering Accreditation board (CEAB), requires engineering programs to have a system to assess 12 graduate attributes [38]. The GCS has identified indicators for these 12 attributes, shown in Table 10. The mapping of the attributes and indicators throughout the curriculum is available in section 7.5. These 12 attributes reflect key characteristics that graduates need to possess to become licensed engineers in Canada.

Table 10. Graduate attributes from Engineers Canada Accreditation Board and selected indicators from the GCS.

Graduate attributes	Indicators
A knowledge base for engineering	Knowledge base of mathematics
	Knowledge base of natural science
	Knowledge base in specific domain
Problem analysis	Problem identification and formulation
	Modelling
	Problem solving
	Analysis (uncertainty and incomplete knowledge)
Investigation	Background and hypothesis formulation
	Designing experiments
	Conducting experiments and collection of data
	Analysis and interpretation of data
Design	Define the objective
	Idea generation and selection
	Detailed design
	Validation and implementation
Use of engineering tools	Ability to use appropriate engineering tools, techniques and resources
	Ability to select appropriate tools, techniques, and resources
	Demonstrate awareness of limitations of tools, create and extend tools as necessary
Individual and team work	Cooperation and work ethics
	Contribution: practical/conceptual
	Initiative and leadership
	Delivering results
Communication skills	Writing process
	Information Gathering
	Documentation
	Oral presentation
Professionalism	Role and responsibilities of professional engineers
	Professional practice
Impact of engineering on society & the environment	Awareness of society and environment impact
	Sustainability in design
Ethics and equity	Professional ethics and accountability
	Equity
Economics and project management	Fundamentals of economics
	Economics evaluation of projects
	Project planning and implementation
Life-long learning	Identifying missing knowledge and learning opportunities
	Continuous improvement and self-learning

[38] https://engineerscanada.ca/sites/default/files/Graduate-Attributes.pdf

In 2015, The American Institute of Chemical Engineers (AIChE) published the results of a study that searched to answer the question how should chemical engineering graduates be prepared most effectively for their careers[39]. The key trends identified for undergraduate chemical engineering programs are listed below:

- The fundamental technical topics in chemical engineering (material and energy balances, thermodynamics, separations, reaction kinetics, etc.) are required but are not sufficient.
- Practical understanding of process, equipment, control, and solving process and equipment problems was found to be important.
- Biomolecular engineering is integrated into the program through examples instead of being taught as a separate course. For example, biological systems are part of mass transfer, reaction kinetics courses.
- Formal process-safety instruction must become an academic priority, including environmental and safety regulations.
- Statistics and analytics have emerged as a critical skill for chemical engineers.
- Computing apps /tools used in the industry such as MATLAB, AutoCAD, SolidWorks, and process simulation (including dynamic simulation) must be part of the curriculum.
- Sustainability should be a core topic and is being imbedded in design courses.
- Integrated product-process design is critical for future innovations.
- Communications, teamwork, and critical thinking skills must be incorporated into seminars and project courses.
- Practical experience outside the classroom is extremely valuable. Co-op programs and summer jobs provide opportunities for students to gain valuable experience.

Finally, J. Alford and T. Edgard[40] raise two additional elements that result from biotechnology becoming an important industry for chemical engineers:

- Chemical Engineers need to understand batch processes, and non-linear and discrete control. Chemical engineering curriculum focuses on steady state processes.
- Chemical engineering programs must include unit operations that are relevant to biological processes such as chromatography columns and filters.

The Canadian Engineering Qualifications Board of Engineers Canada requires knowledge of the following topics[41], grouped into mandatory and electives subjects:

- **Mandatory:** Process Balances and Chemical Thermodynamics, Unit Operations and Separation Processes, Heat and Mass Transfer, Chemical Reactor Engineering, Chemical Plant Design and Economics, and Process Dynamics and Control.
- **Electives (three required):** Transport Phenomena, Environmental Engineering, Simulation-Modelling-Optimization, Biochemical Engineering, Pulp and Paper Technology, Petroleum Refining and Petrochemicals, Extractive Metallurgy, Polymer Engineering, Advanced Materials, Life Cycle Assessment (LCA), and Nuclear and Nuclear Chemical Processes.

Based on the above recommendations of what a chemical engineering program should include, we have developed the present curriculum to produce students with the following characteristics, in addition to the 12 graduate attributes:

- Ability to incorporate sustainability into process design at all levels, including feedstock, energy requirements, environmental impacts, etc.
- Proficiency in computing tools for process modeling (MATLAB, ASPEN), equipment design (AutoCAD, SolidWorks), and process control and data acquisition (MATLAB, Simulink, Raspberry Pi, etc.)
- Understanding of batch processes, non-steady state processes, and bioprocess design
- Proficiency in materials science, materials selection for chemical process equipment, and an understanding of metallurgical processes as related to the mining industry in Quebec

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[39] Chemical Engineering Academia-Industry Alignment: Expectations about New Graduates. Y. Luo, P. R. Westmorland, AIChE, 2015.
[40] Preparing Chemical Engineering Students for Industry. J. Alford and T. Edgard. American Institute Of Chemical Engineers , CEP, Nov 2017.
[41] https://engineerscanada.ca/sites/default/files/chemical_engineering_syllabus.pdf

In terms of the appropriateness of the level of study of the program, the program covers all of the mandatory topics for a chemical engineer. It also incorporates sustainability, materials, and design aspects into these core chemical engineering courses.

5.2 General and specific program objectives

The purpose of the proposed program is to train chemical engineers with valuable skills for a broad range of industrial sectors in Quebec and worldwide, who will drive economic growth by manufacturing the products and materials needed for the sustainable circular economy of the future.

5.2.1 General Educational Objectives

- Apply technical knowledge in engineering, natural science, mathematics, and computer science to generate novel solutions to problems in industry and society, including the design or improvement of processes for the manufacture of commodity chemicals, food processing, pharmaceuticals, advanced materials and batteries in industry
- Analyse processes through a lens of sustainability to fully comprehend the environmental and social impacts of various design decisions, and prioritize professional ethics and accountability in decision making
- Earn an advanced degree or certification for the purpose of pursuing a career in academia or teaching, law, medicine, finance, research and development, or entrepreneurship; or become licensed as an engineer
- Propensity to continuously search for new knowledge, learn new skills, and become proficient in new and advanced engineering tools

5.2.2 Specific Program Outcomes

By the end of the program, students should be able to:

- Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics and by using the appropriate engineering tools (Graduate Attributes 3.1.1, 3.1.2, 3.1.5)
- Design sustainable solutions that meet specified needs with consideration of all stakeholder views, public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors (Graduate Attributes 3.1.2, 3.1.4, 3.1.8, 3.1.9, 3.1.10, 3.1.11)
- Communicate complex engineering concepts or processes effectively in oral, written and graphical forms with a range of audiences (Graduate Attributes 3.1.7)
- Contribute within a diverse team to complete an engineering design, while supporting a collaborative and inclusive environment, by generating ideas, setting design criteria, establishing project milestones and tasks, and performing lifecycle and economic analysis (Graduate Attributes 3.1.4, 3.1.5)
- Design and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions (Graduate Attributes 3.1.3, 3.1.4)
- Identify their own learning needs and update their skill sets to maintain competence and contribute to the advancement of knowledge (Graduate Attributes 3.1.12)
- Manage the design process through iterative idea generation, design criteria selection, project milestone and task scheduling, and lifecycle and economic analyses (Graduate Attributes 3.1.11)

6. REGULATORY FRAMEWORK

6.1 Admission Requirements and Processes

A summary of the admission requirements and processes at the GCS is given here, for further description of the admission requirements and processes for Concordia University please consult the following sections of the Undergraduate Calendar (UC): general admissions in Section 13 [42]; and GCS admissions in Section 71.10 [43]. The UC is available online.

6.1.1 General Admission Requirements

All applications to Concordia University go through a single processing center. Quebec applicants must: 1) successfully complete a two-year pre-university program in a Cegep and qualify for a Diploma of Collegial Studies (DEC) or the equivalent, 2) have completed a three-year professional program in a Cegep, or 3) have obtained a French or International Baccalaureate. Graduates from secondary schools in Canadian provinces and territories outside Quebec are considered for admission to the Extended Credit Program (ECP), which requires students to take 30 credits in addition to the regular program requirements. Transfers from other universities are possible. Applicants from outside of Canada are eligible, with further information available in Section 19 of UC [44]. At the time of application, students can identify whether they would like to be considered for the co-operative education program.

The language of instruction at Concordia University is English, while most assignments and examinations may be submitted in French. Students whose first language is not English must demonstrate language proficiency prior to admission through achieving the appropriate score on one of five standardized English tests (Test of English as a Foreign Language, etc.) if they do not satisfy any of the exemption criteria.

6.1.2 Gina Cody School of Engineering and Computer Science (GCS) Admission Requirements for BEng

For Quebec applicants, there is a required Cegep course profile of Mathematics 201 (103 or NYA, 105 or NYC, 203 or NYB), Physics 203 (101 or NYA, 201 or NYB), and Chemistry 202 (101 or NYA). As mentioned above, out-of-province applicants are considered for the ECP program if they do not have sufficient pre-university education (e.g. International Baccalaureate). As mentioned in the previous section, students in the ECP program must take 30 additional credits. The required courses are listed in Section 71.20.3 of the UC and consist of a foundation in mathematics (9 credits), physics (6 credits), and chemistry (3 credits), as well as some electives in humanities and social sciences (6 credits) and electives in natural sciences (6 credits). Mature entry admission requirements are available in Section 14 of the UC.

6.1.3 Chemical and Materials Engineering Admission Requirements

There are no additional admission requirements for this program as compared to the GCS requirements outlined in the previous section. The projected year by year enrolment for the program is provided in Section 4.1.2, with a maximum capacity of 125 students, mainly due to the size of the undergraduate laboratories.

Specific grade requirements for the program will be determined after the Curriculum Committee (defined in Section 6.3.1 of this document) evaluates the applications received, but are expected to be relatively line with the grade requirements of the Mechanical Engineering BEng[45], which are summarized below:

- Quebec Cegep: 25 overall, 23 math, 22 physics
- High school: B overall, B in math, B in physics
- International Baccalaureate: 29 overall, 4 HL or 5 SL math, 5 HL or SL physics
- French Baccalaureate: 13 overall, 13 in math, 13 in science

[42] https://www.concordia.ca/academics/undergraduate/calendar/current/section-13-admission-regulations.html
[43] https://www.concordia.ca/academics/undergraduate/calendar/current/section-71-gina-cody-school-of-engineering-and-computer-science.html
[44] https://www.concordia.ca/academics/undergraduate/calendar/current/section-19-international-students.html
[45] https://www.concordia.ca/academics/undergraduate/mechanical-engineering.html#requirements

6.2 Commitment and structure of the program

The program is 120 credits, with 41 courses, for full time studies with a duration of 4 years. Exceptions are the ECP described in the previous section, requiring 30 additional credits.

Mandatory credits (41 courses, 120 credits):

1. Engineering Core Courses: 10 courses (27 credits)
    a. Includes 1 General Education Elective Course (3 credits)
2. Chemical Engineering Core Courses: 28 courses (84 credits)
3. Technical Elective Courses: 3 courses (9 credits)

Eleven Engineering Core courses are required for a BEng by the GCS in Section 71.20.5 of the UC, of which this program includes only ten. ELEC 275 Principles of Electrical Engineering (3.5 credits) has been omitted from this program in favour of further development in programming, sustainability, and materials. The basic knowledge of circuits is present in the curriculum in ENGR 213, CHME 352, and CHME 360.

For further information on the program structure, please refer to the student paths Section 7.3.

The engineering and chemical engineering core include courses which address:

- Science Knowledge: solid foundation in mathematics, physics, and chemistry
- Professional Engineering Skills: communication, engineering practice, technology and society, and engineering economics
- Chemical Engineering Fundamentals: foundation of chemical and biological processes. Includes thermodynamics, mass and heat transfer, fluid mechanics, chemical thermodynamics, reaction kinetics, process control, and material science
- Experiential learning: courses incorporating practice in theory

The technical elective courses allow students to concentrate in the following subjects:

- Materials Engineering, Biochemical and Food Engineering, Advanced Topics in Chemical Engineering, Sustainable Chemical Engineering, Advanced Process Design and Control, Biomolecular Modelling and Drug Design

Two optional activities, with no credit value, will supplement the proposed curriculum:

- **Internships through the Concordia Institute for Co-operative Education**: All students will have the opportunity to apply to be a member of the Institute and take part in their Undergraduate Co-op Program, Career Edge (C. Edge) Program, or Accelerated Career Experience (ACE) Program
- **Summer at Concordia**: in collaboration with an industrial partner can provide students the possibility to gain industry recognized certifications: Simulation (e.g. AspenTech), IIoT (e.g. Emerson), Sustainability (AIChE).
- **Summer Internships**: with Concordia research institutes (e.g. Centre for Applied Synthetic Biology), or industrial partners (e.g. Saputo, Molson)

6.3 Program oversight

6.3.1 Leadership and composition of the Program Committee

Section 7.1 mentions the accreditation procedures for engineering programs in Canada. It is expected by the 2021 Accreditation Criteria and Procedures [46] that program curriculum changes are overseen by a formally structured curriculum committee, and that the majority of the voting members of the committee are expected to be licensed to practice engineering in Canada.

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[46] https://engineerscanada.ca/sites/default/files/2021-11/Manual_of_Accreditation_Procedures-%28Accreditation-Visit-Cycle-2022-2023%29.pdf

For the proposed program, the Curriculum Committee will be led by a Curriculum Director and an Undergraduate Program Director and consist of 6 members. The Institute for Co-operative Education will have an Academic Director (hereafter referred to as the Co-operative Education Program Director) from the department to recommend admissions to the Institute, keep track of GPA adherence, and grade work term reports. This Co-operative Education Program Director will also have a spot on the Curriculum Committee to provide valuable feedback on student experiences during their work terms. The Curriculum Committee will be responsible for reviewing student feedback on courses, preparing documents for accreditation visits from the CEAB, making recommendations for program admissions, and proposing changes to the curriculum. Any aspects outside of curriculum management will be addressed by the Department Council under the advisement of the Undergraduate Program Director. The Concordia University Part-Time Faculty Association (CUPFA) will appoint a member to advise the Curriculum Committee.

The Undergraduate Program Director will receive half a course remission (1.5 credits) before the program starts. Each of the Undergraduate Program Director, Curriculum Director, and Co-operative Education Program Director will receive a full course remission each year when the program starts. This is part of the budget in Section 10 and in Appendix 7.

The first Curriculum Committee of the Chemical Engineering BEng is proposed to be composed of:

- Prof. Melanie Jane Hazlett, P.Eng.
- Prof. Deniz Meneksedag Erol
- Prof. Ivan Kantor
- Prof. Rolf Wuthrich, ing.
- Prof. Alex De Visscher, P.Eng.
- Dr. Stuart Thiel, ing.

The proposed committee satisfies the expectation that a majority of voting members are licensed engineers in Canada, in addition Prof. Meneksedag Erol and Prof. Kantor are both pursuing licensure.

6.3.2 Study Regulations

Students enrolled in the proposed program will be subject to the Academic Regulations defined by the university (Section 16 of the UC) and by the GCS (Section 71.10.4 of the UC), both available online.

6.3.3 Collaborative Arrangements with other Units, Departments, Faculties, and Institutions

The CME Department is actively engaged with other departments, faculties, and research centres within the institution. All these established relationships will contribute to the vitality of the BEng.

The Chair, Professor Alex De Visscher, is Co-Director of the Centre for Research in Molecular Modeling, a multi-institutional centre with 24 senior members from seven institutions with diverse interests.

The new interfaculty MSc/MASc in Nanoscience and Nanotechnology is a joint program between CME and the Department of Physics. Associate Professor Pantcho Stoyanov is the co-GPD of this program for the Nanotechnology side. Prof. Stoyanov has also collaborated on the certification program for Surface Engineering and Tribology housed in the Concordia Institute for Aerospace Design and Innovation.

Professor Rolf Wuthrich is jointly appointed with the Department of Mechanical, Industrial, and Aerospace Engineering.

Assistant Professor Deniz Meneksedag Erol is cross appointed with the Department of Chemistry and Biochemistry.

Associate Professor Steve Shih, from the Department of Electrical and Computer Engineering, is an associate member of CME.

Professor Gilles Peslherbe, from the Department of Chemistry and Biochemistry, is cross-appointed with CME.

Shared supervision of graduate students commonly occurs with the Department of Chemistry and Biochemistry, and the Department of Mechanical, Industrial, and Aerospace Engineering. Supervisory teams include:

Prof. Pantcho Stoyanov (CME) and Professor Christian Moreau (MIAE).
Professor Alex De Visscher (CME) and Professor Gilles Peslherbe (Chemistry and Biochemistry).

These same professors plus Assistant Professor Xia Li, Professor Paula Wood-Adams, and Professor Zhibin Ye also independently supervise students in other departments, now including the above-mentioned departments and the Department of Building, Civil, and Environmental Engineering.

Courses are regularly cross listed with the Department of Chemistry and Biochemistry. These include CHME 6911 cross listed with CHEM 436/636: Molecular Modelling of Proteins taught by Prof. Meneksedag Erol, CHME 6911 cross listed with CHEM 630: Electrochemical Engineering taught by Assistant Professor Marc-Antoni Goulet, and CHME 6911 cross listed with CHEM 646: Industrial Catalysis taught by Assistant Professor Melanie Hazlett.

Assistant Professors Ivan Kantor and Yaser Khojasteh Salkuyeh (CME) and Assistant Professor Shannon Lloyd (Management) have also developed a Life-Cycle Assessment course to be cross listed with the Management program in the John Molson School of Business.

Professors in CME regularly teach in other departments. For instance, Prof. Stoyanov and Assistant Professor Nhat Truong Nguyen teach offerings of MIAE 221 Materials Science. Prof. Stoyanov also teaches MECH 6431 Introduction to Tribology.

CME professors also teach service courses, valuable to the faculty as a whole. These include ENCS 6021 Engineering Analysis, ENGR 311 Transforming Calculus and Partial Differential Equations, ENGR 213 Applied Ordinary Differential Equations, and ENGR 371 Probability and Statistics.

7. PROGRAM STRUCTURE

7.1 Activities

7.1.1 Mandatory and Optional Courses

The proposed degree is a full-time program offering 41 courses, corresponding to 120 credits in total. The curriculum consists of the chemical engineering core courses, engineering courses, technical electives, and general education elective courses. Table 11 provides a detailed list of the chemical engineering core and engineering courses. Table 12 provides a list of the technical elective courses offered in their respective specialized tracks. All the courses with CHME course codes are new courses proposed to be developed for the degree program. Some of the technical electives are cross listed with existing graduate level courses, which is indicated in Appendix 2.

Table 11. A list of the chemical engineering core and engineering courses.

Chemical Engineering Core Courses (84 credits)	CHME 200: Introduction to Chemical Process Engineering (3 credits)
	CHME 201: Innovative, Sustainable, and Safe Manufacturing in Chemical Industry (3 credits)
	CHME 215: Programming for Chemical and Materials Engineers (3.5 credits)
	CHME 216: Advanced Programming for Chemical Engineers (3.5 credits)
	CHME 220: Material Properties and Chemical Characterization (3 credits)
	CHME 240: Chemical Engineering Lab I (1.5 credits)
	CHME 300: Industrial and Engineering Chemistry (3 credits)
	CHME 301: Chemical Reaction Engineering (3 credits)
	CHME 316: Advanced Data Analysis and Machine Learning for Chemical Engineers (3.5 credits)
	CHME 320: Technical and Advanced Materials (3 credits)
	CHME 321: Chemical and Materials Product Design (3 credits)
	CHME 330: Chemical Process Dynamics and Control (3 credits)
	CHME 340: Chemical Engineering Lab II (1.5 credits)
	CHME 351: Chemical Engineering Thermodynamics (3 credits)
	CHME 352: Energy Conversion and Storage (3 credits)
	CHME 360: Heat Transfer (3 credits)
	CHME 361: Mass Transfer and Unit Operations (3 credits)
	CHME 362: Chemical Separations Engineering (3 credits)
	CHME 390: Design Project (3 credits)
	CHME 415: Computational Modelling for Chemical Engineers (3 credits)
	CHME 440: Chemical Engineering Lab III (1.5 credits)
	CHME 490: Capstone Chemical Process Design (6 credits)
	MIAE 221: Materials Science (3 credits)
	CHEM 221: Organic Chemistry (3 credits)
	ENGR 245: Mechanical Analysis (3 credits)
	ENGR 251: Thermodynamics I (3 credits)
	ENGR 311: Transform Calculus & Partial Differential Equations (3 credits)
	ENGR 361: Fluid Mechanics (3 credits)
Engineering Courses (27 credits)	ENGR 201: Professional Practice and Responsibility (1.5 credits)
	ENGR 202: Sustainable Development & Environmental Stewardship (1.5 credits)
	ENGR 213: Applied Ordinary Differential Equations (3 credits)
	ENGR 233: Applied Advanced Calculus (3 credits)
	ENGR 301: Engineering Management Principles & Economics (3 credits)
	ENGR 371: Probability and Statistics in Engineering (3 credits)
	ENGR 391: Numerical Methods in Engineering (3 credits)
	ENGR 392: Impact of Technology on Society (3 credits)
	ENCS 282: Technical Writing and Communication (3 credits)
	General Education Elective (3 credits)

Table 12. Technical elective courses to be offered in the specialized tracks.

Biochemical and Food Engineering CHME 470: Advanced Biochemical Engineering CHME 471: Colloid and Interface Chemistry CHME 472: Food Engineering CHME 473: Biomaterials and Biochemicals CHEM 271: Biochemistry I BIOL 226: Biodiversity and Ecology BIOL 261 Molecular and General Genetics BIOL 371: Microbiology	**Materials Engineering** CHME 420: Nanomaterials Science and Engineering CHME 421: Metallurgical Engineering CHME 422: Polymer Chemistry and Engineering CHME 423: Advanced Battery Materials and Technologies CHME 424: Advanced Characterization Techniques CHME 425: Hydrometallurgy CHEM 327: Organic Chemistry of Polymers CHEM 427: Polymer Chemistry and Nanotechnology
Sustainable Chemical Engineering CHME 400: Sustainable Industrial and Engineering Chemistry CHME 401: Sustainable Process Design CHME 402: Sustainable Energy Conversion and Management CHME 403: Electrochemical Engineering CHME 404: Clean Energy Science and Technology CHME 405: Introduction to Environmental Engineering CHME 406: Introduction to Lifecycle Assessment CIVI 465: Water Pollution and Control CIVI 467: Air Pollution and Emission Control CIVI 468: Waste Management CHEM 498: Organic Semiconductors (CHEM 498/630-53) CHEM 498: Solar Energy Conversion (CHEM 498/630-52)	**Advanced Process Design and Control Track** CHME 430: Advanced Chemical Engineering Process Dynamics and Control CHME 431: Introduction to Optimization for Chemical Engineers CHME 432: Advanced Process Safety Engineering CHME 416: Data Engineering for Chemical Engineers MECH 472: Mechatronics and Automation **Data Analytics for Chemical Engineers** CHME 416: Data Engineering for Chemical Engineers COMP 333: Data Analytics COMP 352: Data Structures and Algorithms SOEN 363: Data systems for Software Engineers COMP 433: Introduction to Deep Learning COMP 473: Pattern Recognition COMP 474: Intelligent Systems COMP 479: Information Retrieval and Web Search
Advanced Topics in Chemical Engineering CHME 460: Chemical Kinetics and Advanced Reactor Engineering CHME 461: Advanced Chemical Engineering Thermodynamics CHME 462: Industrial Catalysis CHME 463: Advanced Separation Processes	**Biomolecular Modelling and Drug Design** CHME 480: Molecular Modelling of Proteins CHME 481: Multiscale Modelling of Biomaterials CHEM 431: Computational Chemistry for Chemists and Biochemists

7.1.2 Description Activities and Evaluation Methods

Table 13 provides the mapping between the learning outcomes and learning activities included in the proposed program:

- **Coursework:** thirty-seven (37) courses develop the knowledge required for the bachelor's in chemical engineering. The courses favour blended learning format and include, whenever possible, in-class work/discussions solving practical problems, teamwork (projects & presentations). Experts from industry may be invited to present specific topics.
- **Laboratories (Wet and Dry labs):** three (3) laboratory courses allow students to interact with laboratory equipment. Virtual lab simulations will be used to allow students to learn how to operate the equipment prior to the physical lab. The laboratory, whenever possible, can then be used to solve a problem/reach an objective instead of executing a procedure. For example, students could be asked to determine the operating conditions to separate a given mixture, and then operate the lab equipment to obtain the desired separation objective.
- **Capstone Project**: one (1) two-semester capstone design project course will provide students the opportunity to work with industrial partners, other departments, or research organization to solve a real problem. In addition, courses will favour projects rather than assignments to put into practice the concepts learned and promote teamwork.
- **Special activities**: during the summer, students can engage in special activities to earn industry certification, to gain work experience, or work in research in one of Concordia's research centres.

For more information about the course evaluation methods, please refer to the course outlines in Appendix 2.

Table 13. Mapping of the Program Requirements with Learning Outcomes

Learning Outcomes	Learning Activities						Assessment Methods
	Lectures and readings	Wet lab	Dry lab	Fixed answer problem sets	Course Embedded Projects	Design and Capstone project	
Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics and by using the appropriate engineering tools	✓		✓	✓	✓	✓	- Project presentation - Project report - Fixed-answer problem sets - Multiple choice questions - Long answer questions - Lab reports - Simulations
Design sustainable solutions that meet specified needs with consideration of all stakeholder views, public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	✓	✓		✓		✓	- Project presentations - Project reports - Poster presentations - Long answer questions - Case studies
Communicate complex engineering concepts or processes effectively in oral, written and graphical forms with a range of audiences		✓	✓	✓	✓	✓	- Project presentations - Project reports - Poster presentations - Lab reports - Concept maps
Contribute within a diverse team to complete an engineering design, while supporting a collaborative and inclusive environment	✓			✓		✓	- Group project presentations - Group project reports - Project plan deliverable - Long answer questions - Peer evaluation
Design and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions		✓		✓		✓	- Pre-lab quizzes - Lab reports - Long answer questions - Multiple choice questions - Fixed-answer problem sets - Project reports
Identify their own learning needs and update their skill sets to maintain competence and contribute to the advancement of knowledge		✓		✓		✓	- Learning journals - Self-reflective paper - Forum discussions - Project deliverables - Project reports - Lab reports
Manage the design process through iterative idea generation, design criteria selection, project milestone and task scheduling, and lifecycle and economic analyses	✓			✓	✓	✓	- Project plan - Project report - Project presentation - Long-answer questions - Fixed-answer problem sets

7.1.3 Accreditation Activities

After the first class of graduating students from the program, this program will be eligible for accreditation by Engineers Canada. The first accreditation visit may be scheduled in the final year of the first graduating class, in October or November. Currently, accreditation visits are conducted following the 2021 Accreditation Criteria and Procedures [47]. Part of the accreditation process involves assessment of the Graduate Attributes, which were introduced in section 3.1 of this document. Another important part is the assessment of the curriculum content and quality, measured by Accreditation Units (AUs). AUs are defined on an hourly basis depending on the learning activity (1 AU for lecture hour, 0.5 AU for laboratory or tutorial hour, for 50 minutes of total activity). The minimum curriculum components for an engineering program are given in Table 14, along with the AUs in the provided program (assuming the students come in with the listed AUs from CEGEP). A complete course by course calculation of AUs for the program is included in Appendix 5. Note that the AU calculations are done without considering the three technical electives, indicating that the minimum path regardless of the technical elective courses students choose meets accreditation requirements. Thus, AUs of the technical electives proposed are not required to be calculated, and not included in the graduate attribute mapping.

Table 14. Required AUs by 2021 Accreditation Criteria and Procedures by Engineers Canada and Calculated AUs for proposed BEng in Chemical Engineering

<table>
<tr><th>Components</th><th colspan="2">Minimum number of AUs required</th><th colspan="2">Number of AUs from CEGEP</th><th colspan="2">Number of AUs from proposed program</th><th colspan="2">Total number of AUS for proposed program and CEGEP</th></tr>
<tr><td>Mathematics</td><td>195</td><td rowspan="2">420</td><td>108</td><td rowspan="2">288</td><td>213.2</td><td rowspan="2">402.0</td><td>321.2</td><td rowspan="2">690</td></tr>
<tr><td>Natural Sciences</td><td>195</td><td>180</td><td>188.8</td><td>368.8</td></tr>
<tr><td>Engineering Science</td><td>225</td><td rowspan="2">900**</td><td>0</td><td rowspan="2">0</td><td>644.0</td><td rowspan="2">969.9</td><td>644.0</td><td rowspan="2">969.9</td></tr>
<tr><td>Engineering Design</td><td>225*</td><td>0</td><td>325.9</td><td>325.9</td></tr>
<tr><td>Complementary Studies</td><td colspan="2">225</td><td colspan="2">72</td><td colspan="2">209.1</td><td colspan="2">281.1</td></tr>
<tr><td>Overall total</td><td colspan="2">1850</td><td colspan="2">360</td><td colspan="2">1581</td><td colspan="2">1941</td></tr>
</table>

**Must be delivered by faculty members holding professional licensure as specified in the Interpretive statement on licensure expectations and requirements*

***600 must be delivered by faculty members holding, or progressing toward, professional licensure as specified in the Interpretive statement on licensure expectations and requirements*

¥Note AUs have been calculated based on a 12-week semester, in anticipation of Concordia University's eventual move from 13 weeks to 12 weeks

7.2 Pedagogical approaches

7.2.1. Combined theoretical and practical training

All the courses in the degree program will have in-person lectures discussing the relevant theory. In these lectures, the theoretical principles underlying the core chemical engineering concepts will be discussed in detail. The application of these principles will be demonstrated through problem solving. Problem solving skills will be further developed by problem-set assignments.

To bridge the gap between the theory and practice, the many of the core courses in the degree program will have a project component in which students will apply their theoretical knowledge to solve industrially relevant problems. These projects will be carried out in teams to foster teamwork and collaboration, and to enhance the communication and leadership skills of the students. Students will be responsible for identifying a critical need/problem in the industry or a societal need in applicable courses. They will conduct appropriate experimentation/analysis and draw conclusions using their engineering judgment. Students will present and discuss their findings, and participate in evaluating the work of other teams.

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[47] https://engineerscanada.ca/sites/default/files/2021-11/2021%20Accreditation%20Criteria%20Book%20Word.pdf

7.2.2. Hands-on laboratory training

The degree program will have three laboratory courses, Chemical Engineering Lab I (CHME 240, Year 2, Winter), Lab II (CHME 340, Year 3, Winter), and Lab III (CHME 440, Year 4, Fall). Each lab is designed to provide hands-on experience on different core concepts, including thermodynamics, heat transfer, fluid mechanics, unit operations, and process control. Students will work in teams to conduct the experiments, critically analyze the data, and draw conclusions. Students will write pre- and post-lab reports, which will form the majority of their performance assessment. Additionally, students will participate in evaluating their peers.

7.2.3. Innovation in Teaching and Learning

Advancing technology will help course instructors deliver some course content. This degree program proposes to develop asynchronous online modules for nine core courses which are explained in detail below. The online modules will cover the Chemical Engineering essentials that recur in the program. The amount of the online content can vary from course to course. The delivery method of the modules will resemble that of a flipped classroom model in which students will study the online content prior to the in-person lectures/discussions. The online modules will be accessible throughout the program; students will be able to revisit the content from previous classes.

An overview of the proposed online content is given below:

- CHME 200 – Introduction to Chemical Process Engineering: Material and energy balances, recycle flows, introduction to flash calculations/equilibrium stages, introduction to kinetics and reaction engineering, how to read process flow diagrams and piping and instrumentation diagrams, principles of process simulation.
- CHME 216 – Advanced Programming for Chemical Engineers: Programming basics, data analysis.
- CHME 351 – Chemical Engineering Thermodynamics: First and second law of thermodynamics, Gibbs free energy and Gibbs relations, activity and chemical potential, phase equilibrium, chemical equilibrium, non-ideal systems – activity and fugacity coefficients, equations of state.
- CHME 360 – Heat Transfer: Fourier's law of conduction, convection, radiation, heat transfer coefficients, design of heat exchangers.
- CHME 361 – Mass Transfer and Unit Operations: Fick's law of diffusion, diffusion coefficients, steady and unsteady state mass transfer, pumping, gas compression and expansion, filtration.
- CHME 301 – Chemical Reaction Engineering: Kinetics of homogeneous and heterogeneous reactions, batch reactor, continuous stirred-tank reactor, plug-flow reactor, non-isothermal reactors, non-ideal flow patterns.
- CHME 330 – Process Dynamics and Control: First and second order systems, Laplace transforms, feedback control, proportional-integral-derivative controller.
- CHME 362 – Chemical Separations Engineering: Equilibrium stages, distillation, absorption, extraction, drying.
- CHME 390 – Design Project: Rules of thumb, advanced design aspects of pumping and compression, detailed column design, vessel design, engineering economics, process safety.

7.2.4. Pedagogical approaches in capstone course

The capstone course is a design-focused and project-based course students will take in the last two terms of the degree program. The course learning outcomes, learning activities, evaluation methods and deliverables have been designed to allow students to further develop and demonstrate achievement (at the application level) of all 12 graduate attributes.

The capstone project requires students to work in groups to define a design problem, conduct research, design, and plan the implementation of a chemical plant. Similar to other BEng Capstone design projects at Gina Cody, the pedagogical methods used for this course draws on problem-based learning, collaborative learning, and reflective learning. Students will be evaluated with a midterm report, a progress poster, a final report and a final presentation. These deliverables along with transparent evaluation criteria/rubrics aim to enhance students' ability to solve open-ended design problems, improve teamwork skills, communicate process and solutions in written, oral and visual forms, and identify needs for further learning. Further information can be found in the course outline for CHME 490 in Appendix 2.

7.2.5. Work-Integrated learning

Concordia University offers a variety of structured work-integrated learning programs through the Institute for Co-operative Education. Work-integrated learning is a model of experiential learning that bridges the academic program and the world of work. Among the different modalities offered, the Co-op program is the longest standing and the most popular. Students admitted to the Co-op program will alternate between study terms and three internships with three different employers. The program integrates academic studies with program-relevant work experiences in a progressive manner, giving students the opportunity to transfer knowledge and skills between work and classroom settings.

Students can apply to Co-op by completing the appropriate section on the University Admission form. Admission to the program is based on academic performance and a few other factors. Students can also apply to Co-op after being enrolled in the program as long as they have minimum 90 credits remaining.

All eight existing BEng programs at Concordia offers Co-op options. Two of those programs (Electrical Engineering and Computer Engineering) also added another modality of work-integrated learning called C-Edge (Career Edge) as mandatory part of the curriculum. All students who are not enrolled in the Co-op program must complete one 12-17-week paid internship to graduate. This ensures every student in the program an opportunity for experiential learning in a real-world context.

Capitalizing on other BEng programs' experience in incorporating work-integrated learning in the curriculum, the proposed BEng in Chemical Engineering will also open the Co-op and the C-Edge programs to its students. Both programs will be optional upon the launch of the new program, but a clear pathway and ample support will be provided to students enrolled in those programs. There is a possibility of making C-Edge (one internship) mandatory a few years down the road when enrollments are steady and connections with employers are well established.

<u>Other Experiential Learning (EL) Opportunities</u>

Like students enrolled in any other program at Concordia University, students in the proposed new program will benefit from the following experiential learning and professional development offerings provided by the university to expand their hands-on and professional learning opportunities.

Concordia offers six types of experiential learning opportunities: course-integrated, work-integrated, research-based, community-based, international and student life. Students can search for EL opportunities to participate in by faculty, program, or by type. Career counselors are available to helps students explore how different experiential learning opportunities complement different career pathways or their particular career goals. In addition, a personal EL roadmap tool is available to all students, which helps students plan integrating experiential learning activities into their studies throughout the program.

Concordia has also partnered with Riipen, the world's leading virtual project-based learning platform that connects students with industry and community partners to complete real-world projects for academic credit. Faculty can use Riipen to find real-world projects to use as course assignments and track student progress in real time.

<u>Free professional development courses</u>

Concordia provides students as well as faculty and staff access to more than 4000 free online courses from Udemy covering virtually all disciplines. Chemical Engineering students can find courses that help them solidify prerequisite knowledge, enhance their current studies within the curriculum, and build professional skills as chemical engineers.

7.3 Typical student path

The proposed degree is a full-time, 4-year program with an optional co-op stream. For a detailed mapping of all courses to academic semesters for regular and co-op and students, see the pathways provided in the following pages. Table 15 below shows a sample program pathway for students enrolled in the co-op program. Students wishing to take courses from Computer Science and Software Engineering as part of the Data Analytics for Chemical Engineers are recommended to take CHME 316 in Winter Year 3 instead of their General Education Elective, and we will suggest that CHME 316 can replace COMP 352 as the prerequisite for those courses.

Table 15. Study/Work Sequence for the Co-op Program.

Year	Summer	Fall	Winter
1		Study	Study
2	Study	Work 1	Study
3	Study	Study	Work 2
4	Work 3	Study (Capstone)	Study (Capstone)

Proportion of practical versus theoretical activities

The proportion of practical versus theoretical activities is 37% practical versus 63% theoretical. In this calculation, the theoretical activities correspond to the lecture hours in the AU calculations given in Appendix 5, and the practical activities correspond to the tutorial and laboratory hours given in same. There is a large proportion of practical activities compared to theoretical activities, showing that the program has a strong experiential learning component. Note that this does not include the optional experiential learning opportunities such as the Co-op program, E-Edge, or ACE.

Bachelor of Engineering, Chemical Engineering
Curriculum Structure

Year 1

Fall Term	Winter Term
ENGR 213 Applied Ordinary Differential Equations (3) *Pre/Co: MATH 204, Pre: MATH 205*	**ENCS 282** Technical Writing and Communication (3) *Pre: EWT or ENCS 272*
CHME 200 Introduction to Chemical Process Engineering (3)	**ENGR 233** Applied Advanced Calculus (3) *Pre: MATH 204, or MATH 205*
CHME 215 Programming for Chemical and Materials Engineers (3.5)	**CHME 216** Advanced Programming for Chemical Engineers (3.5) *Pre: CHME 215 or equivalent*
MIAE 221 Materials Science (3)	**CHME 220** Material Properties and Chemical Characterization (3) *Co: MIAE 221*
CHEM 221 Organic Chemistry (3) *Pre: CHEM 205, CHEM 206*	**ENGR 251** Thermodynamics I (3) *Pre: MATH 203*
Fall: 15.5 credits	Winter: 15.5 credits

Year 1: 31 credits

Year 2

Fall Term	Winter Term
ENGR 301 Engineering Management Principles & Economics (3)	**ENGR 361** Fluid Mechanics I (3) *Pre: ENGR 213, ENGR 233, ENGR 251*
ENGR 245 Mechanical Analysis (3) *Pre: PHYS 204* *Pre/Co: ENGR 213*	**CHME 240** Chemical Engineering Lab I (1.5) *Pre: CHME 200, CHME 351* *Co: ENGR 361*
CHME 351 Chemical Engineering Thermodynamics (3) *Pre: ENGR 251* *Co: ENGR 311*	**CHME 300** Industrial and Engineering Chemistry (3) *Pre: CHME 200*
ENGR 311 Transform Calculus & Partial Differential Equations (3) *Pre: ENGR 213, ENGR 233*	**CHME 320** Technical and Advanced Materials (3) *Pre: CHME 220*
CHME 201 Innovative, Sustainable, and Safe Manufacturing in Chemical Industry (3) *Pre: ENGR 251, CHME 220*	**CHME 360** Heat Transfer (3) *Pre: CHME 351, ENGR 311*
ENGR 202 Sustainable Development & Environmental Stewardship (1.5)	**ENGR 201** Professional Practice and Responsibility (1.5)
Fall: 16.5 credits	Winter: 15 credits

Year 2: 31.5 credits

Year 3

Fall Term

- **ENGR 392** Impact of Technology on Society (3)
  Pre: ENCS 282, ENGR 201, ENGR 202
- **ENGR 371** Probability and Statistics in Engineering (3)
  Pre: ENGR 213, ENGR 233
- **CHME 321** Chemical and Materials Product Design (3)
  Pre: CHME 320
- **CHME 361** Mass Transfer and Unit Operations (3)
  Pre: CHME 360
- ***CHME 301** Chemical Reaction Engineering (3)*
  Pre: CHME 200, CHME 351

Fall: 15 credits

Winter Term

- **ENGR 391** Numerical Methods in Engineering (3)
  Pre: ENGR 213, ENGR 233, COMP 248 or COEN 243 or MECH 215 or M IAE 215 or BCEE 231.
- **CHME 330** Chemical Process Dynamics and Control (3)
  Pre: ENGR 311, CHME 301, CHME 361
- **CHME 340** Chemical Engineering Lab II (1.5)
  Pre: CHME 240, CHME 301, CHME 361
- **CHME 362** Chemical Separations Engineering (3)
  Pre: CHME 361
- **CHME 390** Design Project (3)
  Pre: CHME 201, CHME 301, CHME 321
  Co: ENGR 301, CHME 330, CHME 362
- **General Education Elective** Course (3)

Winter: 16.5 credits

Year 3: 31.5 credits

Year 4

Fall Term

- **CHME 415** Computational Modelling for Chemical Engineers (3)
  Pre: CHEM 205, CHME 351, ENGR 391
- **CHME 440** Chemical Engineering Lab III (1.5)
  Pre: CHME 330, CHME 340, CHME 362
- **CHME 490** Capstone Chemical Process Design (3)
  Pre: CHME 390
- **CHME 352** Energy Conversion and Storage (3)
  Pre: CHME 351
- **Technical Elective** Course 1 (3)

Fall: 13.5 credits

Winter Term

- **CHME 490** Capstone Chemical Process Design (3)
  Pre: CHME 390
- **Technical Elective** Course 2 (3)
- **Technical Elective** Course 3 (3)
- **CHME 316** Advanced Data Analysis and Machine Learning for Chemical Engineers (3.5)
  Pre: CHME 216, ENGR 371, ENGR 391

Winter: 12.5 credits

Year 4: 26 credits

Total Program Credits: 120
Total No. of Courses: 41

Engineering Core Course	CHME Core Course	Technical Elective Course	General Education Elective Course	Spanned Course over two terms
24 credits 9 Courses	84 Credits 28 Courses	9 Credits 3 Courses	3 Credits 1 Courses	6 Credits 1 Courses

Pre= Prerequisite Course
Co= Corequisite Course

Prerequisites and corequisites: a prerequisite is a specific course students need to take before another course. A co-requisite is when a specific course must be taken in the same academic term as another course unless students have already successfully completed it.

Bachelor of Engineering, Chemical Engineering Co-op Student Path

	Summer Term	Fall Term	Winter Term
Year 1 31 credits		**ENGR 213** Applied Ordinary Differential Equations (3) *Pre/Co: MATH 204, Pre: MATH 205* **CHME 200** Introduction to Chemical Process Engineering (3) **CHME 215** Programming for Chemical and Materials Engineers (3.5) **MIAE 221** Materials Science (3) **CHEM 221** Organic Chemistry (3) *Pre: CHEM 205, CHEM 206* Fall: 15.5 credits	**ENGR 233** Applied Advanced Calculus (3) *Pre: MATH 204, or MATH 205* **CHME** 201 Innovative, Sustainable, and Safe Manufacturing in Chemical Industry (3) *Pre: ENGR 251, CHME 220* **CHME 216** Advanced Programming for Chemical Engineers (3.5) *Pre: CHME 215 or equivalent* **CHME 220** Material Properties and Chemical Characterization (3) *Co: MIAE 221* **ENGR 251** Thermodynamics I (3) Pre: MATH 203 Winter: 15.5 credits
Year 2 33 credits	**ENGR 201** Professional Practice and Responsibility (1.5) Summer 1 **ENGR 361** Fluid Mechanics I (3) Summer 1 *Pre: ENGR 213, ENGR 233, ENGR 251* **ENCS 282** Technical Writing and Communication (3) *Pre: EWT or ENCS 272* **ENGR 245** Mechanical Analysis (3) *Pre: PHYS 204, Pre/Co: ENGR 213* **ENGR 311** Transform Calculus & Partial Differential Equations (3) *Pre: ENGR 213, ENGR 233* **CHME 351** Chemical Engineering Thermodynamics (3) Summer 2 *Pre: ENGR 251, Co: ENGR 311* Summer: 16.5 credits	Work Term 1	**ENGR 301** Engineering Management Principles & Economics (3) **CHME 240** Chemical Engineering Lab I (1.5) *Pre: CHME 200, CHME 351, Co: ENGR 361* **CHME 300** Industrial and Engineering Chemistry (3) *Pre: CHME 200* ***CHME 301*** *Chemical Reaction Engineering (3)* *Pre: CHME 200, CHME 351* **CHME 320** Technical and Advanced Materials (3) *Pre: CHME 220* **CHME 360** Heat Transfer (3) *Pre: CHME 351, ENGR 311, ENGR 391* Winter: 16.5 credits

	Summer Term	Fall Term	Winter Term
Year 3 30 credits	**ENGR 202** Sustainable Development & Environmental Stewardship (1.5) Summer1 **ENGR 371** Probability and Statistics in Engineering (3) *Pre: ENGR 213, ENGR 233* **ENGR 391** Numerical Methods in Engineering (3) Summer 2 *Pre: ENGR 213, ENGR 233, COMP 248 or COEN 243 or MECH 215 or MIAE 215 or BCEE 231.* **ENGR 392** Impact of Technology on Society (3) *Pre: ENCS 282, ENGR 201, ENGR 202* **CHME 321** Chemical and Materials Product Design (3) *Pre: CHME 320* **CHME 361** Mass Transfer and Unit Operations (3) *Pre: CHME 360* Summer: 16.5 credits	**CHME 330** Chemical Process Dynamics and Control (3) *Pre: ENGR 311, CHME 301, CHME 361* **CHME 340** Chemical Engineering Lab II (1.5) *Pre: CHME 240, CHME 301, CHME 361* **CHME 362** Chemical Separations Engineering (3) *Pre: CHME 361* **CHME 390** Design Project (3) *Pre:* CHME 201, CHME 301, CHME 321 *Co: ENGR 301, CHME 330, CHME 362* **General Education Elective** Course (3) Fall: 13.5 credits	Work Term 2
Year 4 26 credits	Work Term 3	**CHME 415** Computational Modelling for Chemical Engineers (3) *Pre: CHEM 205, CHME 351, ENGR 391* **CHME 440** Chemical Engineering Lab III (1.5) *Pre: CHME 330, CHME 340, CHME 362* **CHME 490** Capstone Chemical Process Design I (3) *Pre: CHME 390* **CHME 352** Energy Conversion and Storage (3) *Pre: CHME 351* **Technical Elective** Course 1 (3) Fall: 13.5 credits	**Technical Elective** Course 2 (3) **Technical Elective** Course 3 (3) **CHME 490** Capstone Chemical Process Design I (3) *Pre: CHME 390* **CHME 316** Advanced Data Analysis and Machine Learning for Chemical Engineers (3.5) *Pre: CHME 216, ENGR 371, ENGR 391* Winter: 12.5 credits

Engineering Core Course	**CHME Core Course**	**Technical Elective Course**	**General Education Elective Course**	**Spanned Course** over two terms
24 credits 9 Courses	84 Credits 28 Courses	9 Credits 3 Courses	3 Credits 1 Courses	6 Credits 1 Courses

Prerequisites and corequisites: a prerequisite is a specific course students need to take before another course. A co-requisite is when a specific course must be taken in the same academic term as another course unless students have already successfully completed it.

Pre= Prerequisite Course
Co= Corequisite Course

Total Program Credits: 120
Total No. of Courses: 41

7.4 Feedback and Evaluation

A description of the feedback and co-operative education program is given in Section 7.4.1. There is no research component of the program.

7.4.1 Feedback and Evaluation Processes for the Co-operative Format

The Institute for Co-operative Education offers a number of work-integrated learning opportunities to students in the GCS. Work-integrated learning is a model of experiential learning that bridges the academic program and the world of work. It provides students with the opportunity to combine study with paid work terms in their chosen fields.

The academic content is identical to that of the regular programs with three work terms interspersed with study terms. However, in order to continue their studies in the co-operative format in the GCS, or to graduate from one of its programs as members of the Institute for Co-operative Education, students must satisfy the following conditions:

i. must be in acceptable standing and maintain a cumulative grade point average (CGPA) of at least 2.50 in their program (the CGPA is calculated in the manner described in Section 16.3.10 Academic Performance under Section 16.3 Evaluation, Administrative Notations, Examinations, and Performance Requirements);
ii. be assigned a grade of pass for each of the three work-term courses (CWTE or CWTC). Under certain conditions, students may be placed on co-op probation status;
iii. remain in their designated work study sequence. Any deviations must have prior approval by the director of the Institute for Co-operative Education in consultation with the co-op program director in their department.

Regulations for Work Terms

- Successful completion of the work terms shown in the Co-op Schedule indicated in Section 24 Institute for Co-operative Education is a prerequisite for graduation as a member of the Institute for Co-operative Education.
- Work-term job descriptions are screened by the co-op coordinator. Only jobs approved by the Institute for Co-operative Education will be accepted as being suitable for the work-term requirements.
- Work-term jobs are full-time employment normally for a minimum of 12 consecutive weeks (14 to 16 weeks preferably).
- A work-term report must be submitted each work term on a subject related to the student's employment. This report must be submitted to the Institute for Co-operative Education on or before the deadline shown in Section 24 Institute for Co-operative Education. Grammar and content of work-term reports are evaluated by the Institute for Co-operative Education and the technical aspects are evaluated by the co-op program director responsible. Evidence of the student's ability to gather material relating to the job, analyze it effectively, and present it in a clear, logical, and concise form is required in the report.
- The required communication component consists of an oral presentation on a technical subject or engineering task taken from the student's work environment. The presentation will be given on campus in a formal setting after students have returned to their study term. A written summary is also required. Guidelines for the preparation of this oral presentation are provided in the Co-op Student Handbook.
- Work terms will be evaluated for satisfactory completion. Assessment is based upon the employer evaluation of performance, the work-term report, graded by the Co-operative Education Program Director, and communication component which together constitute the job performance as related to the whole work term. Students must pass all required components. The grade of pass or fail will be assigned to each of the work-term courses. A failing grade will result in the student's withdrawal from the Institute for Co-operative Education.

Student demand and enrolment

All students will be able to apply for the Co-op program. Those who are not admitted to the Co-op program can enroll in the Career Edge program. Every student who wishes to have an internship will have the opportunity to enroll in the Career Edge program. Please refer to the Letter of Support provided by the Institute for Co-operative Education provided in Appendix 4.

7.5 Alignment of activities, skills and program objectives

Engineering education in Canada is overseen by Engineers Canada. The necessary skills and attributes required of graduating students are well-documented to endure that graduates are achieving the appropriate standard of education to start careers in their selected domains. To this end, 12 graduate attributes are defined that must be addressed by the proposed curriculum. Aligned with these attributes, the courses proposed for the undergraduate chemical engineering program are linked to these attributes and the level at which the attribute is learned or demonstrated (introduce, develop, apply) in a particular course. These attributes are presented in tabular form below (Tables Table 16-Table 27).

Table 16. Graduate attribute mapping for A Knowledge Base for Engineering.

A Knowledge Base for Engineering Demonstrated competence in university-level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.							
		Rubrics		Level			
Indicators	Students can..	Grade	Definition	Introduce	Develop	Apply	Suggested assessment method
Knowledge base of mathematics	• Mathematically model complex engineering problems • Identify appropriate techniques to solve mathematical problems • Show detailed understanding of mathematical concepts and how they are applied in engineering	A	Identifies and applies appropriate techniques for solving the problem in specific context	ENGR 213 ENGR 233	ENGR 245 ENGR 311 CHME 351 CHME 360 CHME 361 CHME 301	ENGR 361 ENGR 371 ENGR 391 CHME 415 CHME 316 CHME 330 CHME 362	Project work Assignments Written examinations Case studies
		B	Identifies approaches for solving the problem, and some of which apply within a specific context.				
		C	Identifies and approach that is only partly applicable for the context				
		F	Does not identify or apply the correct approaches to mathematical problems				
Knowledge base of natural science	• Identify the appropriate techniques for solving natural science problems • Use knowledge in natural science to solve engineering problems • Recall previous learning in natural science	A	Identifies and applies appropriate techniques for solving the problem in specific context	ENGR 245 ENGR 251 MIAE 221 CHME 200 CHME 201 CHME 351	ENGR 233 CHEM 221 CHME 220 CHME 300 CHME 360 CHME 361	ENGR 361 CHME 415 CHME 201 CHME 320 CHME 321 CHME 352 CHME 362	Project work Assignments Written examinations Case studies
		B	Identifies approaches for solving the problem, and some of which apply within a specific context.				
		C	Identifies and approach that is only partly applicable for the context				
		F	Does not identify or apply the correct approaches to natural science problems				
Knowledge base in a specific domain	• Recall solution techniques from engineering, science, and mathematics • Identify the appropriate approach to solve domain-specific problems • Combine methods to solve complex problems • Exhibit deep domain-specific knowledge	A	Capable of expressing real problems in an engineering context using knowledge from the domain and prior learning	ENGR 245 ENGR 371 MIAE 221 CHME 200 CHME 215 CHME 216	ENGR 311 CHME 415 CHME 201 CHME 220 CHME 300 CHME 301	ENGR 361 ENGR 371 ENGR 391 CHME 316 CHME 320 CHME 321 CHME 330 CHME 351 CHME 390 CHME 490	Project work Assignments Written examinations Case studies
		B	Capable of expressing the most important aspects of real problems in the domain, while simplifying or neglecting some aspects				
		C	Some difficulty to express and/or solve engineering problems and to leverage prior knowledge				
		F	Capable of expressing or solving only the simplest problems in the domain				

Table 17. Graduate attribute mapping for Problem Analysis.

Problem analysis

An ability to use appropriate knowledge and skills to identify, analyze, and solve complex engineering problems in order to reach substantiated conclusions.

		Rubrics		Level			
Indicators	Students can..	Grade	Definition	Introduce	Develop	Apply	Suggested assessment method
Problem identification and formulation	• Demonstrate a good understanding of the problem. • Demonstrate confidence in answering questions: What information is given? What more information do you need? • Demonstrates the capability of identifying unknowns and ambiguities (assumptions). • Describe in general terms what a solution would look like.	A	Demonstrates understanding of how various pieces of the problem relate to each other and the whole. Identifies multiple approaches for solving the problem that apply within a specific context.	ENGR 213 ENGR 233 ENGR 245 ENGR 251 CHME 200 CHME 201 CHME 216 CHME 220 CHME 240	ENGR 361 CHME 300 CHME 320 CHME 321 CHME 340 CHME 351 CHME 360 CHME 361 CHME 415	CHME 301 CHME 330 CHME 352 CHME 362 CHME 390 CHME 440 CHME 490	Project work Assignments Written examinations
		B	Demonstrates some understanding of how various pieces of the problem relate to each other and the whole. Identifies multiple approaches for solving the problem, only some of which apply within a specific context.				
		C	Demonstrates minimal understanding of how various pieces of the problem relate to each other and the whole. Identifies only a single approach for solving the problem that does apply within a specific context.				
		F	Demonstrates no understanding of how various pieces of the problem relate to each other and the whole. Identifies one or more approaches for solving the problem that do not apply within a specific context.				
Modelling	• Extract parameters and variables from problem statement (look for essence of the problem). • Demonstrate the capability of making valid assumptions. • Use logic (deduction) to formulate model from assumptions. • Demonstrate ability to identify limitations, possible extensions. • Compare modelling strategies: Logical-mathematical models versus physical models.	A	Demonstrates the ability to construct a clear and insightful problem statement with evidence of all relevant contextual factors.	ENGR 213 ENGR 245 CHME 200 CHME 240	ENGR 233 CHME 300 CHME 340 CHME 360 CHME 361	CHME 301 CHME 330 CHME 351 CHME 352 CHME 362 CHME 390 CHME 415 CHME 440 CHME 490	Project work Assignments Written examinations
		B	Demonstrates the ability to construct a problem statement with evidence of most relevant contextual factors, and problem statement is adequately detailed.				
		C	Begins to demonstrate the ability to construct a problem statement with evidence of most relevant contextual factors, but problem statement is superficial.				
		F	Demonstrates a limited ability in identifying a problem statement or related contextual factors.				
Problem solving	• Make educated guesses and verify. • Consider a special case. • Generalize the problem. • Use mathematical tools. • Use computer programs and computer simulation.	A	Not only develops a logical, consistent plan to solve problem, but recognizes consequences of solution and can articulate reason for choosing solution.	ENGR 213 ENGR 245 ENGR 251 ENGR 311 CHME 200 CHME 201 CHME 215 CHME 240 CHME 216	ENGR 233 ENGR 245 ENGR 311 ENGR 361 CHME 300 CHME 320 CHME 340	CHME 301 CHME 330 CHME 351 CHME 352 CHME 360 CHME 361 CHME 362 CHME 390 CHME 415 CHME 440 CHME 490	Project work Assignments Written examinations
		B	Having selected from among alternative, develops a logical, consistent plan to solve the problem.				
		C	Considers and rejects less acceptable approaches to solving problem.				
		F	Only a single approach is considered and is used to solve the problem.				
Analysis (uncertainty and incomplete knowledge)	• Simplify model (remove unnecessary details). • Identify similar problems. • Split problem into sub-parts. • Identify elements of uncertainty. • Derive new facts. • Identify patterns. • Calculate range of expected inputs and outputs. • Demonstrate knowledge of orders of magnitude. • Choose among different alternatives. • Evaluate and pick most appropriate solution based on criteria. • Interpret results of analysis, degree of accuracy.	A	Organizes and synthesizes evidence to reveal insightful patterns, differences, or similarities related to focus.	ENGR 251 CHME 200 CHME 201 CHME 240	ENGR 245 ENGR 361 CHME 215 CHME 300 CHME 340 CHME 360	CHME 301 CHME 351 CHME 352 CHME 361 CHME 362 CHME 390 CHME 440 CHME 490	Project work Assignments Written examinations
		B	Organizes evidence to reveal important patterns, differences, or similarities related to focus.				
		C	Organizes evidence, but the organization is not effective in revealing important patterns, differences, or similarities.				
		F	Lists evidence, but it is not organized and/or is unrelated to focus.				

Table 18. Graduate attribute mapping for Investigation.

Investigation An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.							
		Rubrics		Level			
Indicators	Students can..	Grade	Definition	Introduce	Develop	Apply	Suggested assessment method
Background and hypothesis formulation	Describe the setting for the investigation (Why are we doing it? What are we expecting?) • Consider whether it has been done before and how it relates to theory/other information (hypothesis may not be necessary, could be just measurement)	A	Capable of defining all the fundamentals and formulating the hypothesis related to given engineering problem.	CHME 220 CHME 240 ENGR 371	CHME 320 CHME 340	CHME 390 CHME 440 CHME 490	Project work Assignments Written examinations Laboratory experiments
		B	Capable of defining 80% of the fundamentals and formulating the hypothesis related to given engineering problem with minor flaws.				
		C	Capable of defining 50% of the fundamentals and formulating the hypothesis related to given engineering problem with sufficient flaws.				
		F	Not able to comprehend the engineering problem and establish a reasonable test hypothesis.				
Designing experiments	• Identify random sample • Avoid bias • Design a controlled experiment (not all experiments are controllable – how do you deal with this?) • Choose instruments and testing method • Consider limitations of equipment • Demonstrate understanding of concepts of reproducibility, accuracy, feasibility, cost, size • Discuss issue of materials versus measurements • Discuss difficulty of duplication	A	Objective is clear, controllable factors are well defined. Experimental set-up is accurate. Data collection scheme and data analysis methodologies are appropriate. All the safety measures are considered.	CHME 240 ENGR 371	CHME 340	CHME 440	Laboratory experiments Laboratory reports
		B	Objective is clear, controllable factors are defined but has minor flaws. Experimental set-up is accurate. Data collection scheme and data analysis methodologies are addressed well but include some inconsistencies. Safety measures are considered.				
		C	Objective is defined but not clear, selection of controllable factors are not well justified. Experimental set-up has flaws. The methodology proposed for data collection and analysis is not accurate.				
		F	Objective is not clear. Controllable factors are not defined or has major flaws. Proposed methodologies for data collection and analysis are wrong.				
Conducting experiments and collection of data	• Demonstrate knowledge of the tools (related to Use of Engineering Tools attribute) • Consider variability/operator error • Discuss random sampling • Report all data objectively • Discuss safety issues • Discuss ethical issues including obtaining appropriate permissions if experiments involve humans	A	Excellent understanding of a random sampling and applies this when analyzing the experiment. Suggests good measures to either change experiment or address the issues on the collected data.	CHME 240 ENGR 371	CHME 220 CHME 340	CHME 320 CHME 390 CHME 440 CHME 490	Project work Laboratory experiments
		B	Excellent understanding of a random sampling and applies this when analyzing the experiment. Suggests good measures to either change experiment or address the issues on the collected data				
		C	Some significant flaws but displays an adequate understanding of the issues.				
		F	Some basic misunderstanding of the issues				
Analysis and interpretation of data	• Use methods from probability and statistics to analyze and interpret data • Match experimental results with theory • Validate assumptions • Discuss what went wrong/error analysis • Synthesize information to arrive at substantiated conclusions	A	Demonstrates a very strong ability to interpret problem statements, stating semi-formal expectations through use of cases, domain models and operation contracts and providing solutions (how to) through high- and low-level designs as well as planning for implementation. Demonstration of responsibility. Ability to trace requirements to implementation (and vice versa).	CHME 220 CHME 240 ENGR 371	CHME 316 CHME 320 CHME 340	CHME 440 CHME 490	Assignments Laboratory reports
		B	Demonstrates good ability to interpret problem statements, stating intentions (use cases and domain model) and translating them to design/implementation through class interaction.				
		C	Demonstrates an average ability to interpret specifications and translate them to interaction diagrams and/or to code, but no full support on analysis and design.				
		F	Fails to analyze and interpret data or results				

Table 19. Graduate attribute mapping for Design.

