University of Waterloo
SENATE UNDERGRADUATE COUNCIL
Notice of Meeting

DATE: Tuesday 4 October 2022
TIME: 12:30 p.m. – 2:30 p.m.
PLACE: NH 3318

Open Session

Item		Action
1.	Declarations of Conflict of Interest - Excerpt from Senate Bylaw 1*	Information
2.	Approval of the 13 September 2022 Minutes* and Business Arising	UGC
3.	Academic Program Reviews	
	a. FAR – Anthropology*..	UGC
	b. Anthropology*	UGC
4.	Curricular Items for Approval & Information	
	a. Environment*	10 SEN-C, rest UGC
	b. Engineering*	4 SEN-C, 5 SEN-R, 7 information, rest UCG
	c. Mathematics*	UGC
	d. Computing and Financial Management*..	UGC
	e. Software Engineering*	SEN-R
	f. Sustainability and Financial Management*...	2 SEN-R, rest UGC
	g. Co-operative Education*	UGC
5.	Registrar's Office	
	a. Academic Regulations*...	SEN-C
6.	Digital Learning Framework*...	UGC-R
7.	Class Delivery Modes and Components*	UGC-R
8.	Other Business	
9.	Next Meeting: Tuesday 15 November 2022, 12:30 to 2:30 p.m. in NH 3318	

*material attached/to be distributed**
"SEN-C" to be recommended to Senate for approval (consent agenda)
"SEN-R" to be recommended to Senate for approval (regular agenda)
"UGC" to be approved on behalf of Senate & sent to Senate for information

28 September 2022

Tim Weber-Kraljevski
Associate University Secretary

Excerpt from Senate Bylaw 1

8. Declarations of conflict of interest

8.01	At the beginning of each meeting of Senate or any of Senate's committees or councils, the chair will call for members to declare any conflicts of interest with regard to any agenda item. For agenda items to be discussed in closed session, the chair will call for declarations of conflict of interest at the beginning of the closed portion of the meeting. Members may nonetheless declare conflicts at any time during a meeting.
8.02	A member shall be considered to have an actual, perceived or potential conflict of interest, when the opportunity exists for the member to use confidential information gained as a member of Senate, or any of Senate's committees or councils, for the personal profit or advantage of any person, or use the authority, knowledge or influence of the Senate, or a committee or council thereof, to further her/his personal, familial or corporate interests or the interests of an employee of the university with whom the member has a marital, familial or sexual relationship.
8.03	Members who declare conflicts of interest shall not enter into debate nor vote upon the specified item upon which they have declared a conflict of interest. The chair will determine whether it is appropriate for said member to remove themselves from the meeting for the duration of debate on the specified item(s).
8.04	Where Senate or a committee or council of Senate is of the opinion that a conflict of interest exists that has not been declared, the body may declare by a resolution carried by two-thirds of its members present at the meeting that a conflict of interest exists and a member thus found to be in conflict shall not enter into debate on the specified item upon which they have declared a conflict of interest. The chair will determine whether it is appropriate for said member to remove themselves from the meeting for the duration of debate on the specified item(s).

University of Waterloo
SENATE UNDERGRADUATE COUNCIL
Minutes of the 13 September 2022 Meeting
[in agenda order]

Present: Veronica Austen, Monica Barra, Benoit Charbonneau, Victoria Chu, Martin Cooke, Daniel Davison, Vivian Dayeh, David DeVidi (Chair), Leeann Ferries, Fatma Gzara, Carol Ann MacGregor, Naman Sood, Catherine Newell Kelly, Tim Weber-Kraljevski (secretary), Richard Wikkerink, Ryan Telford, Johanna Wandel, Stephanie Ye-Mowe

Resources/Guests: Angela Christelis, Blair Clarence, Jennifer Coghlin, Danielle Jeanneault, Carrie Molson, Brenda Denomme

Organization of Meeting: David DeVidi took the chair, and Tim Weber-Kraljevski acted as secretary. The secretary advised that a quorum was present. The agenda was approved without formal motion.

The chair welcomed new members and informed members that Council will be meeting in-person again going forward.

1. DECLARATIONS OF CONFLICTS OF INTEREST

No conflicts of interest were declared.

2. APPROVAL OF THE 28 JUNE 2022 MINUTES AND BUSINESS ARISING

The minutes were approved without formal motion. There was no business arising from the minutes.

3. CURRICULAR ITEMS FOR APPROVAL & INFORMATION

Health. Ferries provided a brief overview of new courses HEALTH 490, HLTH 403, and HLTH 445. There was a motion to approve the new courses on behalf of Senate. Ferries and Charbonneau. Carried. Ferries spoke to the following: proposed course changes for GERON 245, HLTH 101, HLTH 245, HLTH 290, HLTH 350, HLTH 380, HLTH 435, HLTH 471, KIN 100L, KIN 343, KIN 406, KIN 407, REC 120, REC 371, REC 471A, REC 471B, REC 475; course inactivations for WKRPT 200H, WKRPT 300H, WKRPT 400H, WKRPT 500H; and minor plan modifications to the Bachelor of Science, Honours Health Sciences, the Bachelor of Science, Honours Health Sciences, the Bachelor of Public Health, Honours, the Pre-Clinical Specialization, the Health Research Specialization, the Gerontology Minor, the Aging Studies Option, and the Diploma in Gerontology. Following discussions concerning also offered online, the title change of REC 471A, and conflicts with the proposed item 4a latter in the agenda, a motion was put forward to approve the proposed course changes, course inactivations and minor plan modifications on behalf of Senate. Ferries and Davison. Carried. Ferries took members through the proposed regulations changes for the Undergraduate Communication Requirement. There was a motion to recommend that Senate approve the proposed regulations changes. Ferries and Charbonneau. Carried. Follow discussion Council suggested that external transfer credits would be a good topic for Undergraduate Communications Requirement Group (UCRG) to explore.

Science. Barra presented the following: new course BIO 251; course changes for BIOL 110, BIOL 120/220, BIOL 150, BIOL 310, BIOL 312, BIOL 323, BIOL 383, BIOL 350, BIOL 351, BIOL 414, BIOL 428, BIOL 433, BIOL 450, BIOL 451, BIOL 452, BIOL 455, BIOL 457, BIOL 458, BIOL 485, BIOL 489, BIOL 490A, BIOL 490B, BIOL 490C, BIOL 490D, BIOL 498A, BIOL 498B, CHEM 350, EARTH 121, SCBUS 13, and SCBUS 225; and course inactivations of BIOL 321, BIOL 426, CHEM 201, and CHEM 301. A motion was put forward to approve the proposed new course, course changes, and course inactivations on behalf of Senate. Barra and Davison. Carried. Barra spoke to the minor academic plan changes for Honours Biology, Honours Biomedical Sciences, Honours Environmental Sciences, Ecology Specialization, Honours Material and Nanosciences, and the Science and Business Programs, along with the major modification to address inconsistent names for

Environmental Sciences plans. A motion was put forward to the approve the proposed minor plan changes on behalf of Senate and to recommend that Senate approve the proposed major plan changes. Barra and Charbonneau. Carried. Barra also presented changes associated with the COVID-19 pandemic for information.

Christelis spoke to future expectations that students and recent graduates will need to be consulted with any major modifications. Council heard that the process is currently being developed, and will be presented to Council once it is ready, with time for members to prepare prior to the implementation.

4. REGISTRAR'S OFFICE

Academic Regulations. Jeanneault presented proposed academic regulation revision to the Invalid Plan Combinations. Discussion was had on how students are informed if their plan combinations are invalid. There was a motion to recommend that Senate approve the proposed revision to the Invalid Plan Combinations. Newel-Kelly and Charbonneau. Carried. Following a discussion of including more credentials in the calendar text, Council heard that while work has been done to standardize across faculties, some credentials are still under grandfather rules, prohibiting defining these publicly, and also that a Credential Framework Committee has recently been created to look at credentials across campus.

New Undergraduate Scholarships, Awards, And Bursaries. This item was received for information. Discussion included appreciation of including the Wood family's association with the University of Waterloo in the Cam and Nancy Wood Entrance Bursary description and the possibility of sharing this innovation with advancement teams across campus.

5. ACCELERATED MASTER'S PROGRAMS

The chair presented for information that the approval to create, change or inactivate Accelerated Master's programs will no longer be the purview of Council, but should be solely approved by the Senate Graduate and Research Council (SGRC) going forward, with the exception of approving any changes to the undergraduate program curriculum impacted by these programs which will still require Council approval.

6. OTHER BUSINESS.

The chair spoke to including more strategic plan into future Council agendas and the possibility of the creation Curriculum Sub-Committee as part of the Senate Governance Review.

7. NEXT MEETING

The next meeting is Tuesday 4 October 2022, 12:30 to 2:30 p.m. in NH 3318.

26 September 2022

Tim Weber-Kraljevski
Associate University Secretary

Final Assessment Report

Anthropology (BA, Minor), Public Issues Anthropology (MA)

June 2021

Executive Summary

External reviewers found that the Anthropology (BA, Minor) and Public Issues Anthropology (MA) delivered by the Department of Anthropology were in good standing.

> "Our overall assessment is that it is a very good program that has the potential to be better. We were very impressed by the full-time and sessional faculty members we met, and based on our conversations with them, we feel that they are ready and willing to make the most of the opportunities for improvement we are recommending."

A total of 3 recommendations were provided by the reviewers, regarding governance, structure, curriculum, and support. In response, the program created a plan outlining the specific actions proposed to address each recommendation as well as a timeline for implementation. The next cyclical review for this program is scheduled for 2026-2027.

Student Complement (All Years)

	Anthropology				Public Issues Anthropology
	General	Honours	Co-op	Minor	MA
Fall 2020	3	26	8	23	20
Fall 2019	6	24	9	19	18
Fall 2018	9	26	6	16	12

*based on Active Students Extract retrieved from Quest December 21, 2020.

Background

In accordance with the University of Waterloo's Institutional Quality Assurance Process (IQAP), this final assessment report provides a synthesis of the external evaluation and the internal response of the Anthropology (BA, Minor) and Public Issues Anthropology (MA) delivered by the Department of Anthropology. A self-study (Volume I, II, III) was submitted to the Associate Vice-President, Academic and Associate Vice-President, Graduate Studies and Postdoctoral Affairs on October 18, 2019. The self-study (Volume I) presented the program descriptions and learning outcomes, an analytical assessment of the programs, including the data collected from a student survey, along with the standard data package prepared by the Office of Institutional Analysis & Planning (IAP). The CVs for each faculty member with a key role in the delivery of the program(s) were included in Volume II of the self-study.

From Volume III, two arm's-length external reviewers were selected by the Associate Vice-President, Academic and Associate Vice-President, Graduate Studies and Postdoctoral Affairs: Dr. Rob Hoppa, Professor of Anthropology, University of Manitoba, and Dr. Andrew Walsh, Associate Professor of Sociocultural Anthropology, Western University.

Reviewers appraised the self-study documentation and conducted a site visit to the University on February 10-11, 2020. An internal reviewer from the University of Waterloo, Dr. Peter van Beek, Professor of Computer Science, was selected to accompany the external reviewers. The visit included interviews with the Vice-President, Academic & Provost; Associate Vice-President, Academic and Associate Vice-President, Graduate Studies and Postdoctoral Affairs; Dean of the Faculty of Arts; Arts Associate Deans of Undergraduate Programs, Graduate Studies, and Research, respectively; Chair and Associate Chairs of the Department of Anthropology, as well as faculty members, staff and current undergraduate and graduate students. The Review Team also had an opportunity to tour the facilities and meet with representatives from the Library.

Following the site visit, the external reviewers submitted a report on their findings, with recommendations. In response, the program responded to each recommendation and outlined a plan for implementation of the recommendations. Finally, the Dean responded to the external reviewers' recommendations, and endorsed the plans outlined by the program.

This final assessment report is based on information extracted, in many cases verbatim, from the self-study, the external reviewers' report, the program response and the Dean's response.

Program Characteristics

Anthropology (BA, Minor): Upon completing a bachelor's degree, a student will be cognizant of the diversity of the human condition around the world, historically and today, and will be able to utilize the techniques of research design and field methods used in socio- cultural anthropology, archaeological anthropology, and biological anthropology. All degrees in Anthropology require a core set of three second-year courses in Socio-cultural, Archaeological and Biological Anthropology, three sub-fields of Anthropology.

- **Three-year General BA**: requirements include 30 courses, of which 10 are in Anthropology, plus six courses at the 300-level or above, with at least one 400-level course; a minimum overall average of 60% and a minimum major average of 65%.
- **Four-year General BA**: requirements include 40 courses, of which 16 are in Anthropology, plus ten courses at the 300-level or above, with at least two 400-level courses; a minimum

overall average of 60% and a minimum major average of 65%.

- **Honours BA**: requirements include 40 courses, of which 16 are in Anthropology, plus ten courses at the 300-level or above, with at least two 400-level courses; a minimum overall average of 60% and a minimum major average of 70%.
- **Minor**: requirements include eight courses in Anthropology with a minimum Anthropology average of 65%.

Public Issues Anthropology (MA): Students who complete the Public Issues Anthropology Master's program should also be able to utilize anthropological knowledge in ways that are relevant to issues of demonstrated interest to society.

- MA in Public Issues Anthropology: requirements include three core courses plus one elective, with a minimum average of 80%, as well as the preparation and defense of a research thesis.

Summary of Strengths, Challenges and Weaknesses based on Self-Study

Undergraduate Program

Strengths

- In this relatively small program, students get to know, and support, each other well, and students and faculty get to know each other well, too.
- There is an array of student awards and scholarships that help to support the education and professionalization of students.
- Important to a number of students are the opportunities provided by the University of Waterloo's Co-op programs, in particular, the Arts and Business Co-op. Beyond Co-op, students have many opportunities for experiential learning, including hands-on laboratory work in biological and archaeological anthropology, as well as in field schools and study abroad courses.
- In a recently conducted survey of current undergraduates and alumni, students were impressed by the breadth and variety of courses on offer in the Department and how these courses complemented those in other disciplines (e.g., Psychology and History).
- Students were also pleased with the helpful and passionate nature of their professors, and delighted with the opportunities for experiential education in the form of field schools, study abroad courses, and laboratory-based courses.

Challenges

- The main challenge of this undergraduate program is to attract and retain undergraduate students.
- A further challenge is the inability to offer all courses every year, or at least predictably, so that students can plan ahead better.

- It has been challenging to claim a place or voice for anthropology on campus, as we keep being surprised by a certain innocence of our interlocutors about what anthropology can contribute to various discourses and debates. This challenge is aggravated by new or proposed Minor and Major programs in the Faculty of Arts that resonate with core concerns of (socio-cultural) anthropology (Cultural Identities, in particular), but have involved Anthropology only marginally.
- One of the enduring challenges is space. There is no lounge and/or meeting room that would help making the Department a comfortable environment for students to interact among themselves and with faculty. Given additional osteological collections that will arrive in conjunction with the Jordan field school, the tight limits of storage space are an additional concern.
- In a recently conducted survey, undergraduates thought the Department should employ new media technologies (e.g., video essays and podcasts) to better engage with the public and further strengthen the program.
- In addition to the need for better communication and outreach, students also commented on the lack of resources available to support undergraduate education, particularly in regard to preparing students for careers outside academia.

Weaknesses

- Anthropology lacks another faculty position in archaeology, a subfield that students have expressed much interest in, but in which offerings are limited because of the existing faculty complement.
- Curriculum revisions following the last program review removed a required 300-level course on the History of Anthropological Theory. This may weaken graduates' applications to other programs.
- Introductory courses (particularly ANTH 100, 201 and 202) are periodically taught by sessional instructors, but Anthropology is unable to tell students when these instructors will again teach courses again.
- The survey of current and former Undergraduates indicated that some students felt there were not enough courses on offer from term to term. Moreover, of those courses on offer, some felt the same topics were taught too frequently. It was also suggested that upper-year offerings did not properly build from concepts learned in earlier 'core courses' (i.e., ANTH 201, 202, and 204).

<u>Graduate Program</u>

Strengths

- The small sizes of the MA student cohorts and the small size of the Department facilitate students' interactions among themselves and with all faculty members.
- The program is unique in its Public Issues focus and in that it incorporates theory, perspectives, approaches, and methods from sociocultural, biological, and

archaeological anthropology. There is one faculty member who is a linguistic anthropologist, thus giving the small program the full breadth of North American anthropology's four- fields.

- With three required courses and one elective, coursework is flexible to meet student interests. With a length of 16 months, the program is compact; students typically finish on time, the completion rate is high, and students are offered a competitive funding package.

Challenges

- Application numbers have improved significantly, with an especially strong interest in biological and archaeological anthropology, but lesser interest in socio-cultural anthropology. This aggravates a shortage of office space for graduate students.
- With individual students' interests often being oriented toward a single subfield of anthropology, teaching adequately across the three subfields in required graduate courses has been a challenge as well.
- Providing adequate supervision when advisors are on sabbatical or other leave is an ongoing challenge for the MA program, especially given its relatively short duration.

Weaknesses

- The January graduation date has posed employment challenges especially for archaeological anthropologists whose work may be weather-dependent. This is part of a broader concern regarding post-MA employment. In survey responses, many (~75%) students report a 3-6 month delay in finding employment, compared with only ~12% who have employment arranged prior to completion.
- The lack of funding for international students significantly limits the ability to attract international students.

Summary of Key Findings from the External Reviewers

The reviewers' assessment is that this is a very good program that has the potential to be better. The reviewers were very impressed by the full-time and sessional faculty members with whom they met, and based on these conversations, they feel that faculty are ready and willing to make the most of the opportunities for improvement the reviewers are recommending.

The external reviewers found that the chief strengths of the program are to be found in the people who make it up. With the exception of several senior faculty members who are likely nearing retirement, most members of the Department are relatively junior. Most have active (and mostly funded) research projects on the go and are participating in all aspects of undergraduate and graduate programs. In addition, the program has been benefiting greatly

from the dedicated efforts of a number of sessional instructors, and, over the past year, from the work of a single staff-member with a great deal on her plate.
The major challenges currently facing the program relate to departmental governance and undergraduate enrolments. Accordingly, we are making two major recommendations that should serve to address these two major challenges.