Design An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations. complex engineering problems in order to reach substantiated conclusions.							
		Rubrics		Level			
Indicators	Students can..	Grade	Definition	Introduce	Develop	Apply	Suggested assessment method
Define the Objective	• Consult client and ask questions • Gather information and describe the problem • Gather information on prior solutions • Find out about social and environmental needs • Define the objective of the corporate (owner of the design)	A	Identify key issues in the design that will impact the client. Can describe the needs of the client beyond what they say they want. Readily gathers relevant information and develop elegant models to apply to their design.	CHME 200 CHME 201 CHME 216 CHME 220 CHME 360	CHME 300 CHME 320 CHME 321 CHME 351 CHME 352 CHME 361	CHME 301 CHME 362 CHME 330 CHME 390 CHME 490	Project Work Design Projects
		B	Can identify the needs of the client in the design. Shows how these needs have guided the design. Can articulate the needs of the client related to the need being addressed by the current project. May include extraneous information, but ultimately find correct ones and develop model(s) to apply to their designs.				
		C	Can identify what the client says they want in the design. Can identify few needs of the customer relative to the design. Has difficulty deciding what information to use, but may develop a close to correct model to apply to their design.				
		F	Cannot identify how the needs of the client relate to the design of the current project. Cannot identify relevant information or develop models to apply to their design.				
Idea generation and selection	• Critique alternative solutions • Create new, unique, untried solutions • Demonstrate thinking outside the box • Generate many possible diverse solutions, followed by a rational process of selection • Use techniques to help evaluate different solutions with a good argument (e.g., brainstorm, lateral thinking, and for selection (e.g., decision grids, force-field analysis)	A	Extends a novel or unique idea, question, format, or product to create new knowledge or knowledge that crosses boundaries. Thoroughly analyzes different solutions and carefully evaluates the relevance of contexts when presenting an argument.	ENGR 245 CHME 200 CHME 201 CHME 216 CHME 220 CHME 360	CHME 300 CHME 320 CHME 321 CHME 352 CHME 361	CHME 301 CHME 362 CHME 330 CHME 390 CHME 490	Project Work Design Projects.
		B	Creates a novel or unique idea, question, format, or product. Identifies own and others' assumptions and several relevant contexts when presenting a position. Identifies different solutions and evaluates the relevance of contexts when presenting an argument.				
		C	Experiments with creating a novel or unique idea, question, format, or product. Identifies limited solutions and evaluates the relevance of contexts when presenting an argument.				
		F	Reformulates a collection of available ideas. Shows awareness of different solutions. Begins to identify some contexts when presenting an argument.				
Detailed Design	Describe a complex solution that allows implementation	A	Reviews a number of reasonable alternatives before finalizing design decisions. Initiates appropriate design iterations. Excellent cost estimates. Design principles applied appropriately and without error.	CHME 200 CHME 201 CHME 215 CHME 216 CHME 220	CHME 300 CHME 321 CHME 352 CHME 361	CHME 301 CHME 362 CHME 330 CHME 390 CHME 490	Project Work Design Projects
		B	Identifies some alternative approaches before finalizing design decisions. Occasionally initiates design iterations, or done with prompting. Provides reasonable cost estimates. Applies design principles appropriately to achieve reasonable solution.				
		C	Few if any alternative approaches explored for design decisions. Serious deficiencies in iterating through the design process. Reasonable cost estimates. Uses design principles but with serious errors.				
		F	Does not consider alternatives when making design decisions. No appropriate iterations in the design process considered. No review of prior work. Sound design principles are not used or used incorrectly. No cost estimates.				
Validation and Implementation	Validate design against specs (does it meet all requirements, e.g., cost, efficiency, codes, etc.?)	A	Design meets or exceeds requirement and constraints. Insightful evaluation supports conclusions and recommendations.	CHME 200 CHME 201 CHME 215 CHME 216 CHME 320	CHME 300 CHME 321 CHME 352 CHME 361	CHME 301 CHME 330 CHME 362 CHME 390 CHME 490	Project Work Design Projects
		B	Design meets requirements and constraints with moderately effective use of resources. Sound evaluation of design supports conclusions.				
		C	Design barely meets requirements and constraints. Evaluation of design incomplete or partially erroneous.				
		F	Design does not meet requirements and constraints. No evaluation of design done or done incorrectly.				

Table 20. Graduate attribute mapping for Use of Engineering Tools

Use of engineering tools

An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.
Note: Programs should identify a list of essential tools and which courses cover their use.

		Rubrics		Level			
Indicators	Students can..	Grade	Definition	Introduce	Develop	Apply	Suggested assessment method
Ability to select appropriate tools, techniques, and resources	• Evaluate suitability of the tools for the task. • In labs, choose the right tools/techniques for problem. • In projects, demonstrate ability to select appropriate tools and techniques.	A	Defends assumptions and approximations made.	CHME 200 CHME 215 CHME 216 CHME 240	ENGR 391 CHME 300 CHME 340 CHME 390	CHME 301 CHME 316 CHME 415 CHME 440 CHME 490	In-class assignments; Lab assignments; Term project
		B	Selects and applies appropriate quantitative model to solve problems, using reasonable approximations and assumptions.				
		C	Selects model but some errors and inappropriate assumptions.				
		F	Does not select model, or selected model is inappropriate.				
Ability to use appropriate engineering tools, techniques and resources	• Demonstrate individual use of tools (to be assessed in labs and assignments).	A	Successfully performs experiments involving chemical engineering principles, including bench scale unit operations, and correctly documents all required results.	CHME 215 CHME 220 CHME 240	ENGR 391 CHME 216 CHME 300 CHME 330 CHME 340 CHME 351	CHME 301 CHME 316 CHME 415 CHME 440 CHME 490	In-class assignments; Lab assignments; Term project
		B	Successfully performs experiments involving chemical engineering principles, including bench scale unit operations, and correctly documents some of the results.				
		C	Makes a few errors in the experiments leading to errors.				
		F	Unable to perform the experiments.				
Demonstrate awareness of limitations of tools, create and extend tools as necessary	• Demonstrate awareness of limitations of tools used. • Address limitations of given tools by extending tools and combining tools. • Address limitations of given tools by creating new tools. • Address limitations of given tools by choosing different tools. • Create small software tools (more complicated tools can be built by some students in Capstone projects).	A	Shows excellent understanding of the system operating procedures, accuracy of the sensors and limitations of the experiment in the analysis and discussion of the experimental results.	CHME 215 CHME 216 CHME 220 CHME 240	ENGR 391 CHME 300 CHME 340 CHME 390	CHME 316 CHME 415 CHME 440 CHME 490	In-class assignments; Lab reports; Term project
		B	Shows good understanding of how the system works. Considers and takes into account the experimental errors.				
		C	Can reasonably operate the system. Shows satisfactory understanding of major experimental errors.				
		F	Lacks understanding of the system operation. Does not analyze experimental results in light of accuracy of data or experimental limitations.				

Table 21. Graduate attribute mapping for Communication Skills.

Communication Skills An ability to communicate complex engineering concepts within the profession and with society at large. Such abilities include reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions. complex engineering problems in order to reach substantiated conclusions.							
		Rubrics		Level			
Indicators	Students can..	Grade	Definition	Introduce	Develop	Apply	Suggested assessment method
Writing Process	• Identify audience needs, interests and level of knowledge • Frame supportable, significant theses and arguments • Develop appropriate expository annd argumentative strategies • Identify and utilize relevant, high-quality resources • Create drafts and revisions • Respond to critical feedback	A	Demonstrates understanding of how various pieces of the problem relate to each other and the whole. Identifies multiple approaches for solving the problem that apply within a specific context.	ENGR 301 ENCS 282 CHME 201 CHME 220 CHME 240	ENGR 392 CHME 300 CHME 320 CHME 321 CHME 340 CHME 390	CHME 440 CHME 490	Lab Reports and Term Projects
		B	Demonstrates some understanding of how various pieces of the problem relate to each other and the whole. Identifies multiple approaches for solving the problem, only some of which apply within a specific context.				
		C	Demonstrates minimal understanding of how various pieces of the problem relate to each other and the whole. Identifies only a single approach for solving the problem that does apply within a specific context.				
		F	Demonstrates an understanding of how various pieces of the problem relate to each other and the whole. Identifies one or more approaches for solving the problem that do not apply within a specific context.				
Information Gathering	• Articulate research questions • Formulate research plans and data collection strategies • Develop effective use of databases, library resources • Evaluate quality and usefulness of sources • Maintain complete and accurate records of sources used	A	Synthesizes in-depth information from relevant sources representing various points of view/approaches.	ENGR 301 ENCS 282 CHME 201 CHME 220 CHME 240	ENGR 392 CHME 216 CHME 300 CHME 320 CHME 321 CHME 340 CHME 352 CHME 390	CHME 440 CHME 490	Lab Reports and Term Projects
		B	Presents in-depth information from relevant sources representing various points of view/approaches.				
		C	Presents information from relevant sources representing limited points of view/approaches.				
		F	Presents information from irrelevant sources representing limited points of view/approaches.				
Documentation	• Choose correct genre and format • Organize information appropriately for readers' use • Identify and utilize correct citation format • Differentiate between correct source usage and plagiarism	A	Has exemplary ability to use information in ways that are true to original context; distinguishing between common knowledge and ideas requiring attribution and demonstrate a full understanding of the ethical and legal restrictions on the use of published, confidential, and/or proprietary information.	ENCS 282 CHME 201 CHME 220 CHME 240	ENGR 392 CHME 216 CHME 300 CHME 320 CHME 321 CHME 340 CHME 390	CHME 440 CHME 490	Lab Reports, Term Projects, and Capstone Projects
		B	Has proficient ability to use information in ways that are true to original context; distinguishing between common knowledge and ideas requiring attribution and demonstrate some understanding of the ethical and legal restrictions on the use of published, confidential, and/or proprietary information.				
		C	Has developing ability to use information in ways that are true to original context; distinguishing between common knowledge and ideas requiring attribution and demonstrate minimal understanding of the ethical and legal restrictions on the use of published, confidential, and/or proprietary information.				
Oral Presentation	• Demonstrate understanding of cognitive and conceptual differences between oral and written presentation • Create appropriate scope for treatment of topic in oral presentation • Adapt written text to oral presentation • Identify audience needs, interests and level of knowledge • Plan, design and effectively utilize visual materials • Utilize effective presentation techniques • Identify strategies to overcome linguistic difference • Adapt presentation to heterogeneous audiences	A	Language choices are imaginative, memorable, and compelling, and enhance the effectiveness of the presentation. Delivery techniques make the presentation compelling, and speaker appears polished and confident. A variety of types of supporting materials make appropriate reference to information or analysis that significantly supports the presentation or establishes the presenter's credibility/authority on the topic.	ENGR 251 ENCS 282 CHME 201 CHME 216	ENGR 392 CHME 300 CHME 352 CHME 390	CHME 490	Term Projects and Capstone Projects
		B	Language choices are thoughtful and generally support the effectiveness of the presentation. Delivery techniques make the presentation interesting, and speaker appears comfortable. Supporting materials make appropriate reference to information or analysis that generally supports the presentation or establishes the presenter's credibility/authority on the topic.				
		C	Language choices are mundane and commonplace and partially support the effectiveness of the presentation. Delivery techniques make the presentation understandable, and speaker appears tentative. Supporting materials make appropriate reference to information or analysis that partially supports the presentation or establishes the presenter's credibility/authority on the topic.				
		F	Language choices are unclear and minimally support the effectiveness of the presentation. Delivery techniques detract from the understandability of the presentation, and speaker appears uncomfortable. Insufficient supporting materials make reference to information or analysis that minimally supports the presentation or establishes the presenter's credibility/authority on the topic.				

Table 22. Graduate attribute mapping for Individual and Team Work.

Individual and Team Work An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.							
		Rubrics		Level			
Indicators	Students can..	Grade	Definition	Introduce	Develop	Apply	Suggested assessment method
Cooperation and work ethics	• Actively participate in meetings • Communicate within the group • Co-operate within the group • Assist teammates when needed • Volunteer for tasks • Respect teammates	A	Actively participates in team meetings; assists the team members when needed; respects the team members and their ideas; displays a positive attitude within the team; respects the deadlines; respects the commitments and is co-operative with other team members.	ENGR 213 ENGR 301 CHME 201 CHME 216 CHME 220 CHME 240	CHME 300 CHME 320 CHME 321 CHME 340 CHME 390	CHME 440 CHME 490	Lab Reports, Term Projects, and Capstone Projects
		B	Participates in team meetings; assists the team members; respects the team members; respects the deadlines; co-operative with other team members.				
		C	Tries to participate in the team meetings; assists the team members a few times; respects the deadlines; is generally respectful to other team members and their ideas.				
		F	Does not attend the team meetings regularly; does not communicate with other team members; disrespectful to other team members; does not meet the deadlines.				
Contribution: practical/conceptual	• Research and gather information • Ensure the quality of individual contribution • Suggest ideas • Write reports or section of reports • Provide constructive feedback on the report(s) or presentations • Contribute to the presentation	A	Completes all assigned tasks by deadline; work accomplished is thorough, comprehensive, and advances the project. Proactively helps other team members complete their assigned tasks to a similar level of excellence. Helps the team move forward by articulating the merits of alternative ideas or proposals.	ENGR 301 CHME 201 CHME 216 CHME 220 CHME 240	CHME 300 CHME 320 CHME 321 CHME 340 CHME 390	CHME 440 CHME 490	Lab Reports, Term Projects, and Capstone Projects
		B	Completes all assigned tasks by deadline; work accomplished is thorough, comprehensive, and advances the project. Offers alternative solutions or courses of action that build on the ideas of others.				
		C	Completes all assigned tasks by deadline; work accomplished advances the project. Offers new suggestions to advance the work of the group.				
		F	The ideas and work provided do not advance the work of the group.				
Initiative and leadership	• Conceptual contribution as measured by peer evaluation • Demonstrates leadership and initiative • Supports shared leadership?	A	Takes initiative to do most of the activities of the project; voluntarily takes the leadership of the team; organizes the meetings; respects other team members and their ideas; volunteers to do the project presentation; manages any kind of conflicts within the group.	CHME 201 CHME 216 CHME 220 CHME 240	CHME 300 CHME 320 CHME 321 CHME 340 CHME 352 CHME 390	CHME 440 CHME 490	Lab Reports, Term Projects, and Capstone Projects
		B	Takes initiative to do different activities of the project; voluntarily takes the leadership of the project team; organizes the meetings; respects other team members and their ideas; tries to manage any kind of conflicts within the group.				
		C	Takes initiative to do some of the activities of the project; upon discussion with the group, takes the leadership of the project team; organizes most of the meetings; usually respects other team members and their ideas; tries to manage any kind of conflicts within the group.				
		F	Does not take initiative to do the activities of the project; does not have the leadership skill; is sometimes not respectful to other team members and their ideas; does not volunteer to do the project presentation; cannot manage conflicts within the group.				
Delivering results	• Has the group delivered the expected results in a timely manner? • Will the group members work together on a new project in the future?	A	Delivers an extemporaneous presentation, with clearly defined objectives, an easy-to-follow structure, and a simple straightforward presentation style. Responds to questions with confidence and ease. The presentation respects the time specifications.	CHME 201 CHME 216 CHME 220 CHME 240 CHME 320	CHME 300 CHME 320 CHME 321 CHME 340 CHME 352 CHME 390	CHME 440 CHME 490	Lab Reports, Term Projects, and Capstone Projects
		B	Delivers a presentation that may or may not rely on notes, or may be memorized. The objectives of the presentation may be buried in unnecessary information, but are available to the audience. Presentation style is easy, but may be awkward at times, or seem unpracticed. Responds adequately to questions. The presentation may run under or over the time limits.				
		C	Delivers a presentation that relies heavily on notes, or is stiffly memorized. The objectives of the presentation are unclear, and the audience is not able to follow the presentation structure. Presentation style is awkward. Attempts but may not respond directly to questions. Presentation is over or under time restrictions.				
		F	Delivers a presentation that is read. The objectives of the presentation are unclear, impossible to follow, or not present. Presentation style is uncomfortable. Fails to respond to audience questions. Presentation does not follow the time restrictions.				

Table 23. Graduate attribute mapping for Professionalism.

Professionalism An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.							
		Rubrics		Level			
Indicators	Students can..	Grade	Definition	Introduce	Develop	Apply	Suggested assessment method
Role and responsibilities of the professional engineer	• Appreciate the role filled by professional engineers and the imperative of the security of the public. • Describe the role of engineers in Quebec's professional system. • Differentiate between professional and personal roles. • Understand the professional values of the engineering profession: competence, responsibility, ethical conduct, and social engagement. • Distinguish between dimensions of responsibility – moral, legal and social. • Describe liability in Quebec's legal system. • Identify legal issues and responsibility pertaining to life, occupational health and safety, and intellectual property. • Apply responsibility in professional context.	A	Cites correct, relevant professional standards. Application of standards to project is well-detailed and thorough. If none are applicable, provides clear explanation, and indicates what kind of standards might be useful for project. Clearly indicates superior understanding of professional standards. Excellent understanding of the different dimensions of professional responsibility.	ENCS 282 ENGR 201 CHME 200	ENGR 202 ENGR 301 ENGR 371 ENGR 392 CHME 201 CHME 300	CHME 390 CHME 490	Term project. Concept test online. Relevance to the project in Capstone and other project courses.
		B	Cites correct, relevant professional standards, and applies them to project. If none are applicable, clear reasoning is provided. Clearly indicates good understanding of professional standards and responsibility.				
		C	Cites relevant professional standards. Identifies the standards that apply to projects or states clearly if none are applicable. Indicates satisfactory understanding of professional responsibility.				
		F	Cites poor or provides no reference to professional standards or code; no clear evidence of appreciation or understanding of professional standards. Unsatisfactory understanding of professional responsibility.				
Professional practice	• Communicate through accepted professional means. • Identify relevant professional standards. • Adopt a professional conduct. • Consider their engineering practice in the perspective of sustainability.	A	Cites correct, relevant and complete professional standards. Application of standards to projects is well-detailed and thorough. If none are applicable, provides clear explanation, and indicates what kind of standards might be useful for project. Clearly indicates understanding of professional standards.	ENCS 282 ENGR 201 CHME 240	ENGR 301 ENGR 371 ENGR 392 CHME 340	CHME 390 CHME 440 CHME 490	Term project. Concept test online. Relevance to the project in Capstone and other project courses.
		B	Cites correct, relevant professional standards, and applies them to project. If none are applicable, clear reasoning is provided.				
		C	Cites relevant professional standards. Identifies the standards that apply to projects or states clearly if none are applicable.				
		F	Cites poor or provides no reference to professional standards or code; no clear evidence of appreciation of professional standards.				

Table 24. Graduate attribute mapping for Impact of Engineering on Society & the Environment.

Impact of engineering on society & the environment An ability to analyze social and environmental aspects of engineering activities. Such abilities include an understanding of the interactions that engineering has with the economic, social, health, safety, legal and cultural aspects of society.							
		Rubrics		Level			
Indicators	Students can..	Grade	Definition	Introduce	Develop	Apply	Suggested assessment method
Awareness of society and environment	• Recognize relevance of societal impact of engineering to improving innovation • Categorize wide range of engineering and society relationships, including economic, social, health, safety, legal and cultural aspects • Demonstrate familiarity with evolution of technologies	A	Complete understanding of environmental aspects. Effective in addressing of environmental issues leading to a better result.	ENGR 202 ENGR 301 CHME 200 CHME 360	ENGR 392 CHME 201 CHME 300 CHME 352 CHME 390	CHME 301 CHME 490	Case Study Project work Design Project
		B	Sound understanding of environmental aspects. Mostly effective in addressing environmental issues.				
		C	Environmental aspects are addressed ineffectively with little or no effect on end results.				
		F	No understanding or appreciation of the importance of environmental concerns.				
Sustainability in design	• Identify social and environmental protection issues • Locate challenges to sustainability from technological design • Identify knowledge gaps and the need for additional data when designing for optimal social and environmental impact • Design strategies for incorporating social sustainability • Utilize appropriate models in engineering design for optimal social and environmental impact	A	Able to demonstrate knowledge of more than one contemporary societal or community issue. Excellent discussion of engineering implications of multiple contemporary issues with reasoned examples and sound rationale. Excellent discussions of one or more larger community need that is being addressed by the project partner.	ENGR 202 CHME 200	ENGR 392 CHME 201 CHME 300 CHME 321 CHME 352 CHME 390	CHME 490	Case Study Project Work Design Project
		B	Able to demonstrate knowledge of one or more contemporary societal or community issues. Able to describe engineering implications of one or more contemporary issues with some examples and rationale. Able to describe at least one larger community need that is being addressed by the project partner.				
		C	With assistance, can demonstrate some knowledge of one contemporary community or societal issue. Explanation of implications of engineering to a societal issue is mostly ineffective and lacking. Needs assistance to identify one larger community need being addressed by the project partner.				
		F	Unable to demonstrate knowledge of one or more contemporary societal or community issues. Unable to describe engineering implications of one or more contemporary issues. Unable to describe at least one larger community need that is being addressed by the project partner.				

Table 25. Graduate attribute mapping for Ethics and Equity.

Ethics and equity An ability to apply professional ethics, accountability and equity.								
		Rubrics		Level				
Indicators	Students can..	Grade	Definition	Introduce	Develop	Apply	Suggested assessment method
Professional ethics and accountability	• Distinguish professional ethics from ethics in Canada and Quebec • Define and categorize concepts such as trust and loyalty • Identify duties and obligations in the professional or engineer's code • Apply professional ethics in case studies • Describe accountability to multiple constituencies: engineering profession, public, client • Apply accountability to professional context	A	Can discuss aspects of professional ethics related to a given situation. Can make a sensible deduction with respect to the situation presented.	ENCS 282 ENGR 201 ENGR 202 CHME 201	ENGR 392 CHME 321 CHME 390	CHME 490	Case studies Assignments
		B	Can discuss aspects of professional ethics related to a given situation but cannot make a clear deduction with respect to the situation.				
		C	Familiar with aspects of professional ethics but cannot make a sensible deduction in the context of the given situation.				
		F	Unfamiliar with basic terminology and issues associated with professional ethics.				
Equity	• Describe professional obligations against discrimination • Appreciate gender dimensions of equity • Identify economic disparity as a challenge in globalization and sustainability	A	Shows comprehensive theoretical and conceptual understanding of social responsibility. Develops insightful examples of social responsibility. Explores the ethical dimensions of social responsibility and implications for equity. Develops a detailed analysis of the tradeoffs and ethical quandaries for businesses and individuals between the profit motive, customer satisfaction and civic responsibility.	ENCS 282 ENGR 201	ENGR 392 CHME 300	CHME 490	Case studies Project work
		B	Explains social responsibility in nuanced terms. Provides detailed examples of real-life instances of social responsibility. Recognizes the ethical dimensions of social responsibility and some equity considerations. Considers tradeoffs and ethical quandaries which occur in the practice of social responsibility.				
		C	References examples of real-life instances. Explains social responsibility in simplistic terms. Mentions tradeoffs and ethical quandaries briefly. Mentions equity issues briefly.				
		F	Provides no examples of instances of social responsibility. Fails to explain social responsibility. Does not acknowledge the ethical or equity issues in social responsibility. Fails to explore the relationship between ethical behavior and social responsibility.				

Table 26. Graduate attribute mapping for Economics and Project Management.

Economics and project management

An ability to appropriately incorporate economics and business practices including project, risk and change management into the practice of engineering and to understand their limitations.

		Rubrics		Level			
Indicators	Students can..	Grade	Definition	Introduce	Develop	Apply	Suggested assessment method
Fundamentals of economics	• Make economic decisions. • Explain engineering costs. • Prepare and use cash flow diagrams. • Explain interest and equivalence. • Perform and use various economic analysis techniques.	A	Outlines a basic plan considering value of money in decision making.	ENGR 301 CHME 201	CHME 300 CHME 320 CHME 321	CHME 390 CHME 490	Term project. Concept test online. Relevance to the project in Capstone and other project courses.
		B	Applies basic principles including one time versus recurring costs and return on investment in decision making.				
		C	Discusses economic principles in a broad or general way without relating to the actual project.				
		F	Makes no mention of economic principles.				
Economic evaluation of projects	• Perform economic assessment of projects. • Evaluate and select alternative projects. • Perform economic sensitivity analysis. • Perform economic risk analysis. • Carry out project cost estimation.	A	Identifies all the requirements and associated resources and realistically assesses the scope, dimensions, scale of effort and indicative costs of an engineering project.	ENGR 301 CHME 200 CHME 201	CHME 300 CHME 321	CHME 390 CHME 490	Term project. Concept test online. Relevance to the project in Capstone and other project courses.
		B	Identifies some of the requirements and associated resources and realistically assesses the scope, dimensions, scale of effort and indicative costs of an engineering project.				
		C	Identifies some of the requirements and associated resources but not capable of assessing the scope, dimensions, scale of effort and indicative costs of an engineering project in a realistic manner.				
		F	Unable to identify requirements and associated resources and not capable of assessing the scope, dimensions, scale of effort and indicative costs of an engineering project in a realistic manner.				
Project planning and implementation	• Explain and select organizational structures. • Develop work breakdown structure. • Develop project schedules. • Perform network diagram analysis. • Identify critical paths. • Build teams and manage team dynamics.	A	Presents an efficient, excellent plan; detailed budget; foresees and mitigates potential risks.	ENGR 301 CHME 200	CHME 300 CHME 321	CHME 390 CHME 490	Term project. Concept test online. Relevance to the project in Capstone and other project courses.
		B	Plans and efficiently manages time and money; regular meetings; safety considerations are clear.				
		C	Poor timeline or budget; infrequent meetings; minor safety problems.				
		F	No useful timeline or budget; missed meetings; inappropriate safety considerations.				

Table 27. Graduate attribute mapping for Life-long Learning.

Life-long learning An ability to identify and to address his/her own educational needs in a changing world, sufficiently to maintain his/her competence and contribute to the advancement of knowledge.							
		Rubrics		Level			
Indicators	Students can..	Grade	Definition	Introduce	Develop	Apply	Suggested assessment method
Identifying missing knowledge and learning opportunities	• Assess the problem and identify when knowledge is missing • Identify sources to seek out necessary information • Self-acquire necessary information from different sources	A	Makes explicit references to previous learning and applies in an innovative (new and creative) way that knowledge and those skills to demonstrate comprehension and performance in novel situations. Identify when knowledge is missing and seek out sources to obtain the missing knowledge	ENGR 201 ENGR 202 ENCS 282 CHME 200 CHME 201	CHME 240 CHME 320 CHME 340 CHME 440 CHME 352 ENGR 371 ENGR 392	CHME 316 CHME 321 CHME 390 CHME 490	Project work
		B	Makes references to previous learning and shows evidence of applying that knowledge and those skills to demonstrate comprehension and performance in novel situations. Identifies when knowledge is missing but may not fully acquire missing knowledge.				
		C	Makes references to previous learning and attempts to apply that knowledge and those skills to demonstrate comprehension and performance in novel situations. Shows some difficulty when faced with problems where knowledge is missing				
		F	Makes vague references to previous learning but does not apply knowledge and skills to demonstrate comprehension and performance in novel situations. Relies only on previous learning, without identifying missing knowledge				
Continuous improvement and self-learning	• Continually seek out new knowledge • Leverage available learning opportunities and knowledge sources to stay current	A	Seeks out new information and latest developments	CHME 301 ENGR 311	CHME 360 CHME 361 CHME 362 ENGR 371 ENGR 391	CHME 316 CHME 390 CHME 415 CHME 490	Exposure to new software Case studies
		B	Keeps current periodically on some aspects and developments in the domain				
		C	Maintains little connection to external improvement and self-learning sources				
		F	Fails to pursue any resources or information outside of coursework				

Specific knowledge, expertise, skills (learning outcomes) which students will acquire

By the end of this program, successful students will be able to do the following:

Knowledge

1. Understanding of sciences related to chemical engineering:
    a. Mathematics
    b. Physics
    c. Chemistry
    d. Biology
2. Understanding of the fundamentals of chemical engineering:
    a. Heat and Mass Transfer
    b. Chemical Thermodynamics
    c. Transport Phenomena (momentum, mass, and heat transfer)
    d. Unit Operations and Separation
    e. Reaction kinetics (including biological systems)
    f. Chemical Reactor Engineering (including biological reactors)
    g. Material science (properties and manufacturing processes)
    h. Process dynamics and control
    i. Sustainability principles
    j. Process design principles
    k. Engineering economics and decision-making
    l. Environmental and safety regulations
    m. Chemical engineering tools (simulation, AutoCAD, MATLAB, programming)
3. Understanding of the fundamentals of the selected specialization:
    a. Core concepts and governing principles
    b. Application of chemical engineering principles to the selected specialization
4. Understand the engineering profession
    a. Code of ethics
    b. Impact on society of engineering projects and technology
    c. Rules and regulations

Skills & Abilities

5. Soft skills/abilities
    a. Critical thinking (structured analysis, research literature, evaluation, conclusion)
    b. Problem solving (problem definition, brainstorming, planning, evaluation)
    c. Communication skills (written, oral, active listening, presentation)
    d. Teamwork (planning and organization, conflict resolution)
6. Technical Skills/abilities
    a. Basic process and equipment troubleshooting
    b. Implement sustainability and safety concepts in process design

8. SUPPORT FOR STUDENT SUCCESS

8.1 Financial support

There are various sources of funding available to support the students. Below is a list of applicable financial support programs to the BEng in Chemical Engineering students.

University-wide sources of funding:

- Concordia Council on Student Life Special Project Funding
- Concordia University Small Grants Program
- Concordia University Alumni Association (CUAA)
- Concordia Student Union (CSU)
- Grants for Religious and Spiritual Groups
- QPIRG Discretionary Fund
- Sustainability Action Fund
- SHIFT Centre for Social Transformation
- Concordia University Undergraduate Entrance Bursary Program
- Concordia University Undergraduate In-Course Bursary program
- Brian T. Counihan Scholarship for Outstanding Contribution to Student Life
- Colors of Concordia Award
- Dr. Dimitri Elia Bitar Scholarships
- Garnet Key Entrance Award
- Lambda Scholarship Tuition Award
- Leadership in Environmental Sustainability Shuffle Award
- Leonard J Bocarro Science, Engineering and Technology Scholarship
- Loyola Foundation Inc. Entrance Scholarship
- NSERC USRA Competition
- Pierre-Peladeau Bourses
- Queen of Angels Academy Foundation Memorial Award
- Susan Levin Woods Scholarship
- Concordia Presidential Scholarship
- Concordia International Scholars
- Student Mobility Program
- Concordia Undergraduate Student Research Awards Program
- External Awards

Gina Cody School of Engineering and Computer Science (GCS) sources of funding:

For all students:

- Fariborz and Roya Haghighat Entrance Scholarship in Engineering $5,000 value
- Gina Cody Undergraduate Entrance Scholarship in Engineering and Computer Science $5,000 value
- Marie and Bob Baird Entrance Scholarship $5,000 value
- Petrogiannis Family Award for Women in Engineering $5,000 value
- Concordia University Shuffle Entrance Scholarship $3,000 value
- Bachelor of Engineering 50th Anniversary Scholarship $2,500 value
- Concordia University Entrance Scholarship $2,500 value
- Concordia University Adopt-A-Student Entrance Scholarship
- Gina Cody School Shuffle Scholarship $1,661.66 value
- Carolina Gallo Scholarship for Women in Engineering and Computer Science $1,000 value
- ENCS Student Life Award $1,000 value

For International students:

- Concordia University International Tuition Entrance Scholarship $5,000 value

For Canadian citizens and permanent residents:

- Normand D. Hébert Scholarship in Engineering $7,000 value
- NDT Technologies Inc. Scholarship for Engineering and Computer Science $5,000 value
- Robert Walsh Entrance Scholarship in Engineering and Computer Science $5,000 value
- Gina Cody School Women in Engineering Entrance Scholarships $2,500 value
- Concordia University Alumni Association Entrance Scholarship $2,000 value
- Jack Bordan Entrance Scholarship in Engineering and Computer Science $2,000 value
- Concordia University Memorial Endowment Entrance Scholarship $1,250 value
- Schouela Family Entrance Scholarship $1,250 value

For Canadian citizens with proof of Quebec resident status

- Distinguished CEGEP Entrance Scholarship in Engineering and Computer Science $5,000 value

For Quebec students

- Gina Cody School Undergraduate Entrance Scholarship $3,000 value

8.2 Student Services

There are a variety of student services, workshops, and events offered by various offices in Concordia, the Department of Chemical and Material Engineering, and various Student Associations. Below is a list of these services:

- Admission advising
- Immigration advising
- Academic advising & support
- Financial support
- Health & well-being
- Career & job resources
- Student life
- Student Emergency and Food Fund
- CME Undergraduate Orientation Session
- CME Gala Event
- CME Undergraduate Research Day
- CME Undergraduate Student Handbook
- CME Workshops
- CME Annual BBQ Event
- CME Seminar Series
- Student Association Events
- Capstone Poster Day

Related Offices:

- Student Academic Services (SAS)
- International Students Office (ISO)
- Student Success Centre
- Financial Aid and Awards Office
- Health Services
- Campus Security
- Access Centre for Students with Disabilities (ACSD)
- Multi-Faith and Spirituality Centre
- Career and Planning Services (CAPS)
- Otsenhákta Student Centre
- Concordia University Student Parents Centre (CUSP)
- Dean of Students
- LIVE Centre
- IT support (AITS)
- ASFA Student Life Volunteer Pool

Student Associations:

1. ECSGA (Engineering and Computer Science Graduate Association)
2. ECA (Engineering and Computer Science Association)
3. Concordia Student Union
4. WIE (Women in Engineering)
5. GCES (Gina Cody School Entrepreneurship Society)
6. EngGames (Engineering Games – Concordia University)
7. Hack Concordia
8. Space Concordia

8.3 Academic and student life

There are various opportunities for students to be involved in the community and in associations within the university.

- **Multi-faith and Spirituality Centre**

A home on campus for all those who wish to celebrate the human spirit, open to all students whether spiritual, secular or religious.

- **Centre for Gender Advocacy**

An independent, student-funded organization mandated to promote gender equality and empowerment particularly as it relates to marginalized communities.

- **Centre for Creative Reuse**

CUCCR is dedicated to diverting materials from inside Concordia's waste-stream and offering them to the general community free of cost.

- **D3 Center for Innovation and Entrepreneurship**

Center for Innovation and Entrepreneurship that provides the necessary tools, resources and knowledge to move from idea to impact with confidence.

- **The SHIFT Centre for Social Transformation**

Supports existing and emerging social transformation initiatives that unite with the goal of creating a more just, inclusive and broadly prosperous Montreal.

- **Sustainability Hub**

Promoting sustainability-related initiatives, tools, resources, research, funds and programs to the Concordia community.

- **Spark!**

Inspiration for students to actively participate in learning experiences at Concordia that have a positive impact on their success.

- **Otsenhákta Student Centre**

An on-campus resource for First Nations, Métis and Inuit students to find community, plan social events and access resources to help them achieve academic success.

- **University of the Streets Café**

A program that organizes bilingual public conversations in cafés and community spaces across Montreal.

- **Zero Waste**

An initiative focused on reducing waste on campus and encouraging the Concordia community to reduce, reuse, recycle and rot.

- **Black Perspectives Office**

Connects and supports activities related to Black perspectives, initiatives and scholarship on campus and within the broader Montreal community.

- **Quebec Public Interest Research Group**

An inclusive resource centre that supports grassroots activism around diverse social and environmental issues and aims to inspire social change.

- **Office of Community Engagement**

Connecting faculty, staff and students with members of the wider Montreal community in order to build meaningful relationships.

- **Queer Concordia**

An on-campus resource centre for queer, lesbian, gay, trans, two-spirited, bisexual, asexual, intersex, questioning and allies.

- **Best Buddies**

In collaboration with Best Buddies Canada to create fun, meaningful and lasting friendships.

- **Homeroom**

A virtual place for new undergraduate students to connect and navigate the university experience together.

- **Student Association Events**

Once the BEng program is formed, a student association for the Chemical Engineering Bachelors program will be started, consisting of academic representatives and social representatives for each year of the program. Academic representatives will be responsible for collecting student feedback from courses and giving it to the Undergraduate Program Director. Social representatives will be responsible for organizing social events for students, including student, staff, and faculty mixers every semester and fundraising events.

9. RESOURCES

9.1 Faculty Resources

9.1.1 Current Faculty

Full-Time Faculty Members:
Chair, Dr. Alex De Visscher, Full Professor, P.Eng (ADV)
Dr. Marc-Antoni Goulet, Assistant Professor (MAG)
Dr. Melanie Jane Hazlett, Assistant Professor, P.Eng (MJH)
Dr. Sana Jahanshahi Anbuhi, Assistant Professor, Concordia University Research Chair (SJA)
Dr. Ivan Kantor, Assistant Professor (IK)
Dr. Yaser Khojasteh Salkuyeh, Assistant Professor (YKS)
Dr. Xia Li, Assistant Professor, Concordia University Research Chair (XL)
Dr. Deniz Meneksedag Erol, Assistant Professor (DME)
Dr. Nhat Truong Nguyen, Assistant Professor (NTN)
Dr. Pantcho Stoyanov, Associate Professor (PS)
Dr. Paula Wood-Adams, Full Professor, P.Eng (PWA)
Dr. Rolf Wuthrich, Full Professor, ing. (RW)
Dr. Zhibin Ye, Full Professor, P.Eng (ZY)
Dr. Karim Zaghib, Full Professor, P.Eng (KZ)

Associate Members:
Dr. Steve Shih, Associate Professor

Please see Appendix 6 for the CVs of current faculty members. A table demonstrating the ability of the faculty to teach the planned CHME courses in this program is given below in Table 28:

Table 28: Faculty Teaching Capabilities

	Course Codes	Course Titles	Professor Initials	# of Profs
Core Courses	CHME 215	Programming for Chemical and Materials Engineers	ADV, MAG, MJH, IK, DME, RW	6
	CHME 216	Advanced Programming for Chemical Engineers	ADV, RW	2
	CHME 220	Material Properties and Chemical Characterization	ADV, MAG, XL, NTN, PS, PWA, KZ	7
	CHME 351	Chemical Engineering Thermodynamics	ADV, MAG, MJH, SJA, IK, YKS, DME	7
	CHME 200	Introduction to Chemical Process Engineering	ADV, MJH, IK, YKS	4
	CHME 201	Innovative, Sustainable, and Safe Manufacturing in Chemical Industry	MAG, MJH, IK, YKS, KZ	5

	CHME 240	Chemical Engineering Lab I	MAG, NTN	2
	CHME 300	Industrial and Engineering Chemistry	ADV, MJH, IK, YKS, KZ	5
	CHME 320	Technical and Advanced Materials	XL, NTN, PS, PWA, KZ	5
	CHME 352	Energy Conversion and Storage	ADV, MAG, MJH, SJA, IK, YKS, KZ	7
	CHME 360	Heat Transfer	ADV, MJH, IK, YKS, XL, DME, PS	7
	CHME 321	Chemical and Materials Product Design	NTN, PS, PWA, KZ	4
	CHME 361	Mass Transfer and Unit Operations	ADV, MAG, MJH, YKS, DME, ZY	6
	CHME 301	Chemical Reaction Engineering	ADV, MAG, MJH, IK, YKS	5
	CHME 330	Chemical Process Dynamics and Control	IK, YKS	2
	CHME 340	Chemical Engineering Lab II	MAG, NTN	2
	CHME 362	Chemical Separations Engineering	ADV, MJH, SJA, YKS, DME, ZY	6
	CHME 390	Design Project	MJH, IK, YKS, ZY	4
	CHME 316	Advanced Data Analysis and Machine Learning for Chemical Engineers	ADV, IK, YKS, RW	4
	CHME 415	Computational Modelling for Chemical Engineers	DME	1
	CHME 440	Chemical Engineering Lab III	NTN	1
	CHME 490	Capstone Chemical Process Design	MJH, IK, YKS, NTN, ZY	5
Technical Electives	CHME 470	Advanced Biochemical Engineering	SJA	1
	CHME 471	Colloid and Interface Chemistry	ZY	1
	CHME 472	Food Engineering		0
	CHME 473	Biomaterials and Biochemicals	PS, PWA	2
	CHME 420	Nanomaterials Science and Engineering	XL, NTN, PS, ZY, KZ	5
	CHME 421	Metallurgical Engineering	PS	1
	CHME 422	Polymer Chemistry and Engineering	PWA, ZY	2
	CHME 423	Advanced Battery Materials and Technologies	MAG, XL, KZ	3
	CHME 424	Advanced Characterization Techniques	XL, PS, ZY	3
	CHME 425	Hydrometallurgy	KZ	1
	CHME 400	Sustainable Industrial and Engineering Chemistry	MJH, IK, YKS	3
	CHME 401	Sustainable Process Design	IK, YKS	2
	CHME 402	Sustainable Energy Conversion and Management	MAG, YKS, XL, RW	4
	CHME 403	Electrochemical Engineering	MAG, XL, RW, KZ	4
	CHME 404	Clean Energy Science and Technology	MAG, IK, XL	3
	CHME 405	Introduction to Environmental Engineering	ADV	1
	CHME 460	Chemical Kinetics and Advanced Reactor Engineering	ADV, MAG, MJH	3
	CHME 461	Adv Chemical Engineering Thermodynamics	ADV, MJH, SJA, XL	4
	CHME 462	Industrial Catalysis	MJH	1
	CHME 463	Advanced Separation Processes	SJA	1
	CHME 430	Advanced Chemical Process Dynamics and Control	IK	1
	CHME 431	Introduction to Optimization for Chemical Engineers	IK, YKS	2
	CHME 432	Advanced Process Safety Engineering	YKS	1
	CHME 433	Data Engineering for Chemical Engineers	RW	1
	CHME 480	Molecular Modeling of Proteins	DME	1
	CHME 481	Multiscale modeling of Biomaterials	DME	1

9.1.2 Faculty Hiring Plan

In Year 0 we will need to select an Undergraduate Program Director with a remission of 1.5 credits to handle the launch of the program. In year 1 this course remission will increase to 3.0 credits per year. In year 1 a Co-operative Education Program Director will be selected to interface with the Institute for Co-operative Education for the students who are enrolled in the various internship options (Co-op program, C-Edge, ACE), also receiving a course remission of 3.0 credits per year. A Curriculum Director will be selected in year 1 as well, also receiving a course remission of 3.0 credits per year.

In terms of faculty hiring for the BEng we require the following positions to be searched (Table 29):

Table 29. Faculty Hiring for Chemical Engineering BEng.

Position	Priority
Polymerization Engineering	1
Solar Cell Materials	2
Drug Delivery Systems and Materials	3
Responsive Polymer Materials	4
Pharmaceutical Engineering	5
Electrochemical Biosensors and Bioassays	6

Currently Searching:

- Chemical and Biomedical Engineering
- Characterization for Energy Conversion and Storage

Priority 1: Polymerization Engineering

One of the major challenges of the chemical industry is to fulfill the growing need for polymers while at the same time contributing to sustainability goals. The polymers of the future will have to be either more recyclable or more biodegradable. To accomplish this, new polymer chemistries will be needed, as well as new approaches to manufacturing those polymers. The objective of this faculty position is to contribute to research that is translatable into more sustainable technical and advanced polymer materials.

- Chemical Engineering tends to be more gender-balanced than most engineering fields. The field is ethnically very diverse. The department has been very successful in recruiting a gender-balanced group of faculty members. CME will build on this success by advertising the position to a broad and diverse audience in Canada and abroad.
- The faculty member will be well-placed to teach courses in the area of industrial chemistry, an important topic in chemical engineering programs.
- The position fits in research theme number 5 of Concordia University's strategic research plan: Advanced Materials and their Applications, as well as in theme number 6: Natural Systems and Sustainability.
- This position fits within the sustainability theme, which is the main theme in CME's research strategy and aligns strategically with the research of Dr. Ye and Dr. Wood-Adams in CME, as well as with Dr. Oh in the Department of Chemistry and Biochemistry.
- The position will support the growth of the new M.A.Sc. programs in Chemical Engineering, as well as the future B.Eng. and M.Eng. programs in Chemical Engineering.

Priority 2: Solar Cell Materials

Concordia University has substantial expertise in solar energy, as evidenced by initiatives such as the CERC in Smart and Sustainable Cities, the Centre for Zero Energy Building Studies, and the Solar House. CME plans to add a materials engineering component to this expertise by establishing a faculty position in solar cell materials. The new position will also complement existing expertise in battery materials and smart materials. Candidates with expertise in any type of novel solar cell materials will be welcome to apply including perovskite solar cells, organic and polymer solar cells, and quantum dot solar cells.

- Chemical Engineering tends to be more gender-balanced than most engineering fields. The field is ethnically very diverse. The department has been very successful in recruiting a gender-balanced group of faculty members. CME will build on this success by advertising the position to a broad and diverse audience in Canada and abroad.
- The faculty member will be well-placed to teach courses in the area of advanced materials.
- The position fits in research theme number 4 of Concordia University's strategic research plan: Enabling and Disruptive Technologies and their Foundations, as well as in theme number 5: Advanced Materials and their Applications, and in theme number 6: Natural Systems and Sustainability.
- This position fits within the sustainability theme, which is the main theme in CME's research strategy and aligns strategically with the research in Smart and Sustainable Cities, Zero Energy Buildings, as well as with the energy conversion and storage research at CME.
- The position will support the growth of the new M.A.Sc. programs in Chemical Engineering, as well as the future B.Eng. and M.Eng. programs in Chemical Engineering.

Priority 3: Drug Delivery Systems and Materials

As reported in March 2021 by Global News, 1 in 4 Canadians do not take their medication as prescribed. The extent is far worse globally where >50% of patients take their medication differently than prescribed or stop taking it without consulting a medical professional. To contribute to addressing this big health concern, CME intends to broaden their team expertise by hiring a faculty member in the area of Drug Delivery Systems and Materials that is focused on engineered technologies for targeted delivery of drugs to desired body sites and/or pre-programmed controlled release of therapeutic agents. To design and produce a new drug delivery system and/or material, one must fully understand the to-be-released drug and its material properties as well as processing variables that affect its release from the system. This requires a solid grasp of chemical engineering's core materials from mass transfer to reaction kinetics, thermodynamics, and transport phenomena. Candidates in areas of chemical and biochemical engineering, as well as pharmaceutical engineering will be welcome to apply to this position.

- Chemical Engineering tends to be more gender-balanced than most engineering fields. The field is ethnically very diverse. The department has been very successful in recruiting a gender-balanced group of faculty members. CME will build on this success by advertising the position to a broad and diverse audience in Canada and abroad.
- The faculty member will teach technical electives in the graduate and future undergraduate programs in Chemical Engineering.
- The position fits in research theme number 4 of Concordia University's strategic research plan: Enabling and Disruptive Technologies and their Foundations, as well as in research theme number 5: Advanced Materials and their Applications.
- This position broadens the scope of the materials engineering core group at CME and aligns strategically with the planned School of Health.
- The position will support the growth of the new M.A.Sc. program in Chemical Engineering, as well as the future B.Eng. and M.Eng. programs in Chemical Engineering.

Priority 4: Responsive Polymer Materials

Responsive polymer materials are materials that change their chemical and/or physical properties in response to a stimulus. These types of materials have applications in (bio)sensing, controlled drug delivery, and as smart coatings. We intend to hire a person with expertise in the chemistry and materials engineering of this type of polymers.

- Chemical Engineering tends to be more gender-balanced than most engineering fields. The field is ethnically very diverse. The department has been very successful in recruiting a gender-balanced group of faculty members. CME will build on this success by advertising the position to a broad and diverse audience in Canada and abroad.
- The faculty member will teach technical electives in the graduate and future undergraduate programs in Chemical Engineering.
- The position fits in research theme number 5 of Concordia University's strategic research plan: Advanced Materials and their Applications.
- This position broadens the scope of the materials engineering core group at CME.
- The position will support the growth of the new M.A.Sc. program in Chemical Engineering, as well as the future B.Eng. and M.Eng. programs in Chemical Engineering.

Priority 5: Pharmaceutical Engineering

Canada's inability to manufacture vaccines during COVID-19 has clearly demonstrated the need to bring pharmaceutical production back to Canada. To help fulfill this need, CME intends to hire a faculty member in pharmaceutical engineering. Pharmaceutical production methods vary widely, from purely chemical to purely biological. Candidates in all areas of pharmaceutical engineering will be welcome to apply to this position.

- Chemical Engineering tends to be more gender-balanced than most engineering fields. The field is ethnically very diverse. The department has been very successful in recruiting a gender-balanced group of faculty members. CME will build on this success by advertising the position to a broad and diverse audience in Canada and abroad.
- The faculty member will teach technical electives in the graduate and future undergraduate programs in Chemical Engineering.
- The position fits in research theme number 4 of Concordia University's strategic research plan: Enabling and Disruptive Technologies and their Foundations, as well as in research theme number 5: Advanced Materials and their Applications.
- This position fits within the sustainability theme, which is the main theme in CME's research strategy, particularly on the interface between sustainability and resilience: making products locally, from locally sourced materials eliminates transportation fuel consumption and makes a region more self-sufficient. It is a new area we wish to develop.
- The position will support the growth of the new M.A.Sc. programs in Chemical Engineering, as well as the future B.Eng.

and M.Eng. programs in Chemical Engineering.

Priority 6: Electrochemical Biosensors and Bioassays

Electrochemical biosensors are sensors that can detect biological agents (cells, enzymes, etc) based on an electrochemical principle. Assays based on this type of sensors finds applications in health monitoring and environmental monitoring. The objective of this position is to develop new, more precise, and more reliable electrochemical biosensors and bioassays based on such sensors.

- Chemical Engineering tends to be more gender-balanced than most engineering fields. The field is ethnically very diverse. The department has been very successful in recruiting a gender-balanced group of faculty members. CME will build on this success by advertising the position to a broad and diverse audience in Canada and abroad.
- The faculty member will teach technical electives in the graduate and future undergraduate programs in Chemical Engineering.
- The position fits in research theme number 4 of Concordia University's strategic research plan: Enabling and Disruptive Technologies and their Foundations, as well as in research theme number 5: Advanced Materials and their Applications.
- This position complements the research of Dr. Anbuhi, who was recently awarded a CURC, and aligns strategically with the planned School of Health.
- The position will support the growth of the new M.A.Sc. programs in Chemical Engineering, as well as the future B.Eng. and M.Eng. programs in Chemical Engineering.

The Bachelor of Engineering, Chemical Engineering has been planned by the offices of the provost and dean since before the establishment of the department itself in 2017. The support for all necessary faculty hires is strong. In the context of the LOI, three new faculty positions were proposed and approved in principle. At this stage a more detailed budget supports the addition of five positions for Year 0 and two more for Year 1. With our projected enrolments the program becomes profitable in Year 5 of its operation.

9.1.3 Support Measures for Teaching

The Centre for Teaching and Learning (CTL) at Concordia University provides new and existing faculty members with a wide range of pedagogical and professional development support, from course design, lesson planning, teaching and assessment strategies, instructional technologies, online or blending learning, inclusive teaching practice, student engagement to course evaluations and teaching dossier. The support is offered in a variety of formats, from web resources, elearning modules, one-on-one teaching consultation to various programming offerings and events such as workshops, webinars, New Faculty Orientation, Winterfest (teaching and learning festivals), and special projects.

CTL web resources

The centre for Teaching and Learning website houses an abundance of teaching and learning resources created or curated by the CTL staff[48]. The content is constantly updated to reflect current needs of instructors teaching at Concordia as well as to keep abreast of recent trends in faculty development in higher education. New faculty will find the website esp. helpful in quickly identifying different kinds of teaching support available to them.

Teaching Academy eLearning modules

The Teaching Academy eLearning modules developed by the CTL in collaboration with eConcordia is dedicated to promoting teaching excellence and continuous professional development for faculty[49]. The topics are divided into modules and further segmented into micro-modules. The content in each module and micro-module both stands alone and clearly links to related topics, allowing instructors to quickly learn some strategies to meet a particular need as well as follow a learning path to systematically improve certain facets or areas in their teaching practice, such as assessment in general. Like the CTL website, Teaching Academy is also public facing and freely available to instructors.

New Faculty Orientation

Faculty new hires are invited to participate in the annual CTL New Faculty Orientation that usually takes place in August. The event introduces new faculty members to various pedagogical support and services available to them and help them kick start their teaching career at Concordia by encouraging them to think about what teaching means and what

[48] https://www.concordia.ca/ctl.html

[49] https://teachingacademy.concordia.ca/

it takes to be an effective teacher.

Workshop and webinars

Faculty members are advised to check the *Event* section of the CTL website regularly, esp. before the start of a new term. The CTL offers workshops and webinars throughout an academic term, esp. in August, September, December and January. The Fall and Winter semester workshop and webinar information and registration links are usually sent to departments as well, which will in turn be shared with all instructors[50].

Teaching consultation

New faculty members are encouraged to book consultations with Teaching Consultants at the CTL, who can meet with instructors to provide advice, support and resources on a wide variety of teaching-related topics. Here are some of the most common consultation topics:

1. Reviewing a course syllabus
2. Decolonizing & indigenizing the classroom/curriculum
3. Selecting and implementing the appropriate pedagogical approach, teaching strategies and techniques, such as: active learning, flipped classroom, group work, class discussions, etc.
4. Classroom management issues
5. Designing assignments and other assessments
6. Grading
7. Selecting the most appropriate technologies
8. Implementing inclusive teaching strategies
9. Lesson planning
10. Preparing a teaching dossier (refer to the Teaching Dossier pages on Carrefour for more information on preparing a teaching dossier[51].)
11. Interpreting course evaluations (refer to the Course evaluations pages on Carrefour for more information on accessing and interpreting your course evaluations[52].)

Teaching observation and feedback

Classroom Observations can be requested by instructors at any stage in their career who are interested in getting feedback on their teaching. The Teaching Consultant regularly observes classes to provide feedback on pedagogy, classroom management, etc.

Once an instructor requests an observation, the Teaching Consultant will be in touch to set up a Pre-Observation meeting to discuss background information and the instructor's specific motivation for the observation. The Teaching Consultant will observe a lecture at a pre-determined time. After the lesson, the instructor completes a reflection, and the Teaching Consultant prepares a confidential report on the lesson. Within one week of the observed lesson, the Teaching Consultant and instructor meet to discuss the lesson and review the report with observations, comments and suggestions before it is finalized.

Course (Re)Design

If an instructor would like support in developing a new course or revamping an existing course, the CTL can work with individual or a team of instructors to ensure the development of the course follows an evidence-based approach to course design. The CTL can provide support materials and expertise on every aspect of the design of courses as they work together with instructors through each step.

Mid-course feedback

Mid-course feedback can provide valuable information for making changes in teaching before summative evaluation of a course. A teaching consultant is available to aid with interpretation of responses and offer suggestions for improving teaching effectiveness.

9.2 Administrative and support staff

[50] https://www.concordia.ca/ctl/events/workshops.html

[51] https://hub.concordia.ca/carrefour/services/faculty/teaching/teaching-dossier.html

[52] https://hub.concordia.ca/carrefour/services/faculty/teaching/course-evaluations.html

9.2.1 Current Administrative, Technical and Support Staff

Department Administrator, Erica Howse
Programs Coordinator, Antonios Daskalakis
Technical Supervisor, Harriet Laryea
Technician, Kerri Warbanski

9.2.2 Future Administrative, Technical and Support Staff

The hiring plan for staff is presented below in Table 30. Currently there is no administrative staff member in the reception area for CME. In Year 0, the pre-launch year for the Bachelor of Engineering program, it will be critical to have a frontline staff member on the team to field and triage inquiries from potential students. At program launch we will require a Programs Coordinator position for the BEng, to work with the Undergraduate Program Director in managing the program, to take on the role of answering program related queries from potential and current students, as well as to support faculty members.

In Year 1 we will need to hire an Engineer in Residence to complete the set-up of the labs and plan for capstone courses. A Technician will be required in Year 2 to prepare and run undergraduate labs (which begin in Year 2) as well as provide hands on technical support to students and account for the increasing workload.

Table 30. Staff Members Hiring Plan.

AY	# BEng Students*	Requested Admin	Requested Tech
2023-24	0	Department Assistant	-
2024-25	50	Programs Coordinator	Engineer in Residence
2025-26	120	-	Technician
2026-27	208	-	-
2027-28	312	-	-
2028-29	373	-	-

**Cohort to grow to 125 in steady state. 10% attrition rate applied. Total enrolments in any given academic year, once a full cohort in all years is achieved, is expected to hover around 430.*

9.3 Material, technological and library resources

9.3.1 Library Space and Holdings

The Concordia University Library Report is found in Appendix 3. It concludes that the collections and resources relevant to Chemical Engineering are adequate to support a BEng in Chemical Engineering.

9.3.2 Classroom space

Classroom space for new CHME and ENGR courses (lectures and tutorials) will be available at the SGW campus for the appropriate enrollments as the course grows and will be assigned through the University. Cross-listed CHME courses may be held at SGW or Loyola campuses, and travel between campuses is available through the Concordia Shuttle Bus. The ENGR courses have been scheduled in the typical student path in order to coincide with current offerings, however the additional enrollment in these courses may lead to larger classrooms or more sections being required.

9.3.3 Laboratory space and equipment

We have been provided space from Concordia University for the laboratory courses, a laboratory space has been built on the tenth floor of the Hall building at the Sir George Williams campus. The planned laboratories for the laboratory courses (CHME 240, 340, and 440) are available in the course outlines in Appendix 2, and the status of the laboratory equipment acquisition is given in Table 31 below:

Table 31. Status of laboratory equipment acquisition.

Course Code	Laboratory Topic	Equipment	Status
CHME 240	Conservation of Energy and Change in Gibbs Free Energy	Calorimeter	Delivered
	Fundamentals of Temperature Measurement	Benchtop unit for temperature measurement	Delivered
	Fundamentals of pressure and hydrostatic pressure measurement	Hydrostatics trainer	Delivered
	Ideal Gas Law: Heat engine cycle	Benchtop refrigeration circuit	Delivered
	Flow Measurement and Pressure Drop in Pipes and Fittings	Fluid mechanics trainer	Delivered
	Demonstration of Bernoulli's Principle		
CHME 340	Reaction kinetics in Continuously stirred tank reactor (CSTR)	Supply unit for chemical reactors with CSTR and PFR modules	Quotation
	Reaction kinetics in Plug flow reactor (PFR)		
	Centrifugal pumps in series and parallel	Benchtop experimental unit for centrifugal pumps in series and parallel	Quotation
	Comparison of different heat exchangers	Experimental unit for comparison of tubular, plate, and shell and tube heat exchangers	Quotation
	Estimating diffusion coefficients	Benchtop experimental units for diffusion in liquids and gases	Quotation
CHME 440	Distillation	Distillation column	Delivered
	Absorption	Falling film absorption experimental unit	Delivered
	Evaporation	Rising film evaporation experimental unit	Quotation
	Process Control	Process control engineering experimental plant	Quotation

9.3.4 Computer laboratories and software licenses

Computer laboratories in the GCS are available for the courses requiring computer simulations. The Chemical and Materials Engineering department pays for Aspen educational licenses, for use in the Aspen simulation labs in the coursework.

9.3.5 Active Learning Classrooms

There are currently ten Active Learning Classrooms (ALCs) at Concordia University, one on Loyola campus and nine on Sir George Williams campus. The active learning classrooms were designed to promote student engagement and peer collaboration. Extra whiteboards and mobile furniture make it easier to plan different classroom layouts so instructors and students can experiment with new learning activities. The smallest ALC holds 24 people and the largest 96. Faculty can learn about ALCs' different capacities and features on the CTL website and request for an active learning classroom using the SIS[53].

9.3.6 Faculty and Administrative Office Space

Additional offices for the eight faculty members, one administrative member (reception desk already available for other administrative member), and two technical staff members, totalling eleven additional offices, will be arranged by the GCS Faculty at the EV building.

[53] https://www.concordia.ca/ctl/teaching/active-learning/classrooms.html#:~:text=The%20active%20learning%20classrooms%20have,can%20experiment%20with%20new%20activities.

10. BUDGET ESTIMATES

Table 32. Summary Budget Table.

Program Financial Viability

REVENUE	Year 0 Start-Up	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Tuition Fee							
Tuition (FTE)		$131,145	$314,748	$545,563	$818,869	$978,801	$2,789,126
Grants							
Teaching Grant (WFTE)		$376,032	$902,478	$1,564,294	$2,347,946	$2,806,517	$7,997,267
Support Grant (FTE)		$103,777	$249,064	$431,710	$647,980	$774,536	$2,207,067
Total grants		$479,809	$1,151,541	$1,996,005	$2,995,926	$3,581,053	$10,204,334
Additional Funding External	$2,468,568	$811,549	$900,953	$838,203	$576,393	$220,029	$5,815,695
Total Revenue	**$2,468,568**	**$1,422,503**	**$2,367,242**	**$3,379,771**	**$4,391,189**	**$4,779,883**	**$18,809,155**

EXPENSES	Year 0 Start-Up	Year 1	Year 2	Year 3	Year 4	Year 5	Total
TEACHING							
Tenure Track	$-	$-	$149,034	$298,068	$298,068	$298,068	$1,043,238
Extended Term Contracts	$-	$119,985	$119,985	$119,985	$119,985	$119,985	$599,925
Limited Term Contracts	$-	$-	$-	$-	$-	$-	$-
Lecturers	$-	$-	$-	$-	$-	$-	$-
Course remissions	$6,250	$37,500	$37,500	$37,500	$37,500	$37,500	$193,750
Technical support	$-	$108,754	$217,508	$217,508	$217,508	$217,508	$978,784
Part Time Contracts	$-	$200,000	$312,500	$450,000	$450,000	$450,000	$1,862,500
Teacher's Assistants	$-	$39,150	$78,300	$117,450	$156,600	$156,600	$548,100
Stipends	$-	$-	$-	$-	$-	$-	$-
Other	$-	$-	$-	$-	$-	$-	$-
ADMIN STAFF							
Administrative Staff	$75,580	$151,160	$151,160	$151,160	$151,160	$151,160	$831,382
Total Payroll	$81,830	$656,549	$1,065,987	$1,391,671	$1,430,821	$1,430,821	$6,057,679
OTHER EXPENSES							
Total Other Expenses	$2,386,738	$155,000	$155,000	$155,000	$155,000	$155,000	$3,161,738
Total Expenses	**$2,468,568**	**$811,549**	**$1,220,987**	**$1,546,671**	**$1,585,821**	**$1,585,821**	**$9,219,417**
CONCORDIA UNIVERSITY SURPLUS / (DEFICIT)	$(0)	$610,954	$1,146,255	$1,833,100	$2,805,368	$3,194,062	$9,589,738

Faculty Financial Viability

ADDITIONAL BASE FUNDING		Year 0 Start-Up	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Additional Base Funding per FTE	$900			$45,000	$108,000	$187,200	$280,980	$621,180
Additional Base Funding per WFTE	$1,200			$126,000	$302,400	$524,160	$786,744	$1,739,304
Additional Base funding - full time TT Hire		$-	$-	$149,034	$298,068	$298,068	$298,068	$1,043,238
Additional Provost, External, Capital or Institutional funding		$2,468,568	$811,549	$900,953	$838,203	$576,393	$220,029	$5,815,695
Total Additional Funding		**$2,468,568**	**$811,549**	**$1,220,987**	**$1,546,671**	**$1,585,821**	**$1,585,821**	**$9,219,417**

ADDITIONAL EXPENSES	Year 0 Start-Up	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Payroll	$81,830	$656,549	$1,065,987	$1,391,671	$1,430,821	$1,430,821	$6,057,679
Other Expenses	$2,386,738	$155,000	$155,000	$155,000	$155,000	$155,000	$3,161,738
Total Expenses	**$2,468,568**	**$811,549**	**$1,220,987**	**$1,546,671**	**$1,585,821**	**$1,585,821**	**$9,219,417**
FACULTY SURPLUS / (DEFICIT)	$(0)	$(0)	$0	$0	$0	$0	$(0)

Budget Rationale

The budget as presented accounts for the full costs of the program – whether or not the costs are net new. For example, the capital amount of just over $2M, has already been allocated and the prospective labs on the tenth floor of the Hall building have been constructed. Remaining funds are being spent on lab equipment. Further, the teaching costs for the program are represented in full, whether or not the capacity already exists to teach some of the courses, or courses are offered by other departments.

Regarding teaching, the number of courses that will be offered in each year are as follows:

Year 1 = 10.5 year 1 courses plus 11 year 2 courses (for students transferring in) plus 2 sections for co-op students
Year 2 = 23.5 year 1 and 2 courses plus 10.5 year 3 courses (transfers) plus 6 sections for co-op students
Year 3 = 38 year 1-3 courses plus 7.5 year 4 courses (transfers)
Year 4 = 45.5 courses

The courses have been allocated in the budget to tenure track, extended term appointment, and part-time faculty.

Teaching assistant needs have been based on an estimate of 10 additional courses per year (the transfer cohort will not be large enough to require TAs), with three TAs per course on 45-hour contracts. The budget is based on the current year's hourly rate.

The rationale for administrative and technical staff has been made in a previous section. Note that in cases where two positions in the same category have been requested, the average of the salaries at the mid-point of the scale has been used for budgetary purposes.

Lab supplies are expected to be a significant ongoing cost for the program. We estimate that in year 0 start-up costs will be $50K and going forward $125K annually.

Additional costs requested are standard amounts and appear in the operating budget cost line starting in year 0 and are required annually: $10K for IT software; $10K for library requisitions; $10K for marketing and recruitment.

We expect high enrolments in this program. Given the market analysis and surveys, and the new focus on sustainability for a chemical engineering program, we estimate a full cohort to reach 125 students. Once full, and accounting for a 10% attrition rate annually, this will result in about 430 active students in the program each year. This is the maximum number of students that we can manage without requests for additional resources in the form of tenure track faculty members and lab space. As it is, this number of students will require the labs to be running full-time at maximum capacity.

The full budget can be found in APPENDIX 7.

11. CONCLUSION

The Chemical and Materials Engineering Department of the Gina Cody School of Engineering and Computer Science proposes a modern undergraduate degree in chemical engineering to be introduced at Concordia University. The department, established in 2017, has rapidly built the pedagogical and research expertise to offer a cutting-edge and unique chemical engineering program to complement the existing programs offered at the Gina Cody School. The proposed undergraduate program includes the necessary fundamentals of chemical engineering education but also proposes an evolution of the discipline to provide skills and knowledge relevant for the current and anticipated future needs of existing and burgeoning industries. The program specifically places an emphasis on:

1. Industrial digitalization enabling Industry 4.0 through IIoT, leveraging state-of-the-art techniques in data analytics, machine learning, and AI to enable chemical engineers to make meaningful contributions to the future of their chosen industries;
2. Sustainability integrated in the core of the program, stemming from the leadership of Concordia University toward efficiency and sustainability in the university and its educational pursuits; and,
3. Deep understanding of materials and material engineering, necessary for the evolution of industry, materials and battery research, and integrated design approaches considering material aspects.

The proposed program offers various unique directions for students and provides additional opportunities to pursue chemical engineering at the university level in Québec, where current offerings are limited. Concordia provides a competitive program in this domain, while providing complementary opportunities for collaboration within Concordia but also externally in Québec, throughout Canada, and internationally.

This proposal explicitly addresses needs within Quebec and Canada to increase enrollments in chemical engineering while modernizing the curriculum to be aligned with current employment trends and requirements of an evolving industrial environment. Graduates of the program are expected to encounter a favourable job market in Canada and will contribute to the social and economic well-being of their regions.

Existing resources in the department and university provide support for the program, in addition to several positions to be filled closer to the commencement of the first students. The budget forecast for the program shows that initial investment in teaching and research capacity, staff, and laboratory equipment are compensated by the expected enrollments, such the program achieves its financial break-even point in less than five years.

APPENDICES

Appendix 1:	Official description of the program
Appendix 2:	Course outlines and descriptions
Appendix 3:	Needs Analysis, Surveys, Market Analysis, Environmental Scans
Appendix 4:	Letters of Support
Appendix 5:	Accreditation Unit Calculations

Summary and Rationale for Changes

The Department of Chemical and Materials Engineering currently has no accredited undergraduate program and wishes to start its first undergraduate program in Chemical Engineering. The Department of Chemical and Materials Engineering has a strong research specialization in advanced materials and sustainability.

The Department of Chemical and Materials Engineering proposes to launch a BEng program in Chemical Engineering.

The rationale to propose this program is as follows:
• Chemical industry in Quebec employs over 2,000 chemical engineers, and over 10,000 in Canada, indicating that Quebec chemical engineers constitute roughly 20% of Canadian chemical engineers. The employment outlook for chemical engineers in Quebec has been rated as good for the next three years (2021-2023) by the Government of Canada1. Contributing factors to this good job prospect are employment growth, retirement of current workforce, and small numbers of unemployed workers with experience in this occupation. Only three out of the 13 provinces and territories are rated good (highest ranking) at the time of the writing.
• The Department currently offers the Graduate Certificate, Graduate Diploma, MASc, and PhD programs in Chemical Engineering. These programs have graduated 11 students since the department was established in 2017.
• Concordia University is a leader in advanced materials and sustainability research. The Department of Chemical and Materials Engineering currently has 14 professors working on a broad range of chemical engineering research areas.
• The proposed program will enable students to study in the areas of Chemical Engineering and there are clear and significant needs from industry and society in this area.
• The Department of Chemical and Materials Engineering has the resources and expertise to operate this program at the highest level of quality to meet the demands from students, industry, and society.
• There is a current search to hire two new faculty members. Six new faculty members in priority areas will be hired in the short term.
• Many of the courses specified in the proposed program are currently offered by the Faculty (ENGR and ENCS courses), and the Department of Chemical and Materials Engineering has the expertise to offer the new courses. 49 new courses are proposed to create this BEng in Chemical Engineering, 22 of these are core chemical engineering courses in the program, 15 of these are existing graduate courses to be cross listed as undergraduate technical electives, and the remaining 12 are new technical electives to provide training specialized topics in advanced materials and materials processing, data science and engineering, and sustainability and sustainable process design.
• The implementation of the proposed program is feasible with the resources listed herein.
• The proposed program will generate revenue for the University after Year 5.
• This is the second BEng program in Chemical Engineering offered in the English language in Quebec, the first being at McGill University. This program differentiates itself from the program at McGill through a focus in advanced materials, sustainability, computer programming and machine learning, and having a Co-operative Education option.
• The proposed date to introduce the Chemical Engineering BEng program is September 2024.

Summary of Changes (New Undergraduate Program (Regular Process))

Course Changes:

	Subject Code Change	Catalogue Number Change	Title Change	Description Code Change	Prerequisite Change	Note Change (any change to any of the items under "Notes")	Credit Value Change	Component Change	Mode of Instruction Change	Cross-listed Course Change
CHME 200 Introduction to Chemical Process Engineering	X	X	X	X	X		X	X	X	
CHME 201 Innovative, Sustainable, and Safe Manufacturing in Chemical Industry	X	X	X	X	X		X	X	X	
CHME 215 Programming for Chemical and Materials Engineers	X	X	X	X	X		X	X	X	
CHME 216 Advanced Programming for Chemical Engineers	X	X	X	X	X		X	X	X	
CHME 220 Material Properties and Chemical Characterization	X	X	X	X	X		X	X	X	
CHME 240 Chemical Engineering Lab I	X	X	X	X	X		X	X	X	
CHME 300 Industrial and Engineering Chemistry	X	X	X	X	X		X	X	X	
CHME 301 Chemical Reaction	X	X	X	X	X		X	X	X	

Engineering										
CHME 316 Advanced Data Analysis and Machine Learning for Chemical Engineers	X	X	X	X	X		X	X	X	
CHME 320 Technical and Advanced Materials	X	X	X	X	X		X	X	X	
CHME 321 Chemical and Materials Product Design	X	X	X	X	X		X	X	X	
CHME 330 Chemical Process Dynamics and Control	X	X	X	X	X		X	X	X	
CHME 340 Chemical Engineering Lab II	X	X	X	X	X		X	X	X	
CHME 351 Chemical Engineering Thermodynamics	X	X	X	X	X		X	X	X	
CHME 352 Energy Conversion and Storage	X	X	X	X	X		X	X	X	
CHME 360 Heat Transfer	X	X	X	X	X		X	X	X	
CHME 361 Mass Transfer and Unit Operations	X	X	X	X	X		X	X	X	
CHME 362 Chemical Separations Engineering	X	X	X	X	X		X	X	X	
CHME 390 Design Project	X	X	X	X	X		X	X	X	
CHME 400 Sustainable Industrial and Engineering Chemistry	X	X	X	X	X		X	X	X	
CHME 401	X	X	X	X	X		X	X	X	

Sustainable Process Design										
CHME 402 Sustainable Energy Conversion and Management	X	X	X	X	X		X	X	X	
CHME 403 Electrochemical Engineering	X	X	X	X	X		X	X	X	
CHME 404 Clean Energy Science and Technology	X	X	X	X	X		X	X	X	
CHME 405 Introduction to Environmental Engineering	X	X	X	X			X	X	X	
CHME 406 Introduction to Life Cycle Assessment	X	X	X	X			X	X	X	
CHME 415 Computational Modelling for Chemical Engineers	X	X	X	X	X		X	X	X	
CHME 416 Data Engineering for Chemical Engineers	X	X	X	X	X		X	X	X	
CHME 420 Nanomaterials Science and Engineering	X	X	X	X	X		X	X	X	
CHME 421 Metallurgical Engineering	X	X	X	X	X		X	X	X	
CHME 422 Polymer Chemistry and Engineering	X	X	X	X	X		X	X	X	
CHME 423 Advanced Battery Materials and Technologies	X	X	X	X	X		X	X	X	
CHME 424 Advanced Characterization Techniques	X	X	X	X	X		X	X	X	

CHME 425 Hydrometallurgy	X	X	X	X	X		X	X	X	
CHME 430 Advanced Chemical Engineering Process Dynamics and Control	X	X	X	X	X		X	X	X	
CHME 431 Introduction to Optimization for Chemical Engineers	X	X	X	X	X		X	X	X	
CHME 432 Advanced Process Safety Engineering	X	X	X	X	X		X	X	X	
CHME 440 Chemical Engineering Lab III	X	X	X	X	X		X	X	X	
CHME 460 Chemical Kinetics and Advanced Reactor Engineering	X	X	X	X	X		X	X	X	
CHME 461 Advanced Chemical Engineering Thermodynamics	X	X	X	X	X		X	X	X	
CHME 462 Industrial Catalysis	X	X	X	X	X		X	X	X	
CHME 463 Advanced Separation Processes	X	X	X	X	X		X	X	X	
CHME 470 Advanced Biochemical Engineering	X	X	X	X	X		X	X	X	
CHME 471 Colloid and Interface Chemistry	X	X	X	X	X		X	X	X	
CHME 472 Food Engineering	X	X	X	X	X		X	X	X	
CHME 473	X	X	X	X	X		X	X	X	

Biomaterials and Biochemicals										
CHME 480 Molecular Modelling of Proteins	X	X	X	X			X	X	X	X
CHME 481 Multiscale Modelling of Biomaterials	X	X	X	X			X	X	X	
CHME 490 Capstone Chemical Process Design	X	X	X	X	X		X	X	X	

<u>Defined Group Changes:</u>

Defined Groups

	Defined Group Title Change	Defined Group Requirements Change	Change to Total Credit Value of Defined Group
Chemical Engineering Core	X	X	X
Chemical Engineering Technical Elective Courses	X	X	X
Tech Elective track - Advanced Process Design and Control	X	X	
Tech Elective track - Advanced Topics in Chemical Engineering	X	X	
Tech Elective track - Biochemical and Food Engineering	X	X	
Tech Elective track - Biomolecular Modelling and Drug Design	X	X	
Tech Elective track - Data Analytics for Chemical Engineers	X	X	
Tech Elective track - Materials Engineering	X	X	
Tech Elective track - Sustainable Chemical Engineering	X	X	

<u>Regulation Changes:</u>

- The Co-operative Format Change
- C.Edge Option Change
- Accelerated Career Experience Option Change
- Chem Eng Degree Requirements

REGULATIONS CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: The Co-operative Format
Calendar Section Type: Regulation
Description of Change: The Co-operative Format Change

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Type of change: Regulation Change

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.10 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.10.8 Co-operative Education in the Gina Cody School of Engineering and Computer Science

Present Text (from 2021) calendar

The Co-operative Format

The Institute for Co-operative Education offers a number of work-integrated learning opportunities to students in the Gina Cody School of Engineering and Computer Science. Work-integrated learning is a model of experiential learning that bridges the academic program and the world of work. It provides students with the opportunity to combine study with paid work terms in their chosen fields.

Co-operative Education Programs

The co-op format is available in the following programs in the BCompSc and BEng degrees:
- BEng in Aerospace Engineering
- BEng in Building Engineering
- BEng in Civil Engineering
- BEng in Computer Engineering
- BCompSc in Computer Science
- BEng in Electrical Engineering
- BEng in Industrial Engineering
- BEng in Mechanical Engineering
- BEng in Software Engineering

The academic content is identical to that of the regular programs with three work terms interspersed with study terms. However, in order to continue their studies in the co-operative format in the Gina Cody School of Engineering and Computer Science, or to graduate from one of its programs as members of the Institute for Co-operative Education, students must satisfy the following conditions:

(i) must be in acceptable standing and maintain a cumulative

Proposed Text

The Co-operative Format

The Institute for Co-operative Education offers a number of work-integrated learning opportunities to students in the Gina Cody School of Engineering and Computer Science. Work-integrated learning is a model of experiential learning that bridges the academic program and the world of work. It provides students with the opportunity to combine study with paid work terms in their chosen fields.

Co-operative Education Programs

The co-op format is available in the following programs in the BCompSc and BEng degrees:
- BEng in Aerospace Engineering
- BEng in Building Engineering
- BEng in Chemical Engineering
- BEng in Civil Engineering
- BEng in Computer Engineering
- BCompSc in Computer Science
- BEng in Electrical Engineering
- BEng in Industrial Engineering
- BEng in Mechanical Engineering
- BEng in Software Engineering

The academic content is identical to that of the regular programs with three work terms interspersed with study terms. However, in order to continue their studies in the co-operative format in the Gina Cody School of Engineering and Computer Science, or to graduate from one of its programs as members of the Institute for Co-operative Education, students must satisfy the following conditions:

(i) must be in acceptable standing and maintain a cumulative grade point average (CGPA) of at least 2.50 in their program (the CGPA is calculated in

Present Text (from 2021) calendar	Proposed Text
grade point average (CGPA) of at least 2.50 in their program (the CGPA is calculated in the manner described in Section 16.3.10 Academic Performance under Section 16.3 Evaluation, Administrative Notations, Examinations, and Performance Requirements);	the manner described in Section 16.3.10 Academic Performance under Section 16.3 Evaluation, Administrative Notations, Examinations, and Performance Requirements);
(ii) be assigned a grade of pass for each of the three work-term courses (CWTE or CWTC). Under certain conditions, students may be placed on co-op probation status;	(ii) be assigned a grade of pass for each of the three work-term courses (CWTE or CWTC). Under certain conditions, students may be placed on co-op probation status;
(iii) remain in their designated work study sequence. Any deviations must have prior approval by the director of the Institute for Co-operative Education in consultation with the co-op program director in their department.	(iii) remain in their designated work study sequence. Any deviations must have prior approval by the director of the Institute for Co-operative Education in consultation with the co-op program director in their department.
For a full description of the co-operative education program format and requirements, please refer to Section 24 Institute for Co-operative Education of this Calendar.	For a full description of the co-operative education program format and requirements, please refer to Section 24 Institute for Co-operative Education of this Calendar.
Regulations for Work Terms - Successful completion of the work terms shown in the Co-op Schedule indicated in Section 24 Institute for Co-operative Education is a prerequisite for graduation as a member of the Institute for Co-operative Education. - Work-term job descriptions are screened by the co-op coordinator. Only jobs approved by the Institute for Co-operative Education will be accepted as being suitable for the work-term requirements. - Work-term jobs are full-time employment normally for a minimum of 12 consecutive weeks (14 to 16 weeks preferably). - A work-term report must be submitted each work term on a subject related to the student's employment. This report must be submitted to the Institute for Co-operative Education on or before the deadline shown in Section 24 Institute for Co-operative Education . Grammar and content of work-term reports are evaluated by the Institute for Co-operative Education and the technical aspects are evaluated by the co-op program director responsible. Evidence of the student's ability to gather material relating to the job, analyze it effectively, and present it in a clear, logical, and concise form is required in the report. - The required communication component consists of an oral presentation on a technical subject or engineering task taken from the student's work environment. The presentation will be given on campus in a formal setting after students have returned to their study term. A written summary is also required. Guidelines for the preparation of this oral presentation are provided in the Co-op Student Handbook. - Work terms will be evaluated for satisfactory completion. Assessment is based upon the employer evaluation of performance, the work-term report and communication component which together constitute the job performance as related to the whole work term. Students must pass all required	**Regulations for Work Terms** - Successful completion of the work terms shown in the Co-op Schedule indicated in Section 24 Institute for Co-operative Education is a prerequisite for graduation as a member of the Institute for Co-operative Education. - Work-term job descriptions are screened by the co-op coordinator. Only jobs approved by the Institute for Co-operative Education will be accepted as being suitable for the work-term requirements. - Work-term jobs are full-time employment normally for a minimum of 12 consecutive weeks (14 to 16 weeks preferably). - A work-term report must be submitted each work term on a subject related to the student's employment. This report must be submitted to the Institute for Co-operative Education on or before the deadline shown in Section 24 Institute for Co-operative Education . Grammar and content of work-term reports are evaluated by the Institute for Co-operative Education and the technical aspects are evaluated by the co-op program director responsible. Evidence of the student's ability to gather material relating to the job, analyze it effectively, and present it in a clear, logical, and concise form is required in the report. - The required communication component consists of an oral presentation on a technical subject or engineering task taken from the student's work environment. The presentation will be given on campus in a formal setting after students have returned to their study term. A written summary is also required. Guidelines for the preparation of this oral presentation are provided in the Co-op Student Handbook. - Work terms will be evaluated for satisfactory completion. Assessment is based upon the employer evaluation of performance, the work-term report and communication component which together constitute the job performance as related to the whole work term. Students must pass all required components. The grade of pass or fail will be assigned to each of the work-term courses. A failing grade will result in the student's withdrawal from the Institute for Co-operative Education.

Present Text (from 2021) calendar	Proposed Text
components. The grade of pass or fail will be assigned to each of the work-term courses. A failing grade will result in the student's withdrawal from the Institute for Co-operative Education.	

Rationale:

The BEng in CME is added to the list of Co-op offerings as per the letter of support from the Institute for Co-operative Education.

Resource Implications:

REGULATIONS CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: C.Edge Option
Calendar Section Type: Regulation
Description of Change: C.Edge Option Change

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Type of change: Regulation Change

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.20 BEng > Section 71.20.8 C.Edge (Career Edge) and Accelerated Career Experience Options

Present Text (from 2021) calendar	Proposed Text
C.Edge Option	C.Edge Option
The C.Edge option is available in the following programs in the BCompSc and BEng degrees: - BEng in Aerospace Engineering - BEng in Building Engineering - BEng in Civil Engineering - BEng in Computer Engineering - BCompSc in Computer Science - BEng in Electrical Engineering - BEng in Industrial Engineering - BEng in Mechanical Engineering - BEng in Software Engineering	The C.Edge option is available in the following programs in the BCompSc and BEng degrees: - BEng in Aerospace Engineering - BEng in Building Engineering - BEng in Chemical Engineering - BEng in Civil Engineering - BEng in Computer Engineering - BCompSc in Computer Science - BEng in Electrical Engineering - BEng in Industrial Engineering - BEng in Mechanical Engineering - BEng in Software Engineering
The academic content is identical to that of the regular programs with the addition of a four-month work term. However, in order to enrol in the C.Edge option in the Gina Cody School of Engineering and Computer Science, students must satisfy the requirements set by the individual department.	The academic content is identical to that of the regular programs with the addition of a four-month work term. However, in order to enrol in the C.Edge option in the Gina Cody School of Engineering and Computer Science, students must satisfy the requirements set by the individual department.
Students may have the C.Edge option recorded on their official transcript and student record, provided they successfully complete the Reflective Learning course associated with this work term.	Students may have the C.Edge option recorded on their official transcript and student record, provided they successfully complete the Reflective Learning course associated with this work term.
C.Edge work terms will be coded as ENGR 107, ENGR 207, and ENGR 307, and the associated Reflective Learning courses will be coded as ENGR 108 , ENGR 208 , and ENGR 308 respectively.	C.Edge work terms will be coded as ENGR 107, ENGR 207, and ENGR 307, and the associated Reflective Learning courses will be coded as ENGR 108 , ENGR 208 , and ENGR 308 respectively.
For a full description of the C.Edge format and requirements, please refer to Section 24 Institute for Co-operative Education of this Calendar.	For a full description of the C.Edge format and requirements, please refer to Section 24 Institute for Co-operative Education of this Calendar.

Rationale:

The BEng in CME is added to the list of C.Edge offerings as per the letter of support from the Institute for Co-operative Education.

Resource Implications:

REGULATIONS CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: Accelerated Career Experience Option
Calendar Section Type: Regulation
Description of Change: Accelerated Career Experience Option Change

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Type of change: Regulation Change

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.20 BEng > Section 71.20.8 C.Edge (Career Edge) and Accelerated Career Experience Options

Present Text (from 2021) calendar

Accelerated Career Experience Option

A limited number of students in the BCompSc and BEng degrees are permitted to supplement their studies with the Accelerated Career Experience option, which is offered in the following programs:
- BEng in Aerospace Engineering
- BEng in Building Engineering
- BEng in Civil Engineering
- BEng in Computer Engineering
- BCompSc in Computer Science
- BEng in Electrical Engineering
- BEng in Industrial Engineering
- BEng in Mechanical Engineering
- BEng in Software Engineering

The academic content is identical to that of the regular programs with the addition of one 12- or 16-month work term. Students are registered in their work experience courses (ACCE 100, 200, 300, 400). However, in order to continue their studies in the Accelerated Career Experience option in the Gina Cody School of Engineering and Computer Science, students must satisfy the following conditions:
- must be in acceptable standing and maintain a cumulative grade point average (CGPA) of at least 2.70 in their program (the CGPA is calculated in the manner described in Section 16.3.10 Academic Performance under Section 16.3 Evaluation, Administrative Notations, Examinations, and Performance Requirements) ;
- be assigned a grade of pass for each of the work experience courses. Under certain conditions, students may be placed on co-op probation status;
- remain in their designated work-study sequence. Any deviations must have prior approval by the director of the

Proposed Text

Accelerated Career Experience Option

A limited number of students in the BCompSc and BEng degrees are permitted to supplement their studies with the Accelerated Career Experience option, which is offered in the following programs:
- BEng in Aerospace Engineering
- BEng in Building Engineering
- BEng in Chemical Engineering
- BEng in Civil Engineering
- BEng in Computer Engineering
- BCompSc in Computer Science
- BEng in Electrical Engineering
- BEng in Industrial Engineering
- BEng in Mechanical Engineering
- BEng in Software Engineering

The academic content is identical to that of the regular programs with the addition of one 12- or 16-month work term. Students are registered in their work experience courses (ACCE 100, 200, 300, 400). However, in order to continue their studies in the Accelerated Career Experience option in the Gina Cody School of Engineering and Computer Science, students must satisfy the following conditions:
- must be in acceptable standing and maintain a cumulative grade point average (CGPA) of at least 2.70 in their program (the CGPA is calculated in the manner described in Section 16.3.10 Academic Performance under Section 16.3 Evaluation, Administrative Notations, Examinations, and Performance Requirements) ;
- be assigned a grade of pass for each of the work experience courses. Under certain conditions, students may be placed on co-op probation status;
- remain in their designated work-study sequence. Any deviations must have prior approval by the director of the Institute for Co-operative Education in consultation with the appropriate co-op academic director;
- must have completed at least 48 credits in their degree/program before applying;

Present Text (from 2021) calendar	Proposed Text
Institute for Co-operative Education in consultation with the appropriate co-op academic director; - must have completed at least 48 credits in their degree/program before applying; - must have at least 15 credits remaining after the completion of the Accelerated Career Experience work term. For a full description of the Accelerated Career Experience format and requirements, please refer to Section 24 Institute for Co-operative Education .	- must have at least 15 credits remaining after the completion of the Accelerated Career Experience work term. For a full description of the Accelerated Career Experience format and requirements, please refer to Section 24 Institute for Co-operative Education .

Rationale:

The BEng in CME is added to the list of ACE offerings as per the letter of support from the Institute for Co-operative Education.

Resource Implications:

REGULATIONS CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: Degree Requirements
Calendar Section Type: Regulation
Description of Change: Chem Eng Degree Requirements

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Type of change: Regulation Change

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.105 Department of Chemical and Materials Engineering > Department of Chemical and Materials Engineering > Section 71.105.1 Course Requirements (BEng in Chemical Engineering)

Present Text (from 2021) calendar	Proposed Text
Degree Requirements	Degree Requirements The program in Chemical Engineering consists of the Engineering Core , the Chemical Engineering Core , and the Chemical Engineering Technical Elective Courses as shown below. The minimum length of the program is 120 credits.

Rationale:
This is the introductory text summarizing program requirements for the new BEng in Chemical Engineering.

Resource Implications:
None.

New Undergraduate Program (Regular Process) - GCS-CME-4421 - VERSION : 2

PROGRAM CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: BEng in Chemical Engineering
Calendar Section Type: Program
Description of Change: BEng in Chemical Engineering requirements summary

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering
Program Name: BEng in Chemical Engineering
Program Type: Major
Degree: Major

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.105 Department of Chemical and Materials Engineering > Department of Chemical and Materials Engineering > Section 71.105.1 Course Requirements (BEng in Chemical Engineering) > Degree Requirements

Type of Change: New Program

Present Text (from 2021) calendar	**Proposed Text**	
credits	**120 credits**	BEng in Chemical Engineering
0	~~0~~	27 credits from the Engineering Core
		84 credits from the Chemical Engineering Core
		9 credits from the Chemical Engineering Technical Elective Courses

Rationale:

This is the summary program header for the new BEng in Chemical Engineering (see attached proposal for rationale).

Note: When the new program is implemented (at the appropriate time), a program change must be submitted for the Engineering Core (Section 71.20 BEng > 71.20.5 Degree Requirements) to modify Note 2 to add the BEng in Chemical Engineering to the list of programs in for which ELEC 275 is not required (and for which the Engineering Core credits are reduced to 27 credits).

Resource Implications:

None.

DEFINED GROUP CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: Chemical Engineering Core
Calendar Section Type: Defined group
Description of Change: Chemical Engineering Core

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.105 Department of Chemical and Materials Engineering > Department of Chemical and Materials Engineering > Section 71.105.1 Course Requirements (BEng in Chemical Engineering) > Degree Requirements > BEng in Chemical Engineering

Type of Change: New Defined Group

Present Text (from 2021) calendar		Proposed Text
	84 credits	Chemical Engineering Core
0	~~0~~	CHEM 221 Introductory Organic Chemistry I (3) CHME 200 Introduction to Chemical Process Engineering (3) CHME 201 Innovative, Sustainable, and Safe Manufacturing in Chemical Industry (3) CHME 215 Programming for Chemical and Materials Engineers (3.5) CHME 216 Advanced Programming for Chemical Engineers (3.5) CHME 220 Material Properties and Chemical Characterization (3) CHME 240 Chemical Engineering Lab I (1.5) CHME 300 Industrial and Engineering Chemistry (3) CHME 301 Chemical Reaction Engineering (3) CHME 316 Advanced Data Analysis and Machine Learning for Chemical Engineers (3.5) CHME 320 Technical and Advanced Materials (3) CHME 321 Chemical and Materials Product Design (3) CHME 330 Chemical Process Dynamics and Control (3) CHME 340 Chemical Engineering Lab II (1.5) CHME 351 Chemical Engineering Thermodynamics (3) CHME 352 Energy Conversion and Storage (3) CHME 360 Heat Transfer (3) CHME 361 Mass Transfer and Unit Operations (3)

Present Text (from 2021) calendar	Proposed Text
	CHME 362 Chemical Separations Engineering (3) CHME 390 Design Project (3) CHME 415 Computational Modelling for Chemical Engineers (3) CHME 440 Chemical Engineering Lab III (1.5) CHME 490 Capstone Chemical Process Design (6) ENGR 245 Mechanical Analysis (3) ENGR 251 Thermodynamics I (3) ENGR 311 Transform Calculus and Partial Differential Equations (3) ENGR 361 Fluid Mechanics I (3) MIAE 221 Materials Science (3)

Rationale:

The Chemical Engineering Core Courses cover the foundation of chemical and biological processes. This includes courses covering the design of chemical processes and unit operations, mass and heat transfer, fluid mechanics, chemical thermodynamics, reaction kinetics, separation processes, process dynamics and control, and material science.

Resource Implications:

See budget.

DEFINED GROUP CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program
Calendar Section Name: Chemical Engineering Technical Elective Courses
Calendar Section Type: Defined group
Description of Change: Chemical Engineering Technical Elective Courses
Proposed: Undergraduate Curriculum Changes
Faculty/School: Gina Cody School of Engineering and Computer Science
Department: Department of Chemical and Materials Engineering
Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.105 Department of Chemical and Materials Engineering > Department of Chemical and Materials Engineering > Section 71.105.1 Course Requirements (BEng in Chemical Engineering) > Degree Requirements > BEng in Chemical Engineering

Type of Change: New Defined Group

Present Text (from 2021) calendar	Proposed Text	
	9 credits	Chemical Engineering Technical Elective Courses
0	~~0~~	9 elective credits chosen from the Technical Elective Courses listed below. Courses are grouped in specialized tracks to facilitate the selection of courses in a particular area of the field: Biochemical and Food Engineering Materials Engineering Data Analytics for Chemical Engineers Sustainable Chemical Engineering Advanced Process Design and Control Advanced Topics in Chemical Engineering Biomolecular Modelling and Drug Design Note: Students may take their three technical electives in up to three different technical tracks; they are not restricted to choosing all elective courses from one track.

Rationale:
The technical electives component of the BEng in Chemical Engineering enables students to study advanced topics for further specialization in certain areas. The courses have been separated into different technical tracks depending on the general area, including sustainability, materials

engineering, data analytics, process design and control, biochemical and food engineering, biomolecular modelling, and other advanced topics in chemical engineering. Students may take their three technical electives in up to three different technical tracks; they are not restricted to choosing all elective courses from one track. The technical tracks group the courses into common themes that are important for chemical engineering, as determined from the market analysis and student survey. Note that these are not options, and students taking all three technical electives from one track does not grant them any advanced credentials in the form of an option.

Resource Implications:

See budget.

DEFINED GROUP CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: Advanced Process Design and Control
Calendar Section Type: Defined group
Description of Change: Tech Elective track - Advanced Process Design and Control

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.105 Department of Chemical and Materials Engineering > Department of Chemical and Materials Engineering > Section 71.105.1 Course Requirements (BEng in Chemical Engineering) > Degree Requirements > BEng in Chemical Engineering > Chemical Engineering Technical Elective Courses

Type of Change: New Defined Group

Present Text (from 2021) calendar	credits	Proposed Text
		Advanced Process Design and Control
0	~~0~~	CHME 416 Data Engineering for Chemical Engineers (3) CHME 430 Advanced Chemical Engineering Process Dynamics and Control (3) CHME 431 Introduction to Optimization for Chemical Engineers (3) CHME 432 Advanced Process Safety Engineering (3) MECH 472 Mechatronics and Automation (3.5)

Rationale:
Advanced Process Design and Control is a technical track for technical elective courses in the new BEng in Chemical Engineering. The purpose is to provide students advanced knowledge in process design and control for chemical processes. It builds on topics from process design and control covered in the BEng core curriculum. Students are free to take one to three of their three technical electives from this technical track, which can be in combination with technical electives from any other track.

Resource Implications:
See budget.

DEFINED GROUP CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: Advanced Topics in Chemical Engineering
Calendar Section Type: Defined group
Description of Change: Tech Elective track - Advanced Topics in Chemical Engineering

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.105 Department of Chemical and Materials Engineering > Department of Chemical and Materials Engineering > Section 71.105.1 Course Requirements (BEng in Chemical Engineering) > Degree Requirements > BEng in Chemical Engineering > Chemical Engineering Technical Elective Courses

Type of Change: New Defined Group

Present Text (from 2021) calendar		Proposed Text
	credits	Advanced Topics in Chemical Engineering
0	~~0~~	CHME 460 Chemical Kinetics and Advanced Reactor Engineering (3) CHME 461 Advanced Chemical Engineering Thermodynamics (3) CHME 462 Industrial Catalysis (3) CHME 463 Advanced Separation Processes (3)

Rationale:
Advanced Topics in Chemical Engineering is a technical track for technical elective courses in the new BEng in Chemical Engineering. The purpose is to provide students advanced knowledge in a range of important topics in chemical engineering. Depending on the course, the elective provides advanced technical knowledge in topics which are covered in the BEng core curriculum. Students are free to take one to three of their three technical electives from this technical track, which can be in combination with technical electives from any other track.

Resource Implications:
See budget.

DEFINED GROUP CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: Biochemical and Food Engineering
Calendar Section Type: Defined group
Description of Change: Tech Elective track - Biochemical and Food Engineering

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.105 Department of Chemical and Materials Engineering > Department of Chemical and Materials Engineering > Section 71.105.1 Course Requirements (BEng in Chemical Engineering) > Degree Requirements > BEng in Chemical Engineering > Chemical Engineering Technical Elective Courses

Type of Change: New Defined Group

Present Text (from 2021) calendar	**credits**	**Proposed Text**
		Biochemical and Food Engineering
0	~~0~~	BIOL 226 Biodiversity and Ecology (3) BIOL 261 Molecular and General Genetics (3) BIOL 371 Microbiology (3) CHEM 271 Biochemistry I (3) CHME 470 Advanced Biochemical Engineering (3) CHME 471 Colloid and Interface Chemistry (3) CHME 472 Food Engineering (3) CHME 473 Biomaterials and Biochemicals (3)

Rationale:
Biochemical and Food Engineering is a technical track for technical elective courses in the new BEng in Chemical Engineering. The purpose is to provide students relevant knowledge for the design of biochemical processes for pharmaceutical or food engineering. Bioreactor design and other applications are introduced in the BEng core curriculum and expanded upon in this technical track. Students are free to take one to three of their three technical electives from this technical track, which can be in combination with technical electives from any other track.

Resource Implications:
See budget

DEFINED GROUP CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: Biomolecular Modelling and Drug Design
Calendar Section Type: Defined group
Description of Change: Tech Elective track - Biomolecular Modelling and Drug Design

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.105 Department of Chemical and Materials Engineering > Department of Chemical and Materials Engineering > Section 71.105.1 Course Requirements (BEng in Chemical Engineering) > Degree Requirements > BEng in Chemical Engineering > Chemical Engineering Technical Elective Courses

Type of Change: New Defined Group

Present Text (from 2021) calendar	credits	Proposed Text
		Biomolecular Modelling and Drug Design
0	~~0~~	CHEM 431 Computational Chemistry for Chemists and Biochemists (3) CHME 480 Molecular Modelling of Proteins (3) CHME 481 Multiscale Modelling of Biomaterials (3)

Rationale:

Biomolecular Modelling and Drug Design is a technical track for technical elective courses in the new BEng in Chemical Engineering. The purpose is to provide students the requisite knowledge in molecular modeling for biomolecule and drug design. This will build on modelling from CHME 415 where molecular modelling is introduced and are expanded in this track for applications in pharmaceutical drug design and drug delivery systems. Students are free to take one to three of their three technical electives from this technical track, which can be in combination with technical electives from any other track.

Resource Implications:

See budget.

DEFINED GROUP CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: Data Analytics for Chemical Engineers
Calendar Section Type: Defined group
Description of Change: Tech Elective track - Data Analytics for Chemical Engineers

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.105 Department of Chemical and Materials Engineering > Department of Chemical and Materials Engineering > Section 71.105.1 Course Requirements (BEng in Chemical Engineering) > Degree Requirements > BEng in Chemical Engineering > Chemical Engineering Technical Elective Courses

Type of Change: New Defined Group

Present Text (from 2021) calendar	credits	Proposed Text
		Data Analytics for Chemical Engineers
0	~~0~~	CHME 416 Data Engineering for Chemical Engineers (3) COMP 333 Data Analytics (4) COMP 352 Data Structures and Algorithms (3) COMP 433 Introduction to Deep Learning (4) COMP 473 Pattern Recognition (4) COMP 474 Intelligent Systems (4) COMP 479 Information Retrieval and Web Search (4) SOEN 363 Data Systems for Software Engineers (3)

Rationale:
Data Analytics for Chemical Engineers is a technical track for technical elective courses in the new BEng in Chemical Engineering. The purpose is to provide chemical engineering students relevant knowledge related to data analytics, automated data processing technologies, and machine learning. It provides advanced depth in topics data analytics topics which are introduced in the programming courses within the BEng core curriculum. Students are free to take one to three of their three technical electives from this technical track, which can be in combination with technical electives from any other track. It is recommended that students take CHME 415 prior to their fourth year if they wish to take courses within this track so they fulfill course prerequisites.

Resource Implications:
See budget.

DEFINED GROUP CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: Materials Engineering
Calendar Section Type: Defined group
Description of Change: Tech Elective track - Materials Engineering

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.105 Department of Chemical and Materials Engineering > Department of Chemical and Materials Engineering > Section 71.105.1 Course Requirements (BEng in Chemical Engineering) > Degree Requirements > BEng in Chemical Engineering > Chemical Engineering Technical Elective Courses

Type of Change: New Defined Group

Present Text (from 2021) calendar	credits	Proposed Text
		Materials Engineering
0	~~0~~	CHEM 327 Organic Chemistry of Polymers (3) CHEM 427 Polymer Chemistry and Nanotechnology (3) CHME 420 Nanomaterials Science and Engineering (3) CHME 421 Metallurgical Engineering (3) CHME 422 Polymer Chemistry and Engineering (3) CHME 423 Advanced Battery Materials and Technologies (3) CHME 424 Advanced Characterization Techniques (3) CHME 425 Hydrometallurgy (3) CHEM 498 Advanced Topics in Chemistry (3) Note: CHEM 498 can be counted as a technical elective course and many topics may be offered.

Rationale:
Materials Engineering is a technical track for technical elective courses in the new BEng in Chemical Engineering. The purpose is to provide students advanced knowledge in advanced materials in applications related to chemical engineering. It builds on topics of material selection and material properties covered in the BEng core curriculum. Students are free to take one to three of their three technical electives from this technical track, which can be in combination with technical electives from any other track.

Resource Implications:
See budget.

DEFINED GROUP CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: Sustainable Chemical Engineering
Calendar Section Type: Defined group
Description of Change: Tech Elective track - Sustainable Chemical Engineering

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.105 Department of Chemical and Materials Engineering > Department of Chemical and Materials Engineering > Section 71.105.1 Course Requirements (BEng in Chemical Engineering) > Degree Requirements > BEng in Chemical Engineering > Chemical Engineering Technical Elective Courses

Type of Change: New Defined Group

Present Text (from 2021) calendar	credits	Proposed Text
		Sustainable Chemical Engineering
0	~~0~~	CHME 400 Sustainable Industrial and Engineering Chemistry (3) CHME 401 Sustainable Process Design (3) CHME 402 Sustainable Energy Conversion and Management (3) CHME 403 Electrochemical Engineering (3) CHME 404 Clean Energy Science and Technology (3) CHME 405 Introduction to Environmental Engineering (3) CHME 406 Introduction to Life Cycle Assessment (3) CIVI 465 Water Pollution and Control (3.5) CIVI 467 Air Pollution and Emission Control (3) CIVI 468 Waste Management (3) CHEM 498 Advanced Topics in Chemistry (3) Note: CHEM 498 can be counted as a technical elective course and many topics may be offered.

Rationale:
Sustainable Chemical Engineering is a technical track for technical elective courses in the new BEng in Chemical Engineering. The purpose is to provide students advanced knowledge in issues of sustainability within the field of chemical engineering. It builds on topics of sustainability covered in the BEng core curriculum. Students are free to take one to three of their three technical electives from this technical track, which can be in combination with technical electives from any other track.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 200
Calendar Section Type: Course
Description of Change: CHME 200 Introduction to Chemical Process Engineering

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	**Proposed Text**
	CHME 200 Introduction to Chemical Process Engineering (3 credits)
Prerequisites:	*Prerequisites:*
	Enrolment in a program offered by the Gina Cody School of Engineering and Computer Science is required. If prerequisites are not satisfied, permission of the Department is required.
Description :	*Description :*
	This introductory course provides the fundamentals of chemical process design and thinking like a chemical engineer. Students are introduced to principles of plant economics, unit conversions, process simulation, and various ways to represent process organization, such as block and process flow diagrams. Fitting correlations to chemical plant data and an introduction to sensors and measuring devices is also included. Basic relationships between physical properties of liquids and gases and chemical reactions are expanded, and material balances are studied in detail. An introduction to engineering software, such as ASPEN, for the modelling of chemical processes is covered.
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Tutorial (2 hours per week)
Notes :	*Notes :*

Rationale:
CHME 200 is a required course for the new BEng in Chemical Engineering, taken in the fall semester of the first year. The purpose is to provide the necessary foundational knowledge on material and energy balances required in chemical process design. It prepares students for their first laboratory course in second year where they do hands on experiments on temperature, pressure, and flow measurements they learned about in this course. It also prepares students for upper-level courses in chemical engineering, including reaction engineering and industrial and engineering chemistry. Primary course learning outcomes include performing material and energy balances in chemical engineering processes, using thermodynamic concepts to calculate compositions of phases and changes in energy, and the formulation and presentation of engineering solutions.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 201
Calendar Section Type: Course
Description of Change: CHME 201 Innovative, Sustainable, and Safe Manufacturing in Chemical Industry

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 201 Innovative, Sustainable, and Safe Manufacturing in Chemical Industry (3 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: CHME 220 ; ENGR 251 .
Description :	*Description :*
	Sustainable development concepts are discussed as they apply to chemical processes. Green chemistry principles and the design of sustainable chemical processes are introduced. Waste minimization, materials recycling, energy conservation and environmental remediation are also covered, as well as sustainability assessments and safety evaluations (HAZOP).
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Tutorial (1 hour per week)
Notes :	*Notes :*

Rationale:

CHME 201 is a required course for the new BEng in Chemical Engineering, taken in the fall semester of the second year. The purpose is to introduce students to sustainability as it relates to chemical process design. It prepares students to include sustainability in their design of chemical processes and unit operations, utilized throughout their coursework and especially through their design project and capstone design course. Primary course learning outcomes include building understanding of green chemistry principles, how sustainability and sustainability indicators can be used in the context of chemical process design, and to identify strategies for sustainable design.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 215
Calendar Section Type: Course
Description of Change: CHME 215 Programming for Chemical and Materials Engineers

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 215 Programming for Chemical and Materials Engineers (3.5 credits)
Prerequisites:	*Prerequisites:*
	Enrolment in a program offered by the Gina Cody School of Engineering and Computer Science is required. If prerequisites are not satisfied, permission of the Department is required.
Description :	*Description :*
	This course focuses on writing programs using assignment and sequences, variables and types, operators and expressions, conditional and repetitive statements, input and output, file access, functions, program structure and organization, pointers and dynamic memory allocation, introduction to classes and objects, and chemical engineering applications.
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Laboratory (2 hours per week)
Notes :	*Notes :*
Anti-requisite Courses :	**Anti-requisite Courses :** Students who have received credit for COEN 243 , COMP 248 , MECH 215, or MIAE 215 may not take this course for credit.

Rationale:

CHME 215 is a required course for the new BEng in Chemical Engineering, taken in the first-year fall semester. The purpose is to introduce students to computer programming to solve chemical engineering applications. Students enrolled in Chemical Engineering are required to take this course, however students who are transferring into this program from other engineering disciplines who have taken a similar programming course may transfer credit for that course. It prepares students to translate solution algorithms in problem solving into computer programming language, which will be used in many subsequent courses. Primary course learning outcomes include the understanding of programming syntax, and designing and programming computer algorithms to solve basic chemical engineering problems.

Note: MECH 215 was given a new subject code to become MIAE 215 as of 2021-2022 (and therefore does not exist in the current calendar). It is list among the anti-requisites because students may have taken the old version of the course.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 216
Calendar Section Type: Course
Description of Change: CHME 216 Advanced Programming for Chemical Engineers

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 216 Advanced Programming for Chemical Engineers (3.5 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 215 or equivalent (COEN 243 , COMP 248 , MECH 215 or MIAE 215).
Description :	*Description :*
	This course discusses theoretical and practical areas pertinent to modern information technology as it is used daily in Canadian SMEs. Topics include object-oriented programming, introduction to relational databases, graphical user interface programming, data acquisition, and document automation.
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Laboratory (2 hours per week)
Notes :	*Notes :*

Rationale:

CHME 216 is a required course for the new BEng in Chemical Engineering, taken in the first-year winter semester. The purpose is to expose students to information technology used for data acquisition. It builds on knowledge from the programming course in the fall semester. It prepares students to design and write programs for data acquisition, which they will use in their laboratory courses. Primary course learning outcomes include demonstrating knowledge of programming interfaces to interconnect software to hardware, understand basic concepts in graphical user interfaces, and design and implement a simple system for data acquisition, processing, and monitoring.

Note: MECH 215 was given a new subject code to become MIAE 215 as of 2021-2022 (and therefore does not exist in the current calendar). It is list in the prerequisites because students may have taken the old version of the course.

Resource Implications:

See budget.

New Undergraduate Program (Regular Process) - GCS-CME-4421 - VERSION : 2

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 220
Calendar Section Type: Course
Description of Change: CHME 220 Material Properties and Chemical Characterization

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 220 Material Properties and Chemical Characterization (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously or concurrently: MIAE 221 .
Description :	*Description :*
	This course provides students with a basic understanding of key material properties, the relationships between the structure-properties-processing-application of materials, and the methods of characterizing materials structures and materials properties. In addition to solid materials, fluid properties of gases and liquids are addressed. The students are expected to apply this knowledge towards solving problems in engineering applications.
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Tutorial (2 hours per week)
Notes :	*Notes :*

Rationale:

CHME 220 is a required course for the new BEng in Chemical Engineering, taken in the winter semester of the first year. The purpose is to provide students with understanding of material properties and identify desired material properties for different chemical engineering applications. It builds on knowledge from their first-year materials science course. It prepares students to design and size chemical engineering unit operation equipment out of appropriate materials given chemical compatibility, and pressure and temperature ratings for materials. Primary course learning outcomes include demonstrate knowledge of key material properties for solids and fluids, how to determine these properties using characterization, and identifying desired properties for various applications.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 240
Calendar Section Type: Course
Description of Change: CHME 240 Chemical Engineering Lab I

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 240 Chemical Engineering Lab I (1.5 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: CHME 200 , CHME 351 . The following course must be completed previously or concurrently: ENGR 361 .
Description :	*Description :*
	This laboratory course emphasizes the practical aspects of introductory chemical engineering topics. Experiments in this course include temperature measurements, calorimetry, pressure measurements, and flow measurements. The theoretical concepts learned in the classroom are demonstrated through application in the laboratory setting using lab- and pilot-scale versions of industrial equipment and software.
Component(s):	*Component(s):*
	Laboratory (6 hours per week, alternate weeks)
Notes :	*Notes :*

Rationale:

CHME 240 is a required course for the new BEng in Chemical Engineering, taken in the winter semester of the second year. The purpose is to give students hands-on experience with concepts learned in their first-year chemical process course (CHME 200) and thermodynamics course (ENGR 251), and second-year chemical thermodynamics course (CHEM 351). It builds on these courses by providing students an opportunity to perform temperature, pressure, and flow measurements and calorimetry. It prepares students to work together in teams and write technical reports to present their findings and demonstrate their understanding. Primary course learning outcomes include understanding and following laboratory safety protocols, following laboratory procedures to collect data, interpreting data and performing error analysis, and communicate findings.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 300
Calendar Section Type: Course
Description of Change: CHME 300 Industrial and Engineering Chemistry

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 300 Industrial and Engineering Chemistry (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 200 .
Description :	*Description :*
	This course provides an overview of prominent chemicals and production routes in the chemical industry. Processes for bulk chemical production using conventional and novel routes are investigated, including oil refining, polymers, hydrometallurgy, and commodity chemicals. Concepts of sustainability, plant economics and PFDs for bulk chemical processes are studied. Simulations of bulk chemical production processes are also conducted using ASPEN software.
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Tutorial (1 hour per week)
Notes :	*Notes :*

Rationale:

CHME 300 is a required course for the new BEng in Chemical Engineering, taken in the winter semester of the second year. The purpose is to provide an overview of prominent chemicals and production routes in the chemical industry. It builds on knowledge acquired in the first year chemical process course (CHME 200) and concepts of sustainability. It prepares students to simulate chemical production processes using software tools such as ASPEN. Primary course learning outcomes include generating process flow diagrams for inorganic and organic industrial processes, identifying safety concerns and environmental impacts of an industrial chemical process, and using engineering tools to simulate and analyze an industrial chemical process.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 301
Calendar Section Type: Course
Description of Change: CHME 301 Chemical Reaction Engineering

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 301 Chemical Reaction Engineering (3 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: CHME 200 , CHME 351 .
Description :	*Description :*
	This course reviews the fundamentals of reaction rates and kinetic parameters and discusses their experimental determination. Mathematical equations for isothermal and non-isothermal batch, semi-batch, continuous, and plug flow reactors are covered and applied to reactor design and sizing. Additional topics include selectivity and optimization of reactors with multiple reactions; heterogeneous catalysis in packed bed reactors with coupled heat and mass transfer effects; and enzyme catalysis and the Michaelis-Menten mechanism for bioreactors.
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Tutorial (2 hours per week)
Notes :	*Notes :*

Rationale:
CHME 301 is a required course for the new BEng in Chemical Engineering, taken in the fall semester of the third year. The purpose is to deliver the fundamental knowledge of chemical reaction engineering. It builds on knowledge from first- and second-year chemical process and chemical thermodynamics courses (CHME 200, ENGR 251, CHME 351). It prepares students to design reactors used in the chemical industry to transform raw materials into desired products. Primary course learning outcomes include the sizing of various types of reactors for homogeneous and heterogeneous chemical reactions and the determination of reaction rates from experimental data.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 316
Calendar Section Type: Course
Description of Change: CHME 316 Advanced Data Analysis and Machine Learning for Chemical Engineers

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 316 Advanced Data Analysis and Machine Learning for Chemical Engineers (3.5 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: CHME 216 ; ENGR 371 , ENGR 391 .
Description :	*Description :*
	This course is designed to cover the theoretical and practical areas pertinent to modern data analysis and machine learning in engineering. Topics include traditional machine learning algorithms based on feature engineering (Linear regression, Logistic Regression, Bayesian classifier, K-nearest neighbors, Bagging and boosting, Random Forests), bias and variance, model selection and regularization, features selection, and introduction to neural networks.
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Tutorial (1 hour per week) ; Laboratory (2 hours per week, alternate weeks)
Notes :	*Notes :*

Rationale:

CHME 316 is a required course for the new BEng in Chemical Engineering, taken in the winter semester of the fourth year. For students interested in taking courses in the Data Analytics for Chemical Engineers technical track, it is recommended to adjust their course sequence to take this course in winter semester of the third year and take their general education elective in winter semester of the fourth year. The purpose of this course is to educate students on theoretical and practical areas of modern data analysis and machine learning in engineering. It builds on programming skills developed in the first and second year of the program, as well as statistics and probability and numerical methods. It prepares students to use machine learning algorithms in chemical engineering applications. Primary course learning outcomes include the application of machine learning algorithms using training data to predict future datasets, select models appropriately and use techniques to identify overfitting.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 320
Calendar Section Type: Course
Description of Change: CHME 320 Technical and Advanced Materials

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	**Proposed Text**
	CHME 320 Technical and Advanced Materials (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 220 .
Description :	*Description :*
	This course focuses on advanced materials, technologies, and processes for mechanical systems in various industries. Topics include advanced structural and functional metallic, ceramic and polymer materials, their composites, and nanostructured materials in the context of their processing, characterization, performance, and applications. Strong emphasis is placed on failure mechanisms and analysis as well as design problems with advanced materials systems in references to industrial applications. Additional topics include processing of advanced materials in order to achieve desired mechanical behavior, design optimization with advanced materials, as well as the economics of such systems. Various case studies will be included throughout the course. The course will include team discussions and laboratory work followed by a comprehensive technical report.
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Tutorial (1 hour per week)
Notes :	*Notes :*

Rationale:
CHME 320 is a required course for the new BEng in Chemical Engineering, taken in the winter semester of the second year. The purpose is to familiarize students with the production of advanced materials and their applications. It builds on knowledge from previous materials science and material properties courses in the first year (MIAE 221, CHME 220). It prepares students to optimize design with advanced materials. Primary course learning outcomes include describing the importance of materials processing on the structure and behaviour of advanced materials and understanding the economics of advanced materials processing.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 321
Calendar Section Type: Course
Description of Change: CHME 321 Chemical and Materials Product Design

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 321 Chemical and Materials Product Design (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 320 .
Description :	*Description :*
	This course discusses chemical and materials products, from their synthesis to their processing into final products in various industries. Topics include design, optimization, and manufacturing of chemicals and materials, material characterization, material performance and applications. Important aspects of the product design process, such as material selection and failure mechanisms, are discussed in detail. This course demonstrates various case studies and requires team discussions, laboratory work and a comprehensive technical report.
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Tutorial (2 hours per week, alternate weeks)
Notes :	*Notes :*

Rationale:

CHME 321 is a required course for the new BEng in Chemical Engineering, taken in the fall semester of the third year. The purpose is to cover chemical and material product design undertaken in various industries. It builds on the knowledge acquired in the previous materials science, material properties, and advanced materials courses and gets students to apply this knowledge to design chemical and material products. Primary course learning outcomes include material selection based on design criteria and economics, identifying sustainability challenges in materials selection, product lifecycles, and designing a chemical or material product for a specified application.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 330
Calendar Section Type: Course
Description of Change: CHME 330 Chemical Process Dynamics and Control

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 330 Chemical Process Dynamics and Control (3 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: CHME 301 , CHME 361 ; ENGR 311 .
Description :	*Description :*
	Process dynamics and control of chemical processes are the fundamentals of this course, focusing on process modelling, controller design, and implementation. Differential equations are used to model dynamic systems and understand responses of first- and second- order systems to set point and disturbance changes. System stability with and without automatic control is assessed. Software is utilized to simulate the dynamic response of systems with/without automatic control and to design controllers.
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Tutorial (1 hour per week)
Notes :	*Notes :*

Rationale:
CHME 330 is a required course for the new BEng in Chemical Engineering, taken in the third-year winter semester. The purpose is to provide students with the ability to design process controllers to control chemical processes based on developed process models. It utilizes transform calculus and applied this to the control of chemical reactions and other chemical unit operations. It prepares students to design a control system for an entire chemical process. Primary course learning outcomes include utilizing Laplace transforms for controller design, applying modeling principles to chemical processes to generate dynamic process models, and use engineering software to simulate dynamic system response and control.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 340
Calendar Section Type: Course
Description of Change: CHME 340 Chemical Engineering Lab II

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 340 Chemical Engineering Lab II (1.5 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: CHME 240 , CHME 301 , CHME 361 .
Description :	*Description :*
	This laboratory course emphasizes the practical aspects of various chemical engineering topics. Experiments in this course are designed to study reaction kinetics in continuous and plug flow reactors, calculate operational characteristic curves and efficiency of centrifugal pumps, compare different heat exchangers, and estimate diffusion coefficients. The theoretical concepts learned in the classroom are demonstrated through application in the laboratory setting using lab- and pilot-scale versions of industrial equipment and software.
Component(s):	*Component(s):*
	Laboratory (6 hours per week, alternate weeks)
Notes :	*Notes :*

Rationale:

CHME 340 is a required course for the new BEng in Chemical Engineering, taken in the winter semester of the third year. The purpose is to provide students with a hands-on application of knowledge learned in their reaction engineering (CHME 301) and unit operations (CHME 361) courses while building on their laboratory and technical writing skills. It continues to prepare students in laboratory skills, experimentation, investigation, and communication. Primary course learning outcomes include demonstrating an understanding of reproducibility and accuracy in laboratory measurements, identifying potential for errors in experimental procedures, and limiting bias as it applies to measuring reaction rates in different reactor types, operating pumps, and comparing different heat exchangers.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 351
Calendar Section Type: Course
Description of Change: CHME 351 Chemical Engineering Thermodynamics

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 351 Chemical Engineering Thermodynamics (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: ENGR 251 . The following course must be completed previously or concurrently: ENGR 311 .
Description :	*Description :*
	This course reviews and applies fundamental principles of thermodynamics, including chemical and phase equilibrium. The course covers application to various chemical processes including pure and multicomponent phases, equilibria in complex chemical reactions, and equilibria in separation processes. The course also covers thermodynamics of non-ideal pure and multicomponent phases.
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Tutorial (1 hour per week)
Notes :	*Notes :*

Rationale:

CHME 351 is a required course for the new BEng in Chemical Engineering, taken in the fall semester of the second year. The purpose is to explore how thermodynamic concepts apply to chemical processes, including complex chemical reaction equilibrium and phase equilibrium for separation process. It builds on concepts of thermodynamics covered in the first year engineering thermodynamics course (ENGR 251) expanded to a chemical engineering context including chemical and phase equilibrium. It prepares students to calculate required thermodynamic properties of solutions in order to perform energy balances for a chemical process. Primary course learning outcomes include calculating fundamental thermodynamic properties for both ideal and non-ideal multicomponent systems.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 352
Calendar Section Type: Course
Description of Change: CHME 352 Energy Conversion and Storage

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	**Proposed Text**
	CHME 352 Energy Conversion and Storage (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 351 .
Description :	*Description :*
	This course covers fundamentals of applied thermodynamics to energy systems, with a focus on renewable power systems. Topics include principles of energy conversion and thermodynamic engine cycles, analysis of energy consumption, conversion, and storage in power and transportation systems, with emphasis on efficiency, performance, and environmental impact.
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Tutorial (1 hour per week)
Notes :	*Notes :*

Rationale:
CHME 352 is a required course for the new BEng in Chemical Engineering, taken in the fall semester of the fourth year. The purpose is to apply chemical thermodynamics to energy systems with a primary focus on renewable power systems. It builds on knowledge from chemical thermodynamics, including using the knowledge to calculate the thermodynamic properties of electrolytic solutions present in battery materials. It prepares students to design energy storage and conversion technologies for renewable energy. Primary course learning outcomes include the design of sustainable solutions to realistic energy demand scenarios and the identification and critical review of advancements in energy conversion technology.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 360
Calendar Section Type: Course
Description of Change: CHME 360 Heat Transfer

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 360 Heat Transfer (3 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: CHME 351 ; ENGR 311 , ENGR 391 .
Description :	*Description :*
	This course discusses the principles of heat transfer in various geometries and configurations. Topics include shell energy balances; steady and unsteady state heat transfer via conduction; free and forced convection and radiation; heat exchangers; heat transfer in laminar and turbulent boundary layers.
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Tutorial (1 hour per week)
Notes :	*Notes :*
Anti-requisite Courses :	**Anti-requisite Courses :** Students who have received credit for MECH 352 may not take this course for credit.