Program Response to External Reviewers' Recommendations

1. The Department should undertake a thorough review of its own governance processes with an eye to developing a departmental committee structure that will ensure that it can make the most of its complement of faculty members. As a starting point, the Department could look to other similarly sized departments for examples of what such a departmental committee structure might look like. At very least, the Department should have a curriculum/undergraduate committee that would be responsible for proposing changes to undergraduate programs, curriculum planning, and so on – changes and planning that, of course, should then be discussed and voted upon at by the whole Department. In addition to the Associate-Chair Undergraduate, this committee should include at least two other faculty members (not including the Chair), and possibly an Undergraduate student liaison who could attend at least some meetings. Another possibility would be to create a performance evaluation committee that would be responsible for institutionally mandated evaluations of faculty members' performance. And so on. As noted above, other similarly sized departments can provide examples. In all cases, committee memberships should change every few years, and efforts should be made to ensure that different faculty members move in and out of different committees over time.

Program Response

The Anthropology Department welcomes and will undertake the recommended thorough review of its governance processes. This timing of this recommendation works out nicely, because until very recently a significant proportion of the regular faculty in the Department were probationary appointments. But as of July 2020, seven of the eight professors in the Department now have tenure and are now in a good position to devote the necessary time and energy to this exercise. Further, a new Chair will be taking on that role probably next summer, and it would be ideal to have these changes made in time for that transition. Anthropology will therefore undertake a review of current administrative positions (Chair; Associate Chair Undergraduate; Associate Chair Graduate) and formalize, to a greater extent than at present, the roles and authorities of the latter positions, as well as how they are assigned. This will allow the definition and population of a formal departmental committee structure appropriate to a department of this size, to replace current ad hoc committees. Anthropology will follow the reviewers' advice to develop policies to ensure that committee memberships change regularly.

With respect to the recommendation to "create a performance evaluation committee that would be responsible for institutionally mandated evaluations of faculty members' performance", this is seen as a small misunderstanding on the part of the external reviewers since, following the MOA, the Department has voted to use and has used a performance evaluation committee for the past five years. There is thus have no need to create such a committee but Anthropology has every intention of continuing to use this procedure.

Dean's Response
I concur; no additional response beyond encouraging the Department in its intention to bring greater formality to its governance processes.

2. The Department should undertake a thorough curriculum review with the assistance of a facilitator. In recent years, the Department has grown in ways and directions that could not have been anticipated at the time of the last curriculum review. Now that things have stabilized, and the Department has an enviable complement of high-achieving researchers and outstanding instructors on hand in full-time and limited-term/sessional positions, the time is right to meet again so as to discuss a number of issues and to propose and prioritize appropriate changes to curriculum and the curriculum planning process. In addition to being a forum for discussing issues raised in the self-study and in this report (concerning first-year courses, on-line courses, and the possibilities presented by co-op students, for example), efforts should be made to ensure that this curriculum review provides the Department's newest faculty members with the opportunity to raise issues of concern and to propose possible changes; having a facilitator run the review would be the best way of ensuring that this happens. This review should also be an occasion for the open discussion of faculty members' own understandings of what a degree in Anthropology from Waterloo offers, or could offer, undergraduate students. Achieving a common vision (however broad) on this last matter could go a long way to promoting the sort of cohesion and consistent messaging that will enable the department to achieve its own great potential while also contributing to Waterloo's larger mission.

Program Response
The Anthropology Department also recognizes the value of this recommendation and will carry it out. For several reasons, it is concluded that the process can best be accomplished in phases, leading up to a final phase where the participation of a facilitator would be helpful. There was clear agreement within the Department about the value of facilitation, but also clear agreement that such facilitated discussions would need to happen in person, which of course will not be possible at least through the Winter 2021 term based on current University guidance regarding Covid-19, and then through the Spring term because some Department members will hopefully be away doing fieldwork. Anthropology therefore proposes to undertake some initial discussions at the sub disciplinary level (e.g., the archaeological

anthropologists would consult together, as would the biological anthropologists, as would the socio-cultural anthropologists) in the Winter 2021 term in order to get this process started. This initial work will be very useful and will help ensure the expeditious success of the facilitator-enabled curriculum review once it becomes feasible, presumably in Fall 2021 or as soon thereafter as possible. The goal in the facilitated process will be to update the undergraduate curriculum to match our understanding of “what a degree in Anthropology from Waterloo offers, or could offer” consistent with the ability of the small complement to offer each course frequently enough that most undergraduate students in the program would have the chance during their time at UW to take most of the Anthropology courses listed in the calendar should they choose to do so.

Dean’s Response
I concur; no additional response beyond agreeing with the Department that most undergraduate students in the Anthropology program should have the chance to take most of the ANTH courses offered.

3. It is clear that a great deal is being expected of the one support staff member employed in the Department. While this staff member appears to be managing this heavy load admirably, she has no backup. Here, it bears noting the truism that keeping a small department running is in many ways no less work, and in some ways much more work, than keeping a large department running. Not knowing what might be possible in the way of relief, we aren’t sure what to recommend – other than that something should be done to alleviate part of the support staff member’s workload in order to ensure that the Department is able to retain this key contributor over the long term.

Program Response
The Anthropology Department agrees with the reviewers’ assessment that the Administrative Manager is required to understand and perform on their own a very large range of tasks in order to support the department and both its undergraduate and Master’s program. Anthropology believes that this workload is not completely unprecedented among the small departments within the Faculty of Arts but would be happy to see the situation altered and will undertake to initiate a review of the position and will consult with the Dean of Arts Office concerning the workload of the Administrative Manager and whether there are options to better support this position.

Dean’s Response
We are aware of the challenges that smaller Departments with a single staff member face. As we move forward with the Faculty’s strategic plan, I am hopeful that we will be able to make some organizational/structural modifications that will alleviate the burden on both faculty and staff in our smaller units.

Implementation Plan

	Recommendations	Proposed Actions	Responsibility for Leading and Resourcing (if applicable) the Actions	Timeline for addressing Recommendations
1.	The department should undertake a thorough review of its own governance processes with an eye to developing a departmental committee structure.	The Anthropology department will schedule Faculty meetings devoted to this topic.	Anthropology department Chair; Associate Chair Undergraduate; Associate Chair Graduate.	Fall term 2020; Winter term 2021.
2.	The Anthropology department will schedule Faculty meetings devoted to this topic	The department will begin to explore the issues at the subdisciplinary level, and will prepare for the facilitated review when it becomes feasible to do so.	Anthropology department Chair; Dean of Arts Office and/or CTE (for the facilitator).	Preliminary phase to begin in Winter term 2021, in anticipation of the facilitated process being possible as soon as Fall, 2021.
3.	Something should be done to alleviate part of the support staff member's workload in order to ensure that the department is able to retain this key contributor over the long term.	The department will consult with the Dean of Arts office concerning the workload of the Administrative Manager and whether there are options to better support this position.	Anthropology department Chair; Dean of Arts Office.	Fall term, 2020.

The Department Chair/Director, in consultation with the Dean of the Faculty shall be responsible for the Implementation Plan.

Date of next program review **2026-2027**

Date

Signatures of Approval

24 Nov 2021

Chair/Director Date

AFIW Administrative Dean/Head (*For AFIW programs only*) Date

March 20, 2022

Faculty Dean Date

Note: AFIW programs fall under the Faculty of ARTS; however, the Dean does not have fiscal control nor authority over staffing and administration of the program.

Dan DeVidi

1 November 2021

Associate Vice-President, Academic Date
(For undergraduate and augmented programs)

26 September 2021

Associate Vice-President, Graduate Studies and Postdoctoral Affairs Date
(For graduate and augmented programs)

Two-Year Progress Report
Anthropology (BA, Minor), Public Issues Anthropology (MA)
January 2022

Background

In accordance with the University of Waterloo's Institutional Quality Assurance Process (IQAP), this final assessment report provides a synthesis of the external evaluation and the internal response of the Anthropology (BA, Minor) and Public Issues Anthropology (MA) delivered by the Department of Anthropology. A self-study (Volume I, II, III) was submitted to the Associate Vice-President, Academic and Associate Vice-President, Graduate Studies and Postdoctoral Affairs on October 18, 2019. The self-study (Volume I) presented the program descriptions and learning outcomes, an analytical assessment of the programs, including the data collected from a student survey, along with the standard data package prepared by the Office of Institutional Analysis & Planning (IAP). The CVs for each faculty member with a key role in the delivery of the program(s) were included in Volume II of the self-study.

From Volume III, two arm's-length external reviewers were selected by the Associate Vice-President, Academic and Associate Vice-President, Graduate Studies and Postdoctoral Affairs: Dr. Rob Hoppa, Professor of Anthropology, University of Manitoba, and Dr. Andrew Walsh, Associate Professor of Sociocultural Anthropology, Western University.

Reviewers appraised the self-study documentation and conducted a site visit to the University on February 10-11, 2020. An internal reviewer from the University of Waterloo, Dr. Peter van Beek, Professor of Computer Science, was selected to accompany the external reviewers. The visit included interviews with the Vice-President, Academic & Provost; Associate Vice-President, Academic and Associate Vice-President, Graduate Studies and Postdoctoral Affairs; Dean of the Faculty of Arts; Arts Associate Deans of Undergraduate Programs, Graduate Studies, and Research, respectively; Chair and Associate Chairs of the Department of Anthropology, as well as faculty members, staff and current undergraduate and graduate students. The Review Team also had an opportunity to tour the facilities and meet with representatives from the Library.

Following the site visit, the external reviewers submitted a report on their findings, with recommendations. In response, the program responded to each recommendation and outlined a plan for implementation of the recommendations. Finally, the Dean responded to the external reviewers' recommendations, and endorsed the plans outlined by the program. A Final

Assessment Report was submitted that included information from the self-study, the external reviewers' report, the program response and the Dean's response.

This **Two-Year Progress Report** draws significantly from the Final Assessment Report. We note that in the month following the site visit, Covid-19 (SARS-CoV-2) was declared a pandemic by the World Health Organization. This has significantly impacted all university activities including those related to the proposed implementation plan developed in response to the recommendations made in the review.

Student Complement (All Years)

	Anthropology				Public Issues Anthropology
	General	**Honours**	**Co-op**	**Minor**	**MA**
Fall 2021	4	24	12	19	18
Fall 2020	3	26	8	23	20
Fall 2019	6	24	9	19	18
Fall 2018	9	26	6	16	12

*based on Active Students Extract retrieved from Quest January 7, 2022.

Progress on Implementation Plan

A summary of the key findings from the review, along with three main recommendations and responses from both the department and the Dean are provided in the Final Assessment Report. The review recommendations and departmental actions are summarized in the implementation plan table (adapted from the FAR) at the end of this section.

Recommendations

1. **"The Department should undertake a thorough review of its own governance processes with an eye to developing a departmental committee structure that will ensure that it can make the most of its complement of faculty members**. As a starting point, the Department could look to other similarly sized departments for examples of what such a departmental committee structure might look like. At very least, the Department should have a curriculum/undergraduate committee that would be responsible for proposing changes to undergraduate programs, curriculum planning, and so on – changes and planning that, of course, should then be discussed and voted upon at by the whole Department. In addition to the Associate-Chair Undergraduate, this committee should include at least two other faculty members (not including the Chair), and possibly an Undergraduate student liaison who could attend at least some meetings." (Reviewers' report)

    Status: In progress

Details: We began this process with the generation of a set of documents: 1) The *Anthropology department procedures and practices* document outlines the tasks of administrative positions in the department including, the Chair, Associate Chairs, and the Administrative Manager. This is undergoing revision and is still in draft format. We will add clarification regarding the composition and roles of the new committees (e.g., curriculum) and existing committees (e.g., performance evaluations). 2) A *list/calendar of department administrative tasks* aids in clarifying and anticipating department needs, roles, and expectations. Both of these are living documents that are undergoing continual revision.

Our official proposed action was to "schedule Faculty meetings devoted to this topic". We still plan to do this, however, faculty meetings and department energy have largely been focused on urgent needs during the pandemic, as described below. We expect to address this directly in late 2022, with completion of the major elements by early 2023, and with planned ongoing modifications and revisions.

2. **"The Department should undertake a thorough curriculum review with the assistance of a facilitator.** In recent years, the Department has grown in ways and directions that could not have been anticipated at the time of the last curriculum review. Now that things have stabilized, and the Department has an enviable complement of high-achieving researchers and outstanding instructors on hand in full-time and limited-term/sessional positions, the time is right to meet again so as to discuss a number of issues and to propose and prioritize appropriate changes to curriculum and the curriculum planning process. In addition to being a forum for discussing issues raised in the self-study and in this report (concerning first-year courses, on-line courses, and the possibilities presented by co-op students, for example), efforts should be made to ensure that this curriculum review provides the Department's newest faculty members with the opportunity to raise issues of concern and to propose possible changes; having a facilitator run the review would be the best way of ensuring that this happens. This review should also be an occasion for the open discussion of faculty members' own understandings of what a degree in Anthropology from Waterloo offers, or could offer, undergraduate students. Achieving a common vision (however broad) on this last matter could go a long way to promoting the sort of cohesion and consistent messaging that will enable the department to achieve its own great potential while also contributing to Waterloo's larger mission." (Reviewers' report)

   Status: in progress

   Details: We have held informal discussions regarding the curriculum amongst the sub disciplinary groups. We feel that the curriculum review will be most productive in person and have been waiting until that is possible again. We currently have scheduled a **curriculum**

retreat for March 4^{th}, 2022 and April 1^{st}, 2022. Both meetings are all day (9:30am-4:30pm) and we have reserved space at the Balsillie School of International Affairs. The first meeting will be for the department only, and the second meeting will include a facilitator from CTE. Prior to March 4^{th}, sub disciplinary groups will hold at least one more discussion to set their curricular priorities and concerns. In the event that the public health situation does not allow for in-person meetings at these times, we have agreed to hold virtual meetings of shorter duration (2-4 hours) on these dates in order to begin the curriculum review process. Should this occur, we will likely need to schedule in-person meetings later in 2022.

3. "It is clear that a great deal is being expected of the one support staff member employed in the Department. While this staff member appears to be managing this heavy load admirably, she has no backup. Here, it bears noting the truism that keeping a small department running is in many ways no less work, and in some ways much more work, than keeping a large department running. Not knowing what might be possible in the way of relief, we aren't sure what to recommend – other than that **something should be done to alleviate part of the support staff member's workload in order to ensure that the Department is able to retain this key contributor over the long term**." (Reviewers' report)

    Status: **in progress**

    Details: The *Anthropology department procedures and practices* document, and the *list/calendar of department administrative tasks* detailed above aim to clarify the Administrative Manager's role and tasks. Our response in the FAR was: "The Anthropology Department agrees with the reviewers' assessment that the Administrative Manager is required to understand and perform on their own a very large range of tasks in order to support the department and both its undergraduate and Master's program. Anthropology believes that this workload is not completely unprecedented among the small departments within the Faculty of Arts but would be happy to see the situation altered and will undertake to initiate a review of the position and will consult with the Dean of Arts Office concerning the workload of the Administrative Manager and whether there are options to better support this position."

    The Dean of Arts office is aware of this concern regarding the workload of staff in smaller departments across the Faculty of Arts. We will continue to work with the Dean's office in addressing structural and/or organizational changes that can ameliorate this issue. This is a long-term ongoing issue that is largely out of the hands of the department, but we will continue to address it in our conversations with the Dean's Office. We will revisit this directly with the Dean in Spring term, 2022.

Circumstances that have altered the original implementation plan

The original implementation plan has been delayed due to challenges associated with the Covid-19 pandemic. Faculty, staff, and students have been required to make many adjustments with the shift to online teaching and learning, and work from home rules. New programs, platforms and tools, along with new regulations, needed to be learned and implemented very quickly. Repeated moves between in-person and online teaching (including multiple last-minute shifts in delivery modes) have resulted in significantly elevated workloads. Several faculty and staff members with school-aged children faced additional challenges posed by school closures.

In addition, the department faced multiple leadership changes during the period of the review with one Chair overseeing the preparation of the self-review (Volumes I and II), an Acting and then Interim Chair overseeing the preparation of the FAR, and a new Chair overseeing the preparation of this Two-Year Progress Report. This required a new appointment in the role of Associate Chair of Graduate Studies. We also were challenged by the secondment/cross-appointment of one tenured faculty member to another department resulting in the loss of their service responsibilities to the department, and a one-term medical leave for a faculty member.

Updated Implementation Plan

	Recommendations	Proposed Actions	Responsibility for Leading and Resourcing (if applicable) the Actions	Timeline for addressing Recommendations
1.	The department should undertake a thorough review of its own governance processes with an eye to developing a departmental committee structure.	The Anthropology department will schedule Faculty meetings devoted to this topic, and will continue to refine the *department procedures and practices* and the *list/calendar of department administrative tasks* documents.	Anthropology department Chair; Associate Chair Undergraduate; Associate Chair Graduate.	Fall term 2022. Completion of major elements in Winter 2023. Revisions ongoing.
2.	The Department should undertake a thorough curriculum review with the assistance of a facilitator.	The department will continue to explore the issues at the sub disciplinary level, and will prepare for the facilitated review when it becomes feasible to do so. Curriculum review is currently scheduled for March 4 (department only) and April 1 (with facilitator), 2022.	Anthropology department Chair; Dean of Arts Office and/or CTE (for the facilitator).	Winter term, 2022
3.	Something should be done to alleviate part of the support staff member's workload	The department will consult with the Dean of Arts office concerning the workload of the Administrative Manager and whether there are options to better support this position.	Anthropology department Chair; Dean of Arts Office.	Spring term, 2022 and ongoing

The Department Chair/Director, in consultation with the Dean of the Faculty shall be responsible for monitoring the Implementation Plan.

Date of next program review: 2026 - 2027

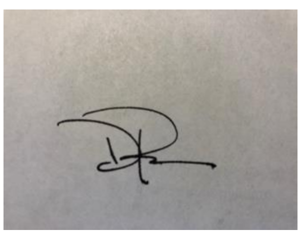
Date

Signatures of Approval:

10 January 2022

Chair/Director Date

AFIW Administrative Dean/Head (For AFIW programs only) Date



17/viii/22

Faculty Dean Date

Note: AFIW programs fall under the Faculty of ARTS; however, the Dean does not have fiscal control nor authority over staffing and administration of the program.