Rationale:
CHME 360 is a required course for the new BEng in Chemical Engineering, taken in the winter semester of the second year. The purpose is to discuss principles of heat transfer for various geometries and configurations and design heat exchangers used in chemical process plants. Students transferring into chemical engineering from mechanical engineering who have already taken MECH 352 are not required to take this course, though they will be required to take the prerequisite course CHME 351 on chemical thermodynamics prior to taking CHME 361. This course builds on topics from thermodynamics and applies topics from transform calculus and partial differential equations. It prepares students to design and analyze the performance of heat exchangers in chemical processes. Primary course learning outcomes include demonstrating understanding of three modes of heat transfer (conduction, convection, and radiation), demonstrate understanding of boundary layer concepts in laminar and turbulent flows, and design heat exchangers in various configurations.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 361
Calendar Section Type: Course
Description of Change: CHME 361 Mass Transfer and Unit Operations

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 361 Mass Transfer and Unit Operations (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 360 .
Description :	*Description :*
	This course covers the fundamentals of mass transfer including diffusive and convective mass fluxes. Mass transfer models leading to ordinary and partial differential equations in various geometries are discussed as well as mass transfer calculations for design of continuous single stage separation units with fluid interfaces such as absorption, stripping, and liquid-liquid extraction. The course introduces mechanical operations and Piping and Instrumentation Diagrams (P&ID).
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Tutorial (1 hour per week)
Notes :	*Notes :*

Rationale:
CHME 361 is a required course for the new BEng in Chemical Engineering, taken in the fall semester of the third year. The purpose is to teach students the mass transfer calculations required to the design of unit operations for separation processes. It builds on the mathematical formulations of heat transfer from the previous semester this time rederived for mass transfer and utilizes chemical thermodynamics for phase equilibrium. It prepares students for the design of phase separation units, including distillation, in future courses. Primary course learning outcomes include the development of mass transport models based on differential equations, and the solution of heat and mass transfer in multiple phase systems.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 362
Calendar Section Type: Course
Description of Change: CHME 362 Chemical Separations Engineering

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 362 Chemical Separations Engineering (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 361 .
Description :	*Description :*
	This course reviews the fundamentals of heat and mass transfer, and phase equilibrium for ideal and non-ideal systems, including the equilibrium stage concept and cascades of stages with and without reflux. Applications in the separation of components by multistage processes including distillation, absorption, stripping, extraction, and leaching are covered as well as applications of simultaneous mass and heat transfer calculations for the design of continuous separation units with fluid interfaces.
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Tutorial (1 hour per week)
Notes :	*Notes :*

Rationale:
CHME 362 is a required course for the new BEng in Chemical Engineering, taken in the winter semester of the third year. The purpose is to teach students how to design separation unit operations in a chemical process. It builds on the knowledge obtained in heat transfer and mass transfer and applies it to the design of separation processes. It prepares students to design distillation columns, absorption or stripping columns, and other separation systems. Primary course learning outcomes include the understanding of phase equilibrium in chemical processes applied to contact separation stages, the application of mass and energy balances on separation units, and the design of separation processes.

Resource Implications:
See budget.

New Undergraduate Program (Regular Process) - GCS-CME-4421 - VERSION : 2

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 390
Calendar Section Type: Course
Description of Change: CHME 390 Design Project

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 390 Design Project (3 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: CHME 201 , CHME 301 , CHME 321 . The following courses must be completed previously or concurrently: CHME 330 , CHME 362 ; ENGR 301 .
Description :	*Description :*
	This course discusses the main steps in engineering systems design and operation with an emphasis on economics, safety, equipment performance, environment, and flexibility. Students work independently and in groups on problem-solving assignments and a term project. There are weekly tutorial sessions focusing on various aspects of process simulation using Aspen software.
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Tutorial (2 hours per week)
Notes :	*Notes :*

Rationale:
CHME 390 is a required course for the new BEng in Chemical Engineering, taken in the winter semester of the third year. The purpose of this design project is to go over the main steps in designing a chemical process, using software. It builds on knowledge from chemical processes, reaction engineering, and product and materials design, as well as knowledge of economics, process control, and separations engineering. It prepares students to be able to design an entire chemical process for their capstone project. Primary course learning outcomes include learning important design considerations for main process equipment and utilization of simulation tools for process development and economic analysis.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 400
Calendar Section Type: Course
Description of Change: CHME 400 Sustainable Industrial and Engineering Chemistry

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 400 Sustainable Industrial and Engineering Chemistry (3 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: CHME 201 , CHME 300 .
Description :	*Description :*
	This course reviews the principles of green chemistry and presents alternatives to conventional routes for producing commodity and fine chemicals. Production of value-added chemicals from sustainable feedstock such as biomass and co-products/residues is discussed. Similarly, established catalytic reactions are compared with alternate production routes such as electrochemical or photochemical synthesis while highlighting the barriers facing these technologies. Economics, energy consumption, risk and environmental trade-offs are used as key metrics for assessing sustainable production.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 400 is an elective course for the new BEng in Chemical Engineering in the Sustainable Chemical Engineering technical elective track, to be taken in the fourth year. The purpose is to evaluate alternative production routes of value-added chemicals from sustainable feedstocks. It builds on sustainability and green chemistry topics covered in the core courses. It prepares students to think critically about the commercial viability and environmental benefits of different synthetic routes.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 401
Calendar Section Type: Course
Description of Change: CHME 401 Sustainable Process Design

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 401 Sustainable Process Design (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 390 .
Description :	*Description :*
	This course aims to familiarize students with sustainable design principles in industries to reduce their overall energy consumption (particularly non-renewable resources) and minimize their negative impacts on health and the environment. This course is built based on three major modules: 1) Sustainability analysis and life cycle assessment; 2) Process integration and intensification for minimal environmental impact; and 3) Optimization of industrial processes.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 401 is an elective course for the new BEng in Chemical Engineering in the Sustainable Chemical Engineering technical elective track, to be taken in the fourth year. The purpose is to build on the design project course in third year with an increased emphasis on sustainability so students can use sustainability analysis techniques and life cycle assessments to evaluate different chemical process designs. Primary course learning outcomes include the application of optimization tools, sustainable design processes, and sustainability and life cycle assessments to solve an open-ended design problem.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 402
Calendar Section Type: Course
Description of Change: CHME 402 Sustainable Energy Conversion and Management

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 402 Sustainable Energy Conversion and Management (3 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: CHME 351 , CHME 352 .
Description :	*Description :*
	This course introduces concepts of renewable energy resources and processes for sustainable chemical production and energy storage. Existing and future energy conversion technologies are analyzed from an engineering perspective, including renewable electricity sources (wind, solar, etc.) and advanced power generation technologies such as chemical looping combustion and gasification, solid oxide fuel cells, and oxyfuel combustion. Energy storage for enabling additional penetration of these technologies is also investigated. Valorization of biomass and waste as valuable chemical feedstock and a variety of thermochemical and biochemical conversion processes provide the introduction to sustainable industrial chemical production. Deep industrial decarbonization is also included by analyzing carbon capture, sequestration and utilization concepts, and technologies.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 402 is an elective course for the new BEng in Chemical Engineering in the Sustainable Chemical Engineering technical elective track, to be taken in the fourth-year winter semester. The purpose is to evaluate energy storage and conversion technologies for renewable energy applications. It builds on knowledge of thermodynamics and energy conversion technologies introduced in the BEng core courses. It prepares students to critically review and analyze recently published research work related to energy storage and management.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 403
Calendar Section Type: Course
Description of Change: CHME 403 Electrochemical Engineering

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 403 Electrochemical Engineering (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 351 .
Description :	*Description :*
	This course demonstrates the fundamentals of electrochemistry using modern applications such as batteries, fuel cells, electrolysis, wastewater treatment, electrodeposition and electrosynthesis. The first part of the course covers the core concepts of thermodynamics, kinetics, and mass transport to explain the design principles common to all electrochemical technologies. The second part of the course focuses on more advanced topics such as electrocatalysis, porous electrode theory, and experimental methods.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 403 is an elective course for the new BEng in Chemical Engineering in the Sustainable Chemical Engineering technical elective track, to be taken in the fourth year. The purpose is to teach students design principles for electrochemical systems. It builds on chemical thermodynamics and mass transport applied to electrochemical technologies. It prepares students to design electrochemical processes. Primary course learning outcomes include the estimation of kinetic and mass transport losses at an electrode, estimation of ohmic losses in electrochemical cells, and calculation of voltage efficiency for electrochemical cells.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 404
Calendar Section Type: Course
Description of Change: CHME 404 Clean Energy Science and Technology

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	**Proposed Text**
	CHME 404 Clean Energy Science and Technology (3 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: CHME 321 , CHME 352 .
Description :	*Description :*
	This course develops student knowledge in clean energy based on different energy storage and conversion systems. Students are familiarized with fundamentals, materials design, characterization and evaluation, and industrial applications of different energy storage and conversion systems. The course brings together some of the world's most preeminent researchers in the clean energy field to share their knowledge and expertise. Several important energy storage and conversion systems are introduced, such as electrochemistry, hydrogen, solar, and other systems.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 404 is an elective course for the new BEng in Chemical Engineering in the Sustainable Chemical Engineering technical elective track, to be taken in the fourth year winter semester. The purpose is to familiarize students with materials design for energy storage and energy conversion systems. It builds on topics covered in the energy conversion and material product design courses from the BEng core courses. It prepares students to work in the field of energy storage and conversion systems. Primary course learning outcomes include the determination of experimental methods used to study key parameters of energy storage materials, and apply knowledge of materials science, reaction kinetics, to solve problems in clean energy.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 405
Calendar Section Type: Course
Description of Change: CHME 405 Introduction to Environmental Engineering

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 405 Introduction to Environmental Engineering (3 credits)
Prerequisites:	*Prerequisites:*
Description :	*Description :*
	This course provides an overview of the main concepts of environmental engineering. Topics include chemical principles applied to natural aquatic systems, biological and ecological principles, environmental risk assessment, air and water quality, and principles of waste management.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 405 is an elective course for the new BEng in Chemical Engineering in the Sustainable Chemical Engineering technical elective track, to be taken in the fourth year. The purpose is to introduce chemical engineering students to topics in environmental engineering, including environmental risk assessment, air and water quality, and principles of waste management, which is important for chemical engineers to understand and consider in their chemical process design. It prepares students to interact with environmental engineers. Primary course learning outcomes include understanding principles of air pollution control, water pollution control, and waste management, and the understanding of environmental risk assessments.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 406
Calendar Section Type: Course
Description of Change: CHME 406 Introduction to Life Cycle Assessment

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	**Proposed Text**
	CHME 406 Introduction to Life Cycle Assessment (3 credits)
Prerequisites:	*Prerequisites:*
Description :	*Description :*
	Life cycle assessment (LCA), which is critical for any engineering and design work, is an analytical framework used within the field of industrial ecology to assess the environmental impact across the entire life cycle of a product, process, or service. This course explores the fundamental principles, standards, and application of LCA to inform diverse public policy, business, supply chain, community development, and other decisions. The course follows the principles, methods, and recommendations of the ISO14040-44 standards, applying a stepwise approach to LCA including project definition, data collection, impact assessment and interpretation. Students apply the principles of the framework using calculation tools in addition to purposebuilt software (OpenLCA) and databases (ecoinvent) to become familiar with the most common methodologies for conducting LCA and demonstrate their capability and knowledge. Students develop an in-depth and hands-on understanding of the frameworks, principles, tools, and applications of LCA to evaluate the cradle-to-grave impacts of any product or system.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:

CHME 406 is an elective course for the new BEng in Chemical Engineering in the Sustainable Chemical Engineering technical elective track, to be taken in the fourth year. The purpose is to give students in-depth and hands-on understanding of the different frameworks, principles, tools, and applications of life cycle assessment. It builds on life cycle. It prepares students to perform cradle-to-grave life cycle impacts for any product or system.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 415
Calendar Section Type: Course
Description of Change: CHME 415 Computational Modelling for Chemical Engineers

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 415 Computational Modelling for Chemical Engineers (3 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: CHEM 205 , CHME 351 ; ENGR 391 .
Description :	*Description :*
	This course presents various computational tools used in molecular and multiphysics modelling. The lectures provide the underlying theoretical and foundational concepts; the tutorials present practical chemical engineering problems and demonstrate how to use the software with hands-on sessions. The topics include density functional theory (DFT), atomistic molecular dynamics (MD) simulations, numerical thermodynamics, and multiphysics simulations using COMSOL. The course includes lectures with hands-on tutorials.
Component(s):	*Component(s):*
	Lecture (3 hours per week) ; Tutorial (2 hours per week)
Notes :	*Notes :*

Rationale:

CHME 415 is a required course for the new BEng in Chemical Engineering, taken in the fall semester of the fourth year. The purpose is to expose students to multiple computational tools they may use for molecular and multiphysics modelling to solve engineering problems. It builds on their knowledge of thermodynamics, chemistry, and numerical methods and applies it to the entire scale of modeling, from the molecular scale to the process scale. It prepares students to work to utilize the advanced computational engineering tools to succeed in industry. Primary course learning outcomes include the identification of relevant computational modelling techniques available in a given situation, and the application of one of these tools to critically analyze data and address a scientific problem.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 416
Calendar Section Type: Course
Description of Change: CHME 416 Data Engineering for Chemical Engineers

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	**Proposed Text**
	CHME 416 Data Engineering for Chemical Engineers (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 215 or equivalent (COEN 243 , MECH 215, MIAE 215).
Description :	*Description :*
	With the trend of digitalization, industry is implementing automated data processing technologies. This course covers the theoretical and practical issues in modern data streaming and processing in engineering with particular focus on chemical process and manufacturing data. Topics include structured and non-structured data, database modelling and SQL language, data streaming using publish subscribe paradigm, introduction to data lakes, ETL versus ELT, introduction to Kafka and Kafka streams, stateless and stateful processing, automating a data pipeline, and data streaming frameworks in industry for manufacturing / production data (MTConnect, MQQT and OPC-UA).
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:

CHME 416 is an elective course for the new BEng in Chemical Engineering in the Data Analytics for Chemical Engineers technical elective track, to be taken in the fourth year. The purpose is to provide chemical engineering students a basis in how data processing technologies and data streaming are applied in chemical process engineering and manufacturing. It applied skills learned in first year computer programming and is open to other engineering disciplines. It prepares students to construct their own automatic data-pipelines. Primary course learning outcomes include identifying between structured and unstructured data and distinguish between stateless and stateful processing.

Note: MECH 215 was given a new subject code to become MIAE 215 as of 2021-2022 (and therefore does not exist in the current calendar). It is listed in the prerequisites because students may have taken the old version of the course.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 420
Calendar Section Type: Course
Description of Change: CHME 420 Nanomaterials Science and Engineering

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	**Proposed Text**
	CHME 420 Nanomaterials Science and Engineering (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 320 .
Description :	*Description :*
	This course covers chemical and engineering aspects of nanomaterials. Topics include synthesis, characterization, properties, and applications of a variety of nanomaterials, with a focus on representative inorganic nanomaterials, as well as carbon nanomaterials such as fullerenes, carbon nanotubes, and graphene.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 420 is an elective course for the new BEng in Chemical Engineering in the Materials Engineering technical elective track, to be taken in the fourth year. The purpose is to introduce chemical engineering students to the synthesis, characterization, and applications of nanomaterials. It builds on knowledge of materials science and advanced materials covered in the BEng core courses. It prepares students to design processes for nanomaterial production. Primary course learning outcomes include understanding different nanomaterial systems (structures and physical properties), describe processing methods for nanomaterial manufacture, understand basic mechanical behaviour of nanomaterials, and understand the economics and safety aspects of nanomaterial processing.

Resource Implications:
See budget.

New Undergraduate Program (Regular Process) - GCS-CME-4421 - VERSION : 2

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 421
Calendar Section Type: Course
Description of Change: CHME 421 Metallurgical Engineering

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 421 Metallurgical Engineering (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 320 .
Description :	*Description :*
	This course reviews crystal structures, phase diagrams, and crystal defects. The theory of alloys and solid solutions is discussed. Physical, electrical, magnetic, optical and mechanical properties of metals and alloys are covered. The preparation, melting and casting of metals and alloys is reviewed. The class investigates steel, lithium, iron, nickel, aluminum and titanium alloys as well as the corrosion and protection of metals. Characterization techniques of metals are taught including light and electron microscopy, X-ray diffraction, and thermal analysis. Case studies and industrial applications are included in class materials.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 421 is an elective course for the new BEng in Chemical Engineering in the Materials Engineering technical elective track, to be taken in the fourth year. The purpose is to cover topics related to metallurgical engineering and metal processing. It builds on knowledge of materials science and advanced materials covered in the BEng core courses. It prepares students to design metal coatings for basic metals and alloys for specific industrial applications. Primary course learning outcomes include understanding the structure and properties of metals and alloys, and establish phase diagrams of binary and ternary alloys.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 422
Calendar Section Type: Course
Description of Change: CHME 422 Polymer Chemistry and Engineering

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 422 Polymer Chemistry and Engineering (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHEM 221 .
Description :	*Description :*
	Topics include the advanced theory and industrial practice of polymers, polymer chemistry, and polymer reactor engineering. The course covers polymer chemistry and polymerization kinetics for various types of polymerization, including condensation, free radical, cationic, anionic, and coordination polymerization, polymer reactor engineering, polymer materials structure and property characterization, and recent developments in the field are included.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 422 is an elective course for the new BEng in Chemical Engineering in the Materials Engineering technical elective track, to be taken in the fourth year. The purpose is to introduce students to polymer chemistry and polymer reaction engineering. It builds on knowledge of organic chemistry and reaction engineering covered in the BEng core courses. It prepares students to design chemical processes in the polymer industry. Primary course learning outcomes include identification of monomers and polymer molecular structure, reaction mechanisms and stereochemistry, and determine parameters important for polymer reaction engineering.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 423
Calendar Section Type: Course
Description of Change: CHME 423 Advanced Battery Materials and Technologies

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 423 Advanced Battery Materials and Technologies (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 351 .
Description :	*Description :*
	Topics include a review of the principles of batteries and fuel cells, including electrodes and electrolytes. This includes discussion of thermodynamics, reaction kinetics, transport phenomena, electrostatics and phase transformations of various energy storage materials, particularly lithium-ion batteries and fuel cells. Experimental methods are discussed and key parameters of energy storage materials are studied, focusing on a materials science approach.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 423 is an elective course for the new BEng in Chemical Engineering in the Materials Engineering technical elective track, to be taken in the fourth year. The purpose is to review principles of batteries and fuel cells for the design of energy storage materials. It builds on knowledge of materials science, chemical thermodynamics, reaction kinetics, and mass transport covered in the BEng core courses. It prepares students to design advanced batteries and fuel cells. Primary course learning outcomes include the application of electrochemistry knowledge to design battery materials and fuel cells.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 424
Calendar Section Type: Course
Description of Change: CHME 424 Advanced Characterization Techniques

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 424 Advanced Characterization Techniques (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 220 .
Description :	*Description :*
	This course develops student knowledge and understanding of the structure, chemical, and surface properties of materials. Students are familiarized with tools to use for materials analysis and characterization for current and future research, as well as for industrial applications. Strong emphasis is placed on the principles, techniques, and analysis used in the characterization of energy storage materials including chemical, microstructural, electrochemical, and surface analysis. In-situ and operando characterization techniques are also included in the course.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 424 is an elective course for the new BEng in Chemical Engineering in the Materials Engineering technical elective track, to be taken in the fourth year. The purpose is to develop student knowledge on advanced chemical and materials characterization techniques. It builds on knowledge of materials science and material properties covered in the BEng core courses. It prepares students to identify appropriate techniques to characterize specific materials in the context of engineering. Primary course learning outcomes include understanding various characterization techniques for advanced materials characterization, perform characterization tests, and interpret the experimental data.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 425
Calendar Section Type: Course
Description of Change: CHME 425 Hydrometallurgy

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 425 Hydrometallurgy (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 351 .
Description :	*Description :*
	Hydrometallurgy is the refining of metal ores based on aqueous solutions. Topics include an overview of ore minerals and their critical importance in today's economy, kinetics, equilibrium and thermodynamics in aqueous media, leaching, precipitation, reaction displacement and deposition, cementation, electrochemical methods, metal extraction and purification. Environmental issues are also considered. Applications to chemical analysis, mining, and process design are discussed.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 425 is an elective course for the new BEng in Chemical Engineering in the Materials Engineering technical elective track, to be taken in the fourth year. The purpose is to introduce chemical engineering students to the refining of metal ores. It builds on knowledge of chemical thermodynamics covered in the BEng core courses and applies it to hydrometallurgical processes. It prepares students to design metal extraction and purification processes used in the mining industry. Primary course learning outcomes include analyzing chemical reactions and transformations of metals in aqueous media and the design of a hydrometallurgical process for extraction and purification of metals.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 430
Calendar Section Type: Course
Description of Change: CHME 430 Advanced Chemical Engineering Process Dynamics and Control

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 430 Advanced Chemical Engineering Process Dynamics and Control (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 330 .
Description :	*Description :*
	This course reviews the fundamentals of process control with chemical engineering applications and introduces advanced topics such as data reconciliation and model predictive control. Topics include process modeling and dynamic systems; step response curves; data reconciliation; classic PID control; alternative strategies for chemical process control; process model identification; dynamic chemical process simulation; model-predictive control; and assessment of controller performance.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 430 is an elective course for the new BEng in Chemical Engineering in the Advanced Process Design and Control technical elective track, to be taken in the fourth year. The purpose is build on topics covered in CHME 330 on process dynamics and control, focusing on advanced topics such as data reconciliation and model predictive control. It prepares students to design and tune various controller types within a chemical process. Primary course learning outcomes include mathematically modeling dynamic chemical processes, identifying a suitable controller type, assessing system stability with and without process control, and designing and tuning controllers within a simulated chemical process.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 431
Calendar Section Type: Course
Description of Change: CHME 431 Introduction to Optimization for Chemical Engineers

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 431 Introduction to Optimization for Chemical Engineers (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 330 .
Description :	*Description :*
	This course introduces the basic concepts of mathematical optimization, with special interest for chemical engineering applications. Fundamental optimization algorithms such as simplex and branch-and-bound are introduced. Concepts of linear, quadratic, binary, integer, mixed-integer and nonlinear programming are explored using graphical and mathematical techniques, as well as through the use of software for larger problems. Common applications in chemical engineering design and operation are used to highlight the usefulness of these optimization techniques. The primal optimization problem and its dual representation are presented, as well as the relationship between them. Sensitivity analysis of optimization models is shown through the dual representation.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 431 is an elective course for the new BEng in Chemical Engineering in the Advanced Process Design and Control technical elective track, to be taken in the fourth year. It builds on topics of process optimization and sensitivity models introduced in various courses in the BEng core. The purpose is to cover topics in mathematical optimization in chemical processes, and it prepares students to solve various types of optimization problems. Primary course learning outcomes include identifying different types of optimization problems, implement optimization problems in appropriate software tools and quantify sensitivity in the optimization results.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 432
Calendar Section Type: Course
Description of Change: CHME 432 Advanced Process Safety Engineering

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 432 Advanced Process Safety Engineering (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 390 .
Description :	*Description :*
	In this course, the primary aspects of safety in the design and operation of process plants are covered. Students gain an understanding of the standards and procedures, such as HAZOP, that must be considered to achieve a safe design. The codes, standards, and recommended practices for designing safety facilities for the protection of equipment are reviewed. Various types of relief systems and devices (e.g. safety valves, rupture discs) are introduced. Furthermore, the procedures to identify the primary hazardous scenarios, such as fire, equipment protection, operational failure, and solid formation are discussed. Calculations for the required relief capacities are developed. The design and rating of the relief systems and the sizing of the flare network for the safe disposal of relieved materials are the last parts of safety engineering covered in this course. Aspen Safety Analysis and Aspen Flare System Analyzer are used to examine the dynamic behaviour of the relief devices and flare systems.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 432 is an elective course for the new BEng in Chemical Engineering in the Advanced Process Design and Control technical elective track, to be taken in the fourth year. The purpose is to introduce students to different standards and procedures that need to be considered for safe design. It builds on topics covered in the design project and introduces various types of relief systems and devices. It prepares students to design and rate relief systems in a chemical process. Primary course learning outcomes include the development of safety devices to create a reliable and safe chemical process, and understand the safety and environmental aspects of chemical systems design.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 440
Calendar Section Type: Course
Description of Change: CHME 440 Chemical Engineering Lab III

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 440 Chemical Engineering Lab III (1.5 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: CHME 330 , CHME 340 , CHME 362 .
Description :	*Description :*
	This laboratory course emphasizes the practical aspects of chemical engineering topics in the final years of study. Experiments in this course include distillation, absorption, drying, process dynamics, and process control. The theoretical concepts learned in the classroom are demonstrated through application in the laboratory setting using lab- and pilot-scale versions of industrial equipment and software.
Component(s):	*Component(s):*
	Laboratory (6 hours per week, alternate weeks)
Notes :	*Notes :*

Rationale:
CHME 440 is a required course for the new BEng in Chemical Engineering, taken in the fall semester of the fourth year. The purpose is to provide a hands-on application for knowledge learned in process control and separations engineering coursework. It builds on and expands the skills developed in previous lab courses to investigate and communicate experimental results. It prepares students to effectively communicate their findings in technical reports. Primary course learning outcomes include demonstrating a practical understanding of unit operations, and effectively controlling various parameters in a chemical process.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 460
Calendar Section Type: Course
Description of Change: CHME 460 Chemical Kinetics and Advanced Reactor Engineering

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 460 Chemical Kinetics and Advanced Reactor Engineering (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 301 .
Description :	*Description :*
	This course reviews chemical kinetics and their use in chemical reactor design and chemical plant operation. Both homogeneous and heterogeneous kinetics, including catalysis, are considered. Topics include residence time distribution; multiphase and dispersed plug flow reactors; radial mass and heat transfer limitation; mass and heat transfer limitation in and around porous catalysts.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 460 is an elective course for the new BEng in Chemical Engineering in the Advanced Topics in Chemical Engineering technical elective track, to be taken in the fourth year. The purpose is to introduce advanced topics in reactor engineering, such as multiphase reactors, porous catalytic reactors, and fluidized bed reactors. It builds on topics covered in the chemical reaction engineering and chemical thermodynamics courses within the BEng core. It prepares students to design advanced reactors for chemical processes. Primary course learning outcomes include utilizing computational models to calculate mass transfer limitations, simulate reactions with mass and heat transfer rates within porous catalyst, and the calculation of kinetic parameters from experimental data in advanced reactors.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 461
Calendar Section Type: Course
Description of Change: CHME 461 Advanced Chemical Engineering Thermodynamics

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 461 Advanced Chemical Engineering Thermodynamics (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 351 .
Description :	*Description :*
	Topics include principles, concepts, and laws / postulates of classical and statistical thermodynamics and their link to applications that require quantitative knowledge of thermodynamic properties from a macroscopic to a molecular level; basic postulates of classical thermodynamics and their application; criteria of stability and equilibria; constitutive property models of pure materials and mixtures, including molecular-level effects using statistical mechanics; equations of state; phase and chemical equilibria of multicomponent systems; and thermodynamics of polymers. Applications are emphasized through extensive problem work relating to practical cases.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 461 is an elective course for the new BEng in Chemical Engineering in the Advanced Topics in Chemical Engineering technical elective track, to be taken in the fourth year. The purpose is to review chemical thermodynamics and introduce advanced topics in phase and chemical equilibria of multicomponent non-ideal systems. It builds on knowledge of chemical thermodynamics provided in the BEng core CHME 351. It prepares students to apply advanced thermodynamic models to chemical systems. Primary course learning outcomes include the identification of suitable thermodynamic models as they apply to specific systems, solve complex thermodynamic problems with chemical and phase equilibrium for multiple phases and reactions.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 462
Calendar Section Type: Course
Description of Change: CHME 462 Industrial Catalysis

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 462 Industrial Catalysis (3 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: CHME 301 , CHME 351 .
Description :	*Description :*
	Basic and recent concepts in catalysis are described with particular emphasis on heterogenous catalysis. The course starts with fundamentals of catalysis, such as catalyst structure, characterization, kinetic theory, reaction mechanisms, and catalyst preparation. Then industrial catalytic applications are covered, including the technical, economic and environmental aspects. The processes to be studied are chosen from the petroleum industry, the natural gas industry, and the treatment of industrial pollutants with catalytic converters.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 462 is an elective course for the new BEng in Chemical Engineering in the Advanced Topics in Chemical Engineering technical elective track, to be taken in the fourth year. The purpose is to provide fundamental knowledge in catalyst design, structure, and preparation, as well as cover specific industrial catalytic processes. It builds on knowledge from reaction engineering and chemical thermodynamics. It prepares students to select suitable catalyst materials for a given process and design new catalytic processes. Primary course learning outcomes include the identification of reaction mechanisms, catalyst deactivation mechanisms, to evaluate current industrial catalytic processes and to evaluate novel catalyst technologies and their implementation in a chemical process.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 463
Calendar Section Type: Course
Description of Change: CHME 463 Advanced Separation Processes

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 463 Advanced Separation Processes (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 362 .
Description :	*Description :*
	Topics covered in this course include a review of basic chemical and mechanical separations; multicomponent separations; membrane separations; adsorption; chromatographic separations; and ion exchange.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 463 is an elective course for the new BEng in Chemical Engineering in the Advanced Topics in Chemical Engineering technical elective track, to be taken in the fourth year. The purpose is to introduce advanced topics in separation engineering, building on principles of separation engineering from the third year. It prepares students to design advanced separation processes. Primary course learning outcomes include the application of engineering principles to size various separation processes and consider health, safety, and environmental standards in the design of separation units, and to design a separation unit for a specific application.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 470
Calendar Section Type: Course
Description of Change: CHME 470 Advanced Biochemical Engineering

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 470 Advanced Biochemical Engineering (3 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: CHME 301 , CHME 362 .
Description :	*Description :*
	Topics include the interaction of chemical engineering, biochemistry, and microbiology, as well as mathematical representations of microbial systems. Kinetics of growth, death, and metabolism are also covered, as well as studies of continuous fermentation, agitation, mass transfer, scale-up in fermentation systems, and enzyme technology.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 470 is an elective course for the new BEng in Chemical Engineering in the Biochemical and Food Engineering technical elective track, to be taken in the fourth year. The purpose is to explore topics in biochemical and bioprocess engineering. It builds on reaction engineering and separation engineering principles, applying them to bioprocess engineering. It prepares students to design bioprocesses. Primary course learning outcomes include demonstrating knowledge of microbiology, biochemistry, and genetics, applying chemical engineering principles to bioreactor design and the selection of appropriate methods for product recovery and purification.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 471
Calendar Section Type: Course
Description of Change: CHME 471 Colloid and Interface Chemistry

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 471 Colloid and Interface Chemistry (3 credits)
Prerequisites:	*Prerequisites:*
	The following courses must be completed previously: CHME 220 , CHME 351 .
Description :	*Description :*
	This course focuses on the properties of colloids and surfactants. This includes the physical and chemical interactions between colloidal particles (attraction and repulsion), the stability of colloidal dispersions, and the coagulation and flocculation of colloids. It also includes the surface and interface tension (wettability). The relationships between interface energy and adsorption and the adsorption of surfactants on interfaces (micelles) will be covered, as well as surfactants in nanotechnology and adsorption in porous media. The characterization methods of colloidal particles and surface characterization are discussed.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 471 is an elective course for the new BEng in Chemical Engineering in the Biochemical and Food Engineering technical elective track, to be taken in the fourth year. The purpose is to provide fundamental knowledge of colloid and surfactant properties. It builds on materials science and chemical thermodynamics as applied to colloids and surfactants. Primary course learning outcomes include utilizing chemical thermodynamic and electrostatic properties of colloids to solve problems, examining physical and chemical interactions between colloidal particles, and assessing the stability of colloidal dispersions.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 472
Calendar Section Type: Course
Description of Change: CHME 472 Food Engineering

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 472 Food Engineering (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 390 .
Description :	*Description :*
	This course introduces fundamentals of food processing systems, such as process classification, mass and energy balances, fluid mechanics and transport, steady-state and unsteady-state heat transfer. It further covers the most popular food processing unit operations, including thermal processing, microwave processing, evaporation, and freezing. This course also provides knowledge for selecting processes and equipment and determining the appropriate procedures of operation.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 472 is an elective course for the new BEng in Chemical Engineering in the Biochemical and Food Engineering technical elective track, to be taken in the fourth year. The purpose is to provide the fundamentals on food processing systems. It builds on knowledge from various courses in the BEng, primarily related to process design and unit operations. It prepares students to design food processing systems. Primary course learning outcomes include the selection of heat transfer and mass transfer equipment for food engineering applications.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 473
Calendar Section Type: Course
Description of Change: CHME 473 Biomaterials and Biochemicals

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 473 Biomaterials and Biochemicals (3 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 220 .
Description :	*Description :*
	This course is divided into two sections. The first section focuses on fundamental principles in biomedical engineering, material science, and chemistry. Different classes of materials (metals, ceramics, polymers, and composites) will be discussed, emphasizing their properties, biocompatibility, and utilization in implanted medical devices. The second section introduces cellular chemistry, including the structure and function of biological molecules, nucleic acids, enzymes and other proteins, carbohydrates, lipids, and vitamins.
Component(s):	*Component(s):*
	Lecture (3 hours per week)
Notes :	*Notes :*

Rationale:
CHME 473 is an elective course for the new BEng in Chemical Engineering in the Biochemical and Food Engineering technical elective track, to be taken in the fourth year. The purpose is to provide fundamental knowledge in biomedical engineering, material science, and chemistry, as well as the design of biomaterials for biomedical applications. It builds on knowledge of materials science as applied to biomaterials. It prepares students to design biocompatible materials for use in implanted medical devices in biomedical engineering. Primary course learning outcomes include the understanding of the structure and function of biological molecules and macromolecules in cells and how biocompatibility is determined for various materials.

Resource Implications:
See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 480
Calendar Section Type: Course
Description of Change: CHME 480 Molecular Modelling of Proteins

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 480 Molecular Modelling of Proteins (3 credits)
	Also listed as CHEM 436 .
Prerequisites:	*Prerequisites:*
Description :	*Description :*
	This course offers a hands-on introduction to the modelling tools to study protein structure and dynamics. Topics include molecular visualization, biological databases, protein sequence alignment, force fields, and molecular dynamics simulations. Students have hands-on practice in weekly tutorials following lectures.
Component(s):	*Component(s):*
	Lecture (1.5 hours per week) ; Laboratory (1.5 hours per week (computer lab))
Notes :	*Notes :*

Rationale:
CHME 480 is an elective course for the new BEng in Chemical Engineering in the Biomolecular Modelling and Drug Design technical elective track, to be taken in the fourth year. The purpose is to provide a hands-on introduction to modelling tools to study protein structure and dynamics. It prepares students to model and tune protein structure and function. Primary course learning outcomes include the classification of various molecular modelling techniques and utilizing these techniques to investigate proteins and carry out biomolecular simulations.

Resource Implications:
See budget.

New Undergraduate Program (Regular Process) - GCS-CME-4421 - VERSION : 2

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)

Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 481

Calendar Section Type: Course

Description of Change: CHME 481 Multiscale Modelling of Biomaterials

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer

Planning and Promotion: 01 Sep 2024

Effective/Push to SIS date: 01 Sep 2024

Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 481 Multiscale Modelling of Biomaterials (3 credits)
Prerequisites:	*Prerequisites:*
Description :	*Description :*
	This course offers a hands-on introduction to the multiscale modelling tools to design and study biomaterials. Topics include molecular visualization of material systems, force fields, molecular dynamics simulations, multiscale modelling techniques such as coarse graining, estimation of mechanical properties from the simulation data. Students have hands-on practice in weekly tutorials following lectures.
Component(s):	*Component(s):*
	Lecture (2 hours per week) ; Laboratory (1 hour per week (computer lab))
Notes :	*Notes :*

Rationale:

CHME 481 is an elective course for the new BEng in Chemical Engineering in the Biomolecular Modelling and Drug Design technical elective track, to be taken in the fourth year. The purpose is to provide a hands-on introduction to multiscale modelling tools to design and study biomaterials. It builds on multiscale modelling topics introduced in the BEng core. Primary course learning outcomes include carrying our molecular dynamics simulations to design and characterize novel biomaterials and use the simulation results to estimate mechanical properties of materials.

Resource Implications:

See budget.

COURSE CHANGE FORM

Dossier Type: New Undergraduate Program (Regular Process)
Dossier Title: BEng Chemical Engineering new program

Calendar Section Name: CHME 490
Calendar Section Type: Course
Description of Change: CHME 490 Capstone Chemical Process Design

Proposed: Undergraduate Curriculum Changes

Faculty/School: Gina Cody School of Engineering and Computer Science

Department: Department of Chemical and Materials Engineering

Calendar publication date: 2024/2025/Summer
Planning and Promotion: 01 Sep 2024
Effective/Push to SIS date: 01 Sep 2024
Implementation/Start date: 01 Sep 2024

Path: Undergraduate > 2023-2024 Undergraduate Calendar > Faculties > Section 71 Gina Cody School of Engineering and Computer Science > Gina Cody School of Engineering and Computer Science > Section 71.60 Engineering Course Descriptions > Chemical and Materials Engineering Courses

Type of Change: New Course

Present Text (from 2021) calendar	Proposed Text
	CHME 490 Capstone Chemical Process Design (6 credits)
Prerequisites:	*Prerequisites:*
	The following course must be completed previously: CHME 390 .
Description :	*Description :*
	This course requires students to apply their chemical engineering knowledge using a process design approach. Students work in groups to conduct research, design, and plan the implementation of a chemical plant. The project plan and the results of the developed process are documented as a technical report and presented as a seminar. Students use the simulation results to conduct the techno-economic analysis and life cycle assessment results to evaluate the financial feasibility and environmental aspects of their design.
Component(s):	*Component(s):*
	Modular (10 hours per week, combined Lectures/Laboratory.)
Notes :	*Notes :*

Rationale:
CHME 490 is a required course for the new BEng in Chemical Engineering, a two-semester course taken in the fourth year. The purpose of the capstone is to provide an opportunity for students to use a culmination of all their knowledge to implement a process design using the engineering design process. It prepares students to be able to work in a team for the design of a chemical process. Primary course learning outcomes include the development of an open-ended practical project with meaningful applications, making use of knowledge gained to come up with various solutions, working through design criteria, selecting an optimal solution for the project, and creating a comprehensive report to explain and defend the choices made in the recommended design.

Resource Implications:
See budget.

Impact Report

Programs

BEng in Chemical Engineering requirements summary
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.105 Department of Chemical and Materials Engineering -> Department of Chemical and Materials Engineering -> Section 71.105.1 Course Requirements (BEng in Chemical Engineering) -> Degree Requirements
Source of Impact

Defined Groups

Chemical Engineering Core
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.105 Department of Chemical and Materials Engineering -> Department of Chemical and Materials Engineering -> Section 71.105.1 Course Requirements (BEng in Chemical Engineering) -> Degree Requirements -> BEng in Chemical Engineering
Source of Impact

Chemical Engineering Technical Elective Courses
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.105 Department of Chemical and Materials Engineering -> Department of Chemical and Materials Engineering -> Section 71.105.1 Course Requirements (BEng in Chemical Engineering) -> Degree Requirements -> BEng in Chemical Engineering
Source of Impact

Tech Elective track - Advanced Process Design and Control
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.105 Department of Chemical and Materials Engineering -> Department of Chemical and Materials Engineering -> Section 71.105.1 Course Requirements (BEng in Chemical Engineering) -> Degree Requirements -> BEng in Chemical Engineering -> Chemical Engineering Technical Elective Courses
Source of Impact

Tech Elective track - Advanced Topics in Chemical Engineering
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.105 Department of Chemical and Materials Engineering -> Department of Chemical and Materials Engineering -> Section 71.105.1 Course Requirements (BEng in Chemical Engineering) -> Degree Requirements -> BEng in Chemical Engineering -> Chemical Engineering Technical Elective Courses
Source of Impact

Tech Elective track - Biochemical and Food Engineering
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.105 Department of Chemical and Materials Engineering -> Department of Chemical and Materials Engineering -> Section 71.105.1 Course Requirements (BEng in Chemical Engineering) -> Degree Requirements -> BEng in Chemical Engineering -> Chemical Engineering Technical Elective Courses
Source of Impact

Tech Elective track - Biomolecular Modelling and Drug Design
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.105 Department of Chemical and Materials Engineering -> Department of Chemical and Materials Engineering -> Section 71.105.1

Course Requirements (BEng in Chemical Engineering) -> Degree Requirements -> BEng in Chemical Engineering -> Chemical Engineering Technical Elective Courses
Source of Impact

Tech Elective track - Data Analytics for Chemical Engineers
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.105 Department of Chemical and Materials Engineering -> Department of Chemical and Materials Engineering -> Section 71.105.1 Course Requirements (BEng in Chemical Engineering) -> Degree Requirements -> BEng in Chemical Engineering -> Chemical Engineering Technical Elective Courses
Source of Impact

Tech Elective track - Materials Engineering
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.105 Department of Chemical and Materials Engineering -> Department of Chemical and Materials Engineering -> Section 71.105.1 Course Requirements (BEng in Chemical Engineering) -> Degree Requirements -> BEng in Chemical Engineering -> Chemical Engineering Technical Elective Courses
Source of Impact

Tech Elective track - Sustainable Chemical Engineering
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.105 Department of Chemical and Materials Engineering -> Department of Chemical and Materials Engineering -> Section 71.105.1 Course Requirements (BEng in Chemical Engineering) -> Degree Requirements -> BEng in Chemical Engineering -> Chemical Engineering Technical Elective Courses
Source of Impact

Courses

CHME 200 Introduction to Chemical Process Engineering
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 201 Innovative, Sustainable, and Safe Manufacturing in Chemical Industry
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 215 Programming for Chemical and Materials Engineers
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 216 Advanced Programming for Chemical Engineers
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 220 Material Properties and Chemical Characterization
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses

Source of Impact

CHME 240 Chemical Engineering Lab I
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 300 Industrial and Engineering Chemistry
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 301 Chemical Reaction Engineering
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 316 Advanced Data Analysis and Machine Learning for Chemical Engineers
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 320 Technical and Advanced Materials
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 321 Chemical and Materials Product Design
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 330 Chemical Process Dynamics and Control
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 340 Chemical Engineering Lab II
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 351 Chemical Engineering Thermodynamics
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 352 Energy Conversion and Storage
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 360 Heat Transfer
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 361 Mass Transfer and Unit Operations
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 362 Chemical Separations Engineering
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 390 Design Project
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 400 Sustainable Industrial and Engineering Chemistry
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 401 Sustainable Process Design
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 402 Sustainable Energy Conversion and Management
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 403 Electrochemical Engineering
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 404 Clean Energy Science and Technology
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering

Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 405 Introduction to Environmental Engineering
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 406 Introduction to Life Cycle Assessment
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 415 Computational Modelling for Chemical Engineers
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 416 Data Engineering for Chemical Engineers
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 420 Nanomaterials Science and Engineering
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 421 Metallurgical Engineering
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 422 Polymer Chemistry and Engineering
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 423 Advanced Battery Materials and Technologies
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 424 Advanced Characterization Techniques
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 425 Hydrometallurgy
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 430 Advanced Chemical Engineering Process Dynamics and Control
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 431 Introduction to Optimization for Chemical Engineers
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 432 Advanced Process Safety Engineering
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 440 Chemical Engineering Lab III
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 460 Chemical Kinetics and Advanced Reactor Engineering
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 461 Advanced Chemical Engineering Thermodynamics
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 462 Industrial Catalysis
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 463 Advanced Separation Processes
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 470 Advanced Biochemical Engineering
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering

Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 471 Colloid and Interface Chemistry
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 472 Food Engineering
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 473 Biomaterials and Biochemicals
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 480 Molecular Modelling of Proteins
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 481 Multiscale Modelling of Biomaterials
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

CHME 490 Capstone Chemical Process Design
Undergraduate -> 2023-2024 Undergraduate Calendar -> Faculties -> Section 71 Gina Cody School of Engineering and Computer Science -> Gina Cody School of Engineering and Computer Science -> Section 71.60 Engineering Course Descriptions -> Chemical and Materials Engineering Courses
Source of Impact

Other Units

Addition of **Engineering Core** to **Degree Requirements** requirement
Source of other unit Impact

- Defined group is housed in Section 71.20 BEng

Addition of **BEng in Chemical Engineering** to **C.Edge Option** requirement
Source of other unit Impact

- Program is housed in Section 71.105 Department of Chemical and Materials Engineering

Addition of **BEng in Chemical Engineering** to **Accelerated Career Experience Option** requirement
Source of other unit Impact

- Program is housed in Section 71.105 Department of Chemical and Materials Engineering

Addition of **BEng in Chemical Engineering** to **The Co-operative Format** requirement
Source of other unit Impact

- Program is housed in Section 71.105 Department of Chemical and Materials Engineering

Addition of **COMP 248** to **CHME 215** requirement
Source of other unit Impact

- Course is housed in Section 71.70 Department of Computer Science and Software Engineering

Addition of **COMP 248** to **CHME 216** requirement
Source of other unit Impact

- Course is housed in Section 71.70 Department of Computer Science and Software Engineering

Addition of **Engineering Core** to **BEng in Chemical Engineering** requirement
Source of other unit Impact

- Defined group is housed in Section 71.20 BEng

Addition of **BIOL 226** to **Biochemical and Food Engineering** requirement
Source of other unit Impact

- Course is housed in Section 31.030 Department of Biology

Addition of **BIOL 261** to **Biochemical and Food Engineering** requirement
Source of other unit Impact

- Course is housed in Section 31.030 Department of Biology

Addition of **BIOL 371** to **Biochemical and Food Engineering** requirement
Source of other unit Impact

- Course is housed in Section 31.030 Department of Biology

Addition of **CHEM 271** to **Biochemical and Food Engineering** requirement
Source of other unit Impact

- Course is housed in Section 31.050 Department of Chemistry and Biochemistry

Addition of **CHME 470** to **Biochemical and Food Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 473** to **Biochemical and Food Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 472** to **Biochemical and Food Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 471** to **Biochemical and Food Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHEM 327** to **Materials Engineering** requirement
Source of other unit Impact

- Course is housed in Section 31.050 Department of Chemistry and Biochemistry

Addition of **CHEM 427** to **Materials Engineering** requirement
Source of other unit Impact

- Course is housed in Section 31.050 Department of Chemistry and Biochemistry

Addition of **CHEM 498** to **Materials Engineering** requirement
Source of other unit Impact

- Course is housed in Section 31.050 Department of Chemistry and Biochemistry

Addition of **CHEM 498** to **Materials Engineering** requirement
Source of other unit Impact

- Course is housed in Section 31.050 Department of Chemistry and Biochemistry

Addition of **CHME 420** to **Materials Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 421** to **Materials Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 422** to **Materials Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 423** to **Materials Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 424** to **Materials Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 425** to **Materials Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **COMP 333** to **Data Analytics for Chemical Engineers** requirement
Source of other unit Impact

- Course is housed in Section 71.70 Department of Computer Science and Software Engineering

Addition of **COMP 352** to **Data Analytics for Chemical Engineers** requirement
Source of other unit Impact

- Course is housed in Section 71.70 Department of Computer Science and Software Engineering

Addition of **COMP 473** to **Data Analytics for Chemical Engineers** requirement
Source of other unit Impact

- Course is housed in Section 71.70 Department of Computer Science and Software Engineering

Addition of **COMP 479** to **Data Analytics for Chemical Engineers** requirement
Source of other unit Impact

- Course is housed in Section 71.70 Department of Computer Science and Software Engineering

Addition of **SOEN 363** to **Data Analytics for Chemical Engineers** requirement
Source of other unit Impact

- Course is housed in Section 71.70 Department of Computer Science and Software Engineering

Addition of **COMP 474** to **Data Analytics for Chemical Engineers** requirement
Source of other unit Impact

- Course is housed in Section 71.70 Department of Computer Science and Software Engineering

Addition of **COMP 433** to **Data Analytics for Chemical Engineers** requirement
Source of other unit Impact

- Course is housed in Section 71.70 Department of Computer Science and Software Engineering

Addition of **CHME 416** to **Data Analytics for Chemical Engineers** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHEM 498** to **Sustainable Chemical Engineering** requirement
Source of other unit Impact

- Course is housed in Section 31.050 Department of Chemistry and Biochemistry

Addition of **CHEM 498** to **Sustainable Chemical Engineering** requirement
Source of other unit Impact

- Course is housed in Section 31.050 Department of Chemistry and Biochemistry

Addition of **CIVI 465** to **Sustainable Chemical Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CIVI 467** to **Sustainable Chemical Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CIVI 468** to **Sustainable Chemical Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 400** to **Sustainable Chemical Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 401** to **Sustainable Chemical Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 403** to **Sustainable Chemical Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 405** to **Sustainable Chemical Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 402** to **Sustainable Chemical Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 404** to **Sustainable Chemical Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 406** to **Sustainable Chemical Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **MECH 472** to **Advanced Process Design and Control** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 416** to **Advanced Process Design and Control** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 432** to **Advanced Process Design and Control** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 430** to **Advanced Process Design and Control** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 431** to **Advanced Process Design and Control** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 463** to **Advanced Topics in Chemical Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 462** to **Advanced Topics in Chemical Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 461** to **Advanced Topics in Chemical Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 460** to **Advanced Topics in Chemical Engineering** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHEM 431** to **Biomolecular Modelling and Drug Design** requirement
Source of other unit Impact

- Course is housed in Section 31.050 Department of Chemistry and Biochemistry

Addition of **CHME 481** to **Biomolecular Modelling and Drug Design** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 480** to **Biomolecular Modelling and Drug Design** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHEM 221** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 31.050 Department of Chemistry and Biochemistry

Addition of **ENGR 245** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **ENGR 251** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **ENGR 311** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **ENGR 361** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **MIAE 221** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 200** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 220** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 215** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 216** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 201** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 351** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 240** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 316** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 321** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 360** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 361** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 330** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 352** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 362** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 390** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 440** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 490** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 300** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 320** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 301** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 340** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Addition of **CHME 415** to **Chemical Engineering Core** requirement
Source of other unit Impact

- Course is housed in Section 71.60 Engineering Course Descriptions

Université Concordia University

OFFICE OF THE PROVOST AND
VICE-PRESIDENT, ACADEMIC AFFAIRS

MEMO

DATE: November 8, 2021

TO: Dr. Mourad Debbabi, Dean, Gina Cody School of Engineering

FROM: Dr. Sandra Gabriele, Vice-Provost, Innovation in Teaching & Learning

SUBJECT: Letter of Intent: Bachelor of Engineering in Chemical Engineering

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I am writing on behalf of Dr. Anne Whitelaw, Provost, to support the submitted Letter of Intent (LOI) for a new Bachelor of Engineering in Chemical Engineering and to invite the Department to develop the program proposal for the next phase of approvals.

The LOI holds significant promise for an approach to chemical engineering that is in step with the needs of society by promising to train students to understand sustainability, entrepreneurship, and other key skills to launch small and medium enterprises. Given the considerable pressures on the future work of chemical engineers, this approach to the program design and content is not only responsible, but addresses known future challenges. We look forward to seeing a proposal that will articulate more fully where and how these skills will be developed, particularly how graduates will be trained to be "versatile problem solvers."

While we support this LOI for future development, we offer the following points of feedback for consideration by the Department of Chemical and Materials Engineering.

We are encouraged by the innovative thinking in the design and approach to teaching this LOI promises. In particular, we concur that educational technologies could be leveraged to enhance and deepen learning and wish to support exploring these initiatives. We would advise that the costs of online learning must be included in the budget as these are costs borne by the University, if not directly by the Department.

We welcome some clarification about the data in student enrolment trends. It will be important to understand why the decline in enrolment noted on page 3 is taking place and if this dip is a temporary one in an otherwise strong area of growth (as seen in the ten-year trend cited on page 6 of the LOI). Given the need by the BCI for new programs to demonstrate alignment with Quebec market needs, the local conditions in Montreal will be important. With the assistance of a Curriculum Developer and/or from the Provost's office, some questions to try to answer in the proposal:

- How will this program support growth in the local industries of the Montreal region?

- Do we have a sense of the more specific areas of growth that require the specific skills emerging from the degree?

Given the level of interest in building comprehensive chemistry training, it was surprising not to see consultation with the Chemist and Biochemistry Department already completed. Perhaps more discussion has taken place since 2016, but we urge further collaboration with the Department, to ensure complementarity and continued cooperation. We also invite the Department to consider how this program may also contribute to the development of the School of Health.

Finally, we note that a full rationale for resources is not required at this stage and we welcome further reflection on the true costs to launch the program, including space and equipment. The market analysis suggested above will help the Department to build a reasonable estimate of net new students in order to offset the costs of the requested 3 CUFA members, 4 staff members, eConcordia development costs, and new sections.

We support this developing into an innovation, forward-looking program. Should it be needed, we welcome further discussion with you.

cc: Dr. Anne Whitelaw, Provost & Vice-President, Academic
Dr. Mourad Debbabi, Dean, Gina Cody School of Engineering
Dr. Ali Akgunduz, Associate Dean, Gina Cody School of Engineering
Dr. Alex de Visscher, Chair, Department of Chemical and Materials Engineering
Ms. Julie Johnston, University Curriculum Administrator
Mr. Graham Maisonneuve, Director, Finance & Budgets, Office of the Provost

Section 71.105.1 Course Requirements (BEng in Chemical Engineering)

Degree Requirements

The program in Chemical Engineering consists of the Engineering Core, the Chemical Engineering Core, and the Chemical Engineering Technical Elective Courses as shown below. The minimum length of the program is 120 credits.

BEng in Chemical Engineering (120 credits)

27 credits from the Engineering Core

84 credits from the Chemical Engineering Core

9 credits from the Chemical Engineering Technical Elective Courses

Chemical Engineering Core (84 credits)

- CHEM 221 Introductory Organic Chemistry I (3.00)
- CHME 200 Introduction to Chemical Process Engineering (3.00)
- CHME 201 Innovative, Sustainable, and Safe Manufacturing in Chemical Industry (3.00)
- CHME 215 Programming for Chemical and Materials Engineers (3.50)
- CHME 216 Advanced Programming for Chemical Engineers (3.50)
- CHME 220 Material Properties and Chemical Characterization (3.00)
- CHME 240 Chemical Engineering Lab I (1.50)
- CHME 300 Industrial and Engineering Chemistry (3.00)
- CHME 301 Chemical Reaction Engineering (3.00)
- CHME 316 Advanced Data Analysis and Machine Learning for Chemical Engineers (3.50)
- CHME 320 Technical and Advanced Materials (3.00)
- CHME 321 Chemical and Materials Product Design (3.00)
- CHME 330 Chemical Process Dynamics and Control (3.00)
- CHME 340 Chemical Engineering Lab II (1.50)
- CHME 351 Chemical Engineering Thermodynamics (3.00)
- CHME 352 Energy Conversion and Storage (3.00)
- CHME 360 Heat Transfer (3.00)
- CHME 361 Mass Transfer and Unit Operations (3.00)
- CHME 362 Chemical Separations Engineering (3.00)
- CHME 390 Design Project (3.00)
- CHME 415 Computational Modelling for Chemical Engineers (3.00)
- CHME 440 Chemical Engineering Lab III (1.50)
- CHME 490 Capstone Chemical Process Design (6.00)
- ENGR 245 Mechanical Analysis (3.00)
- ENGR 251 Thermodynamics I (3.00)
- ENGR 311 Transform Calculus and Partial Differential Equations (3.00)
- ENGR 361 Fluid Mechanics I (3.00)
- MIAE 221 Materials Science (3.00)

Chemical Engineering Technical Elective Courses (9 credits)

Students must complete 9 elective credits from the Technical Elective Courses list of courses below. Courses are listed in groups specialized tracks to facilitate the selection of courses in a particular area of the field:
Biochemical and Food Engineering
Materials Engineering
Data Analytics for Chemical Engineers
Sustainable Chemical Engineering
Advanced Process Design and Control
Advanced Topics in Chemical Engineering
Biomolecular Modelling and Drug Design

Biochemical and Food Engineering

- BIOL 371 Microbiology (3.00)
- CHEM 271 Biochemistry I (3.00)
- CHME 470 Advanced Biochemical Engineering (3.00)
- CHME 471 Colloid and Interface Chemistry (3.00)
- CHME 472 Food Engineering (3.00)
- CHME 473 Biomaterials and Biochemicals (3.00)

Materials Engineering

- CHEM 327 Organic Chemistry of Polymers (3.00)
- CHEM 427 Polymer Chemistry and Nanotechnology (3.00)
- CHME 420 Nanomaterials Science and Engineering (3.00)
- CHME 421 Metallurgical Engineering (3.00)
- CHME 422 Polymer Chemistry and Engineering (3.00)
- CHME 423 Advanced Battery Materials and Technologies (3.00)
- CHME 424 Advanced Characterization Techniques (3.00)
- CHME 425 Hydrometallurgy (3.00)
- CHEM 498 Advanced Topics in Chemistry (3.00)

Note: CHEM 498 can be counted as a technical elective course and many topics may be offered.

Data Analytics for Chemical Engineers

- CHME 416 Data Engineering for Chemical Engineers (3.00)
- COMP 333 Data Analytics (4.00)
- COMP 433 Introduction to Deep Learning (4.00)
- COMP 473 Pattern Recognition (4.00)
- COMP 474 Intelligent Systems (4.00)
- COMP 479 Information Retrieval and Web Search (4.00)
- SOEN 363 Data Systems for Software Engineers (3.00)

Sustainable Chemical Engineering

- CHME 400 Sustainable Industrial and Engineering Chemistry (3.00)
- CHME 401 Sustainable Process Design (3.00)
- CHME 402 Sustainable Energy Conversion and Management (3.00)

- CHME 403 Electrochemical Engineering (3.00)
- CHME 404 Clean Energy Science and Technology (3.00)
- CHME 405 Introduction to Environmental Engineering (3.00)
- CHME 406 Introduction to Life Cycle Assessment (3.00)
- CIVI 465 Water Pollution and Control (3.50)
- CIVI 467 Air Pollution and Emission Control (3.00)
- CIVI 468 Waste Management (3.00)
- CHEM 498 Advanced Topics in Chemistry (3.00)

Note: CHEM 498 can be counted as a technical elective course and many topics may be offered.

Advanced Process Design and Control

- CHME 416 Data Engineering for Chemical Engineers (3.00)
- CHME 430 Advanced Chemical Engineering Process Dynamics and Control (3.00)
- CHME 431 Introduction to Optimization for Chemical Engineers (3.00)
- CHME 432 Advanced Process Safety Engineering (3.00)
- MECH 471 Microcontrollers for Mechatronics (3.50)
- MECH 472 Mechatronics and Automation (3.50)

Advanced Topics in Chemical Engineering

- CHME 460 Chemical Kinetics and Advanced Reactor Engineering (3.00)
- CHME 461 Advanced Chemical Engineering Thermodynamics (3.00)
- CHME 462 Industrial Catalysis (3.00)
- CHME 463 Advanced Separation Processes (3.00)

Biomolecular Modelling and Drug Design

- CHEM 431 Computational Chemistry for Chemists and Biochemists (3.00)
- CHME 480 Molecular Modelling of Proteins (3.00)
- CHME 481 Multiscale Modelling of Biomaterials (3.00)

Appendix 1: Official Program Description

Chemical Engineering is concerned with engineering science and design principles related to chemical processes. In a chemical process, matter undergoes a combination of physical and chemical changes to transform into useful products. In designing a chemical process, consideration of the raw materials, the energy use, requirements of the final product, the materials selection for unit operations within a chemical process, and the overall process sustainability, are all critical factors. Chemical engineering science includes the understanding of the mechanisms of chemical reactions to products of interest, and the thermodynamic and kinetics involved in chemical reactions and phase separation processes. Chemical engineering design challenges include scaling up a chemical process from laboratory to industrial scale, unit operation sizing and integration, sustainability and life cycle assessments, and the process control methodology to ensure product quality and process safety. Chemical engineers work in the industrial processing of chemicals, plastics, pharmaceuticals, food, and materials. Chemical engineers also play a major role in the emerging fields of nanotechnology and advanced materials, and sustainable energy. The Chemical Engineering curriculum comprises fundamental engineering courses and technical electives which allow students to obtain advanced knowledge in fields of interest and expected future activities. Sets of technical electives include:

- Biochemical and Food Engineering
- Materials Engineering
- Sustainable Chemical Engineering
- Advanced Process Design and Control
- Data Analytics for Chemical Engineers
- Advanced Topics in Chemical Engineering
- Biomolecular Modelling and Drug Design

Appendix 2: Course outlines and descriptions

Please see Proposed New Chemical Engineering Courses and Course Outlines for each of these in following pages.

Proposed New Chemical Engineering Courses

Chemical Engineering Core Courses

CHME 200 ***Introduction to Chemical Process Engineering*** (3 credits)
This introductory course provides the fundamentals of chemical process design and thinking like a chemical engineer. Students are introduced to principles of plant economics, unit conversions, process simulation, and various ways to represent process organization, such as block and process flow diagrams. Fitting correlations to chemical plant data and an introduction to sensors and measuring devices is also included. Basic relationships between physical properties of liquids and gases and chemical reactions are expanded, and material balances are studied in detail. An introduction to engineering software, such as ASPEN, for the modelling of chemical processes is covered.
Lectures: 3 hours per week. Tutorials: 2 hours per week.

CHME 201 ***Innovative, Sustainable, and Safe Manufacturing in Chemical Industry*** (3 credits)
Prerequisites: ENGR 251, CHME 220.
Sustainable development concepts are discussed as they apply to chemical processes. Green chemistry principles and the design of sustainable chemical processes are introduced. Waste minimization, materials recycling, energy conservation and environmental remediation are also covered, as well as sustainability assessments and safety evaluations (HAZOP).
Lectures: 3 hours per week. Tutorials: 1 hour per week.

CHME 215 ***Programming for Chemical and Materials Engineers*** (3.5 credits)
This course focuses on writing programs using assignment and sequences, variables and types, operators and expressions, conditional and repetitive statements, input and output, file access, functions, program structure and organization, pointers and dynamic memory allocation, introduction to classes and objects, and chemical engineering applications.
Lectures: 3 hours per week. Laboratory: 2 hour per week.
Note: Students who have received credit for COEN 243, COMP 246, MECH 215, or MIAE 215 may not take this course for credit.

CHME 216 ***Advanced Programming for Chemical Engineers*** (3.5 credits)
Prerequisite: CHME 215 or equivalent (MIAE 215, COEN 243, MECH 215, COMP 248).
This course discusses theoretical and practical areas pertinent to modern information technology as it is used daily in Canadian SMEs. Topics include object-oriented programming, introduction to relational databases, graphical user interface programming, data acquisition, and document automation.
Lectures: 3 hours per week. Laboratory: 2 hours per week.

CHME 220 ***Material Properties and Chemical Characterization*** (3 credits)
Corequisite: MIAE 221.
This course provides students with a basic understanding of key material properties, the relationships between the structure-properties-processing-application of materials, and the

methods of characterizing materials structures and materials properties. In addition to solid materials, fluid properties of gases and liquids are addressed. The students are expected to apply this knowledge towards solving problems in engineering applications.
Lectures: 3 hours per week. Tutorials: 2 hours per week.

CHME 240 ***Chemical Engineering Lab I*** (1.5 credits)
Prerequisites: CHME 200, CHME 351. Co-requisite: ENGR 361.
This laboratory course emphasizes the practical aspects of introductory chemical engineering topics. Experiments in this course include temperature measurements, calorimetry, pressure measurements, and flow measurements. The theoretical concepts learned in the classroom are demonstrated through application in the laboratory setting using lab- and pilot-scale versions of industrial equipment and software.
Laboratory: 6 hours per week alternating weeks.

CHME 300 ***Industrial and Engineering Chemistry*** (3 credits)
Prerequisites: CHME 200
This course provides an overview of prominent chemicals and production routes in the chemical industry. Processes for bulk chemical production using conventional and novel routes are investigated, including oil refining, polymers, hydrometallurgy, and commodity chemicals. Concepts of sustainability, plant economics and PFDs for bulk chemical processes are studied. Simulations of bulk chemical production processes are also conducted using ASPEN software.
Lectures: 3 hours per week. Tutorials: 1 hour per week.

CHME 301 ***Chemical Reaction Engineering*** (3 credits)
Prerequisites: CHME 200, CHME 351.
This course reviews the fundamentals of reaction rates and kinetic parameters and discusses their experimental determination. Mathematical equations for isothermal and non-isothermal batch, semi-batch, continuous, and plug flow reactors are covered and applied to reactor design and sizing. Additional topics include selectivity and optimization of reactors with multiple reactions; heterogeneous catalysis in packed bed reactors with coupled heat and mass transfer effects; and enzyme catalysis and the Michaelis-Menten mechanism for bioreactors.
Lectures: 3 hours per week. Tutorials: 2 hours per week.

CHME 316 ***Advanced Data Analysis and Machine Learning for Chemical Engineers*** (3.5 credits)
Prerequisites: CHME 216, ENGR 371, ENGR 391.
This course is designed to cover the theoretical and practical areas pertinent to modern data analysis and machine learning in engineering. Topics include traditional machine learning algorithms based on feature engineering (Linear regression, Logistic Regression, Bayesian classifier, K-nearest neighbors, Bagging and boosting, Random Forests), bias and variance, model selection and regularization, features selection, and introduction to neural networks.
Lectures: 3 hours per week. Tutorials: 1 hour per week. Laboratory: 2 hours per week, alternating weeks.

CHME 320 ***Technical and Advanced Materials*** (3 credits)
Prerequisite: CHME 220. This course focuses on advanced materials, technologies, and processes for mechanical systems in various industries. Topics include advanced structural and functional metallic, ceramic and polymer materials, their composites, and nanostructured materials in the context of their processing, characterization, performance, and applications. Strong emphasis is placed on failure mechanisms and analysis as well as design problems with advanced materials systems in references to industrial applications. Additional topics include processing of advanced materials in order to achieve desired mechanical behavior, design optimization with advanced materials, as well as the economics of such systems. Various case studies will be included throughout the course. The course will include team discussions and laboratory work followed by a comprehensive technical report.
Lectures: 3 hours per week. Tutorials: 1 hour per week.

CHME 321 ***Chemical and Materials Product Design*** (3 credits)
Prerequisite: CHME 320.
This course discusses chemical and materials products, from their synthesis to their processing into final products in various industries. Topics include design, optimization, and manufacturing of chemicals and materials, material characterization, material performance and applications. Important aspects of the product design process, such as material selection and failure mechanisms, are discussed in detail. This course demonstrates various case studies and requires team discussions, laboratory work and a comprehensive technical report.
Lectures: 3 hours per week. Tutorial: 2 hours per week alternating weeks.

CHME 330 ***Chemical Process Dynamics and Control*** (3 credits)
Prerequisites: ENGR 311, CHME 301, CHME 361.
Process dynamics and control of chemical processes are the fundamentals of this course, focusing on process modelling, controller design, and implementation. Differential equations are used to model dynamic systems and understand responses of first- and second- order systems to set point and disturbance changes. System stability with and without automatic control is assessed. Software is utilized to simulate the dynamic response of systems with/without automatic control and to design controllers.
Lectures: 3 hours per week. Tutorials: 1 hour per week.

CHME 340 ***Chemical Engineering Lab II*** (1.5 credits)
Prerequisites: CHME 240, CHME 301, CHME 361.
This laboratory course emphasizes the practical aspects of various chemical engineering topics. Experiments in this course are designed to study reaction kinetics in continuous and plug flow reactors, calculate operational characteristic curves and efficiency of centrifugal pumps, compare different heat exchangers, and estimate diffusion coefficients. The theoretical concepts learned in the classroom are demonstrated through application in the laboratory setting using lab- and pilot-scale versions of industrial equipment and software.
Laboratory: 6 hours per week alternating weeks.

CHME 351 ***Chemical Engineering Thermodynamics*** (3 credits)
Prerequisite: ENGR 251. Co-requisite: ENGR 311
This course reviews and applies fundamental principles of thermodynamics, including chemical and phase equilibrium. The course covers application to various chemical processes including pure and multicomponent phases, equilibria in complex chemical reactions, and equilibria in separation processes. The course also covers thermodynamics of non-ideal pure and multicomponent phases.
Lectures: 3 hours per week. Tutorials: 1 hour per week.

CHME 352 ***Energy Conversion and Storage*** (3 credits)
Prerequisite: CHME 351.
This course covers fundamentals of applied thermodynamics to energy systems, with a focus on renewable power systems. Topics include principles of energy conversion and thermodynamic engine cycles, analysis of energy consumption, conversion, and storage in power and transportation systems, with emphasis on efficiency, performance, and environmental impact.
Lectures: 3 hours per week. Tutorials: 1 hour per week.

CHME 360 ***Heat Transfer*** (3 credits)
Prerequisites: CHME 351, ENGR 311, ENGR 391.
This course discusses the principles of heat transfer in various geometries and configurations. Topics include shell energy balances; steady and unsteady state heat transfer via conduction; free and forced convection, and radiation; heat exchangers; heat transfer in laminar and turbulent boundary layers.
Lectures: 3 hours per week. Tutorials: 1 hour per week.

CHME 361 ***Mass Transfer and Unit Operations*** (3 credits)
Prerequisite: CHME 360.
This course covers the fundamentals of mass transfer including diffusive and convective mass fluxes. Mass transfer models leading to ordinary and partial differential equations in various geometries are discussed as well as mass transfer calculations for design of continuous single stage separation units with fluid interfaces such as absorption, stripping, and liquid-liquid extraction. The course introduces mechanical operations and Piping and Instrumentation Diagrams (P&ID).
Lectures: 3 hours per week. Tutorials: 1 hour per week.

CHME 362 ***Chemical Separations Engineering*** (3 credits)
Prerequisite: CHME 361.
This course reviews the fundamentals of heat and mass transfer, and phase equilibrium for ideal and non-ideal systems, including the equilibrium stage concept and cascades of stages with and without reflux. Applications in the separation of components by multistage processes including distillation, absorption, stripping, extraction, and leaching are covered as well as applications of simultaneous mass and heat transfer calculations for the design of continuous separation units with fluid interfaces.
Lectures: 3 hours per week. Tutorials: 1 hour per week.

CHME 390 ***Design Project*** (3 credits)
Prerequisites: CHME 201, CHME 301, CHME 321. Co-requisites: ENGR 301, CHME 330, CHME 362.
This course discusses the main steps in engineering systems design and operation with an emphasis on economics, safety, equipment performance, environment, and flexibility. Students work independently and in groups on problem-solving assignments and a term project. There are weekly tutorial sessions focusing on various aspects of process simulation using Aspen software.
Lectures: 3 hours per week. Tutorials: 2 hours per week.

CHME 415 ***Computational Modelling for Chemical Engineers*** (3 credits)
Prerequisites: CHEM 205, CHME 351, ENGR 391.
This course presents various computational tools used in molecular and multiphysics modelling. The lectures provide the underlying theoretical and foundational concepts; the tutorials present practical chemical engineering problems and demonstrate how to use the software with hands-on sessions. The topics include density functional theory (DFT), atomistic molecular dynamics (MD) simulations, numerical thermodynamics, and multiphysics simulations using COMSOL. The course includes lectures with hands-on tutorials.
Lectures: 3 hours per week. Tutorials: 2 hours per week.

CHME 440 ***Chemical Engineering Lab III*** (1.5 credits)
Prerequisites: CHME 330, CHME 340, CHME 362.
This laboratory course emphasizes the practical aspects of chemical engineering topics in the final years of study. Experiments in this course include distillation, absorption, drying, process dynamics, and process control. The theoretical concepts learned in the classroom are demonstrated through application in the laboratory setting using lab- and pilot-scale versions of industrial equipment and software.
Laboratory: 6 hours per week alternating weeks.

CHME 490 ***Capstone Chemical Process Design*** (6 credits)
Prerequisite: CHME 390.
This course requires students to apply their chemical engineering knowledge using a process design approach. Students work in groups to conduct research, design, and plan the implementation of a chemical plant. The project plan and the results of the developed process are documented as a technical report and presented as a seminar. Students use the simulation results to conduct the techno-economic analysis and life cycle assessment results to evaluate the financial feasibility and environmental aspects of their design.
Combined Lectures/Laboratory: 10 hours per week.

Technical Electives

Technical electives are organized into six technical tracks:

1. Sustainable Chemical Engineering
2. Materials Engineering
3. Advanced Process Design and Control
4. Advanced Topics in Chemical Engineering
5. Data Analytics for Chemical Engineers
6. Biochemical and Food Engineering
7. Biomolecular Modelling and Drug Design

Sustainable Chemical Engineering Track

CHME 400 ***Sustainable Industrial and Engineering Chemistry*** (3 credits)
Prerequisites: CHME 201, CHME 300
This course reviews the principles of green chemistry and presents alternatives to conventional routes for producing commodity and fine chemicals. Production of value-added chemicals from sustainable feedstock such as biomass and co-products/residues is discussed. Similarly, established catalytic reactions are compared with alternate production routes such as electrochemical or photochemical synthesis while highlighting the barriers facing these technologies. Economics, energy consumption, risk and environmental trade-offs are used as key metrics for assessing sustainable production.
Lectures: 3 hours per week.

CHME 401 ***Sustainable Process Design*** (3 credits)
Prerequisite: CHME 390
This course aims to familiarize students with sustainable design principles in industries to reduce their overall energy consumption (particularly non-renewable resources) and minimize their negative impacts on health and the environment. This course is built based on three major modules: 1) Sustainability analysis and lifecycle assessment; 2) Process integration and intensification for minimal environmental impact; and 3) Optimization of industrial processes.
Lectures: 3 hours per week.

CHME 402 ***Sustainable Energy Conversion and Management*** (3 credits)
Prerequisite: CHME 351, CHME 352
This course introduces concepts of renewable energy resources and processes for sustainable chemical production and energy storage. Existing and future energy conversion technologies are analyzed from an engineering perspective, including renewable electricity sources (wind, solar, etc.) and advanced power generation technologies such as chemical looping combustion and gasification, solid oxide fuel cells, and oxyfuel combustion. Energy storage for enabling additional penetration of these technologies is also investigated. Valorization of biomass and waste as valuable chemical feedstock and a variety of thermochemical and biochemical conversion processes provide the introduction to sustainable industrial chemical production.

Deep industrial decarbonization is also included by analyzing carbon capture, sequestration and utilization concepts, and technologies.
Lectures: 3 hours per week.

CHME 403 ***Electrochemical Engineering*** (3 credits)
Prerequisite: CHME 351
This course demonstrates the fundamentals of electrochemistry using modern applications such as batteries, fuel cells, electrolysis, wastewater treatment, electrodeposition and electrosynthesis. The first part of the course covers the core concepts of thermodynamics, kinetics, and mass transport to explain the design principles common to all electrochemical technologies. The second part of the course focuses on more advanced topics such as electrocatalysis, porous electrode theory, and experimental methods.
Cross-listed with CHME 6911 – Electrochemical Engineering.
Lectures: 3 hours per week.

CHME 404 ***Clean Energy Science and Technology*** (3 credits)
Prerequisite: CHME 321, CHME 352
This course develops student knowledge in clean energy based on different energy storage and conversion systems. Students are familiarized with fundamentals, materials design, characterization and evaluation, and industrial applications of different energy storage and conversion systems. The course brings together some of the world's most preeminent researchers in the clean energy field to share their knowledge and expertise. Several important energy storage and conversion systems are introduced, such as electrochemistry, hydrogen, solar, etc.
Cross-listed with CHME 6911 – Clean Energy Science and Technology.
Lectures: 3 hours per week.

CHME 405 ***Introduction to Environmental Engineering*** (3 credits)
This course provides an overview of the main concepts of environmental engineering. Topics include chemical principles applied to natural aquatic systems, biological and ecological principles, environmental risk assessment, air and water quality, and principles of waste management.
Lectures: 3 hours per week.

CHME 406 ***Introduction to Life Cycle Assessment*** **(3 credits)**
Life cycle assessment (LCA), which is critical for any engineering and design work, is an analytical framework used within the field of industrial ecology to assess the environmental impact across the entire lifecycle of a product, process, or service. This course explores the fundamental principles, standards, and application of LCA to inform diverse public policy, business, supply chain, community development, and other decisions. The course follows the principles, methods, and recommendations of the ISO14040-44 standards, applying a stepwise approach to LCA including project definition, data collection, impact assessment and interpretation. Students apply the principles of the framework using calculation tools in addition to purpose-built software (OpenLCA) and databases (ecoinvent) to become familiar with the most common methodologies for conducting LCA and demonstrate their capability and

knowledge. Students develop an in-depth and hands-on understanding of the frameworks, principles, tools, and applications of LCA to evaluate the cradle-to-grave impacts of any product or system.
Cross-listed with CHME 6911 - Life Cycle Assessment.
Lectures: 3 hours per week.

Data Analytics for Chemical Engineers Track

CHME 416 ***Data Engineering for Chemical Engineers*** (3 credits)
Prerequisites CHME 215 or equivalent (COEN 243, MECH 215, MIAE 215)
With the trend of digitalization, industry is implementing automated data processing technologies. This course covers the theoretical and practical issues in modern data streaming and processing in engineering with particular focus on chemical process and manufacturing data. Topics include structured and non-structured data, database modeling and SQL language, data streaming using publish subscribe paradigm, introduction to data lakes, ETL versus ELT, introduction to Kafka and Kafka streams, stateless and stateful processing, automating a data pipeline, data streaming frameworks in industry for manufacturing / production data (MTConnect, MQQT and OPC-UA).
Lectures: 3 hours per week.

Materials Engineering Track

CHME 420 ***Nanomaterials Science and Engineering*** (3 credits)
Prerequisite: CHME 320
This course covers chemical and engineering aspects of nanomaterials. Topics include synthesis, characterization, properties, and applications of a variety of nanomaterials, with a focus on representative inorganic nanomaterials, as well as carbon nanomaterials such as fullerenes, carbon nanotubes, and graphene.
Cross-listed with CHME 6121 – Nanomaterials Science and Engineering.
Lectures: 3 hours per week.

CHME 421 ***Metallurgical Engineering*** (3 credits)
Prerequisite: CHME 320
This course reviews crystal structures, phase diagrams, and crystal defects. The theory of alloys and solid solutions is discussed. Physical, electrical, magnetic, optical and mechanical properties of metals and alloys are covered. The preparation, melting and casting of metals and alloys is reviewed. The class investigates steel, lithium, iron, nickel, aluminum and titanium alloys as well as the corrosion and protection of metals. Characterization techniques of metals are taught including light and electron microscopy, X-ray diffraction, and thermal analysis. Case studies and industrial applications are included in class materials.
Lectures: 3 hours per week.

CHME 422 ***Polymer Chemistry and Engineering*** (3 credits)
Prerequisite: CHEM 221
Topics include the advanced theory and industrial practice of polymers, polymer chemistry, and polymer reactor engineering. The course covers polymer chemistry and polymerization kinetics for various types of polymerization, including condensation, free radical, cationic, anionic, and coordination polymerization, polymer reactor engineering, polymer materials structure and property characterization, and recent developments in the field are included.
Cross-listed with CHME 6111 – Polymer Chemistry and Engineering.
Lectures: 3 hours per week.

CHME 423 ***Advanced Battery Materials and Technologies*** (3 credits)
Prerequisite: CHME 351
Topics include a review of the principles of batteries and fuel cells, including electrodes and electrolytes. This includes discussion of thermodynamics, reaction kinetics, transport phenomena, electrostatics and phase transformations of various energy storage materials, particularly lithium-ion batteries and fuel cells. Experimental methods are discussed and key parameters of energy storage materials are studied, focusing on a materials science approach.
Cross-listed with CHME 6101 – Advanced Battery Materials and Technologies.
Lectures: 3 hours per week.

CHME 424 ***Advanced Characterization Techniques*** (3 credits)
Prerequisite: CHME 220
This course develops student knowledge and understanding of the structure, chemical, and surface properties of materials. Students are familiarized with tools to use for materials analysis and characterization for current and future research, as well as for industrial applications. Strong emphasis is placed on the principles, techniques, and analysis used in the characterization of energy storage materials including chemical, microstructural, electrochemical, and surface analysis. In-situ and operando characterization techniques are also included in the course.
Cross-listed with CHME 6911 – Advanced Characterization Techniques.
Lectures: 3 hours per week.

CHME 425 ***Hydrometallurgy*** (3 credits)
Prerequisite: CHME 351
Hydrometallurgy is the refining of metal ores based on aqueous solutions. Topics include an overview of ore minerals and their critical importance in today's economy, kinetics, equilibrium and thermodynamics in aqueous media, leaching, precipitation, reaction displacement and deposition, cementation, electrochemical methods, metal extraction and purification. Environmental issues are also considered. Applications to chemical analysis, mining, and process design are discussed.
Cross-listed with CHME 6911 – Hydrometallurgy.
Lectures: 3 hours per week.

Advanced Process Design and Control Track

CHME 430 ***Advanced Chemical Engineering Process Dynamics and Control*** (3 credits)
Prerequisite: CHME 330
This course reviews the fundamentals of process control with chemical engineering applications and introduces advanced topics such as data reconciliation and model predictive control. Topics include process modeling and dynamic systems; step response curves; data reconciliation; classic PID control; alternative strategies for chemical process control; process model identification; dynamic chemical process simulation; model-predictive control; and assessment of controller performance.
Cross-listed with CHME 6041 – Advanced Chemical Engineering Process Dynamics and Control.
Lectures: 3 hours per week.

CHME 431 ***Introduction to Optimization for Chemical Engineers*** (3 credits)
Prerequisite: CHME 330
This course introduces the basic concepts of mathematical optimization, with special interest for chemical engineering applications. Fundamental optimization algorithms such as simplex and branch-and-bound are introduced. Concepts of linear, quadratic, binary, integer, mixed-integer and nonlinear programming are explored using graphical and mathematical techniques, as well as through the use of software for larger problems. Common applications in chemical engineering design and operation are used to highlight the usefulness of these optimization techniques. The primal optimization problem and its dual representation are presented, as well as the relationship between them. Sensitivity analysis of optimization models is shown through the dual representation.
Lectures: 3 hours per week.

CHME 432 ***Advanced Process Safety Engineering*** (3 credits)
Prerequisites: CHME 390
In this course, the primary aspects of safety in the design and operation of process plants are covered. Students gain an understanding of the standards and procedures, such as HAZOP, that must be considered to achieve a safe design. The codes, standards, and recommended practices for designing safety facilities for the protection of equipment are reviewed. Various types of relief systems and devices (e.g. safety valves, rupture discs) are introduced. Furthermore, the procedures to identify the primary hazardous scenarios, such as fire, equipment protection, operational failure, and solid formation are discussed. Calculations for the required relief capacities are developed. The design and rating of the relief systems and the sizing of the flare network for the safe disposal of relieved materials are the last parts of safety engineering covered in this course. Aspen Safety Analysis and Aspen Flare System Analyzer are used to examine the dynamic behaviour of the relief devices and flare systems.
Lectures: 3 hours per week.

Advanced Topics in Chemical Engineering Track

CHME 460 ***Chemical Kinetics and Advanced Reactor Engineering*** (3 credits)
Prerequisite: CHME 301
This course reviews chemical kinetics and their use in chemical reactor design and chemical plant operation. Both homogeneous and heterogeneous kinetics, including catalysis, are considered. Topics include residence time distribution; multiphase and dispersed plug flow reactors; radial mass and heat transfer limitation; mass and heat transfer limitation in and around porous catalysts.
Cross-listed with CHME 6031 Chemical Kinetics and Reactor Engineering.
Lectures: 3 hours per week.

CHME 461 ***Advanced Chemical Engineering Thermodynamics*** (3 credits)
Prerequisite: CHME 351
Topics include principles, concepts, and laws/postulates of classical and statistical thermodynamics and their link to applications that require quantitative knowledge of thermodynamic properties from a macroscopic to a molecular level; basic postulates of classical thermodynamics and their application; criteria of stability and equilibria; constitutive property models of pure materials and mixtures, including molecular-level effects using statistical mechanics; equations of state; phase and chemical equilibria of multicomponent systems; and thermodynamics of polymers. Applications are emphasized through extensive problem work relating to practical cases.
Cross-listed with CHME 6021 Advanced Chemical Engineering Thermodynamics.
Lectures: 3 hours per week.

CHME 462 ***Industrial Catalysis*** (3 credits)
Prerequisites: CHME 301, CHME 351
Basic and recent concepts in catalysis are described with particular emphasis on heterogenous catalysis. The course starts with fundamentals of catalysis, such as catalyst structure, characterization, kinetic theory, reaction mechanisms, and catalyst preparation. Then industrial catalytic applications are covered, including the technical, economic and environmental aspects. The processes to be studied are chosen from the petroleum industry, the natural gas industry, and the treatment of industrial pollutants with catalytic converters.
Cross-listed with CHME 6911/CHEM 646 Industrial Catalysis.
Lectures: 3 hours per week.

CHME 463 ***Advanced Separation Processes*** (3 credits)
Prerequisite: CHME 362
Topics covered in this course include a review of basic chemical and mechanical separations; multicomponent separations; membrane separations; adsorption; chromatographic separations; and ion exchange.
Cross-listed with CHME 6081 Advanced Separation Processes.
Lectures: 3 hours per week.

Biochemical and Food Engineering Track

CHME 470 ***Advanced Biochemical Engineering*** (3 credits)
Prerequisites: CHME 301, CHME 362
Topics include the interaction of chemical engineering, biochemistry, and microbiology, as well as mathematical representations of microbial systems. Kinetics of growth, death, and metabolism are also covered, as well as studies of continuous fermentation, agitation, mass transfer, scale-up in fermentation systems, and enzyme technology.
Cross-listed with CHME 6061 – Advanced Biochemical Engineering.
Lectures: 3 hours per week.

CHME 471 ***Colloid and Interface Chemistry*** (3 credits)
Prerequisites: CHME 220, CHME 351
This course focuses on the properties of colloids and surfactants. This includes the physical and chemical interactions between colloidal particles (attraction and repulsion), the stability of colloidal dispersions, and the coagulation and flocculation of colloids. It also includes the surface and interface tension (wettability). The relationships between interface energy and adsorption and the adsorption of surfactants on interfaces (micelles) will be covered, as well as surfactants in nanotechnology and adsorption in porous media. The characterization methods of colloidal particles and surface characterization are discussed.
Cross-listed with CHME 6131 –Advanced Colloid and Interface Science and Engineering.
Lectures: 3 hours per week.

CHME 472 ***Food Engineering*** (3 credits)
Prerequisite: CHME 390
This course introduces fundamentals of food processing systems, such as process classification, mass and energy balances, fluid mechanics and transport, steady-state and unsteady-state heat transfer. It further covers the most popular food processing unit operations, including thermal processing, microwave processing, evaporation, and freezing. This course also provides knowledge for selecting processes and equipment and determining the appropriate procedures of operation.
Lectures: 3 hours per week.

CHME 473 ***Biomaterials and Biochemicals*** (3 credits)
Prerequisite: CHME 220
This course is divided into two sections. The first section focuses on fundamental principles in biomedical engineering, material science, and chemistry. Different classes of materials (metals, ceramics, polymers, and composites) will be discussed, emphasizing their properties, biocompatibility, and utilization in implanted medical devices. The second section introduces cellular chemistry, including the structure and function of biological molecules, nucleic acids, enzymes and other proteins, carbohydrates, lipids, and vitamins.
Lectures: 3 hours per week.

Biomolecular Modelling and Drug Design Track

CHME 480 ***Molecular Modelling of Proteins*** (3 credits)
This course offers a hands-on introduction to the modelling tools to study protein structure and dynamics. Topics include molecular visualization, biological databases, protein sequence alignment, force fields, and molecular dynamics simulations. Students have hands-on practice in weekly tutorials following lectures.
Cross-listed with CHEM 436/630 and CHME 6911 – Molecular Modelling of Proteins.
Lectures: 1.5 hours per week. Computer laboratory: 1.5 hours per week.

CHME 481 ***Multiscale Modelling of Biomaterials*** (3 credits)
This course offers a hands-on introduction to the multiscale modelling tools to design and study biomaterials. Topics include molecular visualization of material systems, force fields, molecular dynamics simulations, multiscale modelling techniques such as coarse graining, estimation of mechanical properties from the simulation data. Students have hands-on practice in weekly tutorials following lectures.
Lectures: 2 hours per week. Computer laboratory: 1 hour per week, alternate weeks.

CORE COURSES

Course number	Course Title	Term
CHME 200	Introduction to Chemical Process Engineering	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION

This introductory course provides the fundamentals of chemical process design and thinking like a chemical engineer. Students are introduced to principles of plant economics, unit conversions, process simulation, and various ways to represent process organization, such as block and process flow diagrams. Fitting correlations to chemical plant data and an introduction to sensors and measuring devices is also included. Basic relationships between physical properties of liquids and gases and chemical reactions are expanded, and material balances are studied in detail. An introduction to engineering software, such as ASPEN, for the modelling of chemical processes is covered.

PREREQUISITES

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
    - Felder, R.M., Rousseau, R.W., Bullard, L.G. (2016). Elementary Principles of Chemical Processes (4^{th} ed.). John Wiley & Sons, Inc.

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Tel. 514-848-2424 ext. 3109 Fax 514-848-4509 concordia.ca/ginacody

- *Suggested Textbook:*
- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm 1	35
Midterm 2	35
ASPEN Project	15
Assignments	10
Tutorials	5
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
A knowledge base for engineering	Knowledge base in specific domain (Introduce)
	Knowledge base of natural science (Introduce)
Problem analysis	Problem identification and formulation (Introduce)
	Modelling (Introduce)
	Problem solving (Introduce)
	Analysis (uncertainty and incomplete knowledge) (Introduce)
Design	Define the objective (Introduce)
	Idea generation and selection (Introduce)
	Detailed design (Introduce)
	Validation and implementation (Introduce)
Use of engineering tools	Ability to select appropriate engineering tools, techniques, and resources (Introduce)

Professionalism	Role and responsibilities of the professional engineer (Introduce)
Impact of engineering on society & the environment	Awareness of society and environment (Introduce)
	Sustainability in design (Introduce)
Life-long learning	Identifying missing knowledge and learning opportunities (Introduce)

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Perform material and energy balances in chemical engineering processes	**A knowledge base for engineering** Knowledge base in specific domain
B. Recognize what data is required to solve process calculations through degrees of freedom analysis and identify when information is missing	**Problem analysis** Problem identification and formulation **Life-long learning** Identifying missing knowledge and learning opportunities
C. Use thermodynamic concepts to determine compositions of phases, and changes in energy including work and heat transfer for open and closed systems	**A knowledge base for engineering** Knowledge base of natural science **Problem analysis** Problem solving
D. Present engineering solutions, including establishing a basis, developing process diagram, stating assumptions, equations used, and communicating solution method	**Problem analysis** Modelling **Design** Detailed design
E. Perform simultaneous mass and energy balances to model processes, with and without reactions, to improve overall efficiency	**Problem analysis** Analysis (uncertainty and incomplete knowledge) **Design** Define the objective Validation and implementation
F. Utilize engineering software ASPEN for solving material and energy balances chemical processes	**Use of engineering tools** Ability to select appropriate engineering tools, techniques, and resources
G. Identify how professional responsibilities relate to the field of chemical engineering	**Professionalism** Role and responsibilities of the professional engineer
H. Identify different strategies to incorporate sustainability into the design of a chemical process	**Design** Idea generation and selection **Impact of engineering on society & the environment**

	Awareness of society and environment Sustainability in design

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
	3
	4
	5
	6
	7
	8
	9
	10
	11
	12

TERM PROJECT
Topic:

OTHER NOTES

UNIVERSITÉ Concordia UNIVERSITY — GINA CODY SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 201	Innovative, Sustainable, and Safe Manufacturing in Chemical Industry	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION

Sustainable development concepts are discussed as they apply to chemical processes. Green chemistry principles and the design of sustainable chemical processes are introduced. Waste minimization, materials recycling, energy conservation and environmental remediation are also covered, as well as sustainability assessments and safety evaluations (HAZOP).

PREREQUISITES

ENGR 251, CHME 220

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*

- *Suggested Textbook**(s)**:*

  - Ameta, R., & Ameta, S.C. (Eds.). (2013). Green Chemistry: Fundamentals and Applications (1st ed.). Apple Academic Press. https://doi-org.lib-ezproxy.concordia.ca/10.1201/b15500

- Brennan, D. (2012). Sustainable Process Engineering: Concepts, Strategies, Evaluation and Implementation (1st ed.). Jenny Stanford Publishing. https://doi-org.lib-ezproxy.concordia.ca/10.1201/b13145
- Lancaster, M. (2016). Green Chemistry: An Introductory Text (3rd ed.) Royal Society of Chemistry.

- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	20
Final	30
Case Study	10
Project + Presentation: Attendance is mandatory	30
Assignments	10
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
A knowledge base for engineering	Knowledge base of natural science (Introduce)
Problem analysis	Problem identification and formulation (Introduce)
	Problem solving (Introduce)
	Analysis (uncertainty and incomplete knowledge) (Introduce)
Design	Define the objective (Introduce)
	Idea generation and selection (Introduce)

	Detailed design (Introduce)
	Validation and implementation (Introduce)
Individual and teamwork	Cooperation and work ethics (Introduce)
	Contribution: practical/conceptual (Introduce)
	Initiative and leadership (Introduce)
	Delivering results (Introduce)
Communication skills	Writing Process (Introduce)
	Information Gathering (Introduce)
	Documentation (Introduce)
	Oral Presentation (Introduce)
Impact of engineering on society & the environment	Awareness of society and environment impact (Develop)
	Sustainability in design (Develop)
Ethics	Professional ethics and accountability (Introduce)
Economics and project management	Fundamentals of economics (Introduce)
	Economic evaluation of projects (Introduce)
Life-long learning	Identifying missing knowledge and learning opportunities (Introduce)

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Understand 12 principles of green chemistry	**A knowledge base for engineering** Awareness of society and environment
B. Introduce sustainable development and the interactions of social, environmental, and economic systems	**Impact of engineering on society & the environment** Awareness of society and environment impact **Economics and project management** Fundamentals of economics Economic evaluation of projects
C. Understand sustainability and sustainability indicators in the context of chemical processes	**Impact of engineering on society & the environment** Sustainability in design
D. Identify strategies for sustainable design in chemical processes, through waste minimization, energy conservation, and materials recycling	**Design** Idea generation and selection **Problem analysis** Problem identification and formulation **Impact of engineering on society & the environment** Sustainability in design

E. Utilize lifecycle assessments and sustainability assessments to suggest improvements to a process	**Design** Validation and implementation **Problem analysis** Analysis (uncertainty and incomplete knowledge)
F. Identify sustainable design considerations for new processes	**Design** Idea generation and selection
G. Evaluate the sustainability of a chemical process	**Problem analysis** Problem solving **Life-long learning** Identifying missing knowledge and learning opportunities
H. Present sustainable design evaluation in technical report and presentation	**Communication skills** Writing Process Information Gathering Documentation Oral Presentation **Individual and team work** Cooperation and work ethics Contribution: practical/conceptual Initiative and leadership Delivering results

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
	3
	4
	5
	6
	7
	8
	9

	10
	11
	12

TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 215	Programming for Chemical Engineers	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course focuses on writing programs using assignment and sequences, variables and types, operators and expressions, conditional and repetitive statements, input and output, file access, functions, program structure and organization, pointers and dynamic memory allocation, introduction to classes and objects, and chemical engineering applications.

PREREQUISITES

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	30
Final	55
Lab	5
Quizzes	10
Total	100

Passing Criteria:
• If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam. • In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
A knowledge base for engineering	Knowledge base in specific domain (Introduce)
Problem analysis	Problem Solving (Introduce)
	Analysis (uncertainty and incomplete information) (Develop)
Design	Detailed Design (Introduce)
	Validation and implementation (Introduce)
Use of engineering tools	Ability to use appropriate engineering tools, techniques and resources (Introduce)

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A. Understand usage of programming syntax, including data types, operators, expressions, functions, arrays, matrices	**A knowledge base for engineering** Knowledge base in specific domain
B. Apply knowledge of programming syntax in order to write computer programs	**Problem analysis** Problem Solving

C. Recognize the importance of functions for developing modular programs	**A knowledge base for engineering** Knowledge base in specific domain
D. Analyze programs in order to predict the output of a given program	**Problem analysis** Analysis (uncertainty and incomplete information)
E. Design and program computer algorithms for basic chemical engineering applications	**Design** Detailed Design Validation and implementation
F. Implement programs on a personal computer using compiler tools	**Use of engineering tools** Ability to use appropriate engineering tools, techniques, and resources

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
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TERM PROJECT
Topic:

OTHER NOTES

Concordia University — GINA CODY SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

Course Number	Course Title	Term
CHME 216	Advanced Programming for Chemical Engineers	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION

This course discusses theoretical and practical areas pertinent to modern information technology as it is used daily in Canadian SMEs. Topics include object-oriented programming, introduction to relational databases, graphical user interface programming, data acquisition, and document automation.

PREREQUISITES

CHME 215 or equivalent (MIAE 215, COEN 243, MECH 215, COMP 248)

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
    - Exploring Raspberry Pi – Interfacing to the real world with embedded Linux D. Molloy. First edition (2016) ISBN: 978-1-119-18868-1, John Wiley & Sons Inc.
- *Instructor's lecture notes:*

- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Final	30
Project	70
Total	100

Passing Criteria:
• If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam. • In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
A knowledge base for engineering	Knowledge base in a specific domain (Introduce)
Problem analysis	Problem identification and formulation (Introduce)
	Problem solving (Introduce)
Design	Define the objective (Introduce)
	Idea generation and selection (Introduce)
	Detailed Design (Introduce)
	Validation and Implementation (Introduce)
Use of engineering tools	Ability to select appropriate tools, techniques, and resources (Introduce)
	Ability to use appropriate engineering tools, techniques and resources (Develop)
	Demonstrate awareness of limitations of tools, create and extend tools as necessary (Introduce)
Individual and teamwork	Cooperation and work ethics (Introduce)
	Contribution: practical/conceptual (Introduce)
	Initiative and leadership (Introduce)
	Delivering Results (Introduce)
Communication skills	Information Gathering (Develop)

	Documentation (Develop)
	Oral Presentation (Introduce)

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A. Demonstrate fundamental knowledge of programming interfaces for interconnecting software to software and software to hardware	**A knowledge base for engineering** Knowledge base in a specific domain
B. Design and write computer programs for data acquisition	**Design** Define the objective Idea generation and selection Detailed Design Validation and Implementation **Use of engineering tools** Ability to select appropriate tools, techniques, and resources Ability to use appropriate engineering tools, techniques and resources Demonstrate awareness of limitations of tools, create and extend tools as necessary
C. Document computer program to communicate program methodology to future users	**Communication skills** Documentation
D. Understand the basic concepts of developing graphical user interfaces	**Problem analysis** Problem identification and formulation Problem solving **Use of engineering tools** Ability to select appropriate tools, techniques, and resources Ability to use appropriate engineering tools, techniques and resources Demonstrate awareness of limitations of tools, create and extend tools as necessary **Communication skills** Information Gathering
E. Design and implement a simple system for data acquisition, processing, and monitoring	**Design** Define the objective Idea generation and selection Detailed Design Validation and Implementation **Communication skills** Oral Presentation

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
	3
	4
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TERM PROJECT
Topic:

OTHER NOTES

Course number	**Course Title**	**Term**
CHME 220	Material Properties and Chemical Characterization	

Course Instructor	**Office**	**E-Mail**	**Office Hours**

CLASS, LAB AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture		11:45-13:00			
Tutorial		8:45-9:35			
Tutorial		8:45-9:35			
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course provides students with a basic understanding of key material properties, the relationships between the structure-properties-processing-application of materials, and the methods of characterizing materials structures and materials properties. In addition to solid materials, fluid properties of gases and liquids are addressed. The students are expected to apply this knowledge towards solving problems in engineering applications.

PREREQUISITES
Co-requisite: MIAE 221

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
    - Materials Characterization: Introduction to Microscopic and Spectroscopic Methods (Wiley, 2nd Edition) – Yang Leng.
    - Materials Science and Engineering, An Introduction (Wiley, 10th Edition, 2018) – W. D. Callister, D. G. Rethwisch.
- *Suggested Textbook:*
- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES:

GRADING POLICY

Evaluation Tool	Weight
Midterm	35
Final *	35
Lab report	15
Quiz (others)	15
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE

Graduate Attribute	Indicators
A knowledge base for engineering	Knowledge base of natural science (Develop)
	Knowledge base in specific domain (Develop)
Problem analysis	Problem identification and formulation (Introduce)
Investigation	Background and hypothesis formulation (Introduce)

	Conducting experiments and collection of data (Develop)
	Analysis and interpretation of data (Introduce)
Design	Define the objective (Introduce)
	Idea generation and selection (Introduce)
	Detailed design (Introduce)
Use of engineering tools	Ability to use appropriate engineering tools, techniques and resources (Introduce)
	Demonstrate awareness of limitations of tools, create and extend tools as necessary (Introduce)
Individual and teamwork	Cooperation and work ethics (Introduce)
	Contribution: practical/conceptual (Introduce)
	Initiative and leadership (Introduce)
	Delivering results (Introduce)
Communication skills	Writing Process (Introduce)
	Information Gathering (Introduce)
	Documentation (Introduce)

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Demonstrate an understanding of key properties of solid materials and fluids	**A knowledge base for engineering** Knowledge base of natural science
B. Determine/retrieve properties of materials in engineering applications	**A knowledge base for engineering** Knowledge base in specific domain
C. Demonstrate an understanding of the characterization of materials properties	**A knowledge base for engineering** Knowledge base of natural science **Use of engineering tools** Demonstrate awareness of limitations of tools, create and extend tools as necessary
D. Apply characterization techniques to measure or determine materials properties	**Investigation** Background and hypothesis formulation Conducting experiments and collection of data **Use of engineering tools** Ability to use appropriate engineering tools, techniques, and resources
E. Interpret and communicate characterization results	**Investigation** Analysis and interpretation of data **Communication** Writing Process Information Gathering

	Documentation **Individual and teamwork** Cooperation and work ethics Contribution: practical/conceptual Initiative and leadership Delivering results
F. Identify desired material properties for different applications	**Design** Define the objective Idea generation and selection Detailed design **Problem analysis** Problem identification and formulation

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
	3
	4
	5
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	12

TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 240	Chemical Engineering Lab I	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION

This laboratory course emphasizes the practical aspects of introductory chemical engineering topics. Experiments in this course include temperature measurements, calorimetry, pressure measurements, and flow measurements. The theoretical concepts learned in the classroom are demonstrated through application in the laboratory setting using lab- and pilot-scale versions of industrial equipment and software.

PREREQUISITES

CHME 200, CHME 351; Co-requisite: ENGR 361

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
  - Laboratory manual will be provided as a course pack.
- *Suggested Textbook:*
- *Instructor's lecture notes:*

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- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Pre-lab reports	25%
Lab reports	65%
Peer evaluation	10%
Total	100%

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
Problem Analysis	Problem identification and formulation (Introduce)
	Modelling (Introduce)
	Problem solving (Introduce)
	Analysis (uncertainty and incomplete knowledge) (Introduce)
Investigation	Background and hypothesis formulation (Introduce)
	Designing experiments (Introduce)
	Conducting experiments and collection of data (Introduce)
	Analysis and interpretation of data (Introduce)
Use of engineering tools	Ability to select appropriate engineering tools, techniques and resources (Introduce)
	Ability to use appropriate tools, techniques, and resources (Introduce)
	Demonstrate awareness of limitations of tools, create and extend tools as necessary (Introduce)
Individual and Teamwork	Cooperation and work ethics (Introduce)
	Contribution: practical/conceptual (Introduce)
	Initiative and leadership (Introduce)

	Delivering results (Introduce)
Communication skills	Writing process (Introduce)
	Information Gathering (Introduce)
	Documentation (Introduce)
Professionalism	Professional practice (Introduce)

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	**Relationship to Graduate Attributes**
A. Identify hazards and risks of an experiment and follow safety protocols to ensure a safe laboratory environment	**Professionalism** Professional practice **Investigation** Conducting experiments and collection of data
B. Demonstrate technical and manipulative skills in using laboratory equipment, tools, materials, and computer software	**Use of engineering tools** Ability to use appropriate engineering tools, techniques, and resources
C. Follow prescribed laboratory procedures to collect data through observation and experimentation	**Use of engineering tools** Ability to select appropriate engineering tools, techniques, and resources **Investigation** Conducting experiments and collection of data **Individual and teamwork** Contribution: practical/conceptual
D. Identify limitations and potential for error in experimental procedures, and identify steps in experimental procedure that limit bias	**Investigation** Designing experiments **Use of engineering tools** Demonstrate awareness of limitations of tools, create and extend tools as necessary
E. Demonstrate an understanding of reproducibility and accuracy in laboratory measurements	**Investigation** Designing experiments
F. Interpret data and perform an error analysis to arrive at substantiated conclusions	**Problem Analysis** Problem identification and formulation Modelling Problem solving Analysis (uncertainty and incomplete knowledge) **Investigation** Background and hypothesis formulation Analysis and interpretation of data
G. Produce a technical document to communicate laboratory procedures, data, and results	**Communication skills** Writing process Information Gathering

	Documentation **Individual and teamwork** Cooperation and work ethics Contribution: practical/conceptual Initiative and leadership Delivering results
H. Demonstrate a practical understanding of the fundamentals of temperature, pressure, and flow measurement	**Investigation** Designing experiments **Use of engineering tools** Demonstrate awareness of limitations of tools, create and extend tools as necessary

TENTATIVE COURSE OUTLINE

Topics	**Week**
	1
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TERM PROJECT

Topic:

OTHER NOTES

UNIVERSITÉ Concordia UNIVERSITY | GINA CODY SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 300	Industrial and Engineering Chemistry	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION

This course provides an overview of prominent chemicals and production routes in the chemical industry. Processes for bulk chemical production using conventional and novel routes are investigated, including oil refining, polymers, hydrometallurgy, and commodity chemicals. Concepts of sustainability, plant economics and PFDs for bulk chemical processes are studied. Simulations of bulk chemical production processes are also conducted using ASPEN software.

PREREQUISITES

CHME 200

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):* None
- *Suggested Textbook:*
    - Wittcoff, H. A.; Reuben, B. G.; Plotkin, J. S. Industrial Organic Chemicals, 3rd ed.; Wiley: Hoboken, N.J., 2013.

- Benvenuto, M. A. Industrial Inorganic Chemistry; De Gruyter Graduate; Walter de Gruyter GmbH & Co. KG: Berlin, 2015.
- Benvenuto, M. A. Industrial Chemistry: For Advanced Students; De Gruyter Graduate; De Gruyter: Berlin, 2015.
- Swaddle, T. W. Inorganic Chemistry: An Industrial and Environmental Perspective; Academic Press: San Diego, 1997.
- Industrial Catalytic Processes for Fine and Specialty Chemicals; Joshi, S. S., Ranade, V. V., Eds.; Elsevier: Amsterdam, Netherlands, 2016.

- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES:

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm exam	15
Group Project	25
Case Studies	20
ASPEN Simulations	10
Final exam	30
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
	Knowledge base of natural science (Develop)

A knowledge base for engineering	Knowledge base in a specific domain (Develop)
Problem analysis	Problem identification and formulation (Develop)
	Modelling (Develop)
	Problem solving (Develop)
	Analysis (uncertainty and incomplete knowledge) (Develop)
Design	Define the objective (Develop)
	Idea generation and selection (Develop)
	Detailed Design (Develop)
	Validation and Implementation (Develop)
Use of engineering tools	Ability to select appropriate tools, techniques, and resources (Develop)
	Ability to use appropriate engineering tools, techniques and resources (Develop)
	Demonstrate awareness of limitations of tools, create and extend tools as necessary (Develop)
Individual and team work	Cooperation and work ethics (Develop)
	Contribution: practical/conceptual (Develop)
	Initiative and leadership (Develop)
	Delivering results (Develop)
Communication skills	Writing process (Develop)
	Information gathering (Develop)
	Documentation (Develop)
	Oral presentation (Develop)
Professionalism	Role and responsibilities of the professional engineer (Develop)
Impact of engineering on society & the environment	Awareness of society and environment (Develop)
	Sustainability in Design (Develop)
Economics and project management	Fundamentals of Economics (Develop)
	Economic Evaluation of Projects (Develop)

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Demonstrate familiarity with the evolution of industrial chemical processes	**Impact of Engineering on Society** Awareness of society and environment
B. Generate process flow diagrams for inorganic and organic industrial processes	**Knowledge Base** Knowledge base of natural science Knowledge base in a specific domain

C. Identify safety concerns, environmental impacts, challenges to sustainability, and potential professional liabilities of an industrial chemical process	**Impact of Engineering on Society** Sustainability in Design **Professionalism** Role and responsibilities of the professional engineer
D. Perform an economic analysis of a defined chemical process	**Economics and project management** Fundamentals of Economics Economic Evaluation of Projects
E. Use engineering tools to simulate and analyze an industrial chemical process	**Problem Analysis** Problem identification and formulation Modelling Problem solving Analysis (uncertainty and incomplete knowledge) **Use of Engineering Tools** Ability to select appropriate tools, techniques, and resources Ability to use appropriate engineering tools, techniques and resources Demonstrate awareness of limitations of tools, create and extend tools as necessary **Design** Define the objective Idea generation and selection Detailed Design Validation and Implementation **Individual and team work** Cooperation and work ethics Contribution: practical/conceptual Initiative and leadership
F. Present chemical process design effectively using visual materials	**Communication skills** Writing Process Information Gathering Documentation Oral Presentation **Individual and teamwork** Delivering Results

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1

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TERM PROJECT
Topic:

Other Notes

Concordia University — Gina Cody School of Engineering and Computer Science

Course number	Course Title	Term
CHME 301	Chemical Reaction Engineering	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					Lab Start Date
Lab A		9:45-11:35			
Lab B		9:45-11:35			
Lab C		9:45-11:35			
Lab D		9:45-11:35			
Lab E		11:45-13:35			

COURSE CALENDAR DESCRIPTION
This course reviews the fundamentals of reaction rates and kinetic parameters and discusses their experimental determination. Mathematical equations for isothermal and non-isothermal batch, semi-batch, continuous, and plug flow reactors are covered and applied to reactor design and sizing. Additional topics include selectivity and optimization of reactors with multiple reactions; heterogeneous catalysis in packed bed reactors with coupled heat and mass transfer effects; and enzyme catalysis and the Michaelis-Menten mechanism for bioreactors.

PREREQUISITES
CHME 200, CHME 351

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
    - Fogler, "Elements of Chemical Reaction Engineering" 4th edition
- *Suggested Textbook:*

- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES:

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm 1	35
Midterm 2	35
ASPEN Project	15
Assignments	10
Tutorials	5
Total	100

Passing Criteria:

- In order to pass the class, both your cumulative score and the average of the two midterm examinations must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
A knowledge base for engineering	Knowledge base of mathematics (Develop)
	Knowledge base in a specific domain (Develop)
Problem analysis	Problem identification and formulation (Apply)
	Modelling (Apply)
	Problem solving (Apply)
	Analysis (uncertainty and incomplete knowledge) (Apply)
Design	Define the objective (Apply)
	Idea generation and selection (Apply)
	Detailed Design (Apply)
	Validation and Implementation (Apply)
Use of engineering tools	Ability to select appropriate tools, techniques, and resources (Apply)
	Ability to use appropriate tools, techniques, and resources (Apply)

Impact of engineering on society & the environment	Awareness of society and the environment (Apply)

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A) Describe the solution algorithm to solve chemical reaction engineering problems through logic	**A knowledge base for engineering** Knowledge base of mathematics **Problem analysis** Problem identification and formulation Modelling
B) Size isothermal, adiabatic, and non-adiabatic reactors for homogeneous and heterogeneous reactions	**Design** Define the objective Idea generation and selection Detailed Design Validation and Implementation
C) Analyze multiple reactions carried out both isothermally and non-isothermally in flow, batch, and semi-batch reactors to determine selectivity and yield	**Problem analysis** Problem identification and formulation Modelling Problem solving
D) Determine the reaction order and specific reaction rate from experimental data	**Problem analysis** Analysis (uncertainty and incomplete knowledge)
E) Describe the steps in a catalytic mechanism and the methodology in deriving a rate law, mechanism, and rate limiting step that are consistent with experimental data	**A knowledge base for engineering** Knowledge base in a specific domain **Problem analysis** Modelling Problem solving Analysis (uncertainty and incomplete knowledge)
F) Use computer software to simulate reactors with multiple reactions with heat effects	**Design** Detailed Design Validation and Implementation **Use of engineering tools** Ability to select appropriate tools, techniques, and resources Ability to use appropriate engineering tools, techniques and resources
G) Demonstrate critical thinking on reaction and reactor safety	**Design** Validation and Implementation **Impact of engineering on society & the environment** Awareness of society and the environment

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
	3
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TERM PROJECT
Topic:

NOTES

UNIVERSITÉ Concordia UNIVERSITY

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course Number	Course Title	Term
CHME 316	Advanced Data Analysis and Machine Learning for Chemical Engineers	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course is designed to cover the theoretical and practical areas pertinent to modern data analysis and machine learning in engineering. Topics include traditional machine learning algorithms based on feature engineering (Linear regression, Logistic Regression, Bayesian classifier, K-nearest neighbors, Bagging and boosting, Random Forests), bias and variance, model selection and regularization, features selection, and introduction to neural networks.

PREREQUISITES
CHME 216, ENGR 371, ENGR 391

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
    - Numerical Methods for Engineering and Data Science, Rolf Wuthrich, Carole El Ayoubi, CRC Press (to be published 2022)

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- First Course in Machine Learning, Simon Rogers, Mark Girolami, CRC Press
- An Introduction to Statistical Learning, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer
- Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Aurelien Geron, O'Reilly Media

- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES:

GRADING POLICY	
Evaluation Tool	**Weight**
Final *	40
Online labs	60
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
A knowledge base for engineering	Knowledge base of mathematics (Apply)
	Knowledge base in specific domain (Apply)
Investigation	Analysis and interpretation of data (Develop)
Use of engineering tools	Ability to select appropriate tools, techniques, and resources (Apply)
	Ability to use appropriate tools, techniques, and resources (Apply)
	Demonstrate awareness of limitations of tools, create and extend tools as necessary (Apply)
Lifelong learning	Identify missing knowledge and learning opportunities (Apply)
	Continuous improvement and self-learning (Apply)

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A. Understand basic concepts of machine learning and describe the most common machine learning algorithms	**A knowledge base for engineering** Problem identification and formulation Modelling
B. Describe the most common machine learning algorithms	**A knowledge base for engineering** Knowledge base in specific domain
C. Apply machine learning algorithms using training data to predict the outcome of future datasets	**Use of engineering tools** Ability to select appropriate tools, techniques, and resources Ability to use appropriate engineering tools, techniques and resources Demonstrate awareness of limitations of tools, create and extend tools as necessary
D. Model selection and techniques to identify overfitting	**Investigation** Analysis and interpretation of data
E. Identify important up to date databases for machine learning applications	**Lifelong learning** Identify missing knowledge and learning opportunities Continuous improvement and self-learning

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
	3
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TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 320	Technical and Advanced Materials	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course focuses on advanced materials, technologies, and processes for mechanical systems in various industries. Topics include advanced structural and functional metallic, ceramic and polymer materials, their composites, and nanostructured materials in the context of their processing, characterization, performance, and applications. Strong emphasis is placed on failure mechanisms and analysis as well as design problems with advanced materials systems in references to industrial applications. Additional topics include processing of advanced materials in order to achieve desired mechanical behavior, design optimization with advanced materials, as well as the economics of such systems. Various case studies will be included throughout the course. The course will include team discussions and laboratory work followed by a comprehensive technical report.

PREREQUISITES
CHME 220

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*

- Jaluria, Yogesh. Advanced materials processing and manufacturing. Cham, Switzerland: Springer, 2018.

- *Instructor’s lecture notes:*
- *Software Use:*

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	25
Final *	40
Project	15
Lab report	20
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
A knowledge base for engineering.	Knowledge base of natural science (Apply)
	Knowledge base in a specific domain (Apply)
Problem analysis	Problem identification and formulation (Develop)
	Problem solving (Develop)
Investigation	Background and hypothesis formulation (Develop)
	Conducting experiments and collection of data (Apply)
	Analysis and interpretation of data (Develop)
Design	Define the objective (Develop)
	Idea generation and selection (Develop)
	Validation and implementation (Introduce)
Individual and teamwork	Cooperation and Work Ethics (Develop)
	Contribution: practical/conceptual (Develop)
	Initiative and leadership (Develop)
	Delivering Results (Develop)
Communication	Writing Process (Develop)

	Information Gathering (Develop)
	Documentation (Develop)
Economics and project management	Fundamentals of Economics (Develop)
Life-long learning	Identifying missing knowledge and self-learn. (Develop)

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A. Demonstrate a knowledge and understanding of the different material systems, their structures and physical properties	**A knowledge base for engineering** Knowledge base of natural science
B. Demonstrate an understanding of the different manufacturing processes for advanced materials	**A knowledge base for engineering** Knowledge base in a specific domain
C. Perform calculations using mathematical models of manufacturing processes in terms of transport phenomena	**Problem Analysis** Problem identification and formulation Modelling Problem solving Analysis (uncertainty and incomplete knowledge)
D. Describe the importance of processing methods on the structure and behavior of advanced materials	**A knowledge base for engineering** Knowledge base in a specific domain
E. Demonstrate an understanding of the basic mechanical behaviour of materials and explain the difference between strength and stiffness	**A knowledge base for engineering** Knowledge base of natural science
F. Perform appropriate materials characterization tests and report results in a technical laboratory report	**Investigation** Background and hypothesis formulation Conducting experiments and collection of data Analysis and interpretation of data **Communication** Writing Process Information Gathering Documentation **Individual and teamwork** Cooperation and work ethics Contribution: practical/conceptual Initiative and leadership Delivering Results
G. Understand the economics of advanced material processing	**Economics and project management** Fundamentals of Economics

H. Find out relevant material from various sources to prepare a summary report on a topic related to but not directly covered in class	**Design** Define the objective Idea generation and selection Detailed Design **Communication** Writing Process Information Gathering Documentation **Life-long learning** Identifying missing knowledge and self-learn. **Individual and teamwork** Cooperation and work ethics Contribution: practical/conceptual Initiative and leadership Delivering Results

TENTATIVE COURSE OUTLINE

Topics	**Week**
	1
	2
	3
	4
	5
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	10
	11
	12

TERM PROJECT

Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 321	Chemical and Materials Product Design	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course discusses chemical and materials products, from their synthesis to their processing into final products in various industries. Topics include design, optimization, and manufacturing of chemicals and materials, material characterization, material performance and applications. Important aspects of the product design process, such as material selection and failure mechanisms, are discussed in detail. This course demonstrates various case studies and requires team discussions, laboratory work and a comprehensive technical report.

PREREQUISITES
CHME 320

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
    - Ashby, Michael F., and Kara Johnson. Materials and design: the art and science of material selection in product design. Butterworth-Heinemann, 2013.