10 June 2022

Associate Vice-President, Academic Date
(For undergraduate and augmented programs)

17 May 2022

Associate Vice-President, Graduate Studies and Postdoctoral Affairs | Date
(For graduate and augmented programs)

Senate Undergrad Committee
Faculty of Environment
October 4, 2022

Course Approvals – (attachment 1)

1. New
2. Revised
3. Inactivated

Academic Plan revisions (major):

4. N/A

Academic Plan revisions (minor):

5. Climate and Environmental Change – (attachment 2)
6. Knowledge Integration Honours – (attachment 3)
7. Knowledge Integration Honours and Joint Honours – (attachment 4)
8. Knowledge Integration Collaborative Design Specialization – (attachment 5)
9. Knowledge Integration Science, Technology, and Society Specialization – (attachment 6)

Academic Regulation revisions (minor):

10. Undergraduate Communications Requirement – (attachment 7)

NEW COURSES (for approval)

Environment, Resources & Sustainability, School of

Effective 01-SEP-2023

ERS 200 (0.50) LEC, TUT Indigenous Sustainability Entrepreneurship

An overview and introduction to environmental sustainability is provided through the lens of Indigenous entrepreneurship. Through a series of case studies students will be introduced to Indigenous sustainability entrepreneurs addressing pressing environmental challenges for Indigenous Peoples and communities. Ultimately, students will be charged with identifying an environmental challenge facing an Indigenous community and developing a business innovation that is a cultural match to protect the planet and future generations.

Requisites : Antireq: ERS 275 001 W23, ERS 275 001 W21

Rationale : Indigenous sustainability entrepreneurship can be defined by a commitment to nation building and economic development centered on Indigenous culture and ways of knowing for the protection of the planet and future generations. Indigenous Knowledge Systems represent an applied science developed over thousands of years that express complex and sophisticated practices for building sustainable relationships with the environment. Although Indigenous Peoples are diverse, they share many of the same contemporary global sustainability challenges such as climate change, water security, food sovereignty and urbanization.
The course gives students the opportunity to apply sustainability concepts to real-life environmental challenges facing Indigenous communities and entrepreneurs. The course content is not currently addressed in our curriculum. Moreover, the course would help to address the Indigenous ways of knowing gaps in the curriculum as identified in the strategic plan. This proposed course also aligns with the Indigenous Entrepreneurship (INDENT) diploma and minor program at United (St. Paul's) College. The course will also serve as an elective for the BSFM program.
Consultation has taken place with BET, SEED, and Arts.
Short title: Indigenous Sust Entr

Geography & Environmental Management

Effective 01-SEP-2023

GEOG 414 (0.50) LEC Climate Justice

An exploration of the implications of climate change through a human rights lens and of related questions about who is responsible for climate change; how the burdens of mitigation, adaptation, and compensation should be distributed; and how to evaluate climate policies, programs, and technologies.

Requisites : Prereq: GEOG 207; Level at least 3A. Antireq: GEOG 474 002 W22

Rationale : This course is one of the series of new courses developed as part of the Climate and Environmental Change (CEC) plan. Although not a required course for the CEC program, this course, together with two others (GEOG 314 Climate Services and GEOG 417 Climate Communication), will substantially enhance the department's offerings on the human dimensions of climate and environmental change.
Need for Consultation: Inclusion of this new course was included as part of the program brief for the new Climate and Environmental Change program, which has since received approval. Extensive discussion and consultation occurred at the time of the development of the program. No issues or concerns were raised with the addition of this course; thus, no further consultation needed.

Short title: Climate Justice

Effective 01-SEP-2023

GEOG 457 (0.50) LEC Wildfire and Landscape Change

Wildfire is a global phenomenon that is expected to increase in extent and severity due to fuel accumulation, shifting land management practices, and climate change. Removal of vegetation by wildfire can alter hydrologic, biogeochemical, and geomorphic processes over a range of spatial and temporal scales in a manner that can be transient or persistent. Alteration of these processes can involve complex responses in both terrestrial and aquatic ecosystems which pose significant financial, environmental, planning, and management challenges. This course will examine the role of climate warming on wildfire behaviour, the impacts of wildfire on landscape form and function, and its impact on hydrologic and geomorphic processes in wildfire impacted landscapes across the globe.

Requisites : Prereq: Level at least 3A. Antireq: GEOG 474 001 W22, GEOG 474 041 W21

Rationale : This course will add to the complement of upper-year courses that explore hydrologic and geomorphic processes, in this case, within the specific context of wildfires. This course complements other fourth year physical geography courses (i.e. GEOG 403: Eutrophication: From Process to Water-Quality Management, GEOG 404: Soil Ecosystem Dynamics, and GEOG 407: Environmental Hydrology of Terrestrial Ecosystems) without duplicating their content. The course will also serve as a viable elective for third- and fourth-year students taking the new BSc in Climate and Environment starting in Fall 2022.
Need for Consultation: Having examined courses offered by other units in the Faculty, and in other Faculties, there does not appear to be any other wildfire-focused course offered on campus. No consultation needed.
Short title: Wildfire & Landscape Change

COURSE CHANGES (for approval)

Dean of Environment

Current Catalog Information

ENVS 395 (2.50) LEC Study Abroad

Study abroad for academic transfer credit under a Faculty of Environment Exchange Program.

Department Consent Required

Effective 01-SEP-2023

Consent Change: Department Consent Required

Rationale : Add "Drop Consent" to this course. This course is the exchange placeholder course for ENV students. Each term the R/O needs to add a 'NG' grade to prevent students from dropping this course without going through the correct process for withdrawing from an exchange. The addition of 'drop consent' streamlines this practice by negating the need for the 'NG' grade to be added.

Current Catalog Information

ENVS 444 (0.50) LAB, LEC Ecosystem and Resource Management in Parks/Natural Areas

From the local to the national level, this course examines the role of protecting and managing terrestrial, aquatic and marine ecosystems. This course also examines the tension between the development of natural resources and conservation by exploring a variety of major themes including biodiversity, ecological integrity and restoration. Normally analytical and field-based activities will be included as well as guest lectures from professionals working in the fields of conservation and protected areas. [Note: WHMIS may be required pending project lab analysis.]

No Special Consent Required

Requisites : Prereq: ENVS 200 or BIOL 150; Level at least 3A

Effective 01-SEP-2023

Requisite Change : Prereq: One of ENVS 200, BIOL 150, BIOL 251; Level at least 3A.

Rationale : BIOL 251 is a new course which is being listed as an anti-req to BIOL 150.

Environment, Resources & Sustainability, School of

Current Catalog Information

ERS 100 (0.50) LEC, TUT Foundations: Environment, Resources and Sustainability

Introduces analytical approaches for problem definition and problem solving that are appropriate for a wide range of environment and resource issues. Considers the limitations of approaches that perceive and attempt to manage issues as isolated phenomena. Also examines alternative approaches that recognize the broader context and underlying roots in ethical positions and ecological, economic, and institutional

systems.
No Special Consent Required
Requisites : Prereq: Environment, Resources and Sustainability students only. Antireq: ERS 110

Effective 01-SEP-2023

Requisite Change :
Rationale : Removal of prerequisite opens this course to all students. Remove antireq as it was last offered 2016/17.

Current Catalog Information

ERS 101 (0.50) LEC, TUT Approaches: Environment, Resources and Sustainability

This course is one of 'solutions-based education' designed to use environmental case studies from local, provincial, national and international communities. We will analyze historical and contemporary cases and consider the interdisciplinary lessons that can be learned from them within the context of climate and technological change, political and economic constraints, community engagement and communication. The specific cases may change year by year depending on current events. Students will be encouraged to critically engage the scholarly, non-governmental, public media literatures and personalities.
No Special Consent Required

Effective 01-SEP-2023

Requisite Change : Prereq: Environment, Resources and Sustainability students only.
Rationale : ERS 101 is the communications course for the ERS plan and only open to ERS students.

Current Catalog Information

ERS 215 (0.50) LEC Environmental and Sustainability Assessment 1

An introduction to processes and techniques for incorporating environmental considerations in planning and evaluating proposals for future undertakings that may have significant social and biophysical effects. The course provides an overview of methodologies for, and controversies surrounding, the design and conduct of biophysical and socioeconomic impact studies, and the testing of reported findings. The main focus is on the purposes and design of environmental assessment processes, with particular reference to the Canadian federal and Ontario provincial legal mandates, and the evolution of assessment into a sustainability framework.
No Special Consent Required
Requisites : Prereq: Level at least 1B

Effective 01-SEP-2023

Course Attribute Change: Only offered Online
Rationale : Course is only offered through CEL. There are no in-person deliveries for this course.

Current Catalog Information

ERS 265 (0.50) LEC, TUT Water: Environmental History and Change

This course explores issues of water management from ancient to recent history. Tensions related to water supply and demand, agriculture and urbanization, health and sanitation, gender and household access to water resources, urban water and wastewater infrastructure, trans-boundary politics, and water privatization debates are considered. Readings and detailed assessments of national and international cases from Europe, Western Asia, and North America are used as a basis for in-class discussion and research projects.

No Special Consent Required

Requisites : Prereq: Level at least 2A Environment, Resources and Sustainability students only.

Effective 01-SEP-2023

Requisite Change : Prereq: Level at least 2A.

Rationale : This course is an elective and should not be restricted to ERS students only.

Current Catalog Information

ERS 335 (0.50) FLD, LEC Restoration Ecology

This course will promote class discussion of the theoretical foundations of restoration ecology and their relationship to project implementation, current academic and professional practice, and forecast trends in the discipline. There will be an emphasis on how restoration ecology is changing in the face of small and large scale ecosystem and cultural dynamics. Class will include instruction and experience on how consultants and private or NGO sectors address restoration ecology. The course will emphasize experiential education in the form of a project scoped for time allotted and involve site design, experimental design, project implementation, statistical analysis of data, and professional level writing for academic and practitioner audiences.

No Special Consent Required

Requisites : Prereq: ENVS 200 or BIOL 150; Level at least 2A. Antireq: ERS 211

Effective 01-SEP-2023

Requisite Change : Prereq: One of ENVS 200, BIOL 150, BIOL 251; Level at least 2A. Antireq: ERS 211.

Rationale : BIOL 251 is a new course which is being listed as an anti-req to BIOL 150.

Current Catalog Information

ERS 337 (0.50) LEC ReWilding and Ecological Restoration

Focus is on restoration and conservation at landscape scale, including an emphasis on connectivity, reintroduction of keystone species, novel ecosystems, re-introduction of apex predators, herbivores, and omnivores. Because ReWilding can be infused with various political agendas and ideologies, technocratic issues, policy ambitions, and governance issues, students can expect to experience a course focused on ecology and technical skills but contextualized and connected to the larger concepts of socioecological change and resilience. There may be opportunities for field experiences.

No Special Consent Required

Requisites : Prereq: ENVS 200 or BIOL 150. Antireq: ERS 375 001 W17; ERS 375 001 W18

Effective 01-SEP-2023

Requisite Change : Prereq: One of ENVS 200, BIOL 150, BIOL 251. Antireq: ERS 375 001 W17, ERS

375 001 W18.

Rationale : BIOL 251 is a new course which is being listed as an anti-req to BIOL 150.

Current Catalog Information

ERS 340 (1.50) FLD, LEC, OLN Ecosystem Assessment

An applied ecology course for those interested in becoming professional ecologists. In keeping with the Ecological Society of America's Professional Ecologist Certification and the Society for Ecological Restoration's Certification Programme, intensive, multiple-weeks of field skill exercises are undertaken including advanced ecological sampling and experimental design, ecological sample analysis, use of provincially recommended protocols such as VSP (Vegetative Sampling Protocol), and intermediate to advanced taxonomic identification skills. May include certification and accreditation opportunities such as the Ontario Benthos Biomonitoring Network (OBBN) and the Ontario Stream Assessment Protocol and training in Electrofishing and Boating (for research). Location of the course will be within southern Ontario. [Note: Field trip fee normally is $700 +HST; it will not exceed $1000+HST. WHMIS required.]

Department Consent Required

Requisites : Prereq: ENVS 200 or BIOL 150; Level at least 2B

Effective 01-SEP-2023

Requisite Change : Prereq: One of ENVS 200, BIOL 150, BIOL 251; Level at least 2B.

Rationale : BIOL 251 is a new course which is being listed as an anti-req to BIOL 150.

Current Catalog Information

ERS 341 (1.50) FLD, LEC, OLN Professional Conservation and Restoration Practice 1

An applied ecology course for those interested in becoming professional ecologists. In keeping with the Ecological Society of America's Professional Ecologist Certification and the Society for Ecological Restoration's Certification Programme, an intensive, multiple-weeks field ecology project that students help design and then implement; students learn how to manage and perform ecosystem restoration and conservation projects. Students also will improve practical site inventory and assessment skills for restoration and conservation goals. Projects may involve site constraints, and potential for bioengineering, bioremediation, vegetation installation, and erosion-control measures. Location of the course will be within southern Ontario. [Note: Field trip fee normally $700+HST; will not exceed $1000+HST. WHMIS required.]

Department Consent Required

Requisites : Prereq: ENVS 200 or BIOL 150; Level at least 2B. Coreq: ERS 340

Effective 01-SEP-2023

Requisite Change : Prereq: One of ENVS 200, BIOL 150, BIOL 251; Level at least 2B.

Rationale : BIOL 251 is a new course which is being listed as an anti-req to BIOL 150.
Remove ERS 340 co-req as these are now stand alone field courses.

Current Catalog Information

ERS 342 (1.00) FLD, LEC Professional Conservation and Restoration Practice 2

An applied ecology course that is designed for those interested in becoming professional ecologists. In keeping with the Ecological Society of America's Professional Ecologist Certification and the Society for Ecological Restoration's Certification Programme, the core vehicle is a 7-10 day field trip that involves on-site discussions of the successes and challenges of ecological restoration and/or conservation projects with practitioners. Normally, these projects are located in the Carolinian Zone and have some focus on coastal areas of Lake Erie. The course will provide a platform for learning the advanced and professional principles of restoration and conservation ecology and the restoration of ecosystem services. [Note: Field trip fee normally $750+HST; will not exceed $1000+HST.]

Department Consent Required

Requisites : Prereq: ENVS 200 or BIOL 150; Level at least 2B

Effective 01-SEP-2023

Requisite Change : Prereq: One of ENVS 200, BIOL 150, BIOL 251; Level at least 2B.

Rationale : BIOL 251 is a new course which is being listed as an anti-req to BIOL 150.

Current Catalog Information

ERS 346 (0.50) LAB, LEC Wildlife Ecology

This course introduces the main concepts and principles of wildlife ecology. Topics include: population dynamics, animal behavior, habitats, genetics, predation, and habitat use. The lab component will introduce students to wildlife data collection, analysis, and interpretation.

No Special Consent Required

Requisites : Prereq: ENVS 178 or STAT 202; ENVS 200 or BIOL 150

Effective 01-SEP-2023

Requisite Change : Prereq: ENVS 178 or STAT 202; One of ENVS 200, BIOL 150, BIOL 251.

Rationale : BIOL 251 is a new course which is being listed as an anti-req to BIOL 150.

Current Catalog Information

ERS 382 (1.00) FLD, LEC, OLN Ecological Monitoring

Through online readings and a 10-day field trip, this course provides students with theoretical and practical knowledge of ecological monitoring through active participation in programs applying protocols developed by the Smithsonian Institute/Man and the Biosphere Program. The course is a collaborative effort with professional staff from selected governmental agencies, and independent organizations. [Note: Field trip fee normally $750+HST; will not exceed $1000+HST. Offered: After spring examinations, prior to the fall term.]

Instructor Consent Required

Requisites : Prereq: ENVS 200 or BIOL 150

Effective 01-SEP-2023

Requisite Change : Prereq: One of ENVS 200, BIOL 150, BIOL 251.

Rationale : BIOL 251 is a new course which is being listed as an anti-req to BIOL 150.

Current Catalog Information

ERS 403A (0.50) PRJ Senior Honours Thesis

This course is for students who have defined a problem, which fits within the scope of research in the School of Environment, Resources and Sustainability, and will undertake original research that leads to production of a thesis. ERS 403A normally leads to the production of a research proposal and the beginning of the research tasks; this process may vary slightly, depending on the nature of the research. The research process and thesis write-up will continue and be concluded in ERS 403B. [Note: Students who wish to take this course should begin intensive planning and discussion with potential advisors in a field relevant to their intended research 6-12 months prior to the course. Students must secure agreement with a professor in SERS to act as the thesis advisor no later than 4 months prior to the start of the course. Note: WHMIS may be required pending project lab analysis.]

Instructor Consent Required

Requisites : Prereq: Level at least 3B; Environment, Resources and Sustainability students only. Antireq: ERS 402; ERS 411A

Effective 01-SEP-2023

Requisite Change : Prereq: Level at least 4A Environment, Resources and Sustainability. Antireq: ERS 402; ERS 411A.

Rationale : Senior honours thesis is restricted to students who are in their final year of study (4A/4B) in the ERS plan.

Current Catalog Information

ERS 403B (0.50) PRJ Senior Honours Thesis

This course is a continuation of ERS 403A. It normally consists of a continuation of the research process that began in ERS 403A and leads to the completion of the research and the thesis write-up. It is for students who have defined a problem related to the mission and scope of the School of Environment, Resources and Sustainability and will undertake original research that leads to production of a thesis. The procedures outlined in ERS 403A must be followed. [Note: WHMIS may be required pending project lab analysis.]

Instructor Consent Required

Requisites : Prereq: Level at least 3B; Environment, Resources and Sustainability students only. Antireq: ERS 402; ERS 411B

Effective 01-SEP-2023

Requisite Change : Prereq: Level at least 4A Environment, Resources and Sustainability. Antireq: ERS 402; ERS 411B.

Rationale : Continuation of ERS 403A. Senior Honours Thesis is for students who are in their final year of study (4A/4B) in the ERS plan.