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- *Instructor's lecture notes:*
- *Software Use:*

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	25
Final	40
Design Project Report	15
Lab report	20
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
A knowledge base for engineering.	Knowledge base of natural science (Apply)
	Knowledge base in a specific domain (Apply)
Problem analysis	Problem identification and formulation (Develop)
Design	Define the objective (Develop)
	Idea generation and selection (Develop)
	Detailed Design (Develop)
	Validation and Implementation (Develop)
Individual and teamwork	Cooperation and Work Ethics (Develop)
	Contribution: practical/conceptual (Develop)
	Initiative and leadership (Develop)
	Delivering Results (Develop)
Communication	Writing Process (Develop)
	Information Gathering (Develop)
	Documentation (Develop)
Impact of engineering on society	Sustainability in design (Develop)
Ethics	Professional ethics and accountability (Develop)

Economics and project management	Fundamentals of economics (Develop)
	Economic evaluation of projects (Develop)
	Project planning and implementation (Develop)
Life-long learning	Identifying missing knowledge and self-learn (Develop)

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A. Demonstrate a knowledge and understanding of the different chemical and material systems and their influence of product design	**A knowledge base for engineering** Knowledge base of natural science Knowledge base in a specific domain **Design** Validation and Implementation
B. Demonstrate an understanding of the different manufacturing processes	**A knowledge base for engineering** Knowledge base in a specific domain
C. Describe the importance of processing methods on the structure and behavior of materials	**A knowledge base for engineering** Knowledge base in a specific domain
D. Influencing factors on product design	**A knowledge base for engineering** Knowledge base in a specific domain
E. Select materials for certain applications based on design criteria and economics	**Design** Define the objective Idea generation and selection Detailed Design **Problem analysis** Problem identification and formulation **Economics and project management** Fundamentals of economics Economic evaluation of projects
F. Identify sustainability challenges in the choice of materials, product lifecycles, and professional accountability related design of products	**Impact of engineering on society** Sustainability in design **Ethics** Professional ethics and accountability
G. Find out relevant material from various sources to prepare a design report	**Life-long learning** Identifying missing knowledge and self-learn **Communication** Writing Process Information Gathering Documentation

H. Design a chemical or material product for a specified application in a team	**Design** Define the objective Idea generation and selection Detailed Design **Economics and project management** Fundamentals of economics Economic evaluation of projects Project planning and implementation

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
	3
	4
	5
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	10
	11
	12

TERM PROJECT
Topic:

OTHER NOTES:

Concordia University — Gina Cody School of Engineering and Computer Science

Course number	Course Title	Term
CHME 330	Process Dynamics and Control	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
Process dynamics and control of chemical processes are the fundamentals of this course, focusing on process modelling, controller design, and implementation. Differential equations are used to model dynamic systems and understand responses of first- and second- order systems to set point and disturbance changes. System stability with and without automatic control is assessed. Software is utilized to simulate the dynamic response of systems with/without automatic control and to design controllers.

PREREQUISITES
ENGR 311, CHME 301, CHME 361

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
    - Seborg, D.E., Edgar, T.E., Mellichamp, D.A., Doyle, F.J. (2016) Process Dynamics and Control (4th ed.). John Wiley & Sons, Inc.
- *Suggested Textbook:*

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- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm examination	25
Final examination	50
Simulink/MATLAB tutorials	10
Assignments	15
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
A knowledge base for engineering	Knowledge base of mathematics (Apply)
	Knowledge base in specific domain (Apply)
Problem analysis	Problem identification and formulation (Apply)
	Modelling (Apply)
	Problem solving (Apply)
Design	Define the objective (Apply)
	Idea generation and selection (Apply)
	Detailed design (Apply)
	Validation and Implementation (Apply)
Use of engineering tools	Ability to use appropriate engineering tools, techniques and resources (Develop)

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A. Understand basics of process control, manipulated and measured variables, and control strategies, such as feedback control, feedforward control, and their advantages and disadvantages	**A knowledge base for engineering** Knowledge base in specific domain
B. Demonstrate the use of Laplace transforms and their applications in process modelling and controller design	**A knowledge base for engineering** Knowledge base of mathematics
C. Assess the stability of a system, and factors leading to stability in closed loop systems	**Problem analysis** Problem identification and formulation
D. Apply general modeling principles to chemical processes to generate dynamic process models	**Problem analysis** Modelling
E. Understand when to select different control methods, and implement through design and tuning of controllers (PID, feedforward, multiloop)	**A knowledge base for engineering** Knowledge base in specific domain **Design** Detailed design
F. Use engineering software tools, such as MATLAB Simulink, to simulate dynamic system response and control	**Use of engineering tools** Ability to use appropriate engineering tools, techniques and resources

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
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	4
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	12

TERM PROJECT
Topic:

OTHER NOTES

GINA CODY SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 340	Chemical Engineering Lab II	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This laboratory course emphasizes the practical aspects of various chemical engineering topics. Experiments in this course are designed to study reaction kinetics in continuous and plug flow reactors, calculate operational characteristic curves and efficiency of centrifugal pumps, compare different heat exchangers, and estimate diffusion coefficients. The theoretical concepts learned in the classroom are demonstrated through application in the laboratory setting using lab- and pilot-scale versions of industrial equipment and software.

PREREQUISITES
CHME 240, CHME 301, and CHME 361

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
  - Laboratory manual will be provided as a course pack.
- *Suggested Textbook:*

- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Pre-lab reports	25
Lab reports	65
Peer evaluation	10
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
Problem analysis	Problem identification and formulation (Develop)
	Modelling (Develop)
	Problem solving (Develop)
	Analysis (uncertainty and incomplete knowledge) (Develop)
Investigation	Background and hypothesis formulation (Develop)
	Designing experiments (Develop)
	Conducting experiments and collection of data (Develop)
	Analysis and interpretation of data (Develop)
Use of engineering tools	Ability to select appropriate engineering tools, techniques and resources (Develop)
	Ability to use appropriate engineering tools, techniques, and resources (Develop)
	Demonstrate awareness of limitations of tools, create and extend tools as necessary (Develop)

Individual and teamwork	Cooperation and work ethics (Develop)
	Contribution: practical/conceptual (Develop)
	Initiative and leadership (Develop)
	Delivering results (Develop)
Communication skills	Writing process (Develop)
	Information Gathering (Develop)
	Documentation (Develop)
Professionalism	Professional practice (Develop)
Life-long learning	Identifying missing knowledge and learning opportunities (Develop)

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Identify hazards and risks of an experiment and follow safety protocols to ensure a safe laboratory environment	**Professionalism** Professional practice **Investigation** Conducting experiments and collection of data
B. Demonstrate technical and manipulative skills in using laboratory equipment, tools, materials, and computer software	**Use of engineering tools** Ability to use appropriate engineering tools, techniques, and resources
C. Follow prescribed laboratory procedures to collect data through observation and experimentation	**Use of engineering tools** Ability to select appropriate engineering tools, techniques, and resources **Investigation** Conducting experiments and collection of data **Individual and teamwork** Contribution: practical/conceptual
D. Identify limitations and potential for error in experimental procedures, and identify steps in experimental procedure that limit bias	**Investigation** Designing experiments **Use of engineering tools** Demonstrate awareness of limitations of tools, create and extend tools as necessary
E. Demonstrate an understanding of reproducibility and accuracy in laboratory measurements	**Investigation** Designing experiments
F. Interpret data and perform an error analysis to arrive at substantiated conclusions	**Problem Analysis** Problem identification and formulation Modelling Problem solving Analysis (uncertainty and incomplete knowledge) **Investigation**

	Background and hypothesis formulation Analysis and interpretation of data
G. Produce a technical document to communicate laboratory procedures, data, and results	**Communication skills** Writing process Information Gathering Documentation **Individual and teamwork** Cooperation and work ethics Contribution: practical/conceptual Initiative and leadership Delivering results
H. Provide recommendations to experimental procedures to improve reproducibility or accuracy of experimental results	**Problem Analysis** Analysis (uncertainty and incomplete knowledge) **Life-long learning** Identifying missing knowledge and learning opportunities
I. Demonstrate a practical understanding of reaction kinetics in different reactor types and how to operate centrifugal pumps in series and parallel	**Investigation** Designing experiments **Use of engineering tools** Demonstrate awareness of limitations of tools, create and extend tools as necessary
J. Effectively compare different types of heat exchangers and estimate diffusion coefficients in liquids and gases.	**Investigation** Designing experiments **Use of engineering tools** Demonstrate awareness of limitations of tools, create and extend tools as necessary

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
	3
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	12

TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 351	Chemical Engineering Thermodynamics	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION

This course reviews and applies fundamental principles of the thermodynamics, including chemical and phase equilibrium. The covers covers application to various chemical processes including pure and multicomponent phases, equilibria in complex chemical reactions, equilibria in separation processes. The course also covers thermodynamics of non-ideal pure and multicomponent phases.

PREREQUISITES

ENGR 251; Co-requisite: ENGR 311

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
    - Thermodynamics: An Engineering Approach" by Cengel and Boles, Any edition, McGraw Hill.
    - "Fundamentals of Thermodynamics" by Sonntag, Borgakke, and Van Wylen, Any edition, John Wiley & Sons, Inc.

- “Thermodynamics” by K. Wark, Any edition, McGraw Hill.
- “Fundamentals of Engineering Thermodynamics”, Moran, M.J. and Shapiro, H.N., Any edition, Wiley.

- *Instructor’s lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	25
Final	50
Assignments and Attendance	15
Quiz (others)	10
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
A knowledge base for engineering	Knowledge base of mathematics (Develop)
	Knowledge base of natural science (Introduce)
	Knowledge base in a specific domain (Apply)
Problem analysis	Problem identification and formulation (Develop)
	Modelling (Apply)
	Problem solving (Apply)
	Analysis (uncertainty and incomplete knowledge) (Apply)
Design	Define the objective (Develop)

Use of engineering tools	Ability to use appropriate engineering tools, techniques and resources (Develop)

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A. Derive fundamental equations that govern estimation of solution properties	**A knowledge base for engineering** Knowledge base of natural science Knowledge base in a specific domain
B. Compute phase equilibrium data and construct P-x-y, T-x-y diagrams for ideal binary miscible vapour-liquid systems	**Problem analysis** Modelling Problem solving **Use of engineering tools** Ability to use appropriate engineering tools, techniques, and resources
C. Apply solution thermodynamics fundamentals to solve phase equilibrium problems including bubble point, dew point, and flash point calculations	**Design** Define the objective **Problem analysis** Problem identification and formulation Modelling Problem solving Analysis (uncertainty and incomplete knowledge)
D. Understand fundamental concepts of solution thermodynamics including chemical potential, fugacity, activity, partial molar properties, ideal solutions, and excess properties	**A knowledge base for engineering** Knowledge base of mathematics Knowledge base of natural science Knowledge base in a specific domain
E. Compute phase equilibrium for non-idea binary miscible vapour-liquid systems using van Laar and Margules model and for ideal binary immiscible vapour-liquid systems	**Problem analysis** Modelling Problem solving **Use of engineering tools** Ability to use appropriate engineering tools, techniques, and resources
F. Understand the fundamental principles of chemical reaction equilibria including extent of reaction, equilibrium constant and its temperature dependence, and equilibrium conversion	**A knowledge base for engineering** Knowledge base of mathematics Knowledge base of natural science Knowledge base in a specific domain
G. Apply concepts of heat capacity, latent heat, heat of reaction, heat of combustion and heat of formation	**Design** Define the objective **Problem analysis** Problem identification and formulation Modelling Problem solving

	Analysis (uncertainty and incomplete knowledge)
H. Calculate internal energy, enthalpy, entropy, Helmholtz energy, and Gibbs energy at system conditions assuming both ideal and non-ideal behaviour	**Design** Define the objective **Problem analysis** Problem identification and formulation Modelling Problem solving Analysis (uncertainty and incomplete knowledge)

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
	3
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	12

TERM PROJECT
Topic:

OTHER NOTES

Course number	Course Title	Term
CHME 352	Energy Conversion and Storage	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course covers fundamentals of applied thermodynamics to energy systems, with a focus on renewable power systems. Topics include principles of energy conversion and thermodynamic engine cycles, analysis of energy consumption, conversion, and storage in power and transportation systems, with emphasis on efficiency, performance, and environmental impact.

PREREQUISITES
CHME 351

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Suggested Textbook:*
  - "Thermodynamics: An Engineering Approach" by Cengel and Boles, Any edition, McGraw Hill.
  - "Fundamentals of Thermodynamics" by Sonntag, Borgakke, and Van Wylen, Any edition, John Wiley & Sons, Inc.

- “Thermodynamics” by K. Wark, Any edition, McGraw Hill.

- *Instructor’s lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES
Fundamental principles of the thermodynamics, including chemical and phase equilibrium. Basic integration for calculus. Basic differentiation. Basic knowledge in numerical interpolation.

GRADING POLICY	
Evaluation Tool	**Weight**
Final report	50
Assignment1	12.5
Assignment2	12.5
Presentation	25
Total	100

Passing Criteria:
• If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam. • In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
A knowledge base for engineering	Knowledge base of natural science (Apply)
Problem analysis	Problem identification and formulation (Apply)
	Modelling (Apply)
	Problem solving (Apply)
	Analysis (uncertainty and incomplete knowledge) (Apply)
Design	Define the objective (Develop)
	Idea generation and selection (Develop)
	Detailed Design (Develop)
	Validation and implementation (Develop)
Individual and teamwork	Contribution: practical/conceptual (Develop)
	Delivering results (Develop)

Communication skills	Information Gathering (Develop)
	Oral Presentation (Develop)
Impact of engineering on society & the environment	Awareness of society and environment (Develop)
	Sustainability in design (Develop)
Life-long learning	Identifying missing knowledge and learning opportunities (Develop)

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A. Demonstrate fundamental knowledge of energy conversion, energy storage systems, and energy management	**A knowledge base for engineering** Knowledge base of natural science
B. Critically assess strengths and limitations of energy conversion technologies	**Problem analysis** Problem identification and formulation Modelling Problem solving Analysis **Design** Define the objective Idea generation and selection Detailed Design Validation and implementation
C. Analyze a complete plant using energy system modeling	**Problem analysis** Problem identification and formulation Modelling Problem solving Analysis
D. Design sustainable solutions to realistic energy demand scenarios	**Design** Define the objective Idea generation and selection Detailed Design Validation and implementation **Impact of engineering on society & the environment** Awareness of society and environment Sustainability in design
E. Identify and review advancements in energy conversion technology	**Life-long learning** Identifying missing knowledge and learning opportunities
F. Present a comparison of conventional and sustainable solutions related to energy conversion and storage in a particular application	**Impact of engineering on society & the environment** Awareness of society and environment **Individual and teamwork**

	Contribution: practical/conceptual Delivering results **Communication skills** Information Gathering Oral Presentation

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
	3
	4
	5
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	11
	12

TERM PROJECT
Topic:

OTHER NOTES

GINA CODY SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 360	Heat Transfer	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course discusses the principles of heat transfer in various geometries and configurations. Topics include shell energy balances; steady and unsteady state heat transfer via conduction; free and forced convection, and radiation; heat exchangers; heat transfer in laminar and turbulent boundary layers.

PREREQUISITES
CHME 351, ENGR 311

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
- *Instructor's lecture notes:*
- *Software Use:*

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Tel. 514-848-2424 ext. 3109 Fax 514-848-4509 concordia.ca/ginacody

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm 1	35
Midterm 2	35
ASPEN Project	15
Assignments	10
Tutorials	5
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
A knowledge base for engineering	Knowledge base of mathematics (Develop)
	Knowledge base of natural science (Develop)
Problem analysis	Problem identification and formulation (Develop)
	Modelling (Develop)
	Problem solving (Apply)
	Analysis (uncertainty and incomplete knowledge) (Develop)
Design	Define the objective (Introduce)
	Idea generation and selection (Introduce)
Life-long learning	Continuous improvement and self-learning (Develop)

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A) Demonstrate an understanding of three modes of heat transfer; conduction, convection, and radiation	**A knowledge base for engineering** Knowledge base of natural science

B) Demonstrate understanding of thermal properties of states of matter (solids, liquids, gases)	**A knowledge base for engineering** Knowledge base of natural science
C) Formulate one and two dimensional steady-state conduction in various geometries	**A knowledge base for engineering** Knowledge base of mathematics **Problem analysis** Problem identification and formulation Modelling Problem solving
D) Formulate one dimensional transient conduction in various geometries	**A knowledge base for engineering** Knowledge base of mathematics **Problem analysis** Problem identification and formulation Modelling Problem solving
E) Demonstrate an understanding of boundary layer concepts in laminar and turbulent flows	**A knowledge base for engineering** Knowledge base of natural science Knowledge base of mathematics
F) Identify important dimensionless numbers in heat transfer	**A knowledge base for engineering** Knowledge base of natural science Knowledge base of mathematics **Problem analysis** Problem identification and formulation Modelling
G) Design and analyze the performance of heat exchangers in various configurations	**Design** Define the objective Idea generation and selection Problem identification and formulation **Problem analysis** Modelling Problem solving Analysis (uncertainty and incomplete knowledge) **Life-long learning** Continuous improvement and self-learning

TENTATIVE COURSE OUTLINE	
Topics	**Week**

TERM PROJECT
Topic:

OTHER NOTES

UNIVERSITÉ Concordia UNIVERSITY — GINA CODY SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 361	Mass Transfer and Unit Operations	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION

This course covers the fundamentals of mass transfer including diffusive and convective mass fluxes. Mass transfer models leading to ordinary and partial differential equations in various geometries are discussed as well as mass transfer calculations for design of continuous single stage separation units with fluid interfaces such as absorption, stripping, and liquid-liquid extraction. The course introduces mechanical operations and Piping and Instrumentation Diagrams (P&ID).

PREREQUISITES

CHME 360

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
- *Instructor's lecture notes:*
- *Software Use:*

1455 De Maisonneuve Blvd. W., EV-2.139, Montreal, Quebec, Canada H3G 1M8
Tel. 514-848-2424 ext. 3109 Fax 514-848-4509 concordia.ca/ginacody

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	25
Final	35
Project	20
Assignments	20
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
A knowledge base for engineering	Knowledge base of mathematics (Develop)
	Knowledge base of natural science (Develop)
Problem analysis	Problem identification and formulation (Develop)
	Modelling (Develop)
	Problem solving (Apply)
	Analysis (uncertainty and incomplete knowledge) (Apply)
Design	Define the objective (Develop)
	Idea generation and selection (Develop)
	Detailed Design (Develop)
	Validation and Implementation (Develop)
Use of engineering tools	Continuous improvement and self-learning (Develop)

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A) Identify mechanisms of mass transfer	**Problem analysis** Problem identification and formulation

	Problem solving Analysis
B) Develop mass transport models based on the differential equations of mass transfer	**A knowledge base for engineering** Knowledge base of mathematics Knowledge base of natural science **Problem analysis** Problem identification and formulation Problem solving
C) Estimate mass transfer coefficients based on dimensional analysis, boundary layer analysis	**A knowledge base for engineering** Knowledge base of mathematics Knowledge base of natural science **Problem analysis** Problem identification and formulation Modelling Problem solving Analysis
D) Solve problems involving convective heat and mass transfer in one-phase and two-phase systems	**A knowledge base for engineering** Knowledge base of mathematics Knowledge base of natural science **Problem analysis** Problem identification and formulation Modelling Problem solving Analysis
E) Estimate diffusivities for gas, liquid, and solid mixtures	**A knowledge base for engineering** Knowledge base of mathematics Knowledge base of natural science **Problem analysis** Problem identification and formulation Modelling Problem solving Analysis
F) Estimate the rates of mass transfer in typical chemical engineering processes	**Design** Define the objective Idea generation and selection Detailed Design Validation and Implementation **Use of engineering tools** Continuous improvement and self-learning

TENTATIVE COURSE OUTLINE	
Topics	**Week**

TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 362	Chemical Separations Engineering	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION

This course reviews the fundamentals of heat and mass transfer, and phase equilibrium for ideal and non-ideal systems, including the equilibrium stage concept and cascades of stages with and without reflux. Applications in the separation of components by multistage processes including distillation, absorption, stripping, extraction, and leaching are covered as well as applications of simultaneous mass and heat transfer calculations for the design of continuous separation units with fluid interfaces.

PREREQUISITES

CHME 361

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
    - Seader J.D., Henley E.J., Roper D.K. Separation Process Principles. 4th Edition. Wiley (2016).
- *Suggested Textbook:*

- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm 1	35
Midterm 2	35
Design Project	15
Assignments	10
Tutorials	5
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
A knowledge base for engineering	Knowledge base of mathematics (Apply)
	Knowledge base of natural science (Apply)
Problem analysis	Problem identification and formulation (Apply)
	Modelling (Apply)
	Problem solving (Apply)
	Analysis (uncertainty and incomplete knowledge) (Apply)
Design	Define the objective (Apply)
	Idea generation and selection (Apply)
	Detailed Design (Apply)
	Validation and Implementation (Apply)

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A) Understand concepts of phase equilibrium in chemical processes (vapour-liquid, gas-liquid, liquid-liquid, etc) as applied to contact separation stages	**A knowledge base for engineering** Knowledge base of mathematics Knowledge base of natural science
B) Perform mass and energy balances on separation units and analyze phase equilibria for vapour-liquid, gas-liquid, liquid-liquid, and solid-liquid systems	**Problem analysis** Problem identification and formulation Modelling Problem solving Analysis (uncertainty and incomplete knowledge)
C) Apply equilibrium stage concept to design separation processes such as distillation, absorption, stripping, and liquid-liquid extraction systems	**Design** Define the objective Idea generation and selection Detailed Design Validation and Implementation

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
	3
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	11

	12

TERM PROJECT
Topic:

OTHER NOTES

Course number	**Course Title**	**Term**
CHME 390	Design Project	

Course Instructor	**Office**	**E-Mail**	**Office Hours**

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course discusses the main steps in engineering systems design and operation with an emphasis on economics, safety, equipment performance, environment, and flexibility. Students work independently and in groups on problem-solving assignments and a term project. There are weekly tutorial sessions focusing on various aspects of process simulation using Aspen software.

PREREQUISITES
CHME 201, CHME 301, CHME 321; Co-requisites: ENGR 301, CHME 330, CHME 362

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
  - A Working Guide to Process Equipment; Authors: N. Lieberman and E. Lieberman.
  - Process design and engineering practice; Authors: Donald R. Woods.

- Product and Process Design Principles - Synthesis, Analysis and Evaluation; Seider, Seader, Lewin and Widagdo.

- *Instructor's lecture notes:*

- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Tutorials	10
Assignments	25
Midterm	15
Lab Exam	10
Term Project	20
Final exam	20
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
A knowledge base for engineering	Knowledge base in a specific domain (Apply)
Problem analysis	Problem identification and formulation (Apply)
	Problem solving (Apply)
	Modeling (Apply)
	Analysis (uncertainty and incomplete knowledge) (Apply)
Investigation	Background and hypothesis formulation (Apply)
Design	Define the objective (Apply)
	Idea generation and selection (Apply)
	Detailed design (Apply)

	Validation and Implementation (Apply)
Use of engineering tools	Ability to use appropriate engineering tools, techniques and resources (Develop)
Individual and teamwork	Cooperation and work ethics (Develop)
	Contribution: practical/conceptual (Develop)
	Initiative and leadership (Develop)
	Delivering results (Develop)
Communication skills	Writing process (Develop)
	Information Gathering (Develop)
	Documentation (Develop)
	Oral presentation (Develop)
Professionalism	Role and responsibilities of the professional engineer (Apply)
	Professional practice (Apply)
Impact of engineering on society & the environment	Awareness of society and environment impact (Develop)
	Sustainability in design (Develop)
Ethics and equity	Professional ethics and accountability (Develop)
Economics and project management	Fundamentals of economics (Apply)
	Economics evaluation of projects (Apply)
	Project planning and implementation (Apply)
Life-long learning	Identifying missing knowledge and learning opportunities (Apply)
	Continuous improvement and self-learning (Apply)

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Learn how to design the main process equipment.	**A knowledge base for engineering** Knowledge base in a specific domain **Problem analysis** Problem identification and formulation Problem solving Modeling Analysis (uncertainty and incomplete knowledge) **Investigation** Background and hypothesis formulation **Design** Define the objective Idea generation and selection Detailed design Validation and Implementation **Use of engineering tools** Ability to use appropriate engineering tools, techniques and resources

B. Understand how to use simulation tools for process development and economic analysis.	**Use of engineering tools** Ability to use appropriate engineering tools, techniques, and resources
C. Understand the safety and environmental aspects of chemical systems design.	**Impact of engineering on society & the environment** Awareness of society and environment impact Sustainability in design **Professionalism** Role and responsibilities of the professional engineer Professional practice
D. Perform an economic analysis of a chemical process	**Economics and project management** Fundamentals of economics Economics evaluation of projects **Professionalism** Role and responsibilities of the professional engineer Professional practice
E. Communicate effectively when presenting technical issues in both a report and oral presentation	**Communication skills** Writing process Documentation Oral presentation
F. Work in a team to solve an open-ended chemical engineering design problem	**Individual and teamwork** Cooperation and work ethics Contribution: practical/conceptual Initiative and leadership Delivering results **Communication skills** Information Gathering **Ethics and equity** Professional ethics and accountability **Life-long learning** Identifying missing knowledge and learning opportunities Continuous improvement and self-learning
G. Assign tasks in a team project in an equitable manner	**Individual and teamwork** Cooperation and work ethics **Economics and project management** Project planning and implementation

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1

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TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 415	Computational Modelling for Chemical Engineers	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course presents various computational tools used in molecular and multiphysics modelling. The lectures provide the underlying theoretical and foundational concepts; the tutorials present practical chemical engineering problems and demonstrate how to use the software with hands-on sessions. The topics include density functional theory (DFT), atomistic molecular dynamics (MD) simulations, numerical thermodynamics, and multiphysics simulations using COMSOL. The course includes lectures with hands-on tutorials.

PREREQUISITES
CHEM 205, CHME 351, ENGR 391

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):* None
- *Suggested Textbook:*
- *Instructor's lecture notes:*

- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES:

GRADING POLICY	
Evaluation Tool	**Weight**
Lab reports	40
Project	35
Midterm exam	25
Total	100

Passing Criteria:
• If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam. • In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
A knowledge base for engineering	Knowledge base of mathematics (Apply)
	Knowledge base of natural science (Apply)
	Knowledge base in a specific domain (Develop)
Problem analysis	Problem identification and formulation (Develop)
	Modelling (Apply)
	Problem solving (Apply)
Use of engineering tools	Ability to select appropriate tools, techniques, and resources (Apply)
	Ability to use appropriate engineering tools, techniques and resources (Apply)
	Demonstrate awareness of limitations of tools, create and extend tools as necessary (Apply)
Life-long learning	Continuous improvement and self-learning (Apply)

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**

A. Classify different computational modelling techniques available given an engineering problem.	**Problem Analysis** Problem identification and formulation **Use of Engineering Tools** Ability to select appropriate tools, techniques, and resources
B. Describe potential energy surfaces, molecular structure, density functional theory.	**Knowledge Base** Knowledge base of natural science Knowledge base in a specific domain
C. Describe equations of motion, Hamiltonian, ensembles.	**Knowledge Base** Knowledge base of mathematics Knowledge base of natural science Knowledge base in a specific domain
D. Explain application of different numerical methods to solve problems in chemical engineering thermodynamics.	**Knowledge Base** Knowledge base of mathematics Knowledge base of natural science Knowledge base in a specific domain
E. Identify a knowledge gap and design a project to address it using one or more of the available computational modelling tools.	**Problem Analysis** Problem identification and formulation Modelling Problem solving **Use of Engineering Tools** Ability to select appropriate tools, techniques, and resources Ability to use appropriate engineering tools, techniques and resources Demonstrate awareness of limitations of tools, create and extend tools as necessary
F. Critically analyze the quantitative and qualitative data obtained from modelling software and discuss the results to address the scientific problem.	**Problem Analysis** Modelling Problem solving **Use of Engineering Tools** Ability to use appropriate engineering tools, techniques and resources Demonstrate awareness of limitations of tools, create and extend tools as necessary **Life long learning** Continuous improvement and self-learning

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
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TERM PROJECT
Topic:

Other Notes

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 440	Chemical Engineering Lab III	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This laboratory course emphasizes the practical aspects of chemical engineering topics in the final years of study. Experiments in this course include distillation, absorption, drying, process dynamics, and process control. The theoretical concepts learned in the classroom are demonstrated through application in the laboratory setting using lab- and pilot-scale versions of industrial equipment and software.

PREREQUISITES
CHME 330, CHME 340, and CHME 362

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
  - Laboratory manual will be provided as a course pack.
- *Suggested Textbook:*
- *Instructor's lecture notes:*

- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Pre-lab reports	25
Lab reports	65
Peer evaluation	10
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
Problem analysis	Problem identification and formulation (Apply)
	Modelling (Apply)
	Problem solving (Apply)
	Analysis (uncertainty and incomplete knowledge) (Apply)
Investigation	Background and hypothesis formulation (Apply)
	Designing experiments (Apply)
	Conducting experiments and collection of data (Apply)
	Analysis and interpretation of data (Apply)
Use of engineering tools	Ability to select appropriate engineering tools, techniques and resources (Apply)
	Ability to use appropriate engineering tools, techniques, and resources (Apply)
	Demonstrate awareness of limitations of tools, create and extend tools as necessary (Apply)
Individual and teamwork	Cooperation and work ethics (Apply)
	Contribution: practical/conceptual (Apply)
	Initiative and leadership (Apply)
	Delivering results (Apply)

Communication skills	Writing process (Apply)
	Information Gathering (Apply)
	Documentation (Apply)
Professionalism	Professional practice (Apply)
Life-long learning	Identifying missing knowledge and learning opportunities (Develop)

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Identify hazards and risks of an experiment and follow safety protocols to ensure a safe laboratory environment	**Professionalism** Professional practice **Investigation** Conducting experiments and collection of data
B. Demonstrate technical and manipulative skills in using laboratory equipment, tools, materials, and computer software	**Use of engineering tools** Ability to use appropriate engineering tools, techniques, and resources
C. Follow prescribed laboratory procedures to collect data through observation and experimentation	**Use of engineering tools** Ability to select appropriate engineering tools, techniques, and resources **Investigation** Conducting experiments and collection of data **Individual and teamwork** Contribution: practical/conceptual
D. Identify limitations and potential for error in experimental procedures, and identify steps in experimental procedure that limit bias	**Investigation** Designing experiments **Use of engineering tools** Demonstrate awareness of limitations of tools, create and extend tools as necessary
E. Demonstrate an understanding of reproducibility and accuracy in laboratory measurements	**Investigation** Designing experiments
F. Interpret data and perform an error analysis to arrive at substantiated conclusions	**Problem Analysis** Problem identification and formulation Modelling Problem solving Analysis (uncertainty and incomplete knowledge) **Investigation** Background and hypothesis formulation Analysis and interpretation of data
G. Produce a technical document to communicate laboratory procedures, data, and results	**Communication skills** Writing process Information Gathering

	Documentation **Individual and teamwork** Cooperation and work ethics Contribution: practical/conceptual Initiative and leadership Delivering results
H. Provide recommendations to experimental procedures to improve reproducibility or accuracy of experimental results	**Problem Analysis** Analysis (uncertainty and incomplete knowledge) **Life-long learning** Identifying missing knowledge and learning opportunities
I. Demonstrate a practical understanding of unit operations (distillation, absorption, and drying)	**Investigation** Designing experiments **Use of engineering tools** Demonstrate awareness of limitations of tools, create and extend tools as necessary
J. Effectively control various parameters that are dependent on one another to obtain and maintain optimal operating conditions. Simulate various processes to investigate the effect of different control schemes.	**Problem Analysis** Analysis (uncertainty and incomplete knowledge) **Investigation** Designing experiments **Use of engineering tools** Demonstrate awareness of limitations of tools, create and extend tools as necessary

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
	3
	4
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TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 490	Capstone Chemical Process Design	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course requires students to apply their chemical engineering knowledge using a process design approach. Students work in groups to conduct research, design, and plan the implementation of a chemical plant. The project plan and the results of the developed process are documented as a technical report and presented as a seminar. Students use the simulation results to conduct the techno-economic analysis and life cycle assessment results to evaluate the financial feasibility and environmental aspects of their design.

PREREQUISITES
CHME 390

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
    - Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design; Authors: Gavin Towler and Ray Sinnott; 2nd Edition

- Product and Process Design Principles: Synthesis, Analysis and Evaluation; Authors: Warren D. Seider, Daniel R. Lewin, J. D. Seader, Soemantri Widagdo, Rafiqul Gani, Ka Ming Ng; 4th Edition
- Analysis, Synthesis, and Design of Chemical Processes; Authors: Richard Turton, Richard C. Bailie, Wallace B. Whiting, Joseph A. Shaeiwitz; 5th Edition

- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Meeting participation	5
Individual assessment	15
Midterm report	15
Poster	5
Final report	45
Project organization	5
Process diagrams	10
Equipment datasheets	10
Calculation sheets and design notes	10
Simulation models	10
Final presentation	15
Total	100

Passing Criteria:
• In order to pass the class, both your cumulative score and the final report and presentation must be above 50%.

GRADUATE ATTRIBUTES: SKILLS TO LEARN AND/OR UTILIZE	
Graduate Attribute	**Indicators**
A knowledge base for engineering	Knowledge base in specific domain (Apply)
Problem analysis	Problem identification and formulation (Apply)

	Modelling (Apply)
	Problem solving (Apply)
	Analysis (uncertainty and incomplete knowledge) (Apply)
Investigation	Background and hypothesis formulation (Apply)
	Conducting experiments and collection of data (Apply)
	Analysis and interpretation of data (Apply)
Design	Define the objective (Apply)
	Idea generation and selection (Apply)
	Detailed design (Apply)
	Validation and implementation (Apply)
Use of engineering tools	Ability to use appropriate engineering tools, techniques and resources (Apply)
	Ability to select appropriate tools, techniques, and resources (Apply)
	Demonstrate awareness of limitations of tools, create and extend tools as necessary (Apply)
Individual and teamwork	Cooperation and work ethics (Apply)
	Contribution: practical/conceptual (Apply)
	Initiative and leadership (Apply)
	Delivering results (Apply)
Communication skills	Writing process (Apply)
	Information Gathering (Apply)
	Documentation (Apply)
	Oral presentation (Apply)
Professionalism	Role and responsibilities of a professional engineer (Apply)
	Professional practice (Apply)
Impact of engineering on society & the environment	Awareness of society and environment (Apply)
	Sustainability in design (Apply)
Ethics and equity	Professional ethics and accountability (Apply)
	Equity (Apply)
Economics and project management	Fundamentals of economics (Apply)
	Economic evaluation of projects (Apply)
	Project planning and implementation (Apply)
Life-long learning	Identifying missing knowledge and learning opportunities (Apply)
	Continuous improvement and self-learning (Apply)

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course, students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A. Develop an open-ended practical project with meaningful applicability.	Investigation Design Life-long learning
B. Make use of commercial software and knowledge gained from previous courses.	A knowledge base for engineering Design Use of engineering tools Impact of engineering on society & the environment Economics and project management Life-long learning
C. Understand how to use the standards and other engineering documents to develop the design criteria	Investigation Design Professionalism Ethics Life-long learning
D. Learn how to collaborate with other team members to create a more complex and realistic design than would be achievable working alone.	Investigation Individual and teamwork
E. Understand how to breakdown a technical problem into its component elements in order to address problems in a methodical and progressive manner.	Problem analysis Investigation Design
F. Utilize project management skills to handle complex technical problems, assign tasks in an equitable manner	Individual and teamwork Communication skills Economics and project management Ethics
G. Improve communication abilities and get experience presenting technical concepts in a team manner.	Individual and teamwork Communication skills
H. Develop the ability to create technical proposals and progress reports that effectively illustrate design ideas via the use of precise technical terminology and formats.	Communication skills
I. Create comprehensive, comprehensible, clear, and stylistically consistent presentation slides to demonstrate the technical report's design elements, and express and articulate the recommended design principles coherently.	Communication skills

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
	3
	4
	5
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	11
	12

TERM PROJECT
Topic:

OTHER NOTES

TECHNICAL ELECTIVES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 400	Sustainable Industrial and Engineering Chemistry	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course reviews the principles of green chemistry and presents alternatives to conventional routes for producing commodity and fine chemicals. Production of value-added chemicals from sustainable feedstock such as biomass and co-products/residues is discussed. Similarly, established catalytic reactions are compared with alternate production routes such as electrochemical or photochemical synthesis while highlighting the barriers facing these technologies. Economics, energy consumption, risk and environmental trade-offs are used as key metrics for assessing sustainable production.

PREREQUISITES
CHME 201, CHME 300

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
- *Instructor's lecture notes:*

- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY

Evaluation Tool	Weight
Midterm	20
Assignments	10
Project + Presentation: Attendance is mandatory	30
Final Exam	40
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Understand the relevant principles of sustainable chemistry and identify the stakeholders to be considered in every step of an industrial process	
B. Determine which metrics are most important to each stakeholder for any given industrial process	
C. Identify alternative synthetic routes for achieving desired products	
D. Demonstrate critical thinking around the commercial viability and environmental benefits of different synthetic routes	
E. Provide an overview of the technological landscape and the most crucial existing industrial processes that need to be replaced with alternative methods	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
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	12
	13

TERM PROJECT
Topic:

OTHER NOTES

Concordia University — Gina Cody School of Engineering and Computer Science

Course number	Course Title	Term
CHME 401	Sustainable Process Design	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course aims to familiarize students with sustainable design principles in industries to reduce their overall energy consumption (particularly non-renewable resources) and minimize their negative impacts on health and the environment. This course is built based on three major modules: 1) Sustainability analysis and lifecycle assessment; 2) Process integration and intensification for minimal environmental impact; and 3) Optimization of industrial processes.

PREREQUISITES
CHME 390

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Assignments	50
Quiz (others)	10
Term project	40
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS)

By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Learn how to design sustainable processes using renewable resources.	
B. Understand how to use optimization tools to improve process performance.	
C. Understand the environmental aspects of chemical systems design.	
D. Communicate effectively when presenting technical issues in both a report and oral presentation	
E. Work in a team to solve an open-ended chemical engineering design problem	
F. Assign tasks in a team project in an equitable manner	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
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TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 402	Sustainable Energy Conversion and Management	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course introduces concepts of renewable energy resources and processes for sustainable chemical production and energy storage. Existing and future energy conversion technologies are analyzed from an engineering perspective, including renewable electricity sources (wind, solar, etc.) and advanced power generation technologies such as chemical looping combustion and gasification, solid oxide fuel cells, and oxyfuel combustion. Energy storage for enabling additional penetration of these technologies is also investigated. Valorization of biomass and waste as valuable chemical feedstock and a variety of thermochemical and biochemical conversion processes provide the introduction to sustainable industrial chemical production. Deep industrial decarbonization is also included by analyzing carbon capture, sequestration and utilization concepts, and technologies.

PREREQUISITES
CHME 351, CHME 352

TEXTBOOK AND ADDITIONAL COURSE MATERIALS
• *Required textbook(s):*

- *Suggested Textbook:*
- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES
General chemistry, basic knowledge of electrochemistry and physical chemistry, fundamental principles of the thermodynamics.

GRADING POLICY	
Evaluation Tool	**Weight**
Presentation: Attendance is mandatory	20
Assignments	15
Final report*	50
Quiz (others)	15
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A. Understanding of general types of energy conversion systems, and details of specific systems	
B. Awareness of important current problems in energy conversion	
C. Ability to review and analysis the recent published research work in one specific topic in energy storage and management	
D. Ability to apply knowledge in a rational way to analyze a particular problem	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
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TERM PROJECT
Topic:

OTHER NOTES

GINA CODY SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 403	Electrochemical Engineering	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course demonstrates the fundamentals of electrochemistry using modern applications such as batteries, fuel cells, electrolysis, wastewater treatment, electrodeposition and electrosynthesis. The first part of the course covers the core concepts of thermodynamics, kinetics, and mass transport to explain the design principles common to all electrochemical technologies. The second part of the course focuses on more advanced topics such as electrocatalysis, porous electrode theory, and experimental methods.

PREREQUISITES
CHME 351

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
- *Instructor's lecture notes:*

- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	30
Final Project & Presentation: Attendance is mandatory	50
Assignments	20
Total	100

Passing Criteria:
• If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A. Identify the primary electrochemical reactions in any electrochemical device	
B. Search literature and appropriate databases for electrochemical potentials	
C. Solve for the theoretical potential of any electrochemical device under equilibrium conditions	
D. Understand the phenomena present at the electrochemical interface between electrodes and electrolytes	
E. Estimate kinetic losses at an electrode under non-equilibrium conditions	
F. Estimate mass transport losses at an electrode using boundary layer analysis	
G. Estimate ohmic losses in full electrochemical cells due to limited conductivity of components	
H. Solve for voltage efficiency of electrochemical cells under steady-state conditions	

I. Understand how to measure kinetic, mass transport and conductivity parameters experimentally	
J. Recognize porous electrode effects	
K. Quantify the effects of electrocatalytic improvements	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
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	10
	11
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TERM PROJECT
Topic:

OTHER NOTES

UNIVERSITÉ Concordia UNIVERSITY GINA CODY SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

Course number	**Course Title**	**Term**
CHME 404	Clean Energy Science and Technology	

Course Instructor	**Office**	**E-Mail**	**Office Hours**

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION

This course develops student knowledge in clean energy based on different energy storage and conversion systems. Students are familiarized with fundamentals, materials design, characterization and evaluation, and industrial applications of different energy storage and conversion systems. The course brings together some of the world's most preeminent researchers in the clean energy field to share their knowledge and expertise. Several important energy storage and conversion systems are introduced, such as electrochemistry, hydrogen, solar, etc.

PREREQUISITES

CHME 321, CHME 352

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
    - C. Julien, A. Mauger, A. Vijh, K. Zaghib. Lithium Batteries: Science and Technology. Springer (2016).

- Fuel Cell Systems Explained, J. Larminie and A. Dicks, 2nd edition, John Wiley & Sons, 2003.
- Guozhong Gao, "Nanostructures and Nanomaterials: synthesis, Properties and Applications". Imperial College Press, 2004.
- Solar Cells and Their Applications, 2nd Edition Lewis M. Fraas, Larry D. Partain, Wiley, 2010.
- Introduction to Photocatalysis: From Basic Science to Applications, Yoshio Nosaka, Atsuko Nosaka, RSC, 2016.
- Kim Kinoshita, Electrochemical Oxygen Technology, The Electrochemical Society Series of Texts and Monographs, John Wiley & Sons, 1992.
- Allen J. Bard, Martin Stratmann, Stuart Licht, "Semiconductor Electrodes and Photoelectrochemistry", Wiley 2002.

- *Instructor's lecture notes:*

- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	30
Final	30
Project	20
Assignments	20
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS)

By the end of this course students will be able to:

Course Learning Outcome	**Relationship to Graduate Attributes**
A. Distinguish principles of different energy storage and conversion systems	

B. Demonstrate materials design and synthesis, reaction kinetics, advanced characterization techniques, simulation and computational study in clean energy	
C. Determine experimental methods used to study key parameters of energy storage materials	
D. Differentiate and summarize industrial applications of energy storage and conversion	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
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TERM PROJECT
Topic:

OTHER NOTES

Course number	**Course Title**	**Term**
CHME 405	Introduction to Environmental Engineering	

Course Instructor	**Office**	**E-Mail**	**Office Hours**

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course provides an overview of the main concepts of environmental engineering. Topics include chemical principles applied to natural aquatic systems, biological and ecological principles, environmental risk assessment, air and water quality, and principles of waste management.

PREREQUISITES

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	25
Group Project	25
Group Project Presentation: Attendance is mandatory	15
Final Examination	35
Total	100

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A. Understand the vocabulary of an environmental engineer	
B. Understand the principles of air pollution control, water pollution control, and waste management	
C. Understand the principles of risk assessment	
D. Identify environmental diagnostics to identify environmental impacts, such as chemical pollutant measurements and toxicology	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
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TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 406	Introduction to Life Cycle Assessment	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
Life cycle assessment (LCA), which is critical for any engineering and design work, is an analytical framework used within the field of industrial ecology to assess the environmental impact across the entire lifecycle of a product, process, or service. This course explores the fundamental principles, standards, and application of LCA to inform diverse public policy, business, supply chain, community development, and other decisions. The course follows the principles, methods, and recommendations of the ISO14040-44 standards, applying a stepwise approach to LCA including project definition, data collection, impact assessment and interpretation. Students apply the principles of the framework using calculation tools in addition to purpose-built software (OpenLCA) and databases (ecoinvent) to become familiar with the most common methodologies for conducting LCA anddemonstrate their capability and knowledge. Students develop an in-depth and hands-on understanding of the frameworks, principles, tools, and applications of LCA to evaluate the cradle-to-grave impacts of any product or system. A project is required.

PREREQUISITES
None

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Tel. 514-848-2424 ext. 3109 Fax 514-848-4509 concordia.ca/ginacody

TEXTBOOK AND ADDITIONAL COURSE MATERIALS
Suggested textbooks: Matthews, H.S., Hendrickson, C., Matthews, D.H. (2018), Life Cycle Assessment: Quantitative Approaches for Decisions That Matter (http://www.lcatextbook.com/). Jolliet, O., M. Saade-Sbeih, S. Shaked, A. Jolliet. (2015) Environmental Life Cycle Assessment. CRC Press. Boca Raton, Florida. 302 pp. ISBN 978-1-4398-8766-0 Freely available ebook version: https://doi.org/10.1201/b19138 Français: Jolliet, Saadé, Crettaz, Jolliet-Gavin, Shaked (2017). Analyse du cycle de vie : Comprendre et réaliser un écobilan. 3e Edition. Presses polytechniques et universitaires romandes. • *Instructor's lecture notes:* • *Software Use:* Microsoft Excel; openLCA (http://www.openlca.org/)

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Assignments	15
Midterm Exam	15
Term project	40
Final Examination	30
Total	100

Passing Criteria:
• If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam. • In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**

A. Give examples of the concept of a life cycle and its various stages	
B. Explain why sustainable development requires broad thinking and analysis of all life cycle stages	
C. Describe the four major phases of the ISO LCA Standard.	
D. Utilize open and paid life cycle assessment tools and databases, and what underlies them	
E. Select and justify Life Cycle Impact Assessment (LCIA) methods for assessing potential environmental impact	
F. Interpret the results of an LCA and explain how it can be used to develop more sustainable industrial systems	
G. Describe what kinds of outcomes we might expect if we fail to use life cycle thinking	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
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TERM PROJECT
Topic:

OTHER NOTES

UNIVERSITÉ Concordia UNIVERSITY

GINA CODY SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

Course number	**Course Title**	**Term**
CHME 416	Data Engineering for Chemical Engineers	

Course Instructor	**Office**	**E-Mail**	**Office Hours**

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION

With the trend of digitalization, industry is implementing automated data processing technologies. This course covers the theoretical and practical issues in modern data streaming and processing in engineering with particular focus on chemical process and manufacturing data. Topics include structured and non-structured data, database modeling and SQL language, data streaming using publish subscribe paradigm, introduction to data lakes, ETL versus ELT, introduction to Kafka and Kafka streams, stateless and stateful processing, automating a data pipeline, data streaming frameworks in industry for manufacturing / production data (MTConnect, MQQT and OPC-UA).

PREREQUISITES

CHME 215 or equivalent (COEN 243, MECH 215, MIAE 215)

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*

- *Suggested Textbook:*

- Mastering Kafka Streams and ksqlDB – Building Real-Time Data Systems by Example, by Mitch Seymour, O'Reilly, 2021.

- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Final *	40
Project + Presentation: Attendance is mandatory	50
Quiz (others)	10
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS)

By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Distinguish between structured and unstructured data	
B. Demonstrate understanding of data base modeling and SQL query language	
C. Understand the principle of data streaming and the publish and subscribe paradigm	
D. Construct a simple publish/subscribe system with Apache Kafka	
E. Distinguish between stateless and stateful processing	
F. Know about industrial standards for production/manufacturing data representation	

G. Construct a simple automated data-pipeline in the contact of manufacturing/chemical production	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
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TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 420	Nanomaterials Science and Engineering	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course covers chemical and engineering aspects of nanomaterials. Topics include synthesis, characterization, properties, and applications of a variety of nanomaterials, with a focus on representative inorganic nanomaterials, as well as carbon nanomaterials such as fullerenes, carbon nanotubes, and graphene.

PREREQUISITES
CHME 320

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	25
Final	40
Project	15
Lab report	20
Total	100

Passing Criteria:
• If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam. • In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS) By the end of this course students will be able to:	
Course Learning Outcome	**Relationship to Graduate Attributes**
A. Demonstrate a knowledge and understanding of the different nanomaterial systems, their structures and physical properties	
B. Demonstrate an understanding of the different manufacturing processes for nanomaterials	
C. Perform calculations using mathematical models of manufacturing processes for nanotechnology and materials	
D. Describe the importance of processing methods on the structure and behavior of nanomaterials	
E. Demonstrate an understanding of the basic mechanical behaviour of nanomaterials and explain the difference between strength and stiffness	
F. Perform appropriate characterization for nanomaterials in a technical laboratory report	

G. Understand the economics of nanomaterial processing	
H. Find out relevant nanomaterial from various sources to prepare a summary report on a topic related to but not directly covered in class	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
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TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 421	Metallurgical Engineering	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course reviews crystal structures, phase diagrams, and crystal defects. The theory of alloys and solid solutions is discussed. Physical, electrical, magnetic, optical and mechanical properties of metals and alloys are covered. The preparation, melting and casting of metals and alloys is reviewed. The class investigates steel, lithium, iron, nickel, aluminum and titanium alloys as well as the corrosion and protection of metals. Characterization techniques of metals are taught including light and electron microscopy, X-ray diffraction, and thermal analysis. Case studies and industrial applications are included in class materials.

PREREQUISITES
CHME 320

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook:*
    - *Physical Metallurgy and Advanced Materials*, 7th Edition, R.E. Smallman and A. H. W. Ngan, Butterworth-Heinemann (Elsevier), Oxford, United Kingdtom, 2014.

- *Suggested textbooks:*

    - *An Introduction to Metallurgy*. 2nd edition**, Alan Cottrel, Institute** of Materials, London, United Kingdom, 1995.

    - *The Structure of Metals and Alloys*. 5th ed. (revised), William Hume-Rothery, R. E. Smallman and Colin William Haworth, Metals & Metallurgy Trust of of the Institute of Metals and the Institution of Metallurgists, Monograph and Report Series, London, United Kingdom, 1969.

    - *Physical Metallurgy Principles*. 4th edition, SI edition**, Reza Abbaschian, Lara Abbaschian, Robert E. Reed-Hill, Cengage Learning, Stamford**, CT, 2010.

  Instructor's lecture notes:

- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES
General knowledge of materials properties, crystal structure, atomic properties and metallic bonding; elementary thermodynamics.

GRADING POLICY	
Evaluation Tool	**Weight**
Assignments and case studies	20
Project (Report and presentation)	40
Final Examination	40
Total	100

Passing Criteria:
• In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A. Analyze the structure and properties of metals and alloys.	
B. Establish the phase diagram of some binary and ternary alloys.	

C. Conceive a preparation or protection process (eg. metal coating) for basic metals and alloys.	
D. Relate the preparation and properties of metals and alloys to industrial applications.	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
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TERM PROJECT
Topic:

OTHER NOTES

GINA CODY SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 422	Polymer Chemistry and Engineering	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
Topics include the advanced theory and industrial practice of polymers, polymer chemistry, and polymer reactor engineering. The course covers polymer chemistry and polymerization kinetics for various types of polymerization, including condensation, free radical, cationic, anionic, and coordination polymerization, polymer reactor engineering, polymer materials structure and property characterization, and recent developments in the field are included.

PREREQUISITES
CHEM 221

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
    - P. C. Hiemenz, T. P. Lodge. Polymer Chemistry, 2nd Edition, CRC Press (2007).
- *Suggested Textbook:*
    - G. Odian. Principles of Polymerization, 4th Edition, John Wiley (2004).

- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	20
Final	60
Project + Presentation: Attendance is mandatory	10
Assignments	10
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Define the basic concepts and terms in polymer chemistry and different types of polymerization.	
B. Identify the molecular structure of monomers and polymers, reaction mechanism and their stereochemistry.	
C. Determine parameters, such as polymerization rate, reactivity ratios, polymer molecular weight distribution, and copolymer composition for a given polymerization mechanism.	
D. Calculate average molecular weights of polymers in solving problems.	
E. Cooperate with colleagues in teamwork.	

F. Communicate challenges, analysis, and conclusions related to polymer chemistry, both orally and textually, also with respect to the global sustainable development goals.	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
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TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 423	Advanced Battery Materials and Technologies	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
Topics include a review of the principles of batteries and fuel cells, including electrodes and electrolytes. This includes discussion of thermodynamics, reaction kinetics, transport phenomena, electrostatics and phase transformations of various energy storage materials, particularly lithium-ion batteries and fuel cells. Experimental methods are discussed and key parameters of energy storage materials are studied, focusing on a materials science approach.

PREREQUISITES
CHME 351

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
    - C. Julien, A. Mauger, A. Vijh, K. Zaghib. Lithium Batteries: Science and Technology. Springer (2016).

- Gholam-Abbas Nazri, Gianfranco Pistoia. Lithium Batteries Science and Technology Springer (2003).
- R.A. Huggins. Advanced Batteries: Materials Science Aspects. Springer (2009).
- Fuel Cell Systems Explained, J. Larminie and A. Dicks, 2nd edition, John Wiley & Sons, 2003.
- R. O'Hayre, S.W. Cha, W. Colella, F.B. Prinz. Fuel Cell Fundamentals. 3rd Ed., Wiley (2016).

- *Instructor's lecture notes:*
- *Software Use:*

NOWLEDGE BASE FOR ENGINEERING PREREQUISITES
General chemistry, basic knowledge of electrochemistry, physical chemistry.

GRADING POLICY	
Evaluation Tool	**Weight**
Presentation: Attendance is mandatory	40
Final report	40
Quiz and Q&A	20
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Basic knowledge of electrochemistry	
B. Fundamentals of rechargeable batteries with reaction mechanisms	
C. Design principles of battery materials (cathodes, anodes, electrolytes) and basic understanding of the evaluation of Li-ion batteries	
D. Fundamentals of fuel cells with reaction mechanisms	

E. Design principles of materials (cathodes, anodes, catalysts) of different types of fuel cells	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
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TERM PROJECT
Topic:

OTHER NOTES

Course number	Course Title	Term
CHME 424	Advanced Characterization Techniques	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course develops student knowledge and understanding of the structure, chemical, and surface properties of materials. Students are familiarized with tools to use for materials analysis and characterization for current and future research, as well as for industrial applications. Strong emphasis is placed on the principles, techniques, and analysis used in the characterization of energy storage materials including chemical, microstructural, electrochemical, and surface analysis. In-situ and operando characterization techniques are also included in the course.

PREREQUISITES
CHME 220

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
  - Surender Kumar Sharma, "Handbook of Materials Characterization" Springer International Publishing AG, 2018.
  - David Brandon, Wayne D Kaplan, "Microstructural Characterization of Materials", Wiley, 2008.

- *Suggested Textbook:*
- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Final	50
Project + Presentation: Attendance is mandatory	50
Total	100

Passing Criteria:
• If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam. • In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A. Understand, discuss, and evaluate the basic principles of the characterization techniques presented in the course	
B. Recognize the capabilities and limitations of each technique	
C. Identify and select appropriate techniques for specific materials and/or engineering problems; formulate requirements for samples suitable for each technique	
D. Perform simple and routine operations on the experimental setups	
E. Interpret the experimental data	

F. Effectively communicate materials characterization results orally and in writing	
G. Cooperate with colleagues in a teamwork	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
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	12

TERM PROJECT
Topic:

OTHER NOTES

Concordia University — GINA CODY SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 425	Hydrometallurgy	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION

Hydrometallurgy is the refining of metal ores based on aqueous solutions. Topics include an overview of ore minerals and their critical importance in today's economy, kinetics, equilibrium and thermodynamics in aqueous media, leaching, precipitation, reaction displacement and deposition, cementation, electrochemical methods, metal extraction and purification. Environmental issues are also considered. Applications to chemical analysis, mining, and process design are discussed.

PREREQUISITES

CHME 351

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
  - Hydrometallurgy: Fundamentals and Applications, 2nd edition, **Michael L. Free**, The Minerals, Metals & Materials Series, Springer, 2022 *(open access through Concordia library).*
- *Suggested Textbook:*

- Chemical Hydrometallurgy: Theory and Principles, **A. R. Burkin,** Imperial College Press, 2001.
- Electrochemical Methods: Fundamentals and Applications, 2nd edition, **Allen J. Bard**, **Larry R. Faulkner**, John Wiley & Sons, 2002.
- Cementation of Copper and Silver on Granular Iron from Simulated Iron Chloride Leach Solutions.
- Par Donald J. MacKinnon, **J. M. Brannen** · 1986, Report / CANMET, Mineral Sciences Laboratories, 86-107(TR).

* *Instructor's lecture notes:*
* *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES
General knowledge of acid-base theory, redox reaction and chemical kinetics, elementary thermodynamics.

GRADING POLICY	
Evaluation Tool	**Weight**
Assignments	20
Project and presentation	40
Final examination	40
Total	100

Passing Criteria:

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A. Analyze chemical reactions and transformations of metals occurring in aqueous media.	
B. Conceive a hydrometallurgical or electrochemical process for the extraction and purification of selected metals.	
C. Relate hydrometallurgy to mining, industrial and environmental applications.	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
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TERM PROJECT
Topic:

OTHER NOTES

Course number	Course Title	Term
CHME 430	Advanced Chemical Engineering Process Dynamics and Control	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION

This course reviews the fundamentals of process control with chemical engineering applications and introduces advanced topics such as data reconciliation and model predictive control. Topics include process modeling and dynamic systems; step response curves; data reconciliation; classic PID control; alternative strategies for chemical process control; process model identification; dynamic chemical process simulation; model-predictive control; and assessment of controller performance.

PREREQUISITES

CHME 330

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
    - Seborg, D.E., Edgar, T.E., Mellichamp, D.A., Doyle, F.J. (2016) Process Dynamics and Control (4th ed.). John Wiley & Sons, Inc.
- *Suggested Textbooks:*

- Narasimhan S, Jordache C. Data Reconciliation and Gross Error Detection: An Intelligent Use of Process Data. 1st edition. Houston: Gulf Professional Publishing; 1999.
- Karris ST. Introduction to Simulink with Engineering Applications. 1st edition. Fremont, CA: Orchard Pubns; 2006.

- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm examination	30
Assignments	20
Project + Presentation: Attendance is mandatory	50
Total	100

Passing Criteria:
• In order to pass the class, both your cumulative score and the project score must be above 50%.

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Demonstrate mathematical modelling of dynamic chemical processes	
B. Construct digital simulations chemical processes with and without process control using software	
C. Distinguish between different types of process control and justify selections using appropriate metrics	
D. Assess system stability with and without process control	
E. Demonstrate understanding of redundancy in process systems and how it can be used to reconcile plant data	

F. Design and tune various controller types for use within a simulated process	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
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TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 431	Introduction to Optimization for Chemical Engineers	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION

This course introduces the basic concepts of mathematical optimization, with special interest for chemical engineering applications. Fundamental optimization algorithms such as simplex and branch-and-bound are introduced. Concepts of linear, quadratic, binary, integer, mixed-integer and nonlinear programming are explored using graphical and mathematical techniques, as well as through the use of software for larger problems. Common applications in chemical engineering design and operation are used to highlight the usefulness of these optimization techniques. The primal optimization problem and its dual representation are presented, as well as the relationship between them. Sensitivity analysis of optimization models is shown through the dual representation.

PREREQUISITES

CHME 330

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
    - Hillier F, Lieberman G. Introduction to Operations Research 11th edition. 2020.

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- *Suggested Textbook:*
    - Winston W. Operations Research: Applications and Algorithms. 4th edition. Belmont, CA: Duxbury Press; 2003.
- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm examination	25
Project + Presentation: Attendance is mandatory	50
Assignments	25
Total	100

Passing Criteria:
• In order to pass the class, both your cumulative score and the project score must be above 50%.

COURSE LEARNING OUTCOMES (CLOS) *By the end of this course students will be able to:*	
Course Learning Outcome	**Relationship to Graduate Attributes**
A. Construct mathematical representations of optimization problems using inequalities	
B. Distinguish between different types of optimization problems (LP, IP, BP, NLP, MILP, MINLP)	
C. Demonstrate proficiency with fundamental optimization algorithms for solving problems of the appropriate type	
D. Create meaningful graphical representations of problem search space and optimization results	
E. Implement optimization problems in appropriate software tools	
F. Quantify sensitivity in optimization results	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
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TERM PROJECT
Topic:

OTHER NOTES

GINA CODY SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 432	Advanced Process Safety Engineering	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION

In this course, the primary aspects of safety in the design and operation of process plants are covered. Students gain an understanding of the standards and procedures, such as HAZOP, that must be considered to achieve a safe design. The codes, standards, and recommended practices for designing safety facilities for the protection of equipment are reviewed. Various types of relief systems and devices (e.g. safety valves, rupture discs) are introduced. Furthermore, the procedures to identify the primary hazardous scenarios, such as fire, equipment protection, operational failure, and solid formation are discussed. Calculations for the required relief capacities are developed. The design and rating of the relief systems and the sizing of the flare network for the safe disposal of relieved materials are the last parts of safety engineering covered in this course. Aspen Safety Analysis and Aspen Flare System Analyzer are used to examine the dynamic behaviour of the relief devices and flare systems.

PREREQUISITES

CHME 390

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*

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- *Suggested Textbook:*
- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Assignments	40
Midterm exam	20
Final exam	40
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Learn how to develop safety devices in order to create a reliable process.	
B. Knowledge of how to use simulation tools to size safety devices and design the network.	
C. Understand the safety and environment aspects of chemical systems design.	
D. Effectively communicate technical concerns in a written report.	
E. Solve process safety design problems.	

TENTATIVE COURSE OUTLINE

Topics	Week
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TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 460	Chemical Kinetics and Advanced Reactor Engineering	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course reviews chemical kinetics and their use in chemical reactor design and chemical plant operation. Both homogeneous and heterogeneous kinetics, including catalysis, are considered. Topics include residence time distribution; multiphase and dispersed plug flow reactors; radial mass and heat transfer limitation; mass and heat transfer limitation in and around porous catalysts.

PREREQUISITES
CHME 301

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	20
Final Exam	50
Project + Presentation: Attendance is mandatory	10
Assignments	20
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS)

By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Recognize the analytical forms of common reaction kinetics equations	
B. Numerically solve any of the ideal reactors (batch, semi-batch, continuous stirred-tank and plug-flow reactors)	
C. Implement hydrodynamic diffusion limitations in computational models for laminar flow conditions	
D. Simulate ideal reactors under non-isothermal conditions	
E. Simulate reaction, mass transfer and heat transfer rates within porous catalysts	
F. Use appropriate statistical analysis to extract kinetic information from experimental data	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
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TERM PROJECT
Topic:

OTHER NOTES

Course number	Course Title	Term
CHME 461	Advanced Chemical Engineering Thermodynamics	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
Topics include principles, concepts, and laws/postulates of classical and statistical thermodynamics and their link to applications that require quantitative knowledge of thermodynamic properties from a macroscopic to a molecular level; basic postulates of classical thermodynamics and their application; criteria of stability and equilibria; constitutive property models of pure materials and mixtures, including molecular-level effects using statistical mechanics; equations of state; phase and chemical equilibria of multicomponent systems; and thermodynamics of polymers. Applications are emphasized through extensive problem work relating to practical cases.

PREREQUISITES
CHME 351

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
- *Instructor's lecture notes:*

• *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	20
Final	30
Project + Presentation: Attendance is mandatory	25
Assignments	15
Quizzes	10
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Select and implement an appropriate thermodynamic model to a given system	
B. Solve chemical thermodynamic problems with chemical equilibria, including multiple reactions	
C. Solve chemical thermodynamic problems with phase equilibria including pure substances and mixtures, liquid-vapor equilibria and liquid-liquid equilibria	
D. Identify improved thermodynamic models from the literature	
E. Search literature and appropriate databases for thermodynamic data	
F. Present thermodynamic model applied to a given system	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
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TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 462	Industrial Catalysis	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION

Basic and recent concepts in catalysis are described with particular emphasis on heterogenous catalysis. The course starts with fundamentals of catalysis, such as catalyst structure, characterization, kinetic theory, reaction mechanisms, and catalyst preparation. Then industrial catalytic applications are covered, including the technical, economic and environmental aspects. The processes to be studied are chosen from the petroleum industry, the natural gas industry, and the treatment of industrial pollutants with catalytic converters.

PREREQUISITES

CHME 301, CHME 351

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
- *Instructor's lecture notes:*

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- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	25
Project + Presentation: Attendance is mandatory	30
Report	30
Assignments	15
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS)

By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Identify catalyst preparation and characterization techniques for different catalyst types; metal supported catalysts, carbonaceous catalysts, acid/base catalysts	
B. Identify reaction mechanisms for certain catalytic reactions, know how to implement experimental techniques for probing reaction mechanisms at the surface of catalysts	
C. Investigate current industrial catalytic processes	
D. Search the literature for novel catalyst technologies and identify opportunities for future catalyst technologies in the development of a sustainable low-carbon future	
E. Present catalytic process design	

F. Write a technical report about a current industrial process, discussing the relevance, thermodynamics, catalyst mechanism, and reactor technologies	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
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TERM PROJECT
Topic:

OTHER NOTES

CONCORDIA UNIVERSITY
GINA CODY SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 463	Advanced Separation Processes	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
Topics covered in this course include a review of basic chemical and mechanical separations; multicomponent separations; membrane separations; adsorption; chromatographic separations; and ion exchange.

PREREQUISITES
CHME 362

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	20
Final	30
Homework Assignments	20
Class quiz % contribution	12
Presentations	18
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Review knowledge required for the design of separation processes including Sedimentation, Thickeners and Clarifiers, Centrifuges, Cyclones, Filtration, Membranes, Adsorption, Ion Exchange, and Chromatographic	
B. Apply engineering principles to do engineering calculations and size various separation processes	
C. Consider health, safety, environmental standards, and economic factors in the design of separation units	
D. Use correlations and experimental data to evaluate a given separation unit	
E. Design a separation unit for a specific application	

TENTATIVE COURSE OUTLINE

Topics	Week
	1
	2
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	12

TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	**Course Title**	**Term**
CHME 470	Advanced Biochemical Engineering	

Course Instructor	**Office**	**E-Mail**	**Office Hours**

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
Topics include the interaction of chemical engineering, biochemistry, and microbiology, as well as mathematical representations of microbial systems. Kinetics of growth, death, and metabolism are also covered, as well as studies of continuous fermentation, agitation, mass transfer, scale-up in fermentation systems, and enzyme technology.

PREREQUISITES
CHME 301, CHME 362

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
  - S. Katoh, J. Horiuchi, F. Yoshida. Biochemical Engineering. 2nd Ed., Wiley-VCH (2015).
- *Instructor's lecture notes:*

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• *<u>Software Use:</u>*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	15
Final	50
Project + Presentation: Attendance is mandatory	25
Homework Assignments	10
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	**Relationship to Graduate Attributes**
A. Acquire knowledge of basic microbiology, biochemistry, and genetics	
B. Select appropriate kinetic model and determine kinetic parameters for enzymatic and microbial processes	
C. Determine the mass transfer effect on bioreactor kinetics	
D. Apply chemical engineering principles to bioreactor analysis, optimization, and scale-up/down	
E. Select appropriate methods for product recovery and purification	
F. Present a bioprocess design	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
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	12

TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 471	Colloid and Interface Chemistry	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course focuses on the properties of colloids and surfactants. This includes the physical and chemical interactions between colloidal particles (attraction and repulsion), the stability of colloidal dispersions, and the coagulation and flocculation of colloids. It also includes the surface and interface tension (wettability). The relationships between interface energy and adsorption and the adsorption of surfactants on interfaces (micelles) will be covered, as well as surfactants in nanotechnology and adsorption in porous media. The characterization methods of colloidal particles and surface characterization are discussed.

PREREQUISITES
CHME 220, CHME 351

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*

- Ducan Shaw, “Introduction to Colloid and Surface Chemistry”, 4th Ed, Butterworth-Heinemann, 1992.

- *Instructor’s lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	30
Final	35
Presentation	20
Quiz (others)	15
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	**Relationship to Graduate Attributes**
A. Summarize properties of colloids and surfactants	
B. Analyze and solve problems calculations concerning thermodynamic and electrostatic properties of colloids	
C. Discuss fundamental concepts in surface chemistry and formulate calculations to solve surface chemical problems relevant to these concepts	

D. Examine differences between the surface and bulk dominated regimes and behavior and exploitation of nanobehaviour	
E. Differentiate physical and chemical interactions between colloidal particles	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
	3
	4
	5
	6
	7
	8
	9
	10
	11
	12

TERM PROJECT
Topic:

OTHER NOTES

Concordia University — GINA CODY SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 472	Food Engineering	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course introduces fundamentals of food processing systems, such as process classification, mass and energy balances, fluid mechanics and transport, steady-state and unsteady-state heat transfer. It further covers the most popular food processing unit operations, including thermal processing, microwave processing, evaporation, and freezing. This course also provides knowledge for selecting processes and equipment and determining the appropriate procedures of operation.

PREREQUISITES
CHME 390

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
    - R. Paul Singh, Dennis R. Heldman, "Introduction to Food Engineering", 5th Ed, Academic Press, 2014.

- Fuel Cell Systems Explained, J. Larminie and A. Dicks, 2nd edition, John Wiley & Sons, 2003.

- *Instructor's lecture notes:*

- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	30
Final	35
Lab report	25
Quiz (others)	10
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS)

By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Describe the mathematical model of basic heat transfer methods	
B. Assess the advantages and disadvantages of heat transfer equipment and choose the appropriate heat transfer device	
C. Apply basic knowledge of mass transfer processes in food technology	
D. Select and calculate appropriate mass transfer equipment	

E. Identify the mechanisms of unit operations in food processing	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
	3
	4
	5
	6
	7
	8
	9
	10
	11
	12

TERM PROJECT
Topic:

OTHER NOTES

Université Concordia University — GINA CODY SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 473	Biomaterials and Biochemicals	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION

This course is divided into two sections. The first section will focus on fundamental principles in biomedical engineering, material science, and chemistry. Different classes of materials (metals, ceramics, polymers, and composites) are discussed, emphasizing their properties, biocompatibility, and utilization in implanted medical devices. The second section introduces cellular chemistry, including the structure and function of biological molecules, nucleic acids, enzymes and other proteins, carbohydrates, lipids, and vitamins.

PREREQUISITES

CHME 220

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbook:*
  - Shuler, Michael L., and Fikret Kargi. Bioprocess Engineering: Basic Concepts. 2nd ed. Upper Saddle River, NJ: Prentice Hall PTR, 2001. ISBN: 9780130819086.

- Blanch, Harvey W., and D. S. Clark, eds. Biochemical Engineering. New York, NY: Marcel Dekker Incorporated, 1997. ISBN: 9780824700997.
- Bailey, James E., and David F. Ollis. Biochemical Engineering Fundamentals. New York, NY: McGraw-Hill Education, 1986. ISBN: 9780070666016.

- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Midterm	30
Final	40
Assignments	20
Quiz (others)	10
Total	100

Passing Criteria:

- If your total score before the final exam is less than 40% and you decide to defer the final exam, you will receive an ***R*** grade which prevents you to defer the final exam.
- In order to pass the class, both your cumulative score and the final examination must be above 50%.

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A. Describe the fundamental principles in biomedical engineering, chemistry and material science and their contribution to the properties and performance of biomaterials	
B. Distinguish biocompatibility of various materials and how they are used as implanted devices	
C. Identify the structure and functions of macromolecules in the cell	

D. Explain the structure and function of biological molecules	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
	3
	4
	5
	6
	7
	8
	9
	10
	11
	12

TERM PROJECT
Topic:

OTHER NOTES

GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Course number	Course Title	Term
CHME 480	Molecular Modelling of Proteins	

Course Instructor	Office	E-Mail	Office Hours

CLASS, LAB, AND TUTORIAL SCHEDULE					
Section	**Day**	**Time**	**Location**	**Instructor**	**E-mail**
Lecture					
Tutorial					
Tutorial					
Labs					**Lab Start Date**
Lab A					
Lab B					
Lab C					
Lab D					
Lab E					

COURSE CALENDAR DESCRIPTION
This course offers a hands-on introduction to the modelling tools to study protein structure and dynamics. Topics include molecular visualization, biological databases, protein sequence alignment, force fields, and molecular dynamics simulations. Students have hands-on practice in weekly tutorials following lectures.

PREREQUISITES

TEXTBOOK AND ADDITIONAL COURSE MATERIALS

- *Required textbook(s):*
- *Suggested Textbooks:*
    - Daan Frenkel and Berend Smit, Understanding Molecular Simulation: From Algorithms to Applications, Academic Press.

- Tamar Schlick, Molecular Modeling and Simulation: An Interdisciplinary Guide, Springer Science & Business Media.
- Andrew Leach, Molecular Modelling: Principles and Applications, Prentice Hall.
- Paul M. Selzer, Richard J. Marhöfer, Oliver Koch, Applied Bioinformatics: An Introduction, 2nd Edition, Springer.

- *Instructor's lecture notes:*
- *Software Use:*

KNOWLEDGE BASE FOR ENGINEERING PREREQUISITES

GRADING POLICY	
Evaluation Tool	**Weight**
Lab reports	55
Project	45
Total	100

Passing Criteria:

COURSE LEARNING OUTCOMES (CLOS)
By the end of this course students will be able to:

Course Learning Outcome	Relationship to Graduate Attributes
A) Classify different molecular modelling techniques available given a scientific problem pertaining to proteins.	
B) Utilize a variety of tools and software to investigate protein structure, dynamics, and function.	
C) Carry out biomolecular simulations of a small protein.	
D) Analyze the root mean square deviation, root mean square fluctuation, radius of gyration, changes in the secondary structure over time, hydrogen bonds.	
E) Identify a knowledge gap and design a project to address it using one or more of the available molecular modelling tools.	

F) Critically analyze the quantitative and qualitative data obtained from modelling software and discuss the results to address the scientific problem.	

TENTATIVE COURSE OUTLINE	
Topics	**Week**
	1
	2
	3
	4
	5
	6
	7
	8
	9
	10
	11
	12

TERM PROJECT
Topic:

OTHER NOTES

Appendix 3: Needs Analysis, Surveys, Market Analysis, Environmental Scans

Please see Survey Results and Analysis in following pages, as well as the Library Report.

New Program in Chemical Engineering Survey

- Undergraduates in Bachelor degree programs in the Gina Cody School of Engineering and Computer Science as well as Chemistry and Biochemistry undergraduates enrolled in the Winter 2022 term and who had not yet graduated were invited to participate in the online survey (3875 students in total).
- A total of 381 students completed the survey, yielding a response rate of 9.8% and a margin of error (at a 95% confidence level) of ± 4.8%.
- The survey was undertaken between June 30 and July 22, 2022.

Please indicate your current program of study.			
	Counts	Percents	Percents 0 100
Mechanical Engineering (undergraduate)	73	19.2%	
Software Engineering (undergraduate)	64	16.8%	
Computer Engineering (undergraduate)	55	14.4%	
Chemistry and Biochemistry (undergraduate)	53	13.9%	
Electrical Engineering (undergraduate)	38	10.0%	
Civil Engineering (undergraduate)	37	9.7%	
Building Engineering (undergraduate)	30	7.9%	
Industrial Engineering (undergraduate)	16	4.2%	
Other	15	3.9%	
Totals	381	100.0%	

Based on the descriptions on the previous pages, if this Chemical Engineering program had been available at the time you applied, how likely is it you would have preferred this program?			
	Counts	Percents	Percents 0 100
Very likely	60	15.7%	
Likely	57	15.0%	
Somewhat likely	88	23.1%	
Unlikely	162	42.5%	
Don't know	14	3.7%	
Totals	381	100.0%	

What specialized technical tracks within the Chemical Engineering program seem the most interesting to you? (Please check all that apply.)			
	Counts	Percents	Percents 0 100
Biochemical and Food Engineering	173	48.7%	
Materials Engineering	163	45.9%	
Sustainable Chemical Engineering	148	41.7%	
Advanced Process Design and Control	130	36.6%	
Not Applicable	26	6.8%	
Totals	*	*	

* Note: Multiple answer percentage-count totals not meaningful.

I believe that specialized expertise in ______________ could increase my career prospects. (Please fill in the blank with all that apply to you.)			
	Counts	Percents	Percents 0 100
Materials Engineering	174	45.7%	
Data analysis	173	45.4%	
Energy conversion	162	42.5%	
Sustainability	153	40.2%	
Project management	148	38.8%	
Pharmaceuticals	130	34.1%	
Process Engineering	116	30.4%	
Manufacturing	109	28.6%	
Polymer Engineering	89	23.4%	
Food Engineering	75	19.7%	
Pulp and Paper	17	4.5%	
Other	11	2.9%	
Totals	*	*	

* Note: Multiple answer percentage-count totals not meaningful.

Other (specify):

- Nuclear energy and materials for development of more efficient batteries
- Building engineering
- Gearbox design (advanced machine element design)
- Engineering Physics; AI
- None of the above
- Power Transmission
- Household or industrial waste and water treatment
- PCB manufacturing, battery chemistry, semiconductor manufacturing chemistry
- Fermentation
- idk
- Battery or clean energy

In what ways do you think this program can be improved? (Please check all that apply.)			
	Counts	Percents	Percents 0 100
Co-op option available	268	70.3%	
More hands-on training	192	50.4%	
Program options or specialization certificates available	106	27.8%	
More diverse specialized technical tracks	86	22.6%	
Mandatory co-op included in the program	68	17.8%	
Other	18	4.7%	
Totals	*	*	

* Note: Multiple answer percentage-count totals not meaningful.

Other (specify):

- Learning more about energy transfer and generation
- Include cosmetics specialized track
- None I can see
- I see that the first semesters don't have a lot of classes directly related to the field. 1 or 2 CHME classes for semester 1, 2, 3. Semester 4 is the first with mostly chemical courses.
- Don't make co-op mandatory and create an apprenticeship option where students can be sponsored by companies over their 4-5 year undergrad. Mentoring is key to develop better engineers
- Not interested
- More technical electives. A choice of only three is underwhelming and there are existing chemical engineering undergraduate degree programs that offer more choice.
- More material science related classes
- On year 2, students will be given 6 classes per semester which is too much. On year 4 in Winter, students are given 3 classes, making then part-time. Each term should have 4 to 5 classes not more.
- I haven't thought about this
- Some mechanical engineering technical electives or general electives tied to this new program.
- Quite hefty course load.
- idk
- reorganize the schedule to avoid having a course sequence of 6 courses per semester. It is not realistically doable and the course load should be lighter.
- OR C-EDGE like Computer Engineering (1 Mandatory internship semester)
- Graduates from this program will probably be more responsible for taking decisions that impact the environment than anyone else. it is important to have an emphasis on sustainability in this program
- This program should share programming methodology (computer science) class as Electrical or Mechanical engineering. No need to separate programing class by degree, have multiple program share the sam

If you have any final comments or questions regarding the proposed Chemical Engineering undergraduate program, please share them below.

- The course sequence as presented in this survey is unbalanced, with Year 2 having 12 courses spread out over two semesters, while Year 4 having 9 courses. The courses can be more evenly distributed with the addition of a few summer semesters in order to make the sequence feel less overloaded, especially for Year 2.
- "Stop adding new departments to make more money, work on your already existing engineering departments and improve them, because the gina cody school of engineering is really a mess. Thank you"
- I know many people who would be very happy to hear that concordia might open this program. They had to go to polytechnique even though concordia was their first choice. Hopefully, this will happen!!! the course sequence is great
- it's quite interesting and I don't know why Concordia didn't have it.
- "Fluids 2 is a recommended class for Chem Eng.
  A new method of teaching should be developed that closely mimics the industry scenarios."
- If I was in a chemical engineering program at à another university prior to transferring, would the courses be credited to this program? If I were to transfer from my chemistry program (last year) what would be the process and would classes be credited towards the engineering program ?
- It seems like a fun program, but may be lacking some specialization courses
- "With this course outline proposition, I think I would have to get to semester 4 before having a good idea that I actually enjoy chemical engineer and want to pursue my career in that field.

  Another thing I think sucks, is that, in case a concentration change, the programming classes do not seem to be transferable to other engineering degrees, because they seem specifics to certain degrees only. An a SOEN student, I don't understand how these programming classes could be so based on chem eng to be non-transferable. Every engineering student should have the same programming courses, or at least their credits should be transferable to other programming courses for engineering."
- I think having the option to take some technical elective classes in chemical engineering within the existing engineering programs would be good idea, but I don't think it's good idea for undergraduate students to specialize only in chemical engineering because it would make them become to specialize in one field
- This program is great news for Gina Cody School of Engineering
- The capstone(4th year) is way too heavy. You should not be taking 5 classes with a capstone it is not manageable
- Concordia should focus on specializations (fields or research) that will be in high demand in the next 5-10 years. As climate change and the shift to non fossil fuel energy source will drive companies to develop more dense sources of energy(batteries) but also more efficient ways to extract energy (hydrogen fuel) as alternative ways to fossil fuels.
- Presonally, chemistry was never within my interests. On the other hand, I have a friend that would of liked going to Concordia, but it didn't offer Chemical Engineering. Hence, the demand is most likely present for this kind of program.
- It would be an asset to the university to propose Chemical Engineering as an option to their student body; particularly to encourage women into engineering.
- Is it possible to transfer from biochemistry to chemical engineering

- I would’ve definitely applied to this program if I had the option
- Depending on how many credits of the courses, 6 courses in one semester seems too much for a student. The workload seems a lot for the program
- Implement a process to evaluate continuous improvement as per CEAB accreditation. This is majorly lacking and CUFA still has not reinstated student course evaluations. If you care about students getting the most out of this degree, you need to actually listen to their opinions on the program. This is more important than ever with a potential new program.
- I think it is a good thing to have chemical engineering as an additional program, I feel like MECH321 should be a part of the course sequence and maybe include a specialization in materials engineering.
- This is a bad survey to send to Concordia engineering students since nobody in more physics and mathematical design based programs and are interested in organic sciences or biology (there is a reason they chose physics over chem and bio). The people who would be interested in this degree is are more likely to be found in the life sciences faculties so this survey should be sent to them instead.
- I would appreciate if engineering made the switch for other programs within the department with more equivalent courses
- I know someone that did not go to Concordia since it did not had this program
- Look into what McGill is offering already, as well as other universities.
- Record the classes and make them available on Moodle. Student have more time on their hands when listening to the recording in 1.5x or 2.0x speed.
- Interesting new Engineering branch
- Adding chemical engineering to the list of Ugrad studies will improve the interest of other prospects.
- I feel concordia should provide students with the option of Chemical Engineering. I think it is a good idea
- It may be my subjective opinion since chemical engineering is what I was looking to do for my masters I would definitely be switching to this program if it’s available
- i would really like to be a part of the chemical engineering undergraduate program. I was looking at going to mcgill to take party in their program, however since there might be a possibility of concordia having such a program i would transfer from chemistry to chemical engineering. i always planned on getting a bachelors in chemistry and then a masters in chemical engineering. this would save me a lot of time. i do hope concordia chooses to add the chemical engineering program.
- Very dissapointed that this program is only now being offered at Concordia, when materials engineering was started only a few years ago, and chemical engineering has been offered at McGill for years now. Had this program been offered at Concordia when I was enrolling, I would've for sure applied for it, as opposed to mechanical engineering, which was originally my second choice, and my first choice was chemical engineering at McGill, but I didn't have the R-score required to register for it. Now that I'm nearing the completion of my program in mechanical engineering, I am sorely dissapointed that my ideal program is only now being offered. Very sad, but I am happy nonetheless for the future generations who will now have that option that I so desperately wanted back then.
- Met a lot of Chemichal engineering graduates from top universities around the world. Such an interesting major. However, everyone I spoke to told me they had to do COOP training before graduation.

- It must be mix between chemistry and engineering so student who don't come from engineering programs can also apply for this course
- I was deeply split between pursuing mechanical engineering and biochemistry. I enjoy chemistry, and see value for chemical engineering in the agriculture and pharmaceutical industries. Of the available engineering branches available Mechanical was the best fit, but had chemical engineering been available that would have been my first choice.
- If students are interested in switching to this program, there should be an easy transition for transferring credits made.
- NEVER mention chemistry again. I didnt choose this career path to be reminded of chemistry. It goes against the point.
- I think it's a great idea to have a chemical engineering program. I personally would not be highly interested in it due to hating chemistry.
- Based on the description of the course sequence, in Year 2, students are expected to take 6 courses for each semester of that year. As an engineering student, this is too much work for one person as 5 courses is already a lot to get done.
- I'm not into chemical engineering, so this wouldn't be something that I would take. Also I'm almost done my mech undergraduate anyways. However, I still find it interesting and know that there are students that would take this and would like more hands on/coop stuff.
- The course sequence should be reconsidered to making it easier for the student, less overwhelming.
- Nice initiative
- It seems like an amazing idea. I am personally not a fan of chemistry, but I know of plenty of people who would have loved such a program.
- Nice
- This is a really interesting career path as someone who has interest in engineering and health. I think it's really nice to see different applications for this (sustainability, health, materials, process etc) and it has potential for growth.
- I know that McGill has a ChemEng Undergrade while Concordia only has grad studies. This program would need to be competitive with McGills program.
- I think having 6 courses in a semester will be too much for students maybe have at least 5 courses and add summer semesters like we all have in our sequences.
- Good Degree to add to Concordia.
- Very heavy degree. Especially towards the 3rd and 4 th years. It's insanely hard to do 4 classes plus a capstone project. Definitely would not recommend.
- Nice!
- Again, share the same programming classes as other engineering programs (Electrical, mechanical, industrial) would be better than to have separate programming class specific to chemical engineering. By putting different students toghether, it will be easier to administer the courses and will provide flexibility for both the faculty and the students.
- I have struggled at Concordia, but the chemical engineering program has been proposed since I stated studying at Concordia and I have always been interested in it. I hope to be able to pursue my studies in chemical engineering.
- I was considering applying to McGill for this program. I woul definitely switch into this program if it was availabe
- Great program idea.
- Great profs about chemical engineering with helping more on the field than taking anything theoretical

- I think the clean energy is the new trend of the future market, so if we can have more classes regarding clean energy, clean battery, battery recycles, and more project based courses regarding these topics, this program will be better.
- Would have loved to apply to this program if it were available at the time I started at Concordia. I think that adding another engineering discipline at GC is a great idea. If a certificate or something similar were available, I would be interested.

Summary of Student Interest Survey Results: Open Comment Section

The last question of the survey asked respondents to share some final comments or questions. Fifty-five respondents answered the question. Content analysis was conducted, which yielded the following themes and subthemes.

Explicitly supporting the proposed new program (32, 58%)

1. General support with no suggestions (13)
2. General support with some suggestions (6)
3. Personal interest in the new program (8)
4. Perceived interest by others they know (5)

Implying support for the proposed new program (18, 33%)

1. Implied support with suggestions (16)
2. Implied support with questions (2)

Not supporting the proposed new program (5, 9%)

1. No perceived need (2)
2. Curriculum related reasons (2)
3. Not aligned with personal interest (1)

As shown above, 58% of the respondents of this question enthusiastically expressed support for and interest in the proposed new program, 33% offered suggestions and asked questions indicating certain level of support and interest; and only 9% (5/55 respondents) were negative about the need for such a program.

Suggestions and questions put forward by the respondents mainly fall into the following four categories:

1. Course load (marked in yellow, 7)
2. Credit transfer (marked in green, 6)
3. Curriculum content and specialization (marked in blue, 4)
4. Teaching methods/pedagogy (marked in pink, 3)

Note that other suggestions that do not cluster and are not directly relevant to the new program design are NOT color coded and summarized here.

1. **Course load (7)**
   Comments in this category generally indicated that course load is too heavy for certain semesters (4th year capstone course along with 4 other courses; 6 courses per semester in year 2. Some suggested adding summer semesters to help distribute the load)
2. **Credit transfer (6)**
   Comments in this category generally indicated that switching to the new program should be made easy with transferrable credits. Two respondents specified that programming classes should be shared with other engineering programs to allow for

transferrable credits/equivalent courses rather than programming courses being program specific. Two other respondents asked questions about how credit transfer works.

3. **Curriculum content and specialization (4)**
   Comments in this category either pointed out lack of specialization or suggested some specializations (high demand areas in the next 5-10 years such as those related to better energy source, materials engineering)
4. **Teaching methods/pedagogy (3)**
   Comments in this category suggested some teaching approaches, i.e. using industry scenarios, professors bringing in practical experience rather than pure theoretical perspectives, recorded lectures.

With the inherent limitations of the survey (e.g. low response rate, surrogate target audience, etc.) in mind, the curriculum committee have studied the survey results and made some adjustments to the curriculum based on some of the comments deemed as pertinent and helpful.

Adjustments made:

- Added a note to CHME 215 that students who have taken COEN 243, COMP 248, MIAE 215, or MECH 215 cannot take this course to receive credit, and have added these other programming courses as prerequisites for CHME 216 (the next programming course in the sequence) to enhance flexibility for transferring students from other departments in GCS

Rationale for adjustments not made:

- MECH 321 Properties and Failure of Materials was not added to the sequence, as the material properties, failure modes, and materials selection are topics in CHME 220 in a chemical engineering context
- Year 2 course load has not been adjusted. The credit counts of courses were not listed in the course sequence given to students for the survey, if they had they would have noticed that the credit hours are comparable throughout years 1, 2, and 3. For students who do which to reduce their course load, they already have the flexibility to take several ENGR courses over summer semesters. In the co-op student path, which was not given to students, there are also summer offerings of a few CHME courses they may take to lighten their load.
- Year 4 course load has not been adjusted, as some comments said it looked to light and others to heavy there is no clear direction. It can be noted that the technical elective courses taken in this year can be rearranged freely by students to provide a lighter fall or winter semester as desired.

Original Comments Reorganized by Themes

Explicitly supporting the proposed new program (32, 58%)

1. General support with no suggestions (13)
    1) it's quite interesting and I don't know why Concordia didn't have it.
    2) This program is great news for Gina Cody School of Engineering
    3) Interesting new Engineering branch
    4) Adding chemical engineering to the list of Ugrad studies will improve the interest of other prospects.
    5) I feel concordia should provide students with the option of Chemical Engineering. I think it is a good idea
    6) Nice initiative
    7) Nice
    8) This is a really interesting career path as someone who has interest in engineering and health. I think it’s really nice to see different applications for this (sustainability, health, materials, process etc) and it has potential for growth.
    9) Good Degree to add to Concordia.
    10) Nice!
    11) Great program idea.
    12) It would be an asset to the university to propose Chemical Engineering as an option to their student body; particularly to encourage women into engineering.
    13) I think it's a great idea to have a chemical engineering program. I personally would not be highly interested in it due to hating chemistry.

2. General support with some suggestions (6)
    1) "Fluids 2 is a recommended class for Chem Eng. A new method of teaching should be developed that closely mimics the industry scenarios."
    2) It seems like a fun program, but may be lacking some specialization courses
    3) The capstone(4th year) is way too heavy. You should not be taking 5 classes with a capstone it is not manageable
    4) Concordia should focus on specializations (fields or research) that will be in high demand in the next 5-10 years. As climate change and the shift to non fossil fuel energy source will drive companies to develop more dense sources of energy(batteries) but also more efficient ways to extract energy (hydrogen fuel) as alternative ways to fossil fuels.
    5) Depending on how many credits of the courses, 6 courses in one semester seems too much for a student. The workload seems a lot for the program
    6) I think it is a good thing to have chemical engineering as an additional program, I feel like MECH321 should be a part of the course sequence and maybe include a specialization in materials engineering.

3. Personal interest in the new program (8)
    1) Very dissapointed that this program is only now being offered at Concordia, when materials engineering was started only a few years ago, and chemical engineering has

been offered at McGill for years now. Had this program been offered at Concordia when I was enrolling, I would've for sure applied for it, as opposed to mechanical engineering, which was originally my second choice, and my first choice was chemical engineering at McGill, but I didn't have the Rscore required to register for it. Now that I'm nearing the completion of my program in mechanical engineering, I am sorely dissapointed that my ideal program is only now being offered. Very sad, but I am happy nonetheless for the future generations who will now have that option that I so desperately wanted back then.

2) I was deeply split between pursuing mechanical engineering and biochemistry. I enjoy chemistry, and see value for chemical engineering in the agriculture and pharmaceutical industries. Of the available engineering branches available Mechanical was the best fit, but had chemical engineering been available that would have been my first choice.
3) I have struggled at Concordia, but the chemical engineering program has been proposed since I stated studying at Concordia and I have always been interested in it. I hope to be able to pursue my studies in chemical engineering.
4) I was considering applying to McGill for this program. I would definitely switch into this program if it was availabe
5) Would have loved to apply to this program if it were available at the time I started at Concordia. I think that adding another engineering discipline at GC is a great idea. If a certificate or something similar were available, I would be interested.
6) It may be my subjective opinion since chemical engineering is what I was looking to do for my masters I would definitely be switching to this program if it’s available
7) i would really like to be a part of the chemical engineering undergraduate program. I was looking at going to mcgill to take party in their program, however since there might be a possibility of concordia having such a program i would transfer from chemistry to chemical engineering. i always planned on getting a bachelors in chemistry and then a masters in chemical engineering. this would save me a lot of time. i do hope concordia chooses to add the chemical engineering program.
8) I would’ve definitely applied to this program if I had the option

4. Perceived interest by others they know (5)

1) I know someone that did not go to Concordia since it did not had this program
2) I'm not into chemical engineering, so this wouldn't be something that I would take. Also I'm almost done my mech undergraduate anyways. However, I still find it interesting and know that there are students that would take this and would like more hands on/coop stuff.
3) It seems like an amazing idea. I am personally not a fan of chemistry, but I know of plenty of people who would have loved such a program.
4) I know many people who would be very happy to hear that concordia might open this program. They had to go to polytechnique even though concordia was their first choice. Hopefully, this will happen!!! the course sequence is great
5) Presonally, chemistry was never within my interests. On the other hand, I have a friend that would of liked going to Concordia, but it didn’t offer Chemical Engineering. Hence, the demand is most likely present for this kind of program

Implying support for the proposed program **(18, 33%)**

1. Implied support with suggestions (16)
    1) Look into what McGill is offering already, as well as other universities.
    2) It must be mix between chemistry and engineering so student who don't come from engineering programs can also apply for this course
    3) If students are interested in switching to this program, there should be an easy transition for transferring credits made.
    4) Met a lot of Chemichal engineering graduates from top universities around the world. Such an interesting major. However, everyone I spoke to told me they had to do COOP training before graduation.
    5) Based on the description of the course sequence, in Year 2, students are expected to take 6 courses for each semester of that year. As an engineering student, this is too much work for one person as 5 courses is already a lot to get done.
    6) The course sequence should be reconsidered to making it easier for the student, less overwhelming.
    7) I think having 6 courses in a semester will be too much for students maybe have at least 5 courses and add summer semesters like we all have in our sequences.
    8) I think the clean energy is the new trend of the future market, so if we can have more classes regarding clean energy, clean battery, battery recycles, and more project based courses regarding these topics, this program will be better.
    9) The course sequence as presented in this survey is unbalanced, with Year 2 having 12 courses spread out over two semesters, while Year 4 having 9 courses. The courses can be more evenly distributed with the addition of a few summer semesters in order to make the sequence feel less overloaded, especially for Year 2.
    10) I know that McGill has a ChemEng Undergrade while Concordia only has grad studies. This program would need to be competitive with McGills program.
    11) Great profs about chemical engineering with helping more on the field than taking anything theoretical.
    12) Again, share the same programming classes as other engineering programs (Electrical, mechanical, industrial) would be better than to have separate programming class specific to chemical engineering. By putting different students toghether, it will be easier to administer the courses and will provide flexibility for both the faculty and the students.
    13) I would appreciate if engineering made the switch for other programs within the department with more equivalent courses.
    14) Record the classes and make them available on Moodle. Student have more time on their hands when listening to the recording in 1.5x or 2.0x speed.
    15) Implement a process to evaluate continuous improvement as per CEAB accreditation. This is majorly lacking and CUFA still has not reinstated student course evaluations. If you care about students getting the most out of this degree, you need to actually listen to their opinions on the program. This is more important than ever with a potential new program

16) This is a bad survey to send to Concordia engineering students since nobody in more physics and mathematical design based programs and are interested in organic sciences or biology (there is a reason they chose physics over chem and bio). The people who would be interested in this degree is are more likely to be found in the life sciences faculties so this survey should be sent to them instead.

2. Implied support with questions (2)

1) If I was in a chemical engineering program at à another university prior to transferring, would the courses be credited to this program? If I were to transfer from my chemistry program (last year) what would be the process and would classes be credited towards the engineering program ?
2) Is it possible to transfer from biochemistry to chemical engineering

Not Supporting the proposed new program (5, 9%)

1. No perceived need (2)

1) "Stop adding new departments to make more money, work on your already existing engineering departments and improve them, because the gina cody school of engineering is really a mess. Thank you"
2) I think having the option to take some technical elective classes in chemical engineering within the existing engineering programs would be good idea, but I don’t think it’s good idea for undergraduate students to specialize only in chemical engineering because it would make them become to specialize in one field

2. Curriculum related reasons (2)

1) Very heavy degree. Especially towards the 3rd and 4th years. It’s insanely hard to do 4 classes plus a capstone project. Definitely would not recommend.
2) "With this course outline proposition, I think I would have to get to semester 4 before having a good idea that I actually enjoy chemical engineer and want to pursue my career in that field. Another thing I think sucks, is that, in case a concentration change, the programming classes do not seem to be transferable to other engineering degrees, because they seem specifics to certain degrees only. An a SOEN student, I don't understand how these programming classes could be so based on chem eng to be non-transferable. Every engineering student should have the same programming courses, or at least their credits should be transferable to other programming courses for engineering."

3. Not aligned with personal interest (1)

1) NEVER mention chemistry again. I didnt choose this career path to be reminded of chemistry. It goes against the point.

Library Report
For the Proposed

Bachelor of Engineering in Chemical Engineering

Chloe Lei, Teaching & Research Librarian, Engineering & Computer Science

Created: June 15, 2022

Purpose

The purpose of this report is to assess the adequacy of available library resources to support the proposed *Bachelor of Engineering in Chemical Engineering* at Concordia University. The report identifies resources and funding required to support the program.

Summary

The Library cannot support the new program within the Library's current collections budget. Additional funds must be provided to increase the Library's annual collections non-capital budgets, as detailed below:

Non-capital (CAD)

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Library	$9,911	$10,208	$10,515	$10,830	$11,155	$11,490

This fund will support the ongoing acquisition of a critical database for standards.

Concordia programs and comparators

Currently the Faculty offers PhD, Master of Applied Science, Graduate Diploma, and Graduate Certificate in chemical engineering as well as mechanical engineering. In addition, the University offers undergraduate and graduate programs in Chemistry and Biochemistry.
The Steering Committee identified comparator programs at University of Calgary, University of Waterloo, and University of British Columbia. These universities' collection will be used as comparators throughout this report.

Collections Assessment

Monographs

Current Collection Growth

For the current fiscal year, 2022/2023, the budget allocation for Chemical and Materials Engineering is $8,900 ($3,600 annual allocation* and $5,300 new program development allocation**). For the previous three complete fiscal years, our budget allocations and monograph acquisitions have been as follows:

Year	Annual Allocation	Development Allocation	Monographs Acquired
2021-2022	$3,000	$4,400	23
2020-2021	$3,000	$7,500	40
2019-2020	$3,000	$4,100	19

*Annual allocation is the regular monograph budget appropriation.
**Development allocation is additional funding to support collection development for new programs, in this case the graduate programs in Chemical and Materials Engineering.

In addition to monographs acquired using the subject allocations specified above, the library also subscribes to or purchases a number of ebook packages with relevant content for chemical and materials engineering.These include:

- Taylor & Francis ebooks (CHEMICALENGINEERINGnetBASE collection and GENERALENGINEERINGnetBASE collection)
- Springer ebooks
- ScienceDirect ebooks
- Knovel ebooks
- Institution of Engineering and Technology (IET) ebooks
- Synthesis Digital Library of Engineering and Computer Science ebooks

A collection analysis was performed in 14 subject areas that fall within chemical engineering and materials science to determine the average percent growth in area in the past three years at Concordia and the comparator institutions.

	Concordia	Calgary	Waterloo	UBC
Annual percent growth (3 year average)	29.50%	27.99%	29.77%	29.14%

Recommendation

Concordia's annual collection growth is in line with the comparator institutions. The Library can adequately support this new program within its current budget allocation, including the development funding allocated to support the new graduate programs in chemical and materials engineering, which will continue for several more years.

Journals

Current collection

The Library has a substantial collection of electronic journals, which are usually acquired in packages, either from the publisher or an aggregator. These subscriptions, generally managed on a national or provincial level by the CRKN consortium of academic libraries or the BCI Sous-comité des bibliothèques in Quebec, include journals relevant to Chemical and Materials Engineering. They include:

- Elsevier (ScienceDirect)
- American Chemical Society (ACS)
- Royal Society of Chemistry (RSC)
- American Physical Society (APS)
- American Society of Mechanical Engineers (ASME Digital Collection)
- Sage
- Springer
- Taylor & Francis
- Wiley-Blackwell

The Library also subscribes directly to some important journals not included in these packages. Currently the Library directly subscribes to 12 additional titles under American Institute of Physics (AIP), relevant to *Bachelor of Engineering in Chemical Engineering*.

Needs assessment

A core list of 37 journals in chemical engineering and materials science was compiled and compared to Concordia's current holdings. Those titles where Concordia had no access or where there was an embargo on current access, were prioritized as either high, medium or low priorities. There were 3 titles to which Concordia either has no access or an embargo on current access, and none were deemed to be high priority.

Recommendation

The Library's current journal subscriptions and packages are adequate for the needs of the proposed program.

Databases

Current collection

The Library has many subscriptions to electronic databases and indexes. Those most relevant to Chemical and Materials Engineering include:

- *Compendex*: A bibliographic database covering the engineering research literature since 1884.
- *Knovel*: A platform for engineering technical references, including interactive features for material property data and math equations.
- *SciFinder*: A comprehensive database for chemical literature by Checmial Abastracts Service since 1800s.
- *Reaxys*: A chemistry database consisting of compounds and related factual properties, reaction and synthesis information as well as bibliographic data.
- *CHEMnetBASE*: A database of 11 core, authoritative chemistry handbooks by CRC Press.
- *ASM Handbooks Online*: Complete content of twenty-four ASM (American Society for Metals) Handbook volumes plus two ASM Desk Editions.
- *JoVE Ultimate*: Complete access to Journal of Visualized Experiments (JoVE), which is a peer-reviewed journal of experiments in video format.
- *Web of Science*: This multidisciplinary database covers the journal literature of the sciences through the Science Citation Index, which includes the fields of science and engineering.
- *Scopus*: This multidisciplinary database has over 19,000 titles from more than 5,000 international publishers, including journals and conference proceedings in science and technology.

Needs assessment

A review of chemical and materials engineering databases available at the University of Calgary, University of Waterloo, and University of British Columbia was completed. There were 10 databases available at other institutions that are not available at Concordia. Of those, 2 are available at all comparator institutions, while 8 are held by only 1 or 2 of the comparators. The 2 databases available at all comparator institutions but not at Concordia University are *ASTM Compass* and *OnePetro*.

Recommendation

The database *ASTM Compass* is relevant to the proposed program, therefore a new subscription is recommended for:

- ASTM Compass (Standards only): $9,956 CAD non-capital annual cost with 3% anticipated increase each year.

  Online access to all standards by ASTM (American Society for Testing and Materials). The library currently has a standing order of the print version *Annual Book of ASTM Standards* every 5 years. The online subscription will provide the most up-to-date version of the standards and will greatly improve the ease of access. ASTM standards are relevant to many courses in the proposed program.

The above quotes are confidential and tailored to Concordia. These acquisitions represent annual expenditures. The non-capital budget increase needed to acquire 1 recommended database is $9,956 with an anticipated 3% increase each year.

Collections Recommendation Summary

The Library cannot support the new program within the Library's current collections budget. Additional funds must be provided to increase the Library's annual collections non-capital budgets. Typically, library materials such as monographs and journals backfiles are capital expenses; databases and journal with no perpetual access are non-capital. They have been individually identified in the appropriate sections above and are aggregated in the table below.

Non-capital

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Monographs	$0	$0	$0	$0	$0	$0
Journals	$0	$0	$0	$0	$0	$0
Databases	$ 7,683	$7,913	$8,151	$8,395	$8,647	$8,907
Total in USD	$ 7,683	$7,913	$8,151	$8,395	$8,647	$8,907
Total in CAD with conversion factor 1:1.29	$9,911	$10,208	$10,515	$10,830	$11,155	$11,490

Additional Library services

All university libraries in Quebec use the same shared service platform called Sofia, which allows students and faculty from all Quebec university libraries to search, access, request and borrow items from the collections of the 18 partner institutions.

The interlibrary loan service, also integrated in Sofia, provides students and faculty with the ability to request materials that are not available in the Concordia Library collection, including electronic delivery of journal articles.

Academic Support

The subject librarian is available to conduct course-specific library workshops, as requested by faculty, and provides help with library research on an individual basis for all students and faculty in the Department. A team of professional librarians and trained staff help Concordia students and faculty with their basic information and research questions at the Ask Us Desks, as well as via email and chat.

Conclusion

A careful assessment was made of the library's current monograph holdings and journal subscriptions to determine the adequacy of available library resources to support the proposed Bachelor of Engineering in Chemical Engineering at Concordia University. It was determined that the Library cannot support the new program within the Library's current collections budget. In order to properly support Bachelor of Engineering in Chemical Engineering, additional funds must be provided over six years to increase the Library's annual collections non-capital budgets:

Non-capital (CAD)

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Library	$9,911	$10,208	$10,515	$10,830	$11,155	$11,490

Appendix 4: Letters of Support

Please find letters of support in the following pages.

ASSOCIATION POUR LE DÉVELOPPEMENT
ET L'INNOVATION EN CHIMIE AU QUÉBEC

Boucherville, le 3 août 2022

Objet : Appui à la création d'un programme bachelier d'ingénierie chimique

Madame ou Monsieur,

Notre organisation, l'Association pour le développement et l'innovation en chimie au Québec (ADICQ), située en Montérégie, à l'adresse suivante 1271 rue Ampère, Boucherville, Québec, J4B 5Z5, Canada, est heureuse de vous confirmer son soutien au projet de création d'un programme bachelier d'ingénierie chimique de l'Université Concordia.

L'ADICQ regroupe plus de 120 entreprises membres dans le secteur de la chimie au Québec. Notre mission est de soutenir le développement économique, mais également le développement de l'industrie chimique par les biais de l'éducation, la formation, le perfectionnement professionnel et l'innovation dans notre secteur.

Nous savons que l'Université Concordia offre un programme de maîtrise et un programme de doctorat en chimie qui sont essentiels à l'essor de notre secteur au Québec, secteur stratégique et fondamental pour le Québec. L'ADICQ reconnait la portée d'un programme bachelier d'ingénierie chimique non seulement pour capaciter des individus, mais apporter des connaissances et des ressources à toute l'industrie incluant nos entreprises membres.

Nous vous remercions de l'attention que vous portez à notre demande et nous demeurons à votre entière disposition, avec l'espoir que le projet se concrétise et le souhait de collaborer avec l'Université Concordia,

Esteban Bongiovanni

Directeur général, Association pour le développement et l'innovation en chimie au Québec (ADICQ)
1271 rue Ampère, Boucherville, Québec, J4B 5Z5, Canada, 438 863-1711
direction@adicq.qc.ca

Université Concordia University
GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE
Department of Mechanical,
Industrial & Aerospace Engineering

January 17th 2023

Letter of support for the creation of a Bachelor of Engineering: Chemical Engineering

To whom it may concern
I am writing this letter in support of proposal of the Department of Chemical and Materials Engineering (CME) to create a Bachelor of Engineering in the field of Chemical Engineering. As I was a Department Chair in GCS when this new Department was created in 2017 and was also involved in the hiring of its current Chair and several of its initial faculty members, I can say that I am very pleased to see this proposal for a B.Eng. in Chemical Engineering coming forward. At the time of CME's inception, we clearly had in our mind that one of the principal objectives of the CME Department would be an undergraduate program in Chemical Engineering. It is well known in engineering that the Chemical and Materials disciplines have some of the highest proportions of women students compared to the traditional engineering disciplines such as mechanical, civil and electrical. This was seen as a very positive step forward for us in trying to increase the ratio of women students in the Faculty.

Chemical engineering is one of the core engineering disciplines and one that Concordia has been missing. The graduate programs have already been approved and are up and running so I believe it is time for the undergraduate program to be started. There is now a critical mass of professors in the Department, and this will bode well when it is time to seek accreditation from the Canadian Engineering Accreditation Board on behalf of *Engineers Canada*, a critical component in offering a successful engineering undergraduate program in Canada.

I believe that the CME Department, in large part through the leadership of the Department Chair, Dr. Alex De Visscher, has made a very intelligent decision in focusing the proposed program to aspects of sustainability such as battery technology, CO_2 capture and use, recycling and environmental impact etc. It has been difficult for established Chemical Engineering programs to redirect their programs in these essential directions due to traditional approaches and inertia and any changes tend to be piecemeal add-ons. The ability to start a fresh program with a focus on looking forward to solving the current and upcoming problems is a major advantage for this program and my own opinion is that this will make the proposed program very attractive to potential engineering students looking for a meaningful degree where they will get a real education for the real world and one that is focused on engineering the future not mired in the past. This program will be created with sustainability and the environment and society strongly front and centre.

The Gina Cody School of Engineering and Computer Science is already host to eight engineering programs which have all received maximum accreditation. The School has the experience to support the process of accreditation for this new program which is a major advantage in establishing a new engineering program.

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There are approximately 30 credits of common engineering courses taken by students in all eight of the current engineering B.Eng. programs and it is likely that many of these would also be taken by the Chemical Engineering students which reduces the number of new courses needed.

I see that undergraduate laboratory space has also been developed which will allow for the development of hands-on practical experience for the students. Whilst this new program may draw a few students away from the current eight engineering programs, I feel that this program will attract many students who were not considering Concordia at all because of this lack of a program in Chemical Engineering, especially one with such an emphasis on sustainability.

The proposed program lists 2 courses in the MIAE Department:

MIAE
MIAE 221 Materials Science (Core)
MECH 472 Mechatronics and Automation (Elective)

The MIAE 221 course is a first-year course, and five sections are typically offered each year depending on enrolments and adding the Chem. Eng. students will be straightforward. The MECH 472 course is a technical elective, and we can absorb the projected number of Chem. Eng. students expected to take this elective.

In summary I believe this program would be a very positive addition to the Faculty and to Concordia and to society and it has my full support.

Yours sincerely

Martin Pugh, PhD, PEO, FCSME
Chairman and Professor, Department of Mechanical, Industrial & Aerospace Engineering
Concordia University

Concordia University
GINA CODY SCHOOL OF ENGINEERING AND COMPUTER SCIENCE
Department of Computer Science & Software Engineering

January 31, 2023

Sandra Gabriele
Chair, Academic Programs Committee

Dear Sandra:

The Department of Chemical and Materials Engineering has discussed with me their proposal to offer a B. Eng. in Chemical Engineering. I understand that they plan to list the following courses from my department as electives:

CSSE
COMP 333 Data Analytics
SOEN 363 Data Systems for Software Engineers
COMP 433 Introduction to Deep Learning
COMP 473 Pattern Recognition
COMP 474 Intelligent Systems
COMP 479 Information Retrieval and Web Search

On the basis of the projected enrollment in the planned B. Eng in Chemical Engineering, I have been told that 3-4 students from CME would be expected to enroll in each of these electives, at least for the next several years. While these courses are in high demand for our own students, we will be able to reserve a few seats for B. Eng. Chemical Engineering students.

As such, on behalf of the Department of Computer Science and Software Engineering, I support the proposal for the B. Eng. in Chemical Engineering.

Lata Narayanan

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UNIVERSITÉ Concordia UNIVERSITY
GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE
Department of Building, Civil
& Environmental Engineering

January 31, 2023

Letter of support for the creation of a Bachelor of Engineering: Chemical Engineering

To whom it may concern

I am glad to write this letter in support of the proposal of the Department of Chemical and Materials Engineering (CME) to create a Bachelor of Engineering (B. Eng.) program in the field of Chemical Engineering. When the department was created, one of its major goals was to create an undergraduate program in Chemical Engineering. As there is a synergy between the programs and courses in the Department of Building, Civil and Environmental Engineering (BCEE) with the proposed undergraduate program of CME, I am particularly enthusiastic about this program. Another positive aspect of the proposed program is that Chemical and Materials disciplines are expected to attract many women students compared to other traditional engineering disciplines such as mechanical, civil and electrical engineering. This has a potential to increase the ratio of women students in engineering.

Creation of the Chemical and Materials Engineering department at Concordia has been quite significant as it fills the gap in faculty and complements other existing engineering disciplines. While CME's graduate programs were already approved and implemented, the undergraduate program would provide the ability of the department to create new engineers in the domain and train them with the knowledge and tools needed to solve modern day chemical engineering problems. The department has successfully hired many high-quality faculty members since its inception, providing a significant momentum to its capacity-building effort, and generating a critical mass. This is important for the proposed program when it is time to seek accreditation from the Canadian Engineering Accreditation Board on behalf of *Engineers Canada*.

The Department Chair, Dr. Alex De Visscher has been very proactively leading the department to identify the priority areas and shaped the proposed program to train the next generation of chemical engineers in aspects of sustainability, green processes, CO_2 capture and use, adress environmental impact etc. Therefore, the goals and structure of the proposed program do not follow the traditional chemical engineering programs, rather it aims to address the emerging needs of the society such as battery technologies, sustainable and green chemical processes,

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recycle and reduce waste etc. This is expected to prepare the chemical engineering students for the current problems of the real world and help the society in a more meaningful way as compared to the traditional programs in that domain.

The proposed program lists 3 courses from the BCEE department:

- CIVI 465 - Water Pollution and Control,
- CIVI 467 Air Pollution and Emission Control,
- CIVI 468 Waste Management.

These courses are offered regularly and the capacity will be adjusted to accommodate the students from the proposed program who are expected to take these elective courses.

In conclusion, the proposed program provides complementarity to other existing programs in the faculty and provides a new direction in the undergraduate education in chemical engineering. I expect the proposed program to be very successful and popular. I am highly supportive of the program.

Yours sincerely,

Ashutosh Bagchi, Ph.D., P.Eng. (ON), FCSCE
Professor & Chair
Department of Building, Civil & Environmental Engineering
Gina Cody School of Engineering and Computer Science,
Concordia University
1455 de Maisonneuve Blvd West, EV 6.139, QC, H3G 1M8, Montreal, Canada.

Université Concordia University

FACULTY OF ARTS AND SCIENCE

Department of Biology

To: Dr. Alex De Visscher, Chair, Department of Chemical and Materials Engineering

From: Selvadurai Dayanandan,, Chair, Biology Department

Subject: Letter of support – BEng in Chemical Engineering

Date: January 30, 2023

I strongly support the Bachelor of Engineering in Chemical Engineering program proposed by the Department of Chemical and Materials Engineering. The proposed program includes BIOL371 (Microbiology) as an elective. The students taking BIOL371 are required to take 6 credits from BIOL226, BIOL261 or CHEM 271 as pre-requisites.

The Biology Department agrees to allow students in the BEng in Chemical Engineering to take BIOL371 as an elective, and there is sufficient capacity to accommodate these students in BIOL courses.

Sincerely,

Selvadurai Dayanandan
Professor and Chair – Biology Department

7141 Sherbrooke St. W., Montreal, Quebec H4B 1R6
Tel. 514-848-2424 ext. 3400 Fax: 514-848-2881 concordia.ca

Concordia University / Université Concordia

To: Dr. Melanie Hazlett, Assistant Professor, Department of Chemical and Materials Engineering, Gina Cody School of Engineering and Computer Science

Date: September 14th, 2022

Object: Letter of support for the addition work-integrated options BEng program in Chemical Engineering

It is with great pleasure that I write this letter to support for the proposed addition of work-integrated options for the new BEng program in Chemical Engineering at the Gina Cody School of Engineering and Computer Science. These new options of Co-op, Career Edge (C. Edge), and Accelerated Career Experience (ACE) will be for the Undergraduate program in Chemical Engineering and will be administered by the Institute of Co-operative Education.

The Institute for Co-operative Education will coordinate with the department to promote and manage the internships to achieve the experiential goals of the faculty and the university.

Please feel free to contact me if you have any questions.

Kindest regards,

Cherine Zananiri

Director
Experiential Learning & Co-operative Education
1550 De Maisonneuve Blvd. West, Suite 430
T 514-848-2424 x 3951 C 514-825-6152

To Concordia University Provost Office

With this letter I am expressing strong support for the proposal to establish undergraduate program (BEng) in Chemical Engineering at Concordia.

Establishing this program has been planned since the beginnings of the Department of Chemical and Materials Engineering, and, as the LOI demonstrates, by now CME accumulated critical mass of faculty members sufficient to run a vibrant undergraduate program. There also appears to be space for more high-quality Chemical Engineers on the job market, particularly in Quebec. The LOI also addresses the issue of how these graduates will find their distinct niche, particularly in the fields related to sustainability.

Throughout the years, Physics had a number of formal and informal collaborations with CME. These include participating in cross-faculty Masters program in Nanoscience and Nanotechnology and a joint CRC hire in Nanomaterials for Sustainable Energy. Physics is a highly interdisciplinary department these days and some of our graduate students have chemical engineering background. Thus, proposed BEng program could produce local candidates not only for graduate programs in Engineering, but in Physics as well.

Physics has been offering service courses (PHYS 204+224, 205+225, 206+226) to Engineering students, particularly those who have not attended CEGEPs in Quebec, for years. In fact, Engineering students are the largest cohort in these courses. Some Physics electives (E&M, Optics) are also fairly popular among Engineering students. Given the moderate proposed size of the Chemical Engineering BEng program, we believe we could relatively easily accommodate some additional students, and will be happy to do so. These students could in turn bring some interesting perspectives to our classes.

Summarizing, I believe numerous departments of Gina Cody School of Engineering and Arts and Science, including Physics, Concordia university in general, Quebec and Canada will benefit significantly from the launch of BEng in Chemical Engineering at Concordia..

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With best regards,
Valter Zazubovits

August 4, 2022

Professor and Chair,
Department of Physics
Concordia University
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Montreal QC H4B 1R6
Phone: (514) 848-2424 ext 5050
E-mail: valter.zazubovits@concordia.ca
http://www.concordia.ca/artsci/physics/faculty.html?fpid=valter-zazubovits

MEMO

To: Dr Alex De Visscher, Chair, Department of Chemical and Materials Engineering

From: Dr Paul Joyce, Chair, Department of Chemistry and Biochemistry

Date: 03 February 2023

Re: BEng Chemical Engineering

I am writing to express the support of the Department of Chemistry and Biochemistry for the proposed new BEng in Chemical Engineering. That the new program will incorporate principles of sustainability and the reduction of environmental impact into its curriculum is important in the development of our next generation of engineers and will attract students who share the mindset of using engineering to solve these pressing challenges in our world. From the perspective of our department, it is exciting to note that the program is geared toward engineering and applied chemistry. This will help to develop a continuum ranging from biology to biochemistry to chemistry to chemical engineering bringing together theory and practice so that students can see the big picture and how to go from idea to implementation. I look forward to continued discussions as to how Chemistry and Biochemistry can contribute practically to this important new program, *e.g.*, through input into course development or through specific course offerings.

Given the overlap and intersections between the research interests in Chemical and Materials Engineering and those in Chemistry and Biochemistry, graduates of the BEng Chemical Engineering program represent a pool of students who may be interested in graduate study in Chemistry and Biochemistry, particularly in the case for our MSc/MASc in Nanoscience and Nanotechnology program. I look forward to collaborations that may result and know that having Chemistry students interacting with Chemical Engineering students will be to the advantage of both groups.

Specifically, adding courses such as CHEM 271 *Biochemistry*, CHEM 447 *Solar Energy Conversion*, CHEM 327 or 427 on polymer chemistry, CHEM 431 *Computational Chemistry for Chemists and Biochemists*, and Chem 498 *Organic Semiconductors* to your program as electives makes perfect sense given the synergy that could develop in these areas. There should be no issues in finding spaces for your students in these courses, but I should note that we do not offer these courses every year as, except for CHEM 271, they are not degree requirements in our programs. We typically offer them in rotation with other courses.

I also agree that adding CHEM 221 *Organic Chemistry* as a core foundational course in your program is an excellent idea. This course is a required course in all of our Chemistry and Biochemistry programs as well as in many Biology and Psychology programs, so we already offer a large number of sections of

CHEM 221 in the Fall and Winter terms. I anticipate that finding space for your students will require adding more lab sections, but we can work on those details as we move closer to implementation. We should initiate this conversation sooner rather than later though, as there will be significant resource implications (*e.g*., technical support, TAs, materials and supplies, etc.).

In summary, I support this new program which will strengthen the university's undergraduate course offerings and also should have the spinoff effects of increasing interdepartmental interactions, research and graduate study. I look forward to ongoing discussions regarding scheduling issues and securing the necessary resources to offer these courses to the students in your exciting new program.

Yours sincerely,

Paul Joyce

Université Concordia University

FACULTY OF ENGINEERING AND COMPUTER SCIENCE

Office of the Dean

October 24, 2017

School of Graduate Studies Graduate Curriculum Committee
School of Graduate Studies
GM 930.01

Dear Colleagues,

We write in support of the proposal for establishing graduate programs (Certificate, Diploma, MASc, and PhD) in Chemical Engineering in the recently created Department of Chemical and Materials Engineering.