Current Catalog Information

ERS 443 (1.00) FLD, LEC Ecosystem Field Research

This field research course is designed to involve students in high level intensive research on the function and/or structure of ecosystems as they change because of successional and human processes. Students will normally undertake an experimental approach to an ecosystem-based problem and evaluation outcomes of their experiment or long-term data sets. The course will be focused on one ecosystem per offering, e.g. marine, aquatic, terrestrial forest, mountain. It is expected that the course will be off-campus at a field station or protected area within North America but there may be opportunities to deliver it outside of North America. When offered, the syllabus will

provide details on exact location. [Note: Field trip fee normally $2500+HST; will not exceed $3125+HST.]
Department Consent Required
Requisites : Prereq: ENVS 178 or STAT 202; ENVS 200 or BIOL 150

Effective 01-SEP-2023

Requisite Change : Prereq: ENVS 178 or STAT 202; One of ENVS 200, BIOL 150, BIOL 251.
Rationale : BIOL 251 is a new course which is being listed as an anti-req to BIOL 150.

Current Catalog Information

ERS 446 (0.50) LAB, LEC Wildlife Management

This course introduces the main concepts and principles for the management of wildlife species. This course builds on ERS 346 and explores the application of the principles from that course to the management of wildlife. The lab component will build on the skills of wildlife data collection, analysis, and interpretation presented in ERS 346.
No Special Consent Required
Requisites : Prereq: ENVS 178 or STAT 202; ENVS 200 or BIOL 150, ERS 346

Effective 01-SEP-2023

Requisite Change : Prereq: ERS 346; ENVS 178 or STAT 202; One of ENVS 200, BIOL 150, BIOL 251.
Rationale : BIOL 251 is a new course which is being listed as an anti-req to BIOL 150.

Geography & Environmental Management

Current Catalog Information

GEOG 357 (0.50) LEC, SEM, TUT River Management

Human society was born along the world's greatest rivers and we have depended on rivers for agriculture, drinking water, transportation, and recreation for millennia. However, we have also altered river form and function towards an 'unnatural' condition. This course analyzes the ways in which humans affect river systems, the physical and social mechanisms which complicate the relationship between humans and rivers, and how humans can restore rivers to a more natural state. This course also compares geomorphic, ecologic, and social functioning of rivers in pre- and post-alteration systems. The major theme of this course is navigating the delicate balance between allowing rivers to flow naturally and maintain ecologic functionality while simultaneously maintaining the river's ability to provide services of use to humans. What does human alteration of river systems mean for the current and future state of river ecology, morphology, and hydrology? Can we find a way for rivers to provide functionality that satisfies the needs of both society and nature? This course provides students with the background and tools to take on these and other essential questions and challenges.
No Special Consent Required
Requisites : Prereq: Level at least 2B. Antireq: GEOG 374 041 S20, S21

Effective 01-SEP-2023

Requisite Change : Prereq: Level at least 2B. Antireq: GEOG 374 Topic: River Management S20, S21, S22.
Rationale : The course was offered using the special topics course code for the Spring

2022 since it had not yet been regularized as GEOG 357 in the 2021/2022 calendar. This revision adds the special topics course offering in Spring 2022 as an additional anti-req.

Current Catalog Information

GEOG 452 (1.00) PRJ Resource Management Project

Concepts and techniques of resources management and institutional analysis are applied to the study of a current resource or environmental management issue.

No Special Consent Required

Requisites : Prereq: GEOG 293 or GEOG 294

Effective 01-SEP-2023

Title Change: Climate Change and Environment Project

Description Change: Concepts and techniques of resources management and institutional analysis are applied to the study of a current climate change or environmental management issue.

Rationale : This course is one of the capstone courses for the Climate and Environmental Change specialization. The course is also one of the capstone course options for the new Climate and Environmental Change BSc program, and as such, the title of the course should align with the program (it was noted in the CEC program brief that a project-based course for the program would be redeveloped from this particular resource management project course). Short title: Climate Change & Env Project

Knowledge Integration

Current Catalog Information

INTEG 240 (0.50) LEC Bullshit, Bias, and Bad Arguments

Misinformation, disinformation, propaganda, dishonest political ads, and bullshit (i.e., communication intended to persuade without any concern for truth). It seems it's harder than ever to know what to believe and what makes some claims more credible or trustworthy than others. This course is an introduction to information literacy and the art and science of spotting bullshit and other types of false claims. The course will cover a broad range of issues from a social scientific perspective, including comparisons of different types of deceptive information; the role that cognitive biases and social networks play in shaping our perceptions of truth and reality; the importance of data rights, privacy, and governance models for social media platforms and other digital communications; misrepresentations of science; and how influence campaigns undermine political deliberation and democratic institutions. This course will provide students with knowledge and fundamental skills that are important for countering bullshit, biases, and bad arguments.

No Special Consent Required

Requisites : Prereq: Level at least 2A

Effective 01-SEP-2023

Course Attribute Change: Also offered Online

Rationale : The department wishes to have the flexibility to offer this course either online or in-person.

Current Catalog Information

INTEG 410 (0.50) DIS, LEC, PRJ, SEM Interdisciplinary Collaboration

"Interdisciplinary collaboration" is a popular term these days, but what does it mean, exactly, and what makes it successful? In this course, we will examine the nature of interdisciplinarity (such as differences between multi-, inter-, and transdisciplinarity), barriers to collaborating across disciplinary boundaries, and strategies for facilitating more effective collaborations. The course will be taught using collaborative learning techniques that allow students to shape the direction of the course and to work with the instructor to co-create assignments.

No Special Consent Required

Requisites : Prereq: Level at least 2A Knowledge Integration or Level at least 3A.
Antireq: INTEG 475 W19 001, INTEG 475 W21 041

Effective 01-SEP-2023

Requisite Change : Prereq: Level at least 3A Knowledge Integration or Level at least 4A.

Rationale : Course content is sufficiently advanced that an increase of the academic level is warranted.

Planning - School of

Current Catalog Information

PLAN 340 (0.50) LEC Canadian Environmental Policy and Politics

Consideration of the intersection between key ecological themes and recent policy developments. Investigation of current issues in environmental science and politics. Development of critical skills for assessing, framing and conveying information essential to planning, managing and developing policy for environmental stewardship.

No Special Consent Required

Requisites : Prereq: ENVS 200 or BIOL 150

Effective 01-SEP-2023

Requisite Change : Prereq: One of ENVS 200, BIOL 150, BIOL 251.

Rationale : BIOL 251 is a new course which is being listed as an anti-req to BIOL 150.

Environment, Enterprise & Development - School of

Current Catalog Information

INDEV 200 (0.50) LEC, TUT The Political Economy of Development

This course develops students' understanding of how the complex interplay of international economic and political economy factors influence development initiatives and outcomes. The relation of trade, aid, and international institutions (WTO, IMF, World Bank) on development activity is examined using case studies. Different economic views will be examined.

No Special Consent Required

Requisites : Prereq: INDEV 101

Effective 01-SEP-2023

Requisite Change : Prereq: Level at least 2A

Rationale : This prereq revision will open the course to all students.

COURSE INACTIVATIONS (for approval)

Co-operative Education & Career Action

Effective 01-SEP-2023
WKRPT 200E (0.13) Environment Work-term Report 2
Rationale : Effective September 2022, the work report requirement has been removed for the co-op designation on degrees. Therefore the WKRPT courses are no longer required.

Effective 01-SEP-2023
WKRPT 300E (0.13) Environment Work-term Report 3
Rationale : Effective September 2022, the work report requirement has been removed for the co-op designation on degrees. Therefore the WKRPT courses are no longer required.

Effective 01-SEP-2023
WKRPT 400E (0.13) Environment Work-term Report 4
Rationale : Effective September 2022, the work report requirement has been removed for the co-op designation on degrees. Therefore the WKRPT courses are no longer required.

Geography & Environmental Management

Effective 01-SEP-2023
GEOG 340 (0.50) Settlements of Rural Canada
Rationale : This course will no longer be offered. It is not a core requirement for any academic credential.

Effective 01-SEP-2023
GEOG 410 (0.50) Global Navigation Satellite Systems
Rationale : This course will no longer be offered. It is not a core requirement for any academic credential.

Effective 01-SEP-2023
GEOG 454 (0.50) Retail Landscapes
Rationale : This course will no longer be offered. It is not a core requirement for any academic credential.

End of Report

Climate and Environmental Change (revision)

Effective Date: 01 September 2023
Rationale: Students in the CEC program are required to take BIOL 150 in their second year of study. Biology is making changes to their thematic areas, including the addition of a second-year introductory ecology course that incorporates a lab component to provide students with hands-on learning experiences within their 'Ecology and Evolution' theme. This BIOL 251 course is similar in scope and will be an anti-requisite to BIOL 150. Making the adjustment to the CEC program requirements allows CEC students the option to take either BIOL 150 or the higher-level BIOL 251 course that incorporates the lab component. Biology has been consulted and approves this revision.

Calendar text, including additions (bolded) and deletions (strikethroughs):

https://ugradcalendar.uwaterloo.ca/page/ENV-Honours-Climate-Environmental-Change

Year Two

- ~~BIOL 150 Organismal and Evolutionary Biology~~
- **One of:**
  - **BIOL 150 Organismal and Evolutionary Biology**
  - **BIOL 251 Introductory Ecology**
- ENVS 200 Field Ecology
- GEOG 203 Environment and Development in a Global Perspective
- GEOG 205 Principles of Geomorphology
- GEOG 209 Hydroclimatology
- GEOG 271 Earth from Space Using Remote Sensing
- GEOG 294 Approaches to Research in Physical Geography
- GEOG 310 Geodesy and Surveying
- Electives totaling 1.0 unit
- Total of 5.0 units

Knowledge Integration Honours (revision)

Effective Date: 01 September 2023
Rationale:
Due to the interdisciplinary nature of the Breadth Course Requirement, KI must review its course list each year to ensure that listed courses are current across campus. As part of this year's review, a clerical error was found for PSYCH 391 listed in the Probability and Statistics Breadth Requirement. This course should not be on the list, as a student would complete said requirement by completing a prerequisite for the course.

Change in name of "Ethics" Breadth category to "Ethics and Social Justice": As new courses are being offered through Black Studies (BLKST), some of these have been added to our Breadth Course Requirement. The Ethics Breadth category was expanded to include courses that examine social justice, and we noted that courses from GSJ would be appropriate as well. The particular BLKST courses were selected because they have no prerequisites or address the respective topics: Combating Racisms, critical examination of racial power dynamics. GSJ courses were recommended by the GSJ ACUG.

Units delivering Breadth courses	Consultative status
BLKST	As of July 6, dept. has approved BLKST 201 be added to our Breadth Course Requirement list; consultation continues for BLKST 203
GSJ	Dept. has approved courses to be added to our Breadth Course Requirement list

Calendar text, including additions (bolded) and deletions (strikethroughs):

http://ugradcalendar.uwaterloo.ca/page/ENV-Honours-Knowledge-Integration

Ethics **and Social Justice**
One of: **BLKST 201, BLKST 203/ENGL 225, GSJ 201, GSJ 205, GSJ 207, GSJ 304,** INDEV 300, PACS 311, PACS 314, PACS 315, PACS 316, PACS 332, PHIL 215, PHIL 221, PHIL 224, PHIL 226, PHIL 227, PHIL 228, PHIL 319J, PHIL 320, PHIL 326J, PHIL 328, PHIL 329, PHIL 420, RS 283

Probability and Statistics
One of: ARTS 280, ECON 221, ENVS 278, LS 280/SOC 280, PSCI 314, PSYCH 292, ~~PSYCH 391,~~ SDS 250R, STAT 202, STAT 220

Knowledge Integration Honours and Joint Honours (revision)

Effective Date: 01 September 2023
Rationale:
The minimum cumulative major average (MAV) for the BKI Honours and Joint Honours is being lowered to 70% to be consistent with other academic plans in the Faculty.

The published average to be eligible for admission to the BKI Joint Honours degree is being lowered to reflect the revision to the MAV. Other revisions are editorial in nature and mirror the BKI Honours MAV average calculations, which are used for admission to the Joint Honours degree.

Calendar text, including additions (bolded) and deletions (strikethroughs):

http://ugradcalendar.uwaterloo.ca/page/ENV-Honours-Knowledge-Integration
http://ugradcalendar.uwaterloo.ca/page/ENV-Joint-Honours-with-Knowledge-Integration-1

Knowledge Integration Honours

1. Average Requirements

   - Minimum cumulative major average of ~~75%~~ **70%** (all INTEG courses, PHIL 145, ~~SPCOM 223~~ **COMMST 223**, and all courses counted towards the breadth† requirements); and
   - minimum cumulative overall average of 65% (all courses)

Knowledge Integration Joint Honours

Students must meet the requirements of both plans as stated in this Calendar.

Eligibility for Admission

Normally, a student would be eligible for admission to Joint Honours Knowledge Integration only with:

- Completion of at least two of INTEG 120, INTEG 121, INTEG 220, and INTEG 221; and,
- minimum cumulative major average of ~~75%~~ **70%** (all INTEG courses, **PHIL 145, COMMST 223,** and **all** courses ~~that will~~ count**ed** towards ~~core and~~ ~~B~~**b**readth ~~Course~~ requirements); and~~,~~
- ~~a~~ minimum cumulative overall average of 65% (all courses).

Knowledge Integration Honours, Collaborative Design Specialization (revision)

Effective Date: 01 September 2022
Rationale: Retroactive approval is being requested for the addition of INTEG 499A and 499B and subsequent notes as the calendar text approved at SUC October 2022 was missing this final 1.0 unit requirement. Therefore, the requirements stated in the 2022-2023 calendar are incorrect and do not equal the 4.25 unit requirement.

The notes add clarity to requirements of the INTEG 499A and 499B project for it to be counted towards the CDS specialization and the possibility of a substitution using projects in other disciplines that meet the collaborative design element. Due to the interdisciplinary nature of the KI plan, students commonly complete joint degrees that would allow for special project consideration/substitution.

Registrar's Office has been consulted and have approved the retroactive effective date.

Effective Date: 01 September 2023
Rationale: ERS 318 is a regularly offered course with no prereqs that meets the objectives of collaborative design thinking and skills. Addition of topic in place of 'specifically' is an editorial change for consistency.

Table of Specialization Course Requirements

ERS	Dept. has approved that we would like to add their course to our Collaborative Design Specialization

Calendar text, including additions (bolded) and deletions (strikethrough):

http://ugradcalendar.uwaterloo.ca/page/ENV-Specializations-Knowledge-Integration

Collaborative Design Specialization

Requirements

1. Collaborative Design Thinking and Skills:

   - INTEG 120 The Art and Science of Learning
   - INTEG 121 Collaboration, Design Thinking, and Problem Solving
   - INTEG 251 Creative Thinking
   - One of: BET 350, CS 330, DAC 201 / ENGL 203, DAC 202 / ENGL 204, DAC 203 / ENGL 304, DAC 204, DAC 300, DAC 302, DAC 305, DAC 309, ENGL 293, ENGL 392A, ENGL 392B, **ERS 318,** INTEG 375 (~~specifically "~~ **Topic:** Technology Art Studio), INTEG 410, SPCOM 300, STV 302, SYDE 261

2. Collaborative Design Experience:
    - INTEG 320 The Museum Course: Research and Design
    - INTEG 321 The Museum Course: Practicum and Presentation (0.75 unit)
    - **INTEG 499A and INTEG 499B Independent Group Project (see Notes)**

Note**s**

1. **The INTEG 499A and INTEG 499B project must include a collaborative design element and be approved by the** associate chair, undergraduate studies, Knowledge Integration.
2. **Special topic or project** courses (**totaling** 1.0 unit) that include ~~a~~ collaborative design may be used towards the Collaborative Design Experience **theme** ~~requirement~~ with the approval of the associate chair, undergraduate studies, Knowledge Integration.
3. **See the Knowledge Integration web page for guidance on Collaborative Design Experience.**

Knowledge Integration Honours, Science, Technology, and Society Specialization (revision)

Effective Date: 01 September 2023
Rationale: ENVS 210, ENVS 310, and INDEV 387 are regularly offered courses that meet the objectives of the specialization.

Table of Specialization Course Requirements

ENVS	As of July 6, dept. has been contacted that we would like to add their course to our Science, Technology and Society Specialization
INDEV	As of July 6, dept. has been contacted that we would like to add their course to our Science, Technology and Society Specialization

Calendar text, including additions (bolded):

http://ugradcalendar.uwaterloo.ca/page/ENV-Specializations-Knowledge-Integration

Science, Technology, and Society Specialization

Requirements

- INTEG 120 The Art and Science of Learning
- INTEG 220 Nature of Scientific Knowledge
- INTEG 221 The Social Nature of Knowledge
- One INTEG of: INTEG 240, INTEG 375 (topics: Hands on Sustainability or Science and Technology), INTEG 410, INTEG 441, INTEG 475 (topic: Open Science and Technology)
- Three of the following courses (1.5 units), of which two (1.0 unit) must be at the 300- or 400-level. Courses must be chosen from at least two subject codes (i.e., ERS, PLAN, STV, etc.): ANTH 303, ANTH 347, ANTH 430, ARTS 490 (topic: The Socio-Cultural and Political Implications of Artificial Intelligence), ENGL 108D, ENGL 293, **ENVS 210, ENVS 310,** ERS 265, ERS 316, ERS 372, ERS 404, ERS 406, ERS 422, ERS 454, ERS 462, GEOG 203, GEOG 207, GEOG 306, GEOG 307, GEOG 311, GEOG 426, GEOG 432, HIST 216, **INDEV 387,** PACS 301, PACS 302, PHIL 208, PHIL 224, PHIL 226, PHIL 245, PHIL 252, PHIL 256, PHIL 259, PHIL 271, PHIL 447, PLAN 333, PLAN 340, PLAN 346, PLAN 431, PLAN 432, PLAN 433, PLAN 440, SOC 225, SOC 232, SOC 248, SOC 312, SOC 413, STV 100, STV 201, STV 205, STV 210, STV 302, STV 306, STV 400, STV 401

Undergraduate Communication Requirement (revision)

Effective Date: 01 September 2023
Rationale: Allowing external transfer credits to count towards the ENV UCR milestone, will alleviate confusion for students and will bring ENV rules in line with Arts, Math, and Engineering.

Upon admission to ENV from an external accredited post-secondary institution, equivalent courses to those listed specific to each plan, that meet the University of Waterloo grade equivalent of a least 65%, will qualify for a transfer credit and UCR milestone. If the grade is not considered equivalent to a 65%, then the transfer credit will not be granted. Upon approval of this motion, the Registrar's admission team will be notified for implementation for non-OSS admissions, effective September 2023.

This revision aligns with recent decisions made by the ENV Petitions Committee for the June 2022 convocation in which external transfer credits that met the grade equivalent threshold were approved for the UCR milestone.

The rule regarding future registrations being cancelled if the UCR milestone has not been met by the completion of 2B has been removed, as this rule has never been implemented. Instead students are directed to their academic advisor to discuss the completion of this requirement if not met by 2B.

All other changes to this section are editorial in nature.

Calendar text, including additions (bolded) and deletions (strikethroughs):

http://ugradcalendar.uwaterloo.ca/page/ENV-Overview-of-Academic-Plan-Requirements

Undergraduate Communication Requirement

Bachelor of Environmental Studies, Bachelor of Knowledge Integration, and Bachelor of Science

The University requires that all students ~~have~~ **demonstrate** ~~basic~~ competency in English language communications – oral, written, and other media. First-year ~~required~~ **core** courses have been identified in each ~~major~~ **academic plan** that provide the English language communication skills needed for successful completion of degree requirements. These courses are:

- Bachelor of Environmental Studies (BES):
  - Environment and Business: ENVS 131
  - Environment, Resources and Sustainability: ERS 101
  - Geography and Aviation, Geography and Environmental Management, and Geomatics: ENGL 109 or EMLS 129R
  - International Development: INDEV 101
  - Planning: PLAN 102
- Bachelor of Knowledge Integration (BKI):
  - Knowledge Integration: ~~SPCOM 223~~ **COMMST 223**
- Bachelor of Science (BSc):

- Climate and Environmental Change: ENGL 109 or EMLS 129R

The Undergraduate Communication Requirement (UCR) milestone on a student's academic record will indicate that one of the following rules has been met:

1. **The above listed core course for the student's academic plan, or one of the other above listed courses, has been completed with a final grade of 65% or higher.**
2. **The UCR milestone has been earned by the student while enrolled in another University of Waterloo faculty.**
3. **At time of admission to the Faculty of Environment, a transfer credit from an external accredited post-secondary institution has been granted for one of the above listed courses.**

Notes:

- **Earning an UCR milestone and the satisfactory completion of the listed core course specific to each academic plan are two unique and distinct degree requirements. Both requirements must be satisfied to be eligible for a Faculty of Environment degree.**
- **Students who have not attained the UCR milestone by the end of their 2B term must meet with their academic advisor to discuss the completion of this requirement.**
- **If a grade of 65% or higher is not achieved in the core course listed for the academic plan, a student may be eligible to repeat the course to meet the UCR milestone requirement (see Academic Standing as well as the Courses, Enrolment, and Grades pages of this Calendar for more information on repeating courses).**

~~To demonstrate competency in communications, students must achieve a grade of 65% or higher in the identified course for their academic plan.~~

~~Students who do not achieve this grade must fulfil this requirement by the end of their 2B term in one of the following ways:~~

- ~~Repeating the course and achieving 65% or higher (see Academic Standing as well as the Courses, Enrolment, and Grades pages of this Calendar for more information on repeating courses).~~
- ~~Completing any of the above listed courses and achieving 65% or higher. Students may require the permission of the academic unit offering the course to enrol.~~

~~Notes for the BES, BKI, and BSc academic plans~~

1. ~~An Undergraduate Communication Requirement (UCR) milestone on a student's academic record will indicate successful completion of this requirement.~~
2. ~~Students who have not completed the Undergraduate Communication Requirement by the end of second year will have their future registrations cancelled and will be allowed to proceed only after successful completion of this requirement.~~
3. ~~Specialized sessions are available through the Writing and Communication Centre and are open to all students. Students are also invited to visit the Writing and Communication Centre during drop-in hours for course work assistance. The Writing and Communication Centre does not charge students for its services.~~

4. ~~Transfer credits from an external institution cannot be used to satisfy the Undergraduate Communication Requirement.~~
5. ~~Students transferring into the Faculty of Environment who have completed any of the above courses with the required grade of 65% will be granted the UCR milestone.~~
6. ~~An UCR milestone obtained while enrolled in another University of Waterloo faculty will satisfy this requirement.~~

Bachelor of Sustainability and Financial Management (BFSM)

Information on the Undergraduate Communication Requirement for the Bachelor in Sustainability and Financial Management can be found on the degree requirement page for the program. This program is offered jointly by the faculties of Arts and Environment but follows the Faculty of Art's rules and regulations.

WATERLOO | ENGINEERING

Engineering Undergraduate Office

MEMORANDUM

September 20, 2022

TO: **Tim Weber-Kraljevski, Associate University Secretary, Secretariat**

FROM: **Dan Davison, Associate Dean, Undergraduate Studies, Faculty of Engineering**

SUBJECT: **Items for Approval at October 4, 2022 Senate Undergraduate Council**

ALL CURRICULUM CHANGES ARE EFFECTIVE SEPTEMBER 2023 UNLESS OTHERWISE NOTED.

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1. **New Courses** *[For Approval]*
   1.1 General Engineering (GENE 21R and GENE 23R)
   1.2 Biomedical Engineering (BME530, BME540)
   1.3 Mechanical Engineering (ME540)

2. **Course Changes** *[For Approval]*
   2.1. Architectural Engineering (AE392)
   2.2. Biomedical Engineering (BME252, BME587, BME588, BME589)
   2.3. Civil Engineering (CIVE306)
   2.4. Electrical & Computer Engineering (ECE405, ECE457C)
   2.5. Environmental Engineering (BIOL 462/EARTH 444)
   2.6. Mechatronics Engineering (MTE544, MTE545, MTE546)
   2.7. Nanotechnology Engineering (NE109, NE110, NE131, NE140, NE333)
   2.8. Systems Design Engineering (SYDE263)

3. **Course In-activations** *[For Approval]*
   3.1 Architectural Engineering (AE 392)
   3.2 Computer Engineering (ECE100A, ECE100B, ECE 200A, ECE200B, ECE300A, ECE300B, ECE400A, ECE400B)
   3.3 Nanotechnology Engineering (NE101, NE102B, NE201A, NE202B, NE301A, NE302)

4. **Academic Regulations** *[For Approval]*
   4.1. Academic Decisions
   4.2. Academic Promotion Rules

5. **Academic Plans (Major Modifications)** *[For Approval]*
    5.1 Biomedical Engineering
    5.2 Civil Engineering

6. **Academic Plans (Minor Modifications)** *[For Approval]*
    6.1. Architectural Engineering
    6.2. School of Architecture
    6.3. Biomedical Engineering
    6.4. Chemical Engineering
    6.5. Civil Engineering
    6.6. Computer Engineering
    6.7. Electrical Engineering
    6.8. Environmental Engineering
    6.9. Geological Engineering
    6.10. Management Engineering
    6.11. Mechanical Engineering
    6.12. Mechatronics Engineering
    6.13. Nanotechnology Engineering
    6.14. Systems Design Engineering
    6.15. Artificial Intelligence Option
    6.16. Biomechanics Option
    6.17. Management Sciences Option
    6.18. Complementary Studies Electives List

7. **Other**
    7.1. Electrical Engineering *[For Information]*
    7.2. Temporary Calendar Deviations due to the Pandemic

NEW COURSES (for approval)

Dean of Engineering

Effective 01-SEP-2023

GENE 21R (0.50) LEC Topics for Technical Courses Taken on Exchange by Architectural Engineering Students

Courses taken at foreign universities by University of Waterloo engineering students while enrolled in an international exchange institution, and reserved for courses without equivalents at the University of Waterloo. These courses are treated as technical electives in the student's plan. Such courses are reported on the student's transcript with their original titles in English showing as the topic. [Note: The grades for these courses will be either CR or NCR.]

Rationale : Waterloo engineering students occasionally take courses while on exchange at one of our partner universities which are treated as technical electives but do not have a direct equivalent to a Waterloo course. Similar GENE 21x courses were previously created and approved for Architecture, Biomedical, Chemical, Civil, Computer, Electrical, Environmental, Geological, Management, Mechanical, Mechatronics, Nanotechnology, Software, and Systems Design Engineering.
[Short title: Topics: Techn Exchange Courses]

Effective 01-SEP-2023

GENE 23R (0.50) LEC Topics for Natural Science Elective Courses Taken on Exchange by Architectural Engineering Students

Courses taken at foreign universities by University of Waterloo engineering students while enrolled in an international exchange institution, and reserved for courses without equivalents at the University of Waterloo. To earn credit the exchange courses will include the exploration of the physical and chemical interactions of the natural world, and the systematic observation and understanding of physical and natural phenomena through analytical and/or experimental techniques. These courses are treated as natural science electives in the student's plan. Such courses are reported on the student's transcript with their original titles in English showing as the topic. [Note: The grades for these courses will be either CR or NCR.]

Rationale : Waterloo engineering students occasionally take courses while on exchange at one of our partner universities which are treated as Natural Science electives but do not have a direct equivalent to a Waterloo course. Similar GENE 23x courses were previously created for Computer, Civil, Electrical, and Software Engineering.
[Short title: Topics: Nat Sci Exch Courses]

End of Report

NEW COURSES (for approval)

Dean of Engineering

Effective 01-SEP-2023

BME 530 (0.50) LEC The Healthcare System

A broad introduction to the Canadian healthcare system, with emphasis on factors related to biomedical engineering. History, structure, and function of various healthcare organizations, procurement practices in healthcare, electronic health records, and information exchange. [Offered: W]

Requisites : Prereq: Level at least 3A. Antireq: HLTH 245/GERON 245

Rationale : This new course is part of the Medical Artificial Intelligence specialization. It is crucial that such a course is available to biomedical engineering students, because many of their careers will depend on interacting with the healthcare system, and understanding the particular needs and constraints associated with this system. This course topic was first offered in winter 2022 under the subject code of SYDE 599 as a special topics course. This was not ideal, because it is a complementary studies elective, while SYDE 599 is normally used for technical electives. The department is also committed to offering the course regularly going forward.

There is a related existing course, HLTH 245/GERON 245 (Canadian Health Systems), which is open to engineering students. Compared to that course, BME 530 will have less emphasis on health promotion, political issues, and social theory, and more emphasis on procurement practices, healthcare information, and function of healthcare delivery organizations.
[Short title: Healthcare System]
No final exam

Effective 01-SEP-2023

BME 540 (0.50) LEC Fundamentals in Neural and Rehabilitation Engineering

Introduction to the field of neural and rehabilitation engineering (NRE). Topics include describing common neurological and musculoskeletal injuries, related neural and rehabilitation engineering approaches to address disabilities, and the development of a design framework for synthesizing a novel neural and rehabilitation engineering approach. Critical concepts in clinical research design to meet current regulatory, ethical, and practice policies will be studied. [Offered: W]

Requisites : Prereq: Level at least 4A Biomedical or Systems Design Engineering

Cross-listed as: ME 540

Rationale : Fundamentals in Neural and Rehabilitation Engineering was first offered as a graduate special topics course (ME 780) in 2015. Undergraduate students showed an interest and ME 597 (13756) was offered as a technical elective in 2018. The assigned course code (ME 597) was meant to be a temporary special topics designation and needs to be changed to a regular course code to reflect the long-term teaching of this course in MME.

It is one of two BME courses that MME runs as part of MME's contribution to the BME plan with BME 588 (special topics) first offered in 2020. Enrolment has been 20 MME students and 10 SYDE/BME students over the past three years. BME would like to add this course to one of their specializations.
[Short title: Neural & Rehabilitation Eng]
No final exam.

University of Waterloo
Undergraduate Catalog Report
Faculty of Engineering

Run Date 22-JUN-2022
Meeting Number(s) 17

NEW COURSES (for approval)

Mechanical and Mechatronics Engineering

Effective 01-SEP-2023

ME 540 (0.50) LEC Fundamentals in Neural and Rehabilitation Engineering

Introduction to the field of neural and rehabilitation engineering (NRE). Topics include describing common neurological and musculoskeletal injuries, related neural and rehabilitation engineering approaches to address disabilities, and the development of a design framework for synthesizing a novel neural and rehabilitation engineering approach. Critical concepts in clinical research design to meet current regulatory, ethical, and practice policies will be studied. [Offered: W]

Requisites :	Prereq: Level at least 4A Mechanical or Mechatronics Engineering
Cross-listed as:	BME 540
Rationale :	Fundamentals in Neural and Rehabilitation Engineering was first offered as a graduate special topics course (ME 780) in 2015. Undergraduate students showed an interest and ME 597 (13756) was offered as a technical elective in 2018. The assigned course code (ME 597) was meant to be a temporary special topics designation and needs to be changed to a regular course code to reflect the long-term teaching of this course in MME. It is one of two BME courses that MME runs as part of MME's contribution to the BME plan with BME 588 (special topics) first offered in 2020. Enrolment has been 20 MME students and 10 SYDE/BME students over the past three years. BME would like to add this course to one of their specializations. [Short title: Neural & Rehabilitation Eng] No final exam.

End of Report

COURSE CHANGES (for approval)

Civil and Environmental Engineering

Current Catalog Information

AE 392 (0.00)

Effective 01-SEP-2023

Requisite Change :	Prereq: MATH 116; Level at least 3B Architectural Engineering, 2B Civil Engineering, 3A Environmental or Geological Engineering
New Cross Listing :	CIVE 392 ENVE 392 GEOE 392
Rationale :	This course is being added to the existing CIVE/ENVE/GEOE version, This increases the visibility of plans. In order to do so, the existing AE 392 is being inactivated since two existing separate courses can't be combined in the system without this manipulation.

Current Catalog Information

CIVE 306 (0.50) LEC, TUT Mechanics of Solids 3

Membrane stresses in shells. Buckling. Beams on elastic foundations. Plane elasticity. Torsion of non-circular sections. [Offered: F]

No Special Consent Required

Requisites : Prereq: CIVE 205; Level at least 3B Civil or Geological Engineering

Effective 01-SEP-2023

Title Change:	Solid Mechanics 3
Rationale :	The revised title matches the preceding courses CIVE 204 Solid Mechanics 1, and CIVE 205 Solid Mechanics 2. Short title has been updated to Solid Mechanics 3.

Current Catalog Information

CIVE 392 (0.50) LEC, TST, TUT Economics and Life Cycle Cost Analysis

Project financing, life-cycle cost analysis, time value of money, sensitivity analyses, tax, financial implications of infrastructure projects, quantitative decision-making, financial aspects of a business plan. [Offered: S]

No Special Consent Required

Requisites : Prereq: MATH 116; Level at least 2B Civil Engineering. Antireq: MSCI 261, SYDE 262

Cross-listed as: ENVE 392 GEOE 392

Effective 01-SEP-2023

New Cross Listing :	ENVE 392 GEOE 392 AE 392
Rationale :	This course should be cross listed with CIVE, ENVE, GEOE 392 since all are

the same course taught in the Civil and Environmental Engineering department to different cohorts. It is desirable to cross list most common courses so that the subject code matched the student's plan. This increases the visibility of plans, especially Environmental and Geological Engineering, through courses listed in each academic plan.

Current Catalog Information

GEOE 392 (0.50) LEC, TST, TUT Economics and Life Cycle Cost Analysis

Project financing, life-cycle cost analysis, time value of money, sensitivity analyses, tax, financial implications of infrastructure projects, quantitative decision-making, financial aspects of a business plan. [Offered: S]

No Special Consent Required

Requisites : Prereq: MATH 116; Level at least 3A Geological Engineering. Antireq: MSCI 261, SYDE 262

Cross-listed as: CIVE 392 ENVE 392

Effective 01-SEP-2023

New Cross Listing : CIVE 392 ENVE 392 AE 392

Rationale : This course should be cross listed with CIVE, ENVE, GEOE 392 since all are the same course taught in the Civil and Environmental Engineering department to different cohorts. It is desirable to cross list most common courses so that the subject code matched the student's plan. This increases the visibility of plans, especially Environmental and Geological Engineering, through courses listed in each academic plan.

Dean of Engineering

Current Catalog Information

ENVE 392 (0.50) LEC, TST, TUT Economics and Life Cycle Cost Analysis

Project financing, life-cycle cost analysis, time value of money, sensitivity analyses, tax, financial implications of infrastructure projects, quantitative decision-making, financial aspects of a business plan. [Offered: S]

No Special Consent Required

Requisites : Prereq: MATH 116; Level at least 3A Environmental Engineering. Antireq: MSCI 261, SYDE 262

Cross-listed as: CIVE 392 GEOE 392

Effective 01-SEP-2023

New Cross Listing : CIVE 392 GEOE 392 AE 392

Rationale : This course should be cross listed with CIVE, ENVE, GEOE 392 since all are the same course taught in the Civil and Environmental Engineering department to different cohorts. It is desirable to cross list most common courses so that the subject code matched the student's plan. This increases the visibility of plans, especially Environmental and Geological Engineering, through courses listed in each academic plan.

COURSE CHANGES (for approval)

Current Catalog Information

BME 252 (0.50) LEC, TUT Linear Signals and Systems

Models and analysis of linear systems in the context of measurement and processing of biosignals such as electroencephalography (EEG), electrocardiography (ECG), and electromyography. Discrete and continuous time systems, difference and differential equations, impulse and frequency response, transform domain techniques, transfer functions and frequency response, frequency domain analysis of linear systems, sampling theory, stability, and linear filters. [Offered: S]

No Special Consent Required

Requisites : Prereq: Level at least 2B Biomedical Engineering. Antireq: SYDE 252

Effective 01-SEP-2023

Title Change: Linear Systems and Signals

Rationale : The original course title was poorly named as it implied the study of linear signals rather than linear systems. Short title has been updated to Linear Systems & Signals.