The proposal is well aligned with the Faculty's strategic planning, touching on many of our strategic directions, especially our commitment to two important ENCS strategic imperatives, namely Enhancing Research Quality and Reputation, and Enhancing Through Innovation in Academic Programs. The proposal being brought forward also demonstrates our commitment to a third Faculty strategic imperative, Embracing Integration across Engineering, Arts, Science, and Business – Dr. De Visscher and his team have worked closely with colleagues in the Faculty of Arts and Science, in particular Dr. Christine De Wolf (Department of Chemistry and Biochemistry) and Dr. Paul Joyce (Associate Dean, Faculty of Arts and Science). Being interdisciplinary and involving faculty members working in physical sciences and engineering, the proposed programs are sufficiently different from existing graduate programs in chemical engineering offered elsewhere in Quebec. In addition, the proposed programs are modular in structure and offer flexibility to the students, allowing for several exit and entry points.

The institutional commitment to the programs is firm at both the Faculty and the University level. Since its establishment in May 01, 2017, three tenure-track/tenured faculty members have been hired in the Department of Chemical and Materials Engineering with one open position advertised in the 2017/18 hiring cycle. The University is committed to hiring two new faculty members in the Department in the 2018/19 hiring cycle and up to two faculty in 2019/20. Renovations for creating research and wet lab space have started in the Hall building. More space would be made available in the extension to the Science and Engineering Pavilion at the Loyola campus.

Interim Chair De Visscher and his team have shown true leadership and vision in proposing these innovative graduate programs, and we are pleased to offer our full support.

Sincerely,

Amir Asif, PhD, PEng
Dean, Engineering and Computer Science

Graham Carr, PhD
Provost and Vice-President, Academic Affairs

1455 De Maisonneuve Blvd. W., EV 2.139, Montreal, Quebec, Canada H3G 1M8
Tel. 514-848-2424 ext. 3109 Fax 514-848-4509 encs.concordia.ca

Appendix 5: Accreditation Unit Calculations per course for Engineering Core, Chemical Engineering Core, and General Studies Elective

Course Code	Course Title	Lecture	Tutorial or Lab	Total AUs	Mathematics	Natural Science	Complementary Studies	Engineering Science	Engineering Design
ENCS 282	Technical Writing and Communication	3	2	48			48.0		
ENGR 201	Professional Practice and Responsibility	1.5	0.5	21			21.0		
ENGR 202	Sustainable Development and Environmental Stewardship	1.5		18			11.7	6.3	
ENGR 213	Applied Ordinary Differential Equations	3	2	48	48.0				
ENGR 233	Applied Advanced Calculus	3	2	48	48.0				
ENGR 245	Mechanical Analysis	3	1	42		23.3		18.7	
ENGR 251	Thermodynamics I	3	2	48		14.8		33.2	
ENGR 301	Eng Management Principles & Economics	3	1	42			42.0		
ENGR 311	Transform Calculus and Partial Differential Equations	3	2	48	48.0				
ENGR 361	Fluid Mechanics	3	1	42		12.8		29.2	
ENGR 371	Probability and Statistics in Engineering	3	1	42	28.0			14.0	
ENGR 391	Numerical Methods in Engineering	3	1	42	29.2			12.8	
ENGR 392	Impact of Technology on Society	3		36			36.0		
CHME 215	Programming for Chemical and Materials Engineers	3	2	48				48.0	
MIAE 221	Materials science	3	1	42		31.5		10.5	
CHEM 221	Organic Chemistry	3	1	42		42.0			
CHME 216	Advanced Programming for Chemical Engineers	3	2	48				48.0	
CHME 220	Material Properties and Chemical Characterization	3	2	48		32.0		16.0	
CHME 351	Chemical Engineering Thermodynamics	3	1	42		8.4		21.0	12.6

Course Code	Course Title	Lecture	Tutorial or Lab	Total AUs	Mathematics	Natural Science	Complementary Studies	Engineering Science	Engineering Design
CHME 200	Introduction to Chemical Process Engineering	3	2	48				28.8	19.2
CHME 201	Innovative, Sustainable, and Safe Manufacturing in Chemical Industry	3	1	42			8.4	21.0	12.6
CHME 240	Chemical Engineering Lab I	0	3	18				18.0	
CHME 300	Industrial and Engineering Chemistry	3	1	42				31.5	10.5
CHME 320	Technical and Advanced Materials	3	1	42				28.0	14.0
CHME 352	Energy Conversion and Storage	3	1	42				28.0	14.0
CHME 360	Heat transfer	3	1	42				28.0	14.0
CHME 321	Chemical and Materials Product design	3	1	42					42.0
CHME 361	Mass transfer and Unit Operations	3	1	42				28.0	14.0
CHME 301	Chemical Reaction Engineering	3	2	48				32.0	16.0
CHME 330	Chemical Process Dynamics and Control	3	1	42				28.0	14.0
CHME 340	Chemical Engineering Lab II	0	3	18				18.0	
CHME 362	Chemical Separations Engineering	3	1	42				28.0	14.0
CHME 390	Design Project	3	2	48					48.0
CHME 316	Advanced Data Analysis and Machine Learning for Chemical Engineers	3	2	48	12.0			36.0	
CHME 415	Computational Modelling for Chemical Engineers	3	2	48		24.0		24.0	
CHME 440	Chemical Engineering Lab III	0	3	18				9.0	9.0
CHME 490	Capstone Fall	1	4	36					36.0
CHME 490	Capstone Winter	1	4	36					36.0
XXXX XXX	General Studies Elective	3	1	36			36.0		
	BEng Total AUs			1581	213.2	209.1	209.1	644.0	325.9
	BEng AUs + CEGEP AUs			1917	325.2	300.8	321.1	644.0	325.9

Gina Cody School of Engineering
BEng Chemical Engineering

Program Financial Viability

REVENUE	Year 0 Start-Up	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Tuition Fee							
Tuition (FTE)		$ 139,850	$ 335,640	$ 581,776	$ 873,223	$ 1,043,770	$ 2,974,260
Grants							
Teaching Grant (WFTE)		$ 410,130	$ 984,312	$ 1,706,141	$ 2,560,852	$ 3,061,005	$ 8,722,440
Support Grant (FTE)		$ 119,300	$ 286,320	$ 496,288	$ 744,909	$ 890,396	$ 2,537,213
Total grants		$ 529,430	$ 1,270,632	$ 2,202,429	$ 3,305,761	$ 3,951,401	$ 11,259,653
Additionnal Funding External	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Revenue	**$ -**	**$ 669,280**	**$ 1,606,272**	**$ 2,784,205**	**$ 4,178,984**	**$ 4,995,171**	**$ 14,233,912**

EXPENSES	Year 0 Start-Up	Year 1	Year 2	Year 3	Year 4	Year 5	Total
TEACHING							
Tenure Track	$ -	$ -	$ 149,034	$ 298,068	$ 298,068	$ 298,068	$ 1,043,238
Extended Term Contrats	$ -	$ 119,985	$ 119,985	$ 119,985	$ 119,985	$ 119,985	$ 599,925
Limited Term Contracts	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Lecturers	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Course remissions	$ 6,250	$ 37,500	$ 37,500	$ 37,500	$ 37,500	$ 37,500	$ 193,750
Technical support	$ -	$ 108,754	$ 217,508	$ 217,508	$ 217,508	$ 217,508	$ 978,784
Part Time Contracts	$ -	$ 200,000	$ 312,500	$ 450,000	$ 450,000	$ 450,000	$ 1,862,500
Teacher's Assistants	$ -	$ 39,150	$ 78,300	$ 117,450	$ 156,600	$ 156,600	$ 548,100
Stipends	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other	$ -	$ -	$ -	$ -	$ -	$ -	$ -
ADMIN STAFF							
Administrative Staff	$ 75,580	$ 151,160	$ 151,160	$ 151,160	$ 151,160	$ 151,160	$ 831,382
Total Payroll	**$ 81,830**	**$ 656,549**	**$ 1,065,987**	**$ 1,391,671**	**$ 1,430,821**	**$ 1,430,821**	**$ 6,057,679**
OTHER EXPENSES							
Total Other Expenses	**$ 2,386,738**	**$ 155,000**	**$ 155,000**	**$ 155,000**	**$ 155,000**	**$ 155,000**	**$ 3,161,738**
Total Expenses	**$ 2,468,568**	**$ 811,549**	**$ 1,220,987**	**$ 1,546,671**	**$ 1,585,821**	**$ 1,585,821**	**$ 9,219,417**
CONCORDIA UNIVERSITY SURPLUS / (DEFICIT)	**$ (2,468,568)**	**$ (142,269)**	**$ 385,285**	**$ 1,237,534**	**$ 2,593,163**	**$ 3,409,350**	**$ 5,014,495**

US-2023-1-D6

SENATE
OPEN SESSION
Meeting of February 17, 2023

AGENDA ITEM: Institutional Research Data Management Strategy

ACTION REQUIRED: For approval

SUMMARY: Senate is being asked to approve and adopt the Institutional Research Data Management Strategy.

BACKGROUND: In 2016, the Canadian Institutes of Health Research, the Natural Sciences and Engineering Research Council of Canada, and the Social Sciences and Humanities Research Council of Canada, together (the "Tri-Agency"), published a Statement of Principles on Digital Data Management which outlines their expectations in achieving excellence in data management practices. The statement defines the roles and responsibilities of researchers, research communities, institutions, and funders in attaining these expectations through activities such as data management planning, adherence to standards, appropriate collection and storage of research data, metadata creation, preservation, and data citation.

In 2021, the Tri-Agency published a Research Data Management Policy (the "Policy") with the objective to support Canadian research excellence by promoting sound research data management and data stewardship practice. Pursuant to the Policy, each institution administering Tri-Agency funds is required to create an institutional research data management strategy by March 1, 2023, which will outline how institutions will develop awareness of and support for exemplary data management practices.

Concordia University put into place a research data management team, which included representation from the University Library, Record Management and Archives, the Office of Research, IITS among others. The team undertook University wide consultations and sought feedback from various bodies and committees, including the Associate Deans of Research, the University Research Committee, and the Senate Research Committee. The strategy is further detailed in the attached documentation.

DRAFT MOTION: The Senate approve and adopt the Institutional Research Data Management Strategy, as detailed in the attached document and accompanying presentation.

PREPARED BY:

Name: Karan Singh
Date: February 13, 2023

Institutional Research Data Management Strategy

Author: Concordia University Research Data Management Project Team

Date: January 16, 2021

Version: 0.9

Contents

Background

In 2016, the Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Research Council of Canada (NSERC), and the Social Sciences and Humanities Research Council of Canada (SSHRC), hereafter known as the Tri-Agency, published a Statement of Principles on Digital Data Management[1]. which outlines their expectations in achieving excellence in data management practices. The Statement defines the roles and responsibilities of researchers, research communities, institutions, and funders in attaining these expectations through activities such as data management planning, adherence to standards, appropriate collection and storage of research data, metadata creation, preservation, and data citation.

In 2021, the Tri-Agency published a Research Data Management policy with the objective to "support Canadian research excellence by promoting sound [Research Data Management] and data stewardship practices."[2] The policy is divided into three pillars:

1. **Institutional strategy**: The policy requires each institution administering Tri-Agency funds to create an institutional research data management strategy by March 1, 2023, that outlines how institutions will develop awareness of and support for exemplary data management practices.
2. **Data management plans**: Refers to the preparation of a formal document outlining how data will be managed throughout the life of a research project and after its conclusion. These plans will be required for an initial set of funding opportunities to be identified by the Tri-Agency in the spring of 2022.
3. **Data deposits**: Refers to the transfer of research data, collected as part of a research project, into a research data repository. Data deposits will be phased in only after the Tri-Agency reviews each institution's RDM strategy and assesses the Canadian research community's readiness. At no time will researchers be required to share their data. However, the Tri-Agency anticipates that researchers will provide appropriate access to their research data when ethical, cultural, legal and commercial obligations allow. Note that data should be "as open as possible and as closed as necessary"[3]: "open" in order to promote data reuse and to advance research, but "closed" to protect the privacy of research participants.

[1] Government of Canada. (2016). *Tri-Agency statement of principles on digital data management*. Retrieved November 9, 2020 from http://www.science.gc.ca/eic/site/063.nsf/eng/h_83F7624E.html

[2] Government of Canada. (2021). *Tri-Agency Research Data Management Policy*. Retrieved March 15, 2021 from http://www.science.gc.ca/eic/site/063.nsf/eng/h_97610.html

[3] European Directorate (2016) *H2020 Programme Guidelines on FAIR Data Management in Horizon 2020*. Retrieved October 19, 2021 from https://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-data-mgt_en.pdf

Importance of Research Data and Research Data Management

Research data are data used as primary sources to support research, scholarship, or creative practices. What counts as relevant research data varies among and across disciplines, areas of research, and modes of inquiry.

Properly managed research data is the cornerstone of high-quality research outputs. It allows researchers to better organize, store, access, reuse and build upon their research. It is at the heart of making data FAIR[4] (findable, accessible, interoperable and reusable) which is a "key conduit leading to knowledge discovery and innovation, and to subsequent data and knowledge integration and reuse"[5]. It allows researchers to effectively comply with the growing number of research data management policies from granting agencies and editors. And crucially, it fosters reciprocity, allowing research data and outputs to be beneficial to both the researcher and their community (peers, participants, and partners).

Therefore, the objective of this document is to help researchers work towards adopting data management best practices and to express Concordia University's commitment towards excellence in this area. A long-term future ideal state for research data management (RDM) at Concordia University is a future where services, staffing resources, and IT infrastructure enable and support best practices in this area.

[4] Wilkinson, M. D., Dumontier, M., Aalbersberg, Ij. J., Appleton, G., Axton, M., Baak, A., Blomberg, N., Boiten, J.-W., da Silva Santos, L. B., Bourne, P. E., Bouwman, J., Brookes, A. J., Clark, T., Crosas, M., Dillo, I., Dumon, O., Edmunds, S., Evelo, C. T., Finkers, R., … Mons, B. (2016). The FAIR Guiding Principles for scientific data management and stewardship. *Scientific Data*, *3*(1), 160018. https://doi.org/10.1038/sdata.2016.18

[5] European Commission. (n.d.) *Data management*. Horizon 2020 Online Manual. https://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-data-management/data-management_en.htm#

Oversight, review and timeline

In response to the Tri-Agency RDM policy, the following strategy document has been developed by the Research Data Management (RDM) Project Team. This team reports to the Vice-President, Research and Graduate Studies and the University Librarian, and is comprised of the following members:

- Jared Wiercinski, Associate University Librarian, Research & Graduate Studies (Chair)
- Tarik Alj, Manager, IT Research Support, IITS
- Marie-Pierre Aubé, University Archivist
- Danielle Dennie, Research Data Librarian
- Michael Groenendyk, Digital Scholarship Librarian
- Alex Guindon, GIS & Data Librarian
- Dominique Michaud, Director, Research Development, Office of Research
- Monica Toca, Manager, Research Ethics, Office of Research
- Associate Deans (Research) from the four Faculties (on a consultation basis)

The RDM Project Team is responsible for overseeing the implementation of the strategy. The current strategy document covers a three-year period and will be revised by the RDM Team after this time to assess attainment of deliverables and to reflect changes in the research data management landscape at Concordia, as well as provincially, nationally, and internationally.

Inquiries about this strategy can be directed to the Research Data Management Project Team at lib-research.data@concordia.ca.

Stakeholders

The following groups have a stake in RDM at Concordia and will be made aware of the strategy and associated RDM requirements, resources, and support through actions such as presentations and consultations.

- Vice-President, Research and Graduate Studies
- University Librarian
- Librarians
- Office of Research
- Ethics Unit
- Research Units
- Associate Deans, Research
- Faculty Councils (Arts & Science, Engineering, Fine Arts, JMSB)
- Department chairs
- Researchers
- Indigenous Directions Leadership Council
- Records Management and Archives
- Associate Vice President, Information Systems and CIO
- IITS
- Legal Services

Definitions

Archivematica: A free and open-source digital preservation system that is designed to maintain standards-based, long-term access to collections of digital objects.[6]

Data Management Plan (DMP): A formal statement describing how research data will be managed and documented throughout a research project and the terms regarding the subsequent deposit of the data with a data repository for long-term management and preservation.[7]

Dataverse: An open source data repository originally developed at Harvard University used to share, preserve, cite, explore, and analyze research data. It contains datasets, descriptive metadata and data files.[8] Note that the Dataverse discussed in this document is not the Microsoft Dataverse software application.

Research Data: Definitions of research data vary greatly, depending on the discipline. CASRAI provides the following broad definition of research data:

> Data that are used as primary sources to support technical or scientific enquiry, research, scholarship, or artistic activity, and that are used as evidence in the research process and/or are commonly accepted in the research community as necessary to validate research findings and results. All other digital and non-digital content have the potential of becoming research data. Research data may be experimental data, observational data, operational data, third party data, public sector data, monitoring data, processed data, or repurposed data.[9]

However, researchers involved in research-creation may define research data differently. Research-creation is an approach to research that involves both creative and scholarly practices. Research-creation data refers to the data that is generated through such critical, practice-based research. This may include traditional creative forms (such as painting, creative writing, music composition, design, architecture, performance art…) but also more conceptual, interdisciplinary and innovative approaches (for example, social and political practices, collaborative, relational and other emerging forms of production). Documentation of this type of research may also involve more traditional forms of data, such as numbers and text. The specific nature of research-creation data will vary depending on the research question and the methods used.

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[6] Archivematica. (n.d.). *What is Archivematica*. Retrieved December 7, 2020 from https://www.archivematica.org/en/docs/archivematica-1.12/getting-started/overview/intro/#intro

[7] CASRAI. (n.d.). *Data management plan*. Retrieved November 9, 2020 from https://casrai.org/term/data-management-plan/

[8] Dataverse Project. (n.d.). *About*. Retrieved December 7, 2020 from https://dataverse.org/about

[9] CASRAI. (n.d.). *Research data*. Retrieved November 9, 2020 from https://casrai-test.evision.ca/glossary-term/research-data/

Researchers in the humanities may define research data as: “All materials and assets scholars collect, generate and use during all stages of the research cycle.”[10] These materials include whatever the researcher, team and/or collaborators find worthy of their thought and attention. As such, research data in the humanities would include but not be limited to that which they describe, analyze, and/or represent through a variety of sensory means be they musical or otherwise sonic, poetic or literary, experiential or performative, etc.

Research Data Management (RDM): Data Management refers to the storage, access and preservation of data produced from a given investigation. Data management practices cover the entire lifecycle of the data, from planning the investigation to conducting it, and from backing up data as it is created and used to long term preservation of data deliverables after the research investigation has concluded. Specific activities and issues that fall within the category of data management include: File naming (the proper way to name computer files); data quality control and quality assurance; data access; data documentation (including levels of uncertainty); metadata creation and controlled vocabularies; data storage; data archiving and preservation; data sharing and reuse; data integrity; data security; data privacy; data rights; notebook protocols (lab or field).[11]

[10] Harrower, N., Maryl, M., Biro, T., Immenhauser, B., & ALLEA Working Group E-Humanities. (2020) *Sustainable and FAIR Data Sharing in the Humanities: Recommendations of the ALLEA Working Group E-Humanities*. ALLEA. https://doi.org/10.7486/DRI.tq582c863
[11] CASRAI. (n.d.). *Research data management*. Retrieved November 9, 2020 from https://casrai.org/term/research-data-management/

Current Support for Research Data Management at Concordia

RDM Project Team

Concordia's RDM Project Team is responsible for creating guidelines, procedures and policies to formalize research data management practices, services and expectations within the University and developing and implementing associated communication plans.

Training and awareness

Currently, different service units provide awareness materials and resources, as well as support and training for the Concordia community. Note that the services listed below are at different maturity levels but are expected to expand as demand for RDM services increases.

Concordia Library

- Provides a Research Data Management Guide on the Library website, which includes a specific section on research with Indigenous communities;
- Offers workshops and consultations to Concordia faculty, students, and staff;
- Trains subject librarians on RDM to inform their work with faculty and students in their assigned departments;
- In coordination with University Communications Services (UCS), communicates with the community through a variety of communication channels;
- In coordination with Data Scientifique, provides data clinics and workshops in the Library on data management, quantitative statistical methods, and data visualization.

Concordia IT Research Support

- Provides consultation services as well as research storage, research server hosting, and research virtualized servers. The support is run by team that liaises between researchers and IT professionals at Concordia.

Office of Research

- Facilitates workshops on RDM as well as connects researchers with the Library for assistance with issues related to RDM.
- Advises researchers on ethical, legal and commercial issues related to data management, such as data confidentiality and consent forms, that are consistent with requirements expressed in the *Tri-Council Policy Statement: Ethical Conduct for*

Research Involving Humans (2nd edition)[12], the *Tri-Agency Framework: Responsible Conduct of Research*[13], as well as other relevant policies.

Records Management and Archives

- Provides workshops on document management, such as retention, preservation, file naming and organization.
- Provides workshops on collecting and protecting personal information.

Data Management Plans

A Data Management Plan (DMP) is a document that helps researchers and funding agencies to understand the type of data that will be produced, how it will be managed and preserved, and how it will be shared.

The DMP Assistant (https://assistant.portagenetwork.ca/), a tool created by the Portage Network (https://portagenetwork.ca/) in observance with established best practices, can assist researchers in writing DMPs and provides subject-specific templates and local guidance. Knowledge of this tool is not widespread at Concordia. To increase awareness of the DMP Assistant, a limited number of workshops have been provided since 2020 to librarians and to staff in the Office of Research as well as to researchers. Furthermore, a communication plan was launched in the fall of 2020 in order to convey to researchers and graduate students the importance of DMPs and the availability of the DMP Assistant.

Data repositories

Data repositories allow long-term storage and access to research data. There are a variety of repositories available for researchers. They can be either discipline-specific, general, or institutional.

At the conclusion of a research project, Concordia researchers have different options for storing their data for the long-term. They can choose to deposit their data in subject specific repositories that cater to their specific disciplinary needs. They can also deposit data in institutional repositories like Spectrum, where the data is preserved using the preservation software Archivematica. Concordia researchers can also deposit their data in general data repositories like the Concordia instance of Dataverse[14], a Canadian based open-source data repository for small to medium sized datasets. The Library has developed documentation to assist users in the Dataverse deposit process. Datasets in Dataverse are not currently archived with preservation software. Because these two

[12] Government of Canada. (2018). *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans – TCPS 2 (2018)*. https://ethics.gc.ca/eng/policy-politique_tcps2-eptc2_2018.html
[13] Government of Canada. (2016). *Tri-Agency Framework: Responsible Conduct of Research (2016)*. https://rcr.ethics.gc.ca/eng/framework-cadre.html
[14] https://dataverse.scholarsportal.info/dataverse/concordia

institutional offerings (Spectrum and Dataverse) do not support all types of research data, the Library's RDM guide helps guide researchers towards other repositories which may be better suited to their specific needs.

Institutional policies and procedures

Adopting policies, guidelines and/or procedures helps support institutional awareness of RDM and promote good RDM practices. These policies, guidelines, and/or procedures may address a variety RDM issues, such as:

- Data access and sharing
- Data retention
- Long-term data preservation
- Data management plans
- Privacy, ethical issues, and intellectual property
- Consideration of Indigenous data sovereignty

Many policies at Concordia include, to some extent, subject matter pertaining to research data management. These policies include the Policy for the Responsible Conduct of Research[15], the Policy for the Ethical Review of Research Involving Human Participants[16], the Policy on Intellectual Property[17], the Policy on Contract Research[18], the Policy Concerning the Protection of Personal Information[19], the Policy on Data Governance[20], and the Concordia University Dataverse Policy[21]. Concordia also passed a Senate Resolution on Open Access[22]. There is also an increasing number of journal publishers and funding agencies that have current or upcoming policies related to RDM, and more specifically, pertaining to DMPs and / or data sharing.

[15] https://www.concordia.ca/content/dam/common/docs/policies/official-policies/VPRGS-12.pdf
[16] https://www.concordia.ca/content/dam/common/docs/policies/official-policies/VPRGS-3.pdf
[17] https://www.concordia.ca/content/dam/common/docs/policies/official-policies/VPRGS-9.pdf
[18] https://www.concordia.ca/content/dam/common/docs/policies/official-policies/VPRGS-1.pdf
[19] https://www.concordia.ca/content/dam/common/docs/policies/official-policies/SG-9.pdf
[20] https://www.concordia.ca/content/dam/common/docs/policies/official-policies/PRVPA-4.pdf
[21] https://library.concordia.ca/research/data/Concordia_Dataverse_Policy.pdf
[22] Herland, K. (2010) Concordia opens access to its research output. *Concordia Journal*. http://cjournal.concordia.ca/archives/20100429/concordia_opens_access_to_its_research_output.php

Indigenous Data Considerations

This strategy document does not include details on how Concordia University will approach working with data from or about First Nations, Métis, and Inuit individuals, communities, or nations. Concordia University Indigenous Directions is responsible for guiding the decolonization and Indigenization of the institution through its Action Plan[23]. The plan recommends seven specific actions with regards to Indigenous research, encouraging Concordia University to commit to "reimagining how ethical, reciprocal and meaningful Indigenous research, in partnership with Indigenous communities, is conducted."[24] Specifically, one of the recommended actions is the creation of an Indigenous Research Policy that will take into account the Tri-Agency Research Data Management Policy, among other resources.

[23] Concordia University. (2019). *The Indigenous Directions Action Plan: Concordia's path towards decolonizing and Indigenizing the University*. https://www.concordia.ca/content/dam/concordia/offices/oce/docs/IDLG/indigenous-directions-action-plan.pdf

[24] Ibid, 34.

Roadmap towards an ideal state of Research Data Management at Concordia

Many Research Data Management policies, processes, infrastructures, services, and support at Concordia University are not yet formalized or are still under development. Achieving an ideal state of RDM at Concordia will be an incremental process through which the university will guide and support its researchers with the goal of achieving data management best practices. Some elements of an ideal state of RDM would include the following:

- Institutional RDM-related policies, procedures, and guidelines
- Consultation and training in the following areas:
  - RDM and DMPs
  - RDM-related software
  - Data curation
- Availability of active, repository, and archival/preservation storage for both research data and sensitive research data
- Security and risk assessment policies and procedures
- Availability of high-performance computing and file transfer services
- And more…

The following table presents a three-year gradual introduction of RDM related objectives at Concordia. At the end of this three-year period, the objectives will be updated and revised by the RDM Project Team to continue the advancement towards an ideal state of RDM at the University.

1.0 Raising awareness and providing institutional support and training

Communication is key in order to highlight the benefits of and requirements for research data management (RDM) to all Concordia researchers. Outreach activities could include recruiting local champions to promote the value of RDM, engaging with various communities, and developing awareness materials and resources.

Objectives	Strategies	Deliverables	Gaps	Timeline / Priority	Responsibilities
1.1 Recruit local champions	Collaborate with Concordia University Data Science Research Centre on potential data-related training initiatives	One workshop per year through the Library.		December 2023 / Low	Library

	Collaborate with Data Scientifique on RDM-related training initiatives	Continue providing workshops and office hours within the Library		Ongoing / High	Library
	Promote data champions, such as those who deposit in Concordia Dataverse	Communication plan to highlight researchers on Library RDM guide and/or through the Library's social media feeds or news page.		July 2024 / Medium	Library
1.2 Develop awareness materials and resources	Develop brief arguments on the benefits of RDM and use these to tailor different messages for different disciplines or faculties.	Presentation slides on RDM that subject librarians can use for departmental meetings or within graduate workshops.		August 2023 / High	Library
		Promotional material that can be handed out during events such as Open Access Week and graduate and new faculty orientations		August 2023 / Low	Library
	Develop awareness materials surrounding Québec's Law 25, an Act to modernize legislative provisions as regards the protection of personal information	Workshop and / or guide on protecting personal information		December 2024 / High	Records Management & Archives, Office of Research
1.3 Develop training materials	Develop training materials for active data storage	Training capsules on storage of active data and data security, including how to store and share		December 2024 / Medium	IITS training department

	Develop more advanced training materials on research data management	sensitive data with collaborators List of collaborators for training researchers on anonymization / deidentification methods List of collaborators for training researchers on data cleaning		December 2024 / Low December 2024 / Low	Library Library
1.4 Define need for RDM services	Review the need for increase in staffing to assist with RDM services	Map out time spent on and types of RDM activities performed by the RDM librarian, and level of staffing for different tasks.		June 2024 / Medium	Library
1.5 Enhance current documentation in support of the ethical conduct of research	Create documentation that contains research data management language for informed consent	Consent form templates will include information about data sharing Instructions for writing consent forms will be updated to include information about data sharing		August 2023 / High	Research Ethics Unit (Office of Research)

2.0 Data Management Plans (DMP)

A Data Management Plan (DMP) is a document that helps researchers and funding agencies understand the type of data that will be acquired or produced during a project, how it will be managed, described, analyzed, and stored, and how it will be shared and preserved at the end of the project. Although these issues may be well thought out in advance, formalizing the process in a written document helps to identify potential blind spots or weaknesses in a planned project, and provide a record of the project's intentions.

Objectives	Strategies	Deliverables	Gaps	Timeline / Priority	Responsibilities
2.1 Cultivate awareness and use of DMPs by researchers	Promote the DMP Assistant, especially when DMPs are required by funder, and provide training on how to write a DMP	One or two workshops per year, organized through the Office of Research or targeted to specific faculties, on DMPs and how to use the DMP Assistant		Ongoing / High	Library, Office of Research
	Promote the Library and the Office of Research as places where researchers can get assistance with writing DMPs	Establish a DMP consultation service at the Library	Additional human resources may be required to meet the demand	December 2024 / High	Library, Office of Research
		Train Grant Writing Assistants to provide help in writing DMPs through the Grant Writing Assistant (GWA) Registry		December 2024 / High	Office of Research
		Link to the Library RDM guide from the Office of Research website		July 2023 / Low	Library, Office of Research
		Presentation slides about DMPs that subject librarians can use at departmental meetings or within workshops.		August 2023 / High	Library

3.0 Data repositories and archiving

One of the primary goals of RDM is to store data and its accompanying documentation in a way that allows future access by researchers, including the producers of the data themselves. Data repositories are one way of providing long-term storage and access to research data. In fact, there are a variety of repositories available for researchers, and whether they are discipline-specific, general, or institutional, they allow research data to be findable, accessible and reusable.

Objectives	Strategies	Deliverables	Gaps	Timeline / Priority	Responsibilities
3.1 Establish a culture of data deposition and archiving	Promote Concordia Dataverse as a tool for depositing small to medium sized datasets, when appropriate	One or two workshops per year on data repositories, data sharing and how to use Dataverse		Ongoing / High	Records Management & Archives, Library, Office of Research
	Increase the number of datasets deposited by researchers in Concordia Dataverse.	Report for VPRGS and UL that outlines Concordia Dataverse metrics.		Ongoing / Low	Library
	Investigate possibility of preserving datasets through Archivematica	Report to assess the feasibility of archiving research data deposited in Concordia Dataverse either locally or through the creation of a provincial archiving solution. The report would be presented either to the VPRGS and UL or the BCI Groupe de travail sur la Gestion des données de recherche (GT-GDR).	Current lack of archiving solution at the provincial level. Necessary IT hardware and staffing to support archiving several large datasets.	December 2024 / Low	Library, Records Management & Archives
	Collaborate with provincial / national / international organizations for external storage of research data	Training and guidance materials available on the Library RDM guide on using the Federated Research Data Repository (FRDR) for the deposit		Ongoing / Low	Library

		and preservation of large datasets.			
		Representative from Concordia on one of the Portage Expert or Working Groups[25].		Ongoing / Low	Library
	Communicate options to researchers for data sharing according to discipline or types of data produced	Guidance materials available on the Library RDM guide.	Limited options for storing and archiving audio-visual data.	Ongoing / Low	Library

4.0 Institutional policies and procedures

Adopting policies, guidelines and/or procedures helps support institutional awareness of RDM and promote good RDM practices. These policies, guidelines, and/or procedures may address a variety RDM issues, such as: data access and sharing; data retention; long-term data preservation; data management plans; privacy, ethical issues, and intellectual property; and consideration of Indigenous data sovereignty.

Objectives	Strategies	Deliverables	Gaps	Timeline / Priority	Responsibilities
4.1 Develop institutional policies, procedures, or guidelines related to RDM	Develop a data classification standard which outlines how data or information is protected based on its level of sensitivity.	Publish data classification standard and communicate it to researchers		December 2024 / Medium	IITS, Records Management & Archives, Data Governance Steering Committee
	Develop a cloud directive which describes the protections needed when using cloud services	Publish institutional cloud directive and communicate it to researchers		July 2023 / High	IITS, Records Management & Archives

[25] Portage. (n.d.). *Network of Experts*. Retrieved March 1, 2021, from https://portagenetwork.ca/network-of-experts/

	based on the type of data involved and its required security and privacy needs				

Concordia's Institutional Research Data Management Strategy

Presentation to Senate

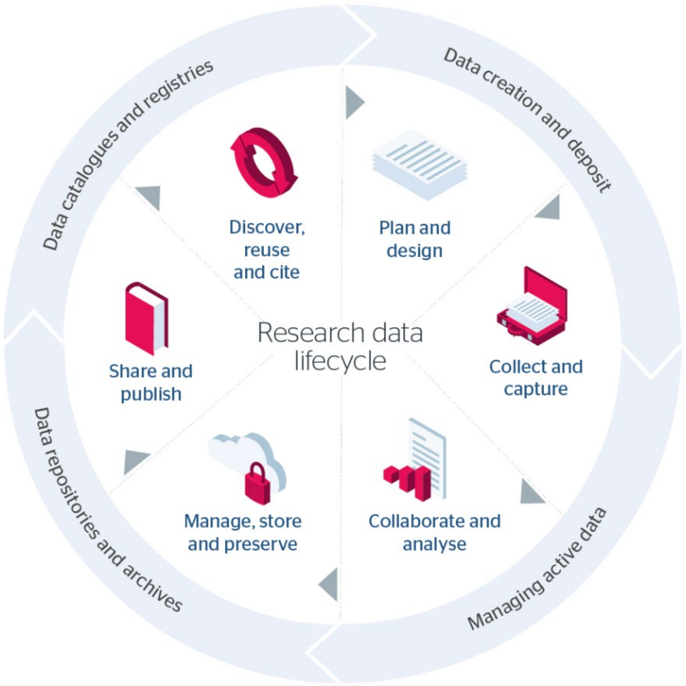
February 17, 2023

Danielle Dennie, Research Data Librarian

What is Research Data Management (RDM)?

What is RDM?

Research data management is a general term covering how you organize, structure, store, and care for the information used or generated during a research project. It includes…

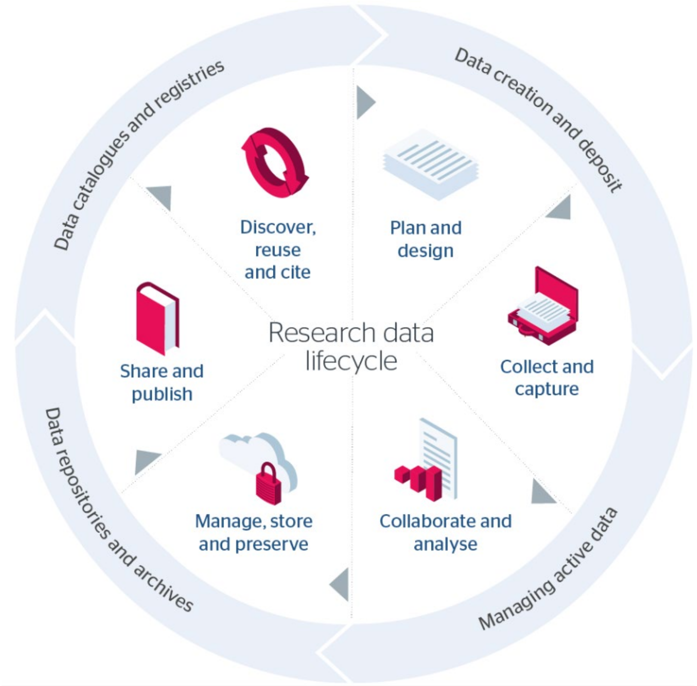


https://researchdata.ox.ac.uk/home/introduction-to-rdm/

https://rdmtoolkit.jisc.ac.uk/research-data-lifecycle/

What is RDM?

- **Planning** how your data will be looked after
- How you deal with information on a **day-to-day** basis over the lifetime of a project
- What happens to data in the **longer term** – what you do with it after the project concludes



https://researchdata.ox.ac.uk/home/introduction-to-rdm/

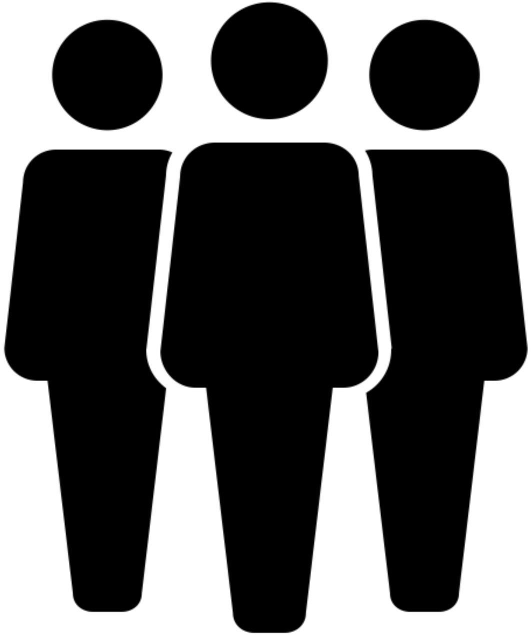
https://rdmtoolkit.jisc.ac.uk/research-data-lifecycle/

Research Data Management at Concordia

RDM Project Team

Purpose:

- Develop an **Institutional RDM Strategy** and associated services to researchers.



RDM Project Team

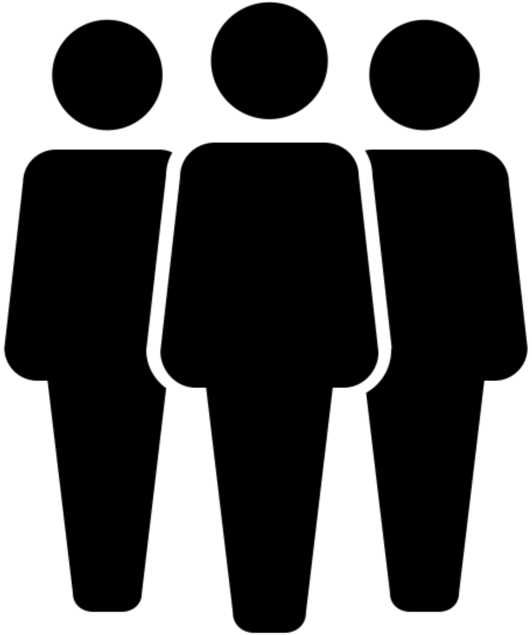
Library: Danielle Dennie, Michael Groenendyk, Alex Guindon, Jared Wiercinski

RMA: Marie-Pierre Aubé

IITS: Tarik Alj

Office of Research: Dominique Michaud, Monica Toca

Associate Deans of Research: on a consultation basis



Tri-Agency Research Data Management Policy

Tri-Agency RDM policy

« The agencies expect the research they fund to be conducted to the highest professional and disciplinary standards (…) . These standards support research excellence by ensuring that research is performed ethically and makes good use of public funds, experiments and studies are replicable, and research results are as accessible as possible. Research data management (RDM) is a necessary part of research excellence.»

Government of Canada Gouvernement du Canada

MENU

Home > Interagency research funding > Policies and Guidelines > Research Data Management

Tri-Agency Research Data Management Policy

1. Preamble

The Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Research Council of Canada (NSERC), and the Social Sciences and Humanities Research Council of Canada (SSHRC) (the agencies) are federal granting agencies that promote and support research, research training, knowledge transfer and innovation within Canada.

The agencies expect the research they fund to be conducted to the highest professional and disciplinary standards, domestically and internationally. These standards support research excellence by ensuring that research is performed ethically and makes good use of public funds, experiments and

http://www.science.gc.ca/eic/site/063.nsf/eng/h_97610.html

Tri-Agency RDM policy

Objective: Promote best practices in RDM

Tri-Agency RDM policy

Tri-Agency Research Data Management Policy:

- Institutional strategy
- Data management plans
- Data deposit

Government of Canada Gouvernement du Canada

MENU

Home > Interagency research funding > Policies and Guidelines > Research Data Management

Tri-Agency Research Data Management Policy

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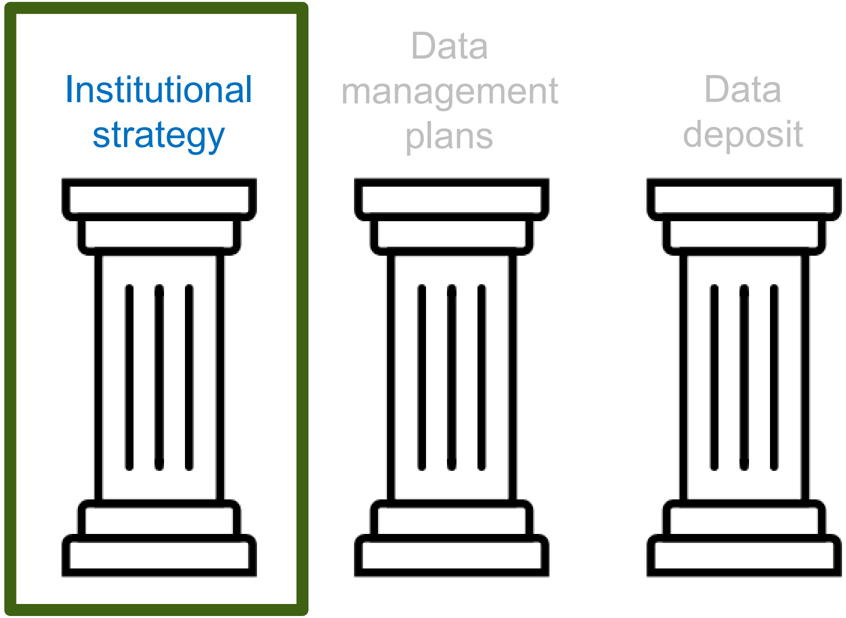
http://www.science.gc.ca/eic/site/063.nsf/eng/h_97610.html

Tri-Agency RDM policy

Institutional Strategy:

« Each institution administering tri-agency funds is required to create an institutional research data management strategy (…) that outline[s] how the institution will provide (…) an environment that enables and supports RDM. »



Tri-Agency RDM policy

Some goals of an institutional strategy

- ✓ promote the importance of data management
- ✓ guide researchers on how to properly manage data, including the development of data management plans
- ✓ provide, or support access to, repository services or other platforms that preserve, curate and provide appropriate access to research data
- ✓ recognize that data created in the context of research by and with Indigenous communities will be managed according to principles developed and approved by those communities, and in partnership with them

Tri-Agency RDM policy

Concordia University Indigenous Directions Action Plan: Currently working on an Indigenous Research Policy

Institutional Research Data Management Strategy

Institutional RDM Strategy

Contents

Roadmap towards an ideal state of Research Data Management at Concordia

Many Research Data Management policies, processes, infrastructures, services, and support at Concordia University are not yet formalized or are still under development. Achieving an ideal state of RDM at Concordia will be an incremental process through which the university will guide and support its researchers with the goal of achieving data management best practices. Some elements of an ideal state of RDM would include the following:

- Institutional RDM-related policies, procedures, and guidelines
- Consultation and training in the following areas:
  - RDM and DMPs
  - RDM-related software
  - Data curation
- Availability of active, repository, and archival/preservation storage for both research data and sensitive research data
- Security and risk assessment policies and procedures
- Availability of high-performance computing and file transfer services
- And more…

The following table presents a three-year gradual introduction of RDM related objectives at Concordia. At the end of this three-year period, the objectives will be updated and revised by the RDM Project Team to continue the advancement towards an ideal state of RDM at the University.

1.0 Raising awareness and providing institutional support and training

Communication is key in order to highlight the benefits of and requirements for research data management (RDM) to all Concordia researchers. Outreach activities could include recruiting local champions to promote the value of RDM, engaging with various communities, and developing awareness materials and resources.

Objectives	Strategies	Deliverables	Gaps	Timeline / Priority	Responsibilities
1.1 Recruit local champions	Collaborate with Concordia University Data Science Research Centre on potential data-related training initiatives	One workshop per year through the Library.		December 2023 / Low	Library

Institutional RDM Strategy

Roadmap towards an ideal state of Research Data Management at Concordia

Sections include:

- Raising awareness and providing institutional support and training
- Data Management Plans (DMP)
- Data repositories and archiving
- Institutional policies and procedures

Institutional RDM strategy: consultations

Group	Date
Associate Deans of Research	May-June 2021
VP R&GS Executive Team	February 2022
University Research Committee	October 2022
Academic Cabinet	November 2022
Senate Research Committee	December 2022
University Senate	Winter 2023

Intitutional RDM strategy

Tri-Agency Deadline:

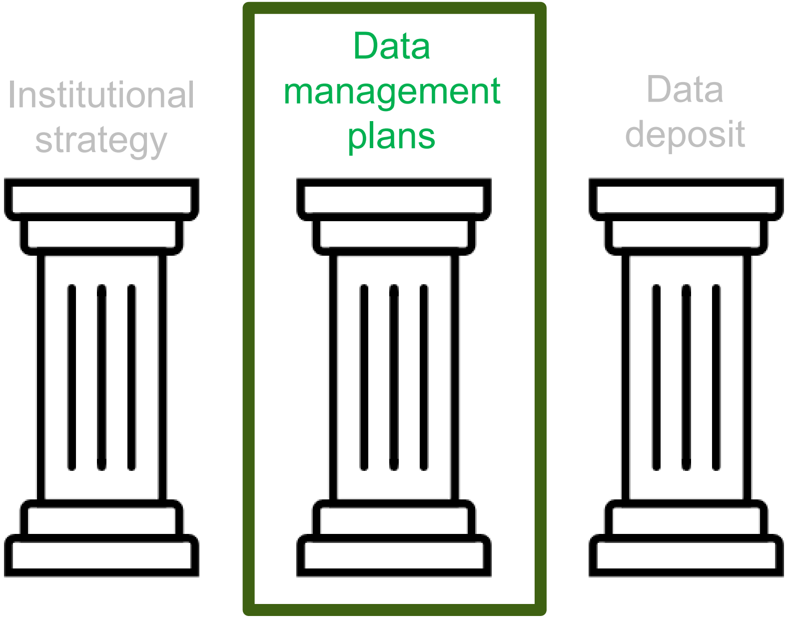
- March 1, 2023

Tri-Agency Research Data Management Policy

Tri-Agency RDM policy

Data Management Plans:

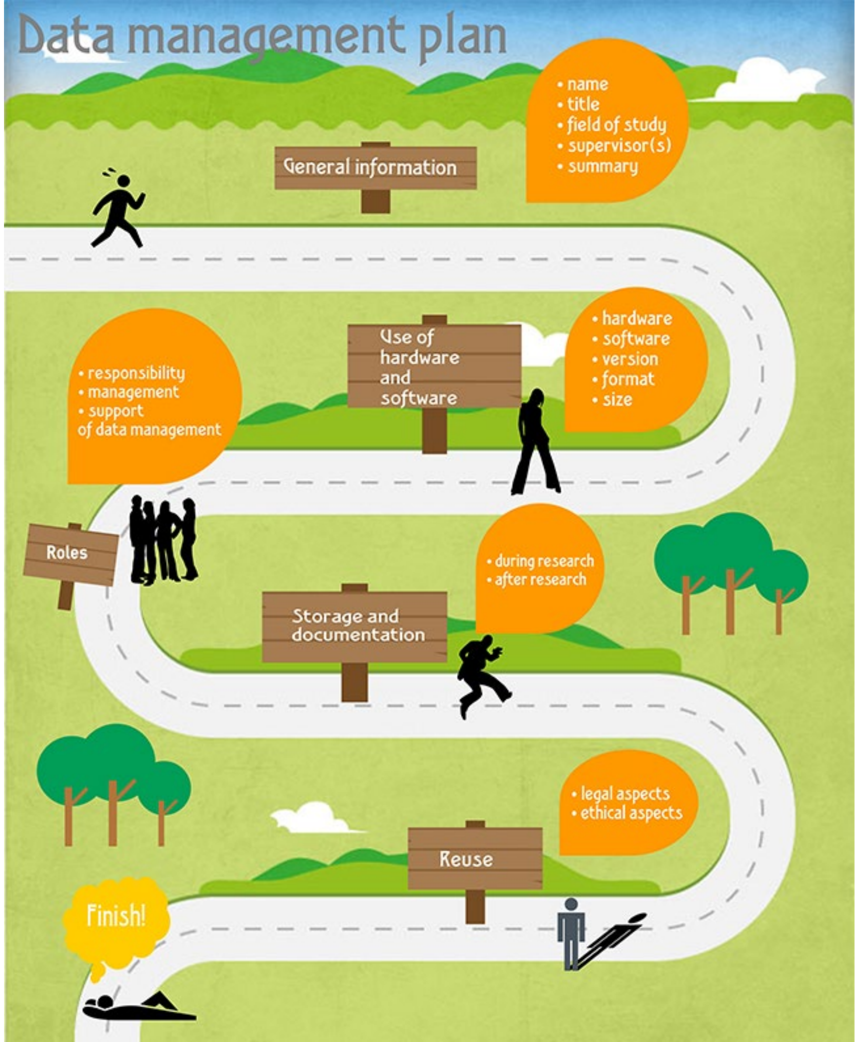
« All grant proposals submitted to the agencies should include methodologies that reflect best practices in RDM. For certain funding opportunities, the agencies will require data management plans (DMPs) »



What is a DMP?

- Formal document
- Outlines what you will do with your data **during** and **after** you complete your research
- Ensures your data is safe for the **present** and the **future**

DataONE, 2016, Lesson 03: Data Management Planning, https://old.dataone.org/education-modules

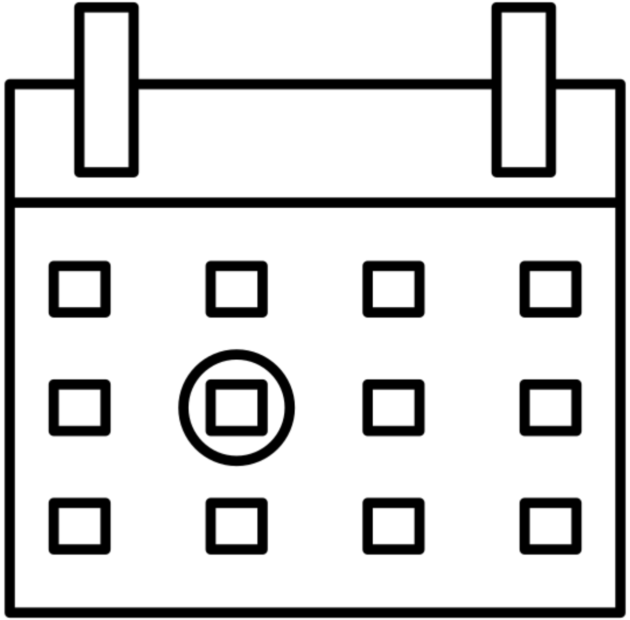


https://libguides.ru.nl/datamanagementEN/dmp

Tri-Agency RDM policy

Implementation date:

Spring 2022, Tri-Agency will identify ***initial set*** of funding opportunities subject to the DMP requirement.



Tri-Agency RDM policy

Initial set of funding opportunities requiring a DMP

CIHR

- Network Grants in Skin Health and Muscular Dystrophy (Anticipated launch fall 2022 or early winter 2023)
- Virtual Care/Digital Health Team Grants (Anticipated launch fall 2022 or early winter 2023)
- Data Science for Equity (Anticipated launch fall 2022 or early winter 2023)

NSERC

- Subatomic Physics Discovery Grants - Individual and Project (Anticipated launch summer 2023)

SSHRC

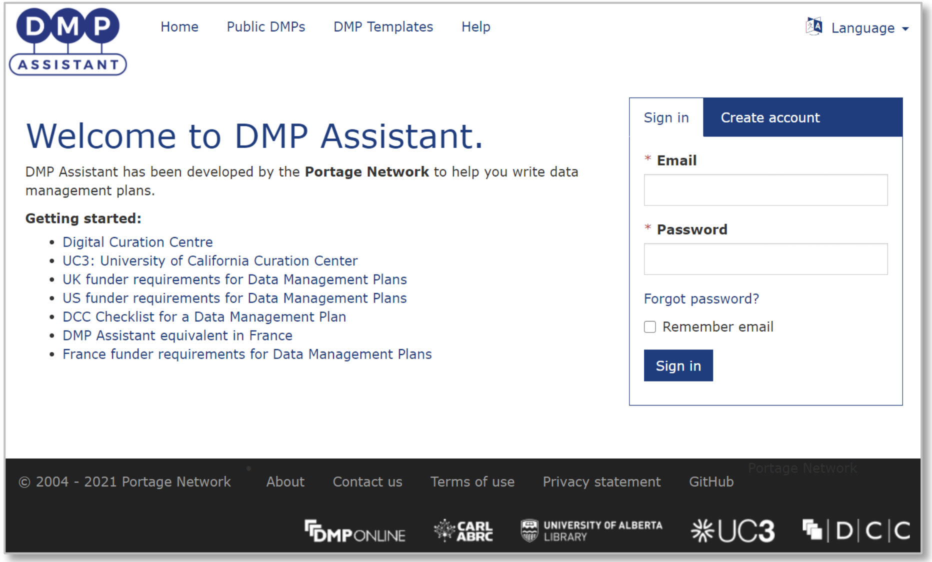
- Partnership Grants Stage 2 (Anticipated launch summer 2023)

https://science.gc.ca/eic/site/063.nsf/eng/h_547652FB.html

Tool to help write a DMP

DMP Assistant:

- Free Canadian online tool for creating DMPs
- Generic DMP template with 20 questions
- 12 discipline specific templates



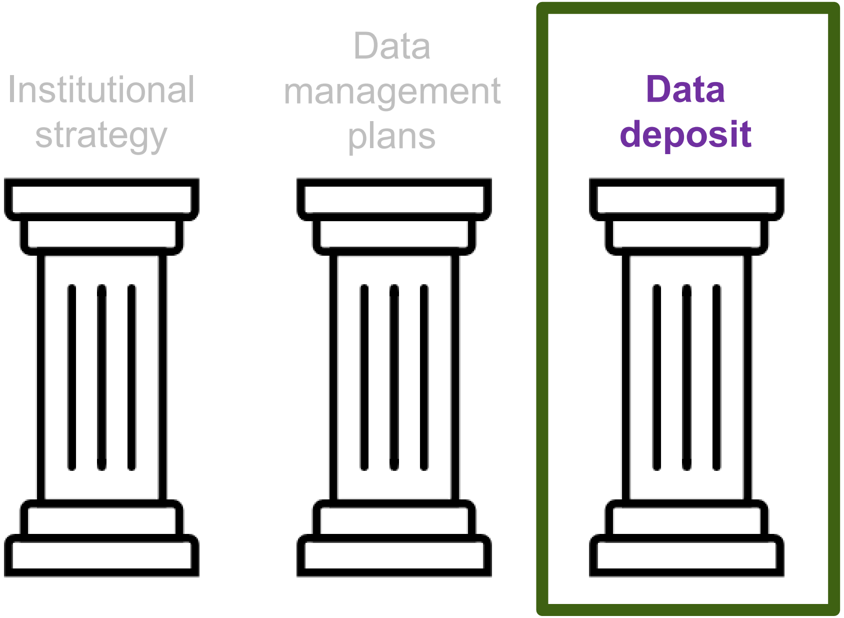
https://assistant.portagenetwork.ca/

Tri-Agency Research Data Management Policy

Tri-Agency RDM policy

Data deposit:

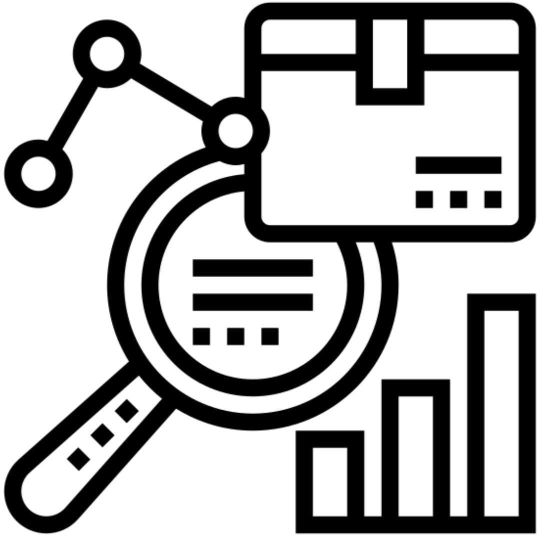
« Grant recipients are required to deposit into a recognized digital repository all digital research data, metadata and code that directly support research conclusions that arise from agency-supported research. »



Tri-Agency RDM policy

What is research data?

Determining what counts as relevant research data, and which data should be preserved, is often highly contextual and should be guided by disciplinary norms



Tri-Agency RDM policy

Grant recipients are **not required to share their data**.

However, the agencies expect researchers to **provide appropriate access to the data where ethical, cultural, legal and commercial requirements allow.**

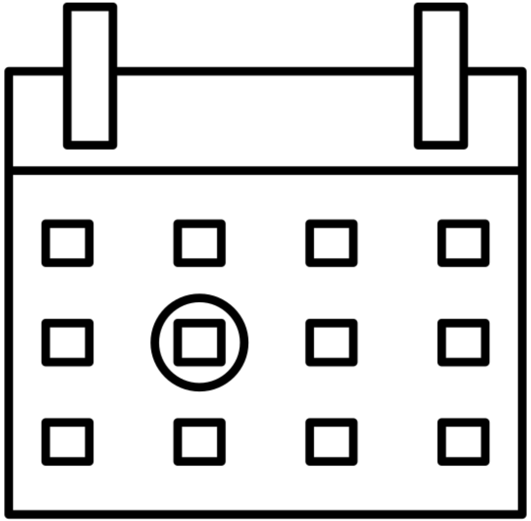
Tri-Agency RDM policy

As open as possible
As closed as necessary

Tri-Agency RDM policy

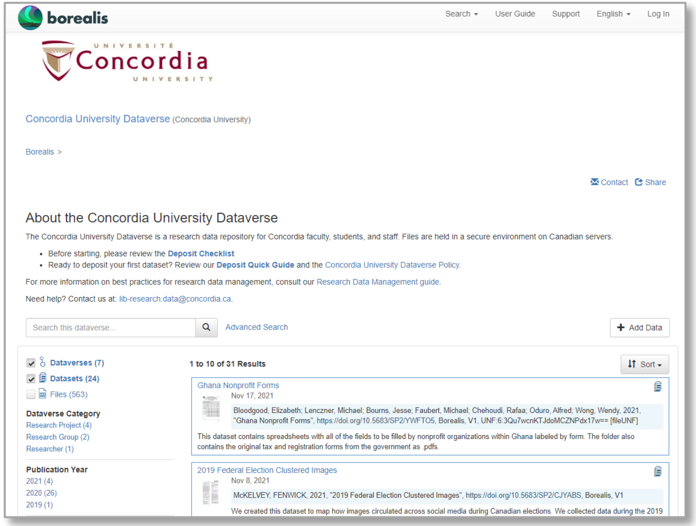
Implementation date:

After March 2023:
Data deposits will be phased in only after the Tri-Agency reviews each institution's RDM strategy and assesses the Canadian research community's readiness.



Data repositories for Concordia researchers

Dataverse (from Borealis)



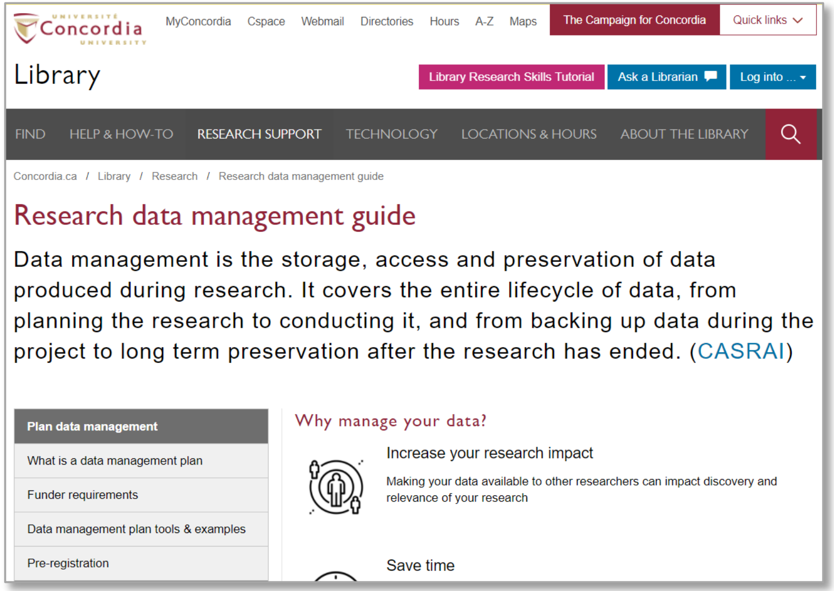
https://borealisdata.ca/dataverse/concordia

Federated Research Data Repository (FRDR)

https://www.frdr.ca/repo/

Help with RDM

- Research Data Management Guide
- Get help:
  - lib-research.data@concordia.ca
- Workshops



Questions?

Thank you!

CONCORDIA.CA