Current Catalog Information

BME 587 (0.50) LEC, TUT Special Topics in Biomedical Signals

This course deals with selected topics at the undergraduate level in medical imaging and diagnostics, biosignals, and neuroscience. [Offered: F, W]

Department Consent Required

Requisites : Prereq: Level at least 3A Engineering

Effective 01-SEP-2023

Consent Change: No Special Consent Required

Requisite Change : Prereq: Level at least 3A Biomedical Engineering

Rationale : The department consent is removed as it created additional administrative work and is not useful beyond the opportunity to consult with the instructor. This course should not require preparation beyond the biomedical engineering core courses. The prerequisite is updated to reflect this. Many of these special topics courses are held with courses in other plans (e.g., Nanotechnology Engineering). Instructors can admit remaining students on a case-by-case basis from other plans.

Current Catalog Information

BME 588 (0.50) LEC, TUT Special Topics in Biomechanics

This course deals with selected topics at the undergraduate level in biofluid mechanics, tissue mechanics, sports engineering, and rehabilitation engineering. [Offered: F, W]

Department Consent Required

Requisites : Prereq: Level at least 3A Engineering

Effective 01-SEP-2023

Consent Change: No Special Consent Required

Requisite Change : Prereq: Level at least 3A Biomedical Engineering

Rationale : The department consent is removed as it created additional administrative work and is not useful beyond the opportunity to consult with the instructor. This course should not require preparation beyond the biomedical engineering core courses. The prerequisite is updated to reflect this. Many of these special topics courses are held with courses in other plans (e.g., Nanotechnology Engineering). Instructors can admit remaining students on a case-by-case basis from other plans.

Current Catalog Information

BME 589 (0.50) LEC, TUT Special Topics in Biomedical Devices

This course deals with selected topics at the undergraduate level in assistive devices, implants, prostheses, orthoses, biomedical technologies, therapeutics, and biocompatibility. [Offered: F, W]

Department Consent Required

Requisites : Prereq: Level at least 3A Engineering

Effective 01-SEP-2023

Consent Change: No Special Consent Required

Requisite Change : Prereq: Level at least 3A Biomedical Engineering

Rationale : The department consent is removed as it created additional administrative work and is not useful beyond the opportunity to consult with the instructor. This course should not require preparation beyond the biomedical engineering core courses. The prerequisite is updated to reflect this. Many of these special topics courses are held with courses in other plans (e.g., Nanotechnology Engineering). Instructors can admit remaining students on a case-by-case basis from other plans.

End of Report

COURSE CHANGES (for approval)

Electrical & Computer Engineering

Current Catalog Information

ECE 405 (0.50) LEC, TUT Introduction to Quantum Mechanics

Introduction to quantization, wave-particle duality and the uncertainty principle. The Schroedinger equation and solvable examples. Topics include stationary states of particle-in-a-box, harmonic oscillator and the hydrogen atom. Quantization of angular momentum and spin. Introduction to approximation methods including time-independent perturbation theory. Modern applications of quantum mechanics. [Offered: W]

No Special Consent Required

Requisites : Prereq: ECE 105, 106, MATH 117, (ECE 205 or MATH 211). Antireq: AMATH 373, CHEM 356, NE 232, PHYS 233, 234

Effective 01-SEP-2023

Requisite Change : Prereq: ECE 105, 106, MATH 117, (ECE 205/MATH 211 or MATH 213). Antireq: CHEM 356, NE 232, PHYS 233, 234

Rationale : The prerequisites are updated adding MATH 213 which is taken by Software Engineering students, and covers both differential equations (using Laplace transforms) and their application in systems and signals. The antirequisites are updated removing AMATH 373 as this course is sufficiently different from ECE 405, and is reasonable for a student to take both courses.

Current Catalog Information

ECE 457C (0.50) LEC, PRJ, TUT Reinforcement Learning

Introduction to reinforcement learning (RL) theory and algorithms for learning decision-making policies in situations with uncertainty and limited information. Topics include Markov decision processes, classic exact/approximate RL algorithms such as value/policy iteration, Q-learning, State-action-reward-state-action (SARSA), Temporal Difference (TD) methods, policy gradients, actor-critic, and Deep RL such as Deep Q-Learning (DQN), Asynchronous Advantage Actor Critic (A3C), and Deep Deterministic Policy Gradient (DDPG). [Offered: S]

No Special Consent Required

Requisites : Prereq: One of BME 213, ECE 203, MTE 201, STAT 206, SYDE 212. Antireq: ECE 493 Quantum Information Processing Devices

Effective 01-SEP-2023

Requisite Change : Prereq: One of BME 213, ECE 203, MTE 201, STAT 206, 230, 240, SYDE 212. Antireq: ECE 493 Probabilistic Reasoning and Reinforcement Learning

Rationale : The prerequisite is updated adding STAT 230 and STAT 240. Computer Science would like to add ECE 457C to their AI Specialization. Computer Science students take STAT 230 or STAT 240, and some Software Engineering students

COURSE CHANGES (for approval)

Mechanical and Mechatronics Engineering

Current Catalog Information

MTE 544 (0.50) LAB, LEC, TUT Autonomous Mobile Robots

Fundamentals of autonomous mobile robotics, including both perception and planning for autonomous operation, sensor modelling, vehicle state estimation using Bayes Filters, Kalman Filters, and Particle Filters as well as onboard localization and mapping. Topics in planning include vehicle motion modelling and control, as well as graph based and probabilistic motion planning of (Micro Electro Mechanical Systems) MEMS devices. [Offered: F]

No Special Consent Required

Requisites : Prereq: Level at least 3B Computer, Electrical, Mechanical, Mechatronics, or Systems Design Engineering

Effective 01-SEP-2023

Requisite Change : Prereq: Level at least 3B Biomedical, Computer, Electrical, Mechanical, Mechatronics, or Systems Design Engineering

Rationale : The prerequisite is updated to add Biomedical Engineering students as they wish to take these courses as fourth-year technical electives. Currently these students require an instructor to enrol them via a course override. This addition will eliminate having to use a course override to enrol.

Current Catalog Information

MTE 545 (0.50) LAB, LEC, TUT Introduction to MEMS Fabrication

Introduction to MEMS. Fabrication processes for MEMS devices. Basic MEMS governing equations in different energy domains (mechanical, electrical, and thermal). Methods for layout, design, and modeling of MEMS devices. Simulation techniques. Techniques for testing and characterization of MEMS devices. [Offered: F]

No Special Consent Required

Requisites : Prereq: Level at least 3B Computer, Electrical, Mechanical, Mechatronics, or Systems Design Engineering

Effective 01-SEP-2023

Requisite Change : Prereq: Level at least 3B Biomedical, Computer, Electrical, Mechanical, Mechatronics, or Systems Design Engineering

Rationale : The prerequisite is updated to add Biomedical Engineering students as they wish to take these courses as fourth-year technical electives. Currently these students require an instructor to enrol them via a course override. This addition will eliminate having to use a course override to enrol.

Current Catalog Information

MTE 546 (0.50) LAB, LEC Multi-sensor Data Fusion

Sensor data and information fusion systems. Sensor modelling, including characterization of uncertainty. Sensor fusion approaches for estimation and decisions including weighted least squares, extended Kalman Filter, Dempster-Shafer evidential reasoning, artificial neural networks; Outlier rejection; Spatial and temporal registration. Course project involving independent study of one aspect of sensor data fusion. [Offered: W]

No Special Consent Required

Requisites : Prereq: ECE 484; (MTE 201 or ME 202)

Effective 01-SEP-2023

Requisite Change : Prereq: Level at least 3B Biomedical, Computer, Electrical, Mechanical, Mechatronics, or Systems Design Engineering

Rationale : The prerequisite is updated to add Biomedical Engineering students as they wish to take these courses as fourth-year technical electives. Currently these students require an instructor to enrol them via a course override. This addition will eliminate having to use a course override to enrol. ECE 484; (MTE 201 or ME202) are being removed as prerequisites to provide more flexibility.

End of Report

COURSE CHANGES (for approval)

Dean of Engineering

Current Catalog Information

NE 109 (0.50) LEC, TUT Societal and Environmental Impacts of Nanotechnology

Nanotechnology in society; health and environmental sustainability; engineering ethics, policies, and regulations; Canadian legal system, tort, and intellectual property; examples of nanotechnology innovation and commercialization. [Offered: F]

No Special Consent Required

Requisites : Prereq: Level 1A Nanotechnology Engineering

Effective 01-SEP-2023

Description Change: Nanotechnology in society; health and environmental sustainability; introduction to environmental life cycle assessments; engineering ethics, policies, and regulations; Canadian legal system, tort, and intellectual property; examples of nanotechnology innovation and commercialization. [Offered: F]

Rationale : It was identified that the Nanotechnology Engineering plan was weak in graduate attribute 9: Impact of engineering on society and the environment. Courses were examined for opportunities to introduce sustainability concepts and techniques into the curriculum. The goal is to insert elements of sustainability that would enhance the NE plan, into the course descriptions and bring it into closer alignment with UW's commitment towards a more sustainable campus. Since Nanotechnology Engineering is a horizontal discipline, sustainable awareness in our students will provide them with opportunity to use this to impact many different sectors in society.

This non-technical course had already delivered sustainability content, and the calendar changes will now reflect this in the course description.

Current Catalog Information

NE 110 (0.50) LEC Introduction to Nanomaterials Health Risks

Nanomaterial impacts on worker, consumer, and environmental health. Engineered nanomaterials and ultrafines. Chemical risk assessment. Nanomaterial exposure characterization. Introductory nanotoxicology. Environmental chemical impacts, transport, and bio-accumulation. Human risks, and benefits. Introductory epidemiology, including study design, strength of association, bias, confounding, and causal inference. [Offered: W]

No Special Consent Required

Requisites : Prereq: Level at least 1B Nanotechnology Engineering

Effective 01-SEP-2023

Description Change: Nanomaterial impacts on worker, consumer, and environmental health. Engineered nanomaterials and ultrafines. Chemical risk assessment. Nanomaterial exposure characterization. Introductory nanotoxicology. Environmental chemical impacts, transport, and bio-accumulation. Introduction to UN Sustainable Development Goals. Human nanomaterial health risks and benefits. Introductory epidemiology, including study design, strength of association, bias, and confounding and causal inference. [Offered: W]

Rationale : It was identified that the Nanotechnology Engineering plan was weak in graduate attribute 9: Impact of engineering on society and the environment. Courses were examined for opportunities to introduce sustainability concepts and techniques into the curriculum. The goal is to insert elements of sustainability that would enhance the NE plan, into the course descriptions and bring it into closer alignment with UW's commitment towards a more sustainable campus. Since Nanotechnology Engineering is a horizontal discipline, sustainable awareness in our students will provide them with opportunity to use this to impact many different sectors in society.

This new course, (first offered Winter 2023) taken by students in their 1B term, aggregates the previous nanomaterial health risks milestone material. This non-technical course will introduce the United Nations' Sustainable Development Goals, building on the program's Global Citizenship learning objective, more specifically examining human health and environmental goals.

Current Catalog Information

NE 131 (0.50) LEC, TST, TUT Physics for Nanotechnology Engineering

A first course in physics that introduces basic topics in classical mechanics, wave mechanics, and physical optics. [Offered: W]

No Special Consent Required

Requisites : Prereq: MATH 117; Level at least 1B Nanotechnology Engineering. Antireq: PHYS 111, 115, 121, SYDE 182

Effective 01-SEP-2023

Component Change: LEC, TST, TUT

Requisite Change : Prereq: MATH 117; Level at least 1B Nanotechnology Engineering. Antireq: BME 182, CIVE 104, ECE 105, PHYS 111, 115, 121, SYDE 182

Rationale : The contact hours for NE students in the 1B term is 30.5 hrs/week. The instructor has described that students expressed they don't have time to reflect on any of the material where there is either class or tutorial every day of the week. The reduction in the contact hours from 4 lectures to 3 lectures would normalize this course in comparison to other 0.5 CR introductory physics courses offered across campus, and would also lighten the workload of students in their 1B term. The antirequisites list is also updated to more fully reflect the courses available to students.

Current Catalog Information

NE 140 (0.50) LAB, LEC, TUT Linear Circuits

Charge, current, and voltage. Resistance, Ohm's Law, Kirchhoff's voltage, and current laws. Nodal, mesh analysis, and source transformation. Superposition, Thévenin, and Norton equivalents. Capacitance, inductance, electrical energy dissipation, and first-order transient response circuits. Phasors, impedances, and alternating current (AC) steady state analysis. Diodes circuit applications. Ideal operational amplifier circuits. Frequency filter types, and active filter circuits' configuration.
[Offered: W]
No Special Consent Required

Requisites : Prereq: Level at least 1B Nanotechnology Engineering. Antireq: BME 392, ECE 140, GENE 123, MTE 120, SYDE 292

Effective 01-SEP-2023

Description Change: Charge, current, and voltage. Resistance, Ohm's Law, Kirchhoff's voltage, and current laws. Nodal, mesh analysis, and source transformation. Superposition, Thévenin, and Norton equivalents. Capacitance, inductance, electrical energy dissipation, and first-order transient response circuits. Phasors, impedances, and alternating current (AC) steady state analysis. Ideal operational amplifier circuits. Frequency filter types, and active filter circuits' configuration. Introduction to the fundamentals of electronic waste recycling. [Offered: W]

Requisite Change : Prereq: Level at least 1B Nanotechnology Engineering. Antireq: AE 123, (BME294 and BME 294L), CIVE 123, ECE 140, ENVE 123, GENE 123, GEOE 123, ME 123, MTE 120, SYDE 292

Rationale : It was identified that the Nanotechnology Engineering plan was weak in graduate attribute 9: Impact of engineering on society and the environment. Courses were examined for opportunities to introduce sustainability concepts and techniques into the curriculum. The goal is to insert elements of sustainability that would enhance the NE plan, into the course descriptions and bring it into closer alignment with UW's commitment towards a more sustainable campus. Since Nanotechnology Engineering is a horizontal discipline, sustainable awareness in our students will provide them with opportunity to use this to impact many different sectors in society.

This course will introduce elements addressing the challenges associated with electronic waste and its recycling. The description change will contribute to the program's Global Citizenship and Disciplinary Connections as students examine the particular challenges associated with sustainable electronics development. The description is updated to also remove diodes circuits applications, as this is covered in NE 242, a more advanced course. The antirequisites list is also updated to fully reflect the courses available to students.

Current Catalog Information

NE 333 (0.50) LEC, TUT Macromolecular Science

Basic definitions and polymer nomenclature, molecular weight averages and distributions, constitutional and configurational isomerism, rubber elasticity, step-growth and free-radical chain-growth polymerizations, emulsion polymerization.
[Offered: S]
No Special Consent Required

Requisites : Prereq: NE 225; 3A Nanotechnology Engineering. Antireq: CHE 541, CHEM 370, MNS 322

Effective 01-SEP-2023

Description Change: Basic definitions, polymer types and nomenclature, molecular weight averages and distributions, structure and properties. Chemical kinetics, step-growth and free-radical chain-growth polymerizations, polymer recycling and sustainable design. [Offered: S]

Rationale : It was identified that the Nanotechnology Engineering plan was weak in graduate attribute 9: Impact of engineering on society and the environment. Courses were examined for opportunities to introduce sustainability concepts and techniques into the curriculum. The goal is to insert elements of sustainability that would enhance the NE plan, into the course descriptions and bring it into closer alignment with UW's commitment towards a more sustainable campus. Since Nanotechnology Engineering is a horizontal discipline, sustainable awareness in our students will provide them with opportunity to use this to impact many different sectors in society.

The course description is updated to include the topic of chemical kinetics. The instructor covered this topic in class but is not in the calendar description, and this subject had been removed from earlier chemistry courses. Material not key to an introductory polymer course, including discussions on emulsion polymerization, have been removed to make room for discussions on sustainability.

COURSE CHANGES (for approval)

Systems Design Engineering

Current Catalog Information

SYDE 263 (0.25) LAB, LEC Engineering Prototyping

This course addresses the practical aspects of design and technical communication. By using a series of workshops culminating in a comprehensive final project, students gain the hands-on experience necessary for prototyping and design validation. Topics include generating technical specifications, material selection, fastener basics, motor selection, electronic switching, reading data sheets and schematics, and advanced microcontroller implementation. [Note: the lecture and laboratory components are offered alternate weeks. Offered: W]

No Special Consent Required

Requisites : Prereq: 2A Systems Design Engineering

Effective 01-SEP-2023

Description Change: This course addresses the practical aspects of design and technical communication. By using a series of workshops culminating in a comprehensive final project, students gain the hands-on experience necessary for prototyping and design validation. Topics include generating technical specifications, material selection, fastener basics, motor selection, electronic switching, reading data sheets and schematics, and advanced microcontroller implementation. [Note: the lecture and laboratory components are offered alternate weeks. This course is graded as CR/NCR. Offered: W]

Rationale : This course was mounted in winter 2021 as pass/fail. The foundation for this course is to give students hands-on experience. From observations and from student feedback, having this course as pass/fail allowed students more freedom to explore the course content (and learn more in the process) as they were not having to worry about achieving a certain numerical grade. [sarecord: please code this course CNC instead of NUM]

End of Report

COURSE INACTIVATIONS (for approval)

Civil and Environmental Engineering

Effective 01-SEP-2023

AE 392 (0.50) Economics and Life Cycle Analysis

Rationale : This course is being cross listed to the existing CIVE/ENVE/GEOE version, and in order to do so the existing AE392 is being inactivated since two existing separate courses cannot be ‘combined” in the system without this manipulation.

End of Report

COURSE INACTIVATIONS (for approval)

Effective 01-SEP-2023
ECE 100A (0.20) Electrical and Computer Engineering Practice
Rationale : This course is inactivated as it is no longer taught. It has been replaced by ECE 190 Engineering Profession and Practice.

Effective 01-SEP-2023
ECE 100B (0.20) Electrical and Computer Engineering Practice
Rationale : This course is no longer taught, and is being replaced with ECE 102.

Effective 01-SEP-2023
ECE 200A (0.10) Electrical and Computer Engineering Practice
Rationale : This course is no longer taught. It has been replaced by the new class-professor seminar course ECE 201 Information Session.

Effective 01-SEP-2023
ECE 200B (0.10) Electrical and Computer Engineering Practice
Rationale : This course is no longer taught. It has been replaced by the new class-professor seminar course ECE 202 Information Session.

Effective 01-SEP-2023
ECE 300A (0.10) Electrical and Computer Engineering Practice
Rationale : This course is no longer taught. It has been replaced by the new class-professor seminar course ECE 301 Information Session.

Effective 01-SEP-2023
ECE 300B (0.10) Electrical and Computer Engineering Practice
Rationale : This course is no longer taught. It has been replaced by the new class-professor seminar course ECE 302 Information Session.

Effective 01-SEP-2023
ECE 400A (0.10) Electrical and Computer Engineering Practice
Rationale : This course is no longer taught. It has been replaced by the new class-professor seminar course ECE 401 Information Session.

Effective 01-SEP-2023
ECE 400B (0.10) Electrical and Computer Engineering Practice
Rationale : This course is no longer taught. It has been replaced by the new class-professor seminar course ECE 402 Information Session.

End of Report

COURSE INACTIVATIONS (for approval)

Effective 01-SEP-2023
NE 101 (0.00) Nanotechnology Engineering Practice
Rationale : Two of Nanotechnology Engineering's three departments with faculty assigned to deliver the NE curriculum do not have class professor tasks assigned to faculty, and so inactivating the seminar/class professor hours would align NE with those departments. This change also increases the flexibility in the student schedules for electives, decreasing the need for override forms when there are conflicts, particularly in terms where the NE plan has heavy time commitments to laboratory courses.

Instead of relying on class professors who may not understand how to answer certain curriculum level questions, the NE director and associate directors will regularly reach out to different cohorts as they progress through their studies. Throughout the pandemic these meetings have been virtual and recorded for those who cannot attend, and this process may work well going forward. This method of communication will help ensure there is a pathway to resolve issues that may not be resolved within the class rep meetings, will let students know who they can reach out to for advising or if they are struggling, and will facilitate meetings with instructors who see unique opportunities arise from which students would benefit.

Effective 01-SEP-2023
NE 102B (0.00) Nanotechnology Engineering Practice
Rationale : see the rationale for NE 101

Effective 01-SEP-2023
NE 201A (0.00) Nanotechnology Engineering Practice
Rationale : see the rationale for NE 101

Effective 01-SEP-2023
NE 202B (0.00) Nanotechnology Engineering Practice
Rationale : see the rationale for NE 101

Effective 01-SEP-2023
NE 301A (0.00) Nanotechnology Engineering Practice
Rationale : see the rationale for NE 101

Effective 01-SEP-2023
NE 302 (0.00) Nanotechnology Engineering Practice
Rationale : see the rationale for NE 101

End of Report

4. Academic Regulations

4.1. Academic Decisions

Rationale:

Updating language as the current wording of the various academic decisions currently doesn't exactly match what students see on Quest, and the current associated descriptions are unclear or incomplete. Parts of the content in the first paragraph are outdated and other parts are unnecessary.

This Academic Decisions section of the calendar applies to all Engineering programs except for Architecture.

Academic Decisions	MARK UP

~~At the end of each term, the examining faculty members submit grades for that term's courses. Each department or board then reviews the performance of its students and makes recommendations to the Engineering Examinations and Promotions Committee. The Engineering Examinations and Promotions Committee then considers the evidence on which the recommendations have been made and assigns the official academic decision. An appeal or petition relating to an assigned academic decision, grade, or other evaluation, or relating to other decisions based on University policies, may be made by following the procedures outlined in Petitions, Grievances and Appeals. All academic decisions and grades are reported to the student through the Office of the Registrar.~~

Academic decisions for Engineering students are based on the performance of the student in the current term and may depend on the previous term decision, as outlined in the Rules. The possible academic decisions and their effect on the student's progress are as follows:

1. **Promoted** – **A student with this decision** proceeds to **the** next term. **For a full-load student, Promoted appears as EXCL, GOOD, or SAT. EXCL, or excellent, is applied if the weighted term average is 80% or above. GOOD is applied if the weighted term average is 70% or above, but less than 80%. SAT, or satisfactory, is applied if the weighted term average is 60% or above, but less than 70%. A student in a reduced-load program completing their 1A requirements will see Promoted.** (Normally appears on transcripts as: EXCL, GOO~~D, SAT, or Promoted).~~
2. ~~**May**~~ **Continue in 1A**~~**, see advisor**.~~ – **A** ~~S~~student **with this decision proceeds to their second 1A Reduced-Load term as part of their first 1A term in Engineering. Thus, the student has zero previous failed terms.** ~~permitted to enrol in one more reduced-load term to complete 1A requirements. (Normally appears on transcripts as May Continue in 1A).~~
3. ~~**May Continue in 1A no previous failed terms, see advisor**. This decision is similar to the May Continue in 1A decision above, however, is used in the case of students with a reduced Load in their first 1A term in Engineering (and thus the student has zero previous failed terms). (Normally appears on transcripts as May Continue in 1A No Penalty).~~ **Continue in 1A With Penalty – A student with this decision is permitted to enrol in one more 1A Reduced-Load term to complete their 1A requirements, after a previously unsuccessful attempt at a 1A term or at a 1A Reduced-Load term.**
4. **Conditional** - ~~added to~~ **Replaces** academic decision 1 or ~~3~~ **2** to indicate that the student has adequate understanding of the term material to permit continuation; however, the failed course(s) must be cleared before graduation. ~~(Normally appears on transcripts as Conditional).~~
5. **Promotion Granted – Replaces an academic decision of Conditional when the student clears the failed course(s), except for students in their first 1A Reduced-Load term in their first 1A term. For students in their first 1A Reduced-Load term in their first 1A term, an**

academic decision of Continue in 1A replaces an academic decision of Conditional when the student clears the failed course.

6. ~~**Academic**~~ **Decision Deferred** – **A** student **with this decision** may not proceed until specified conditions are satisfied. ~~(Normally appears on transcripts as Decision Deferred).~~
7. ~~**Required to**~~ **Failed - Must Repeat Term** – **A student with this decision is required to** ~~a failed term academic decision requiring that the student~~ repeat the most recent term. Except for 1A **students**, the student must stay out a minimum of two terms before repeating. ~~(Normally appears on transcripts as Failed - Must Repeat Term).~~
8. **May Not Proceed** – **A student with this decision** ~~the student~~ may not proceed to the next degree term **n**or take required courses from that term until the academic decision has been changed to Promoted or to Conditional. ~~(Normally appears on transcripts as May Not Proceed).~~
9. **May Not Proceed COOP** - ~~the student~~ **A student with this decision** has three (or more) missing ~~(~~or failed~~)~~ work-term credits and may not proceed to the next term or take required courses from that term until the decision has been changed to Promoted or to Conditional.
10. **Failed - Required to Withdraw** ~~**from Engineering**~~ - ~~the student's~~ **A student with this decision has their** registration in their plan - Bachelor of Applied Science (BASc) or Bachelor of Software Engineering (BSE) - ~~is~~ revoked. Readmission is not possible for four academic terms following the term for which the decision applies. ~~(Normally appears on transcripts as Failed - Required to Withdraw).~~
11. **Failed - Required to Withdraw** ~~**after**~~ **from 1A** ~~**Engineering**~~ - ~~the student's~~ **A student with this decision has their** registration in their plan - Bachelor of Applied Science (BASc) or Bachelor of Software Engineering (BSE) - ~~is~~ revoked. Application for readmission may be considered for a qualifying readmission program immediately; however, the term of entry may vary depending on circumstances. ~~(Normally appears on transcripts as Failed - Required to Withdraw from 1A).~~
12. **Aegrotat** - ~~added to~~ **Replaces** academic decision 1, 2, or 3**.** ~~the term result is successful~~. ~~The student has adequate understanding of the material, but because of illness or other extenuating circumstances, normal evaluation for at least one course was not possible. (Normally appears on transcripts as Aegrotat).~~ **A student with this decision may continue to the next term even though, due to extraordinary circumstances, normal evaluation for at least one course was not possible.**
13. ~~**Proceed o**~~**On Probation** - ~~a~~ **This academic** decision **is** used in exceptional circumstances ~~that~~ **to** allow~~s the~~ **a** student to proceed to the next term. Continued progress in the plan is contingent on satisfying conditions which may be prescribed as the terms of probation. ~~(Normally appears on transcripts as On Probation).~~

Academic Decisions CLEAN COPY

Academic decisions for Engineering students are based on the performance of the student in the current term and may depend on the previous term decision, as outline in the Rules. The possible academic decisions and their effect on the student's progress are as follows:

1. **Promoted** - A student with this decision proceeds to the next term. For a full-load student, Promoted appears as EXCL, GOOD, or SAT. EXCL, or excellent, is applied if the weighted term average is 80% or above. GOOD is applied if the weighted term average is 70% or above, but less than 80%. SAT, or satisfactory, is applied if the weighted term average is 60% or above, but less than 70%. A student in a reduced-load program completing their 1A requirements will see Promoted.
2. **Continue in 1A** - A student with this decision proceeds to their second 1A Reduced-Load term as part of their first 1A term in Engineering. Thus, the student has zero previous failed terms.

3. **Continue in 1A with Penalty** - A student with this decision is permitted to enrol in one more 1A Reduced-Load term to complete their 1A requirements, after a previously unsuccessful attempt at a 1A term or at a 1A Reduced-Load term.
4. **Conditional** - Replaces academic decision 1 or 2 to indicate that the student has adequate understanding of the term material to permit continuation; however, the failed course(s) must be cleared before graduation.
5. **Promotion Granted** – Replaces an academic decision of Conditional when the student clears the failed course(s), except for students in their first 1A Reduced-Load term in their first 1A term. For students in their first 1A Reduced-Load term in their first 1A term, an academic decision of Continue in 1A replaces an academic decision of Conditional, when the student clears the failed course.
6. **Decision Deferred** - A student with this decision may not proceed until specified conditions are satisfied.
7. **Failed - Must Repeat Term** - A student with this decision is required to repeat the most recent term. Except for 1A students, the student must stay out a minimum of two terms before repeating.
8. **May Not Proceed** - A student with this decision may not proceed to the next degree term nor take required courses from that term until the academic decision has been changed to Promoted or to Conditional.
9. **May Not Proceed COOP** - A student with this decision has three (or more) missing or failed work-term credits and may not proceed to the next term or take required courses from that term until the decision has been changed to Promoted or to Conditional.
10. **Failed - Required to Withdraw** - A student with this decision has their registration in their plan - Bachelor of Applied Science (BASc) or Bachelor of Software Engineering (BSE) - revoked. Readmission is not possible for four academic terms following the term for which the decision applies.
11. **Failed - Required to Withdraw from 1A** - A student with this decision has their registration in their plan - Bachelor of Applied Science (BASc) or Bachelor of Software Engineering (BSE) - revoked. Application for readmission may be considered for a qualifying readmission program immediately; however, the term of entry may vary depending on circumstances.
12. **Aegrotat** - Replaces academic decision 1, 2, or 3. A student with this decision may continue to the next term even though, due to extraordinary circumstances, normal evaluation for at least one course was not possible.
13. **On Probation** - This academic decision is used in exceptional circumstances to allow a student to proceed to the next term. Continued progress in the plan is contingent on satisfying conditions which may be prescribed as the terms of probation.

4.2. Academic Promotion Rules

Rationale:

Update wording for the promotion rules to make less challenging to navigate. None of the promotion rules are actually changing.

Update MNP-coop table to include a line for 4F stream students and to fix a typo in the 4S stream line.

Update wording pertaining to work-term report requirements since some programs are replacing separate work-term reports with the reflective reports that are embedded in PD courses.

This Rules section of the calendar applies to all Engineering programs except for Architecture

Rules	MARK UP

The following rules are applied when students' performance is assessed; unless otherwise stated the rules apply to reduced-load 1A, reduced-load, and full-load terms. There are several decision descriptors that can be added to the decision described in the rules below.

1. All (full-load) students are expected to enrol in at least the number of courses specified in this Calendar= for the corresponding term of their plan. A reduced-load student may drop one elective course per term= (as defined by their plan) by obtaining the approval of their academic advisor. These are the courses= used to calculate the term average, which is the basis of promotion decisions. Courses not included in= the degree, term average, or failure count must be identified at the time of enrolment (see Rule ~~11~~ **12**).= See Rule ~~15~~ **16** for information regarding changing a course's designation. The designation of these= courses may be changed (with the approval of the department) at any time prior to four weeks before= the first day of the Final Examination Period for that term. Reduced-load 1A students must enrol in= three courses (a load of at least 1.5 and normally less than a full load) as specified by their academic= advisor. Normally, the reduced-load 1A term will be composed of at least two core courses from the=1A term with other courses specified by the academic advisor in consultation with the student.
2. ~~Term decisions are described in the tables below. There are a number of decision descriptors that can= be added to the decision described in the rules following the table.~~ The term decision is based on the= **student's course load during the term**, **the** previous term decision, the term average for the current= term, and the number of courses **taken that term** with grades below 50. The term average is calculated= using the weight of the course, the status of the course (e.g., DRNA), and the interpreted course grade.= All grades above 32 are interpreted as the submitted grade. Courses with a submitted grade below 32= are interpreted for averaging purposes, as having a value of 32. Both the number of courses below 50=in the current term as well as the cumulative number of To Be Cleared (T~~BC) co~~urses **(the TBC count)** on a student's record can be part of the decision.

Full- and reduced-load terms (excluding reduced-load 1A terms):

~~**Previous Decision**~~	~~**Term average greater than or equal to 60 and:**~~ ~~**0. No failed courses**~~ ~~**1. Full-load term, one or two failed courses, and less than three TBC courses**~~ ~~**2. Reduced-load term, one failed course, and less than three TBC courses**~~ ~~**3. TBC courses more than two, and term 2A or higher**~~	~~**Term average greater than or equal to 50 but less than 60, or Term average greater than or equal to 60 and either**~~ ~~**4. full-load term and more than two failed courses, or**~~ ~~**5. reduced-load term and more than one failed course**~~	~~**Term average less than 50**~~
~~Promoted~~	~~6. Promoted~~ ~~7. Promoted (conditional)~~ ~~8. Promoted (conditional)~~ ~~9. May Not Proceed~~	~~Failed - Required to Repeat~~	~~Failed - Withdrawal Required~~
~~No previous term~~	~~10. Promoted~~ ~~11. Promoted (conditional)~~ ~~12. Promoted (conditional)~~ ~~13. May Not Proceed~~	~~Failed - Required to Repeat~~	~~Failed - Withdraw from 1A~~
~~Failed - Required to Repeat~~	~~14. Promoted (if no failed courses)~~ ~~15. Failed - Withdrawal Required (any failed courses)~~ ~~16. Failed - Withdrawal Required (any failed courses)~~ ~~17. Failed - Withdrawal Required~~	~~Failed - Withdrawal Required~~	~~Failed - Withdrawal Required~~

For students in full-load terms and reduced-load terms, the term decision is based on the current term average, the number of courses taken during the term with a grade below 50%, the previous term decision, and in some cases one or more of, the course load, the level, and the TBC count.

1. Students with a term average of 60% or greater and no course grades below 50% are promoted with a term decision of **SAT** (satisfactory), **GOOD**, or **EXCL** (excellent).
2. Students with a term average of 60% or greater with one or more course grades below 50% who are in their first term of Engineering or whose previous term decision was not Failed – Must Repeat Term, the term decision depends on the level and, for students at level 2A or above, on the TBC count. The TBC count includes courses in the current term with grades below 50%. There are several decision descriptors that can be added to the decision described in the rules below.
3. Students in 1A or 1B, the term decision depends on the course load and the number of course grades below 50%.

        1. Students on a full-course load with no more than two course grades below 50% are promoted with a term decision of **Conditional**.
        2. Students on an elective reduced-course load with no more than one course grade below 50% are promoted with a term decision of **Conditional**.
        3. Students on a full course load with more than two course grades below 50% have a term decision of **Failed – Must Repeat Term**.
        4. Students on an elective reduced-course load with more than one course grade below 50% have a term decision of **Failed – Must Repeat Term**.
    2. Students in 2A and beyond with a TBC count below three, the term decision depends on the course load and the number of course grades below 50%.
        1. Students on a full course load with no more than two course grades below 50% are promoted with a term decision of **Conditional**.
        2. Students on an elective reduced-course load with no more than one course grade below 50% are promoted with a term decision of **Conditional**.
        3. Students on a full course load with more than two course grades below 50% have a term decision of **Failed – Must Repeat Term**.
        4. Students on an elective reduced-course load with more than one course grade below 50% have a term decision of **Failed – Must Repeat Term**.
    3. Students in 2A and beyond with a TBC count above two have a term decision of **May not Proceed.**
3. Students with a term average below 60% and/or one or more course grades below 50%, whose previous term decision was Failed – Must Repeat Term have a term decision of **Failed – Required to Withdraw**.
4. Students with a term average of 50% or greater, but less than 60% who are in their first term of Engineering or whose previous term decision was not Failed – Must Repeat Term, have a term decision of **Failed – Must Repeat Term.**
5. Students with a term average less than 50% who are in their first term of Engineering have a term decision of **Failed – Required to Withdraw from 1A.**
6. Students with a term average less than 50% who are not in their first term of Engineering have a term decision of **Fail – Required to Withdraw**.

Reduced-load 1A terms:

~~**Previous Decision**~~	~~**Term average greater than or equal to 60 and:**~~ ~~**1. No failed courses**~~ ~~**2. One failed course**~~	~~**Term average greater than or equal to 60 and more than one failed course, or term average greater than or equal to 50 but less than 60**~~	~~**Term average less than 50**~~
~~No previous term~~	~~3. May Continue in 1A No Failed Terms~~ ~~4. May Continue in 1A No Failed Terms (Conditional)~~	~~Failed - Required to Repeat~~	Failed - ~~Withdraw from 1A~~
~~MC1A - May Continue in 1A, see advisor~~	~~5. Promoted~~ ~~6. Failed - Withdrawal Required~~	~~Failed - Withdrawal Required~~	~~Failed - Withdrawal Required~~
~~MC1A0 - May Continue in 1A No~~	~~7. Promoted~~	~~May Continue in 1A~~	~~Failed - Withdraw~~

~~Previous Failed Terms, see advisor~~	~~8. Promoted (Conditional)~~		from 1A
Failed - Required to Repeat, see advisor	~~9. May Continue in 1A~~ ~~10. Failed - Withdrawal Required~~	Failed - Withdrawal Required	Failed - Withdrawal Required

For students in the 1A Reduced-Load Program (RLP), the term decision depends on the term (i.e., the first 1A RLP term or the second 1A RLP term) and is based on the current term average, the number of courses taken during the term with a grade below 50%, and the previous term decision.

1. Students with a term average of 60% or greater and no course grades below 50%, the term decision depends on the term.
    1. Students in the first 1A term of the RLP, the term decision depends on the previous term decision.
        1. Students in their first 1A RLP term continue in the RLP with a term decision of **Continue in 1A**.
        2. Students whose previous term decision was Failed – Must Repeat Term continue in the RLP with a term decision of **Continue in 1A With Penalty**.
        3. Students in the second term of the RLP are promoted with a term decision of **Promoted**.
2. Students with a term average of 60% or greater and one course grade below 50%, and whose previous term decision was neither Failed – Must Repeat Term nor Continue in 1A With Penalty, the term decision depends on the term.
    1. Students in their first 1A RLP term continue in the RLP with a term decision of **Conditional**.
    2. Students in their second 1A RLP term are promoted with a term decision of **Conditional**.
3. Students with a term average of 60% or greater and more than one course grade below 50%, and whose previous term decision was neither Failed – Must Repeat Term nor Continue in 1A With Penalty, the term decision depends on the term.
    1. Students in their first 1A RLP term have a term decision of **Failed – Must Repeat Term**.
    2. Students in their second 1A RLP term have a term decision of **Continue in 1A With Penalty**.
4. Students with a term average below 60% and/or one or more course grades below 50%, and whose previous term decision was Failed – Must Repeat Term or Continue in 1A with Penalty, the term decision is **Failed – Required to Withdraw**.
5. Students with a term average of 50% or greater but less than 60%, and whose previous term decision was neither Failed – Must Repeat Term nor Continue in 1A With Penalty, the term decision depends on the term.
    1. Students in their first 1A RLP term have a term decision of **Failed – Must Repeat Term**.
    2. Students in the second 1A RLP term have a term decision of **Continue in 1A With Penalty**.
6. Students with a term average less than 50%, and whose previous term decision was neither Failed – Must Repeat Term nor Continue in 1A With Penalty, are **Required to Withdraw from 1A**.

3. ~~(Conditional) is appended to Promoted, May Continue in 1A, and May Continue in 1A No Failed Terms decisions if the student has a minimum average of 60% and fewer than three failed courses for a~~

~~Promoted decision with a full-load term, or fewer than two failed courses for a Promoted decision with reduced-load term, or May Continue in 1A or May Continue in 1A No Failed Terms.~~ If an academic decision of Conditional is used in place of a Promoted or May Continue in 1A, decision, ~~T~~the condition may be satisfied only by successfully clearing the failed course(s) (see the Introduction). Once the condition is satisfied, the ~~(~~Conditional~~) is removed from the decision~~ **is replaced with a decision of Promotion Granted or May Continue in 1A** . No student may obtain the Bachelor of Applied Science (BASc) or Bachelor of Software Engineering (BSE) degree with an academic decision including (Conditional) remaining on their record.

4. (Aegrotat) is appended to Promoted, May Continue in 1A, ~~May Continue in 1A No Failed Terms,~~ and Proceed on Probation decisions if one or more courses are graded as AEG (Aegrotat, credit granted under extenuating circumstances) and the other conditions for the decision are met.
   <<#5 becomes #6, and #6 becomes #5>>
5. While repeating ~~the~~ **a** term, a student shall be excused from repeating individual courses in which a grade of 70% or better has been achieved. If this occurs, substitute courses, as approved by the department, must be taken, such that the student takes at least a reduced load in the repeat term.
6. (No Penalty) may be appended to the decision to repeat a term. In this case, the requirement to stay out for two terms before repeating the term is waived and the term is not counted as a repeat term with regard to the number of times a term can be repeated or in the calculation of the total number of terms of full-time study in the plan. This condition is normally applied as a result of extenuating circumstances which significantly affect the student's performance in the failed term.
7. ~~A full-load student, at level 2A or higher, who achieves a minimum term average of 60% and has failed zero, one, or two courses in that term for a cumulative total of three or more TBC courses will receive the decision May Not Proceed (MNP). A reduced-load student at level 2A or higher, who achieves a minimum term average of 60% and has failed zero or one course in that term for a cumulative total of three or more TBC courses will receive the decision May Not Proceed.~~ Normally, ~~the~~ a student with an academic decision of May Not Proceed (MNP) will enrol in a non-degree term devoted to retaking or replacing all or as many as possible of the TBC courses. ~~In the event that~~ If some of the TBC courses are not available, the department may specify equivalent or appropriate alternative courses to be taken in their place. If the student is otherwise in good standing, the academic decision will be changed to Promoted when the number of TBC courses has been reduced to none. If the student is otherwise in good standing, the academic decision will be changed to Promoted (Conditional) when the number of TBC courses has been reduced to one. A student clearing TBC courses under this rule must achieve a minimum grade of 50% for failed courses and a minimum grade of 60% for dropped courses, otherwise the student will be Required to Withdraw from Engineering.
8. The plan must be completed in no more than 10 terms of full-time (full-load or reduced-load) study; that is, no more than two repeat terms are allowed. A student receiving a third failed term academic decision will be Required to Withdraw from Engineering. Both full-load and reduced-load students are in this category.
9. In extraordinary circumstances, a student with a term average below 60% may be allowed to Proceed on Probation or if any course grade is AEG (see Rule 3) may be allowed to Proceed on Probation (Aegrotat).
10. A student may be Required to Withdraw from Engineering at any time if in the opinion of the Faculty the student is unlikely to benefit from further participation in Engineering, the student leaves the plan without notification and fails to write examinations (receives a grade of DNW [Did not write examination, no credit granted, value 32] for some courses), or the student has made two or more unsuccessful attempts to clear the same failed course.
11. Courses taken by students during work terms will not be included in the average for any term. However, the grades for the courses taken at the University of Waterloo or at another university on a Letter of Permission will be reported on the student's transcript. Courses taken during work terms are eligible to be used towards a reduced-load term.

12. There are five types of courses applicable to Engineering undergraduate plans (BASc or BSE): depending on whether the course is part of the degree requirements, or not; whether the course will be included in term average calculations, or not; and whether the course is in the TBC count, or not. These courses are shown on the student record and transcripts as follows:

Description	Designation	Degree Requirement	In Average	In To Be Cleared (TBC) Count
Plan requirement, included in average	blank	Yes	Yes	Yes
Plan requirement, not included in average, in TBC count, supplemental exam (SUPP) not permitted	DRNA	Yes	No	Yes
Plan requirement, not in average, and not in TBC count	DRNC	Yes	No	No
Not required for plan, in average, not in TBC count	TRIA	No	Yes	No
Not required for plan, not in average	NRNA	No	No	No

With the exception of work-term reports (see Rule ~~17~~ **18**), a mixture of courses of type DRNA and courses of type TRIA will not be permitted in a single term. Grades for courses that are not included in the term average or not required for the plan will be reported on the student's transcript. Undergraduate students (BASc or BSE) are not permitted to enrol in any course in an audit category. The Faculty of Engineering does not permit other undergraduate students to enrol in Engineering courses in an audit category.

13. DRNC courses, while not in the TBC count, are normally associated with courses that must be completed by a certain point (i.e., must be completed before the end of 3A). That point is referred to as the completion date and is provided in the plan description portion of this Calendar for those plans that use DRNC courses. A student that has not completed the course successfully by the completion date will receive a May Not Proceed decision.
14. Although it is the Senate of the University that confers degrees, the Faculty of Engineering does recommend students for degrees in Engineering. A student who has successfully met all of the requirements will be Recommended for the BASc or BSE degree. The degree awarded will be the one associated with the plan of registration. A student who has demonstrated exceptional performance will be Recommended for the BASc or BSE Degree with Distinction. This recognition is granted to a student who has a cumulative average of 80% or greater, starting with their first enrolment in the 3A term, of those courses that are requirements for their plan, and that have been included in a corresponding term average (i.e., those courses of type blank above). Courses taken while on exchange, or terms for which the academic decision has Aegrotat added as a qualifier, do not contribute to the cumulative average. In such cases, the cumulative average will include the most recent four academic terms completed at Waterloo for which a numerical average is available.
15. Most courses at the University of Waterloo are assigned a numerical grade (between zero and 100) by the examiners. Any grade from zero to 32 is treated as having a value of 32 when averages (for promotions and awards) are calculated. Non-numerical grade definitions and university-level processes are included in the Grades section of this Calendar.
16. Changes to the set of courses included in the term average, which students take in a particular term, may be permitted at the discretion of the student's department. Such changes must normally be

arranged and approved before the end of the Drop/Add Period, specified in the Calendar of Events and Academic Deadlines. After this period, only exceptional cases will be considered. Courses not included in the average in any academic term may be dropped at any time prior to the start of Drop with WF Period, and courses will be graded as WD (withdrew).

17. Students are expected to maintain a balance between the number of academic terms completed and the number of work-term credits earned. Situations that are defined as out of balance are characterized in the table below. For example: 1 (4) - meaning one work-term credit, four work-term opportunities, that would otherwise earn a decision permitting them to enrol in the next academic term, will receive a term decision of **May Not Proceed COOP** and will be unable to enrol in an academic term until they have completed at least two more work terms. Normally, this will require an absence from academic study for one year. During the one year following the academic term with this decision, the student is expected to find employment that can be treated as (at least) two work terms, recovering the work-term credits required to continue academically.

    May Not Proceed COOP

    Number of Credited COOP courses (minimum number of opportunities)
    Current Academic Term (Excellent, Good, Satisfactory, Conditional)

Stream	2B	3A	3B	4A	4B
4	0 (3)	1 (4)	2 (5)	3 (6)	3 (6)
8	not applicable	0 (3)	1 (4)	2 (5)	3 (6)
4D	0 (3)	1 (4)	1 (4)	3 (6)	3 (6)
8D	not applicable	0 (3)	2 (5)	3 (6)	3 (6)
4F	**0 (3)**	**1 (4)**	**1 (4)**	**2 (5)**	**3 (6)**
4S	0 (3)	1 (4)	2 (5)	~~3~~ 2 (5)	3 (6)
8S	not applicable	0 (4)	1 (4)	3 (6)	3 (6)
8X	not applicable	0 (3)	1 (4)	3 (6)	3 (6)

    Once the student has earned credit for two or more additional work terms, the term decision will be changed to the normal academic decision for the term.

18. ~~Three work-term report credits are required of all BASc and BSE students. A work-term report credit is obtained by achieving a grade of satisfactory or better for a work-term report course. No student will be allowed to graduate without having achieved the required work-term report credits.~~

    Work-term report ~~courses~~ **requirements** are plan **dependent and may be met through technical reports, reflective reports, presentations, or some alternative method**.~~specified in the plan section of this Calendar, and depending on the plan, may require reports, presentations, or some alternative method of meeting this requirement~~. If the plan specifies its own courses then those courses may be included in the term average, or excluded from the average. Some plans may use the common work-term report courses (**WKRPT 100**, WKRPT 200 ~~or WKRPT 201~~, WKRPT 300 ~~or WKRPT 301~~, and WKRPT 400 ~~or WKRPT 401~~). For the plans using the shared courses, the following regulations are in place.

Work-term reports submitted as one of the WKRPT courses are due seven days after the first official day of lectures of the academic term in which the report is required. Reports submitted after the deadline will receive grades of **Unacceptable (38)** and will be carried forward to the following academic term for evaluation, and are not eligible for prizes. Failed work-term reports are cleared by retaking the WKRPT course and passing it in a subsequent term.

Work-term report courses **WKRPT 100,** WKRPT 200, WKRPT 300, and WKRPT 400 are considered to be required courses of type DRNA: failed work-term report evaluations contribute to the accumulated failed course count (see Rule 6). For failed work-term reports, the original grade will appear in the grade field. The failed course will be corrected by retaking and passing the course in a subsequent term.

~~Work-term report courses WKRPT 201, WKRPT 301, and WKRPT 401 are considered to be required courses of type DRNC: failed work-term report evaluations do not contribute to the accumulated failed course count but will delay progress if not completed by the specified term (see Rule 12~~ **13**~~). For failed work-term reports, the original grade will appear in the grade field. The failed course will be cleared by retaking and passing the course in a subsequent term.~~

When a work-term report (submitted as one of the WKRPT courses) has been submitted and the grade obtained is **Resubmit**, the student must provide any subsequent submissions by the date lectures end for that term, as specified in this Calendar, in order for those submissions to be considered in that term. Failure to clear a **Resubmit** by the lectures end date will result in a grade of **Unacceptable (38)**. Any submissions after the lectures end date will be deemed to be new submissions and to have been submitted for consideration in the following term.

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Bachelor of Applied Science and Bachelor of Software Engineering Specific Degree Requirements

Examinations and Promotions

Rules

The following rules are applied when students' performance is assessed; unless otherwise stated the rules apply to reduced-load 1A, reduced-load, and full-load terms.

1. All (full-load) students are expected to enrol in at least the number of courses specified in this Calendar for the corresponding term of their plan. A reduced-load student may drop one elective course per term (as defined by their plan) by obtaining the approval of their academic advisor. These are the courses used to calculate the term average, which is the basis of promotion decisions. Courses not included in the degree, term average, or failure count must be identified at the time of enrolment (see Rule 12). See Rule 16 for information regarding changing a course's designation. The designation of these courses may be changed (with the approval of the department) at any time prior to four weeks before the first day of the Final Examination Period for that term. Reduced-load 1A students must enrol in three courses (a load of at least 1.5 and normally less than a full load) as specified by their academic advisor. Normally, the reduced-load 1A term will be composed of at least two core courses from the 1A term with other courses specified by the academic advisor in consultation with the student.
2. The term decision is based on the student's course load during the term, the previous term decision, the term average for the current term, and the number of courses taken that term with grades below 50. The term average is calculated using the weight of the course, the status of the course (e.g., DRNA), and the interpreted course grade. All grades above 32 are interpreted as the submitted grade. Courses with a submitted grade below 32 are interpreted for averaging purposes, as having a value of 32. Both the number of courses below 50 in the current term as well as the cumulative number of To Be Cleared courses (the TBC count) on a student's record can be part of the decision.

   Full- and reduced-load terms (excluding reduced-load 1A terms):
   For students in full-load terms and reduced-load terms, the term decision is based on the current term average, the number of courses taken during the term with a grade below 50%, the previous term decision, and in some cases one or more of, the course load, the level, and the TBC count.

   1. Students with a term average of 60% or greater and no course grades below 50% are promoted with a term decision of **SAT** (satisfactory), **GOOD**, or **EXCL** (excellent).
   2. Students with a term average of 60% or greater with one or more course grades below 50% who are in their first term of Engineering or whose previous term decision was not Failed – Must Repeat Term, the term decision depends on the level and, for students at level 2A or above, on the TBC count. The TBC count includes courses in the current term with grades below 50%. There are several descriptors that can be added to the decision described in the rules below.
      - Students in 1A or 1B, the term decision depends on the course load and the number of course grades below 50%.
        1. Students on a full-course load with no more than two course grades below 50% are promoted with a term decision of **Conditional**.
        2. Students on an elective reduced-course load with no more than one course grade below 50% are promoted with a term decision of **Conditional**.
        3. Students on a full course load with more than two course grades below 50% have a term decision of **Failed – Must Repeat Term**.
        4. Students on an elective reduced-course load with more than one course grade below 50% have a term decision of **Failed – Must Repeat Term**.
      - Students in 2A and beyond with a TBC count below three, the term decision depends on the course load and the number of course grades below 50%.
        1. Students on a full course load with no more than two course grades below 50% are promoted with a term decision of **Conditional**.
        2. Students on an elective reduced-course load with no more than one course grade below 50% are promoted with a term decision of **Conditional**.
        3. Students on a full course load with more than two course grades below 50% have a term decision of **Failed – Must Repeat Term**.
        4. Students on an elective reduced-course load with more than one course grade below 50% have a term decision of **Failed – Must Repeat Term**.
      - Students in 2A and beyond with a TBC count above two have a term decision of **May not**

Proceed.

3. Students with a term average below 60% and/or one or more course grades below 50%, whose previous term decision was Failed – Must Repeat Term have a term decision of **Failed – Required to Withdraw**.
4. Students with a term average of 50% or greater, but less than 60% who are in their first term of Engineering or whose previous term decision was not Failed – Must Repeat Term, have a term decision of **Failed – Must Repeat Term**.
5. Students with a term average less than 50% who are in their first term of Engineering have a term decision of **Failed – Required to Withdraw from 1A**.
6. Students with a term average less than 50% who are not in their first term of Engineering have a term decision of **Fail – Required to Withdraw**.

Reduced-load 1A terms:

For students in the 1A Reduced-Load Program (RLP), the term decision depends on the term (i.e., the first 1A RLP term or the second 1A RLP term) and is based on the current term average, the number of courses taken during the term with a grade below 50%, and the previous term decision.

1. Students with a term average of 60% or greater and no course grades below 50%, the term decision depends on the term.
   - Students in the first 1A term of the RLP, the term decision depends on the previous term decision.
     1. Students in their first 1A RLP term continue in the RLP with a term decision of **Continue in 1A**.
     2. Students whose previous term decision was Failed – Must Repeat Term continue in the RLP with a term decision of **Continue in 1A With Penalty**.
   - Students in the second term of the RLP are promoted with a term decision of **Promoted**.
2. Students with a term average of 60% or greater and one course grade below 50%, and whose previous term decision was neither Failed – Must Repeat Term nor Continue in 1A With Penalty, the term decision depends on the term.
   1. Students in their first 1A RLP term continue in the RLP with a term decision of **Conditional**.
   2. Students in their second 1A RLP term are promoted with a term decision of **Conditional**.
3. Students with a term average of 60% or greater and more than one course grade below 50%, and whose previous term decision was neither Failed – Must Repeat Term nor Continue in 1A With Penalty, the term decision depends on the term.
   1. Students in their first 1A RLP term have a term decision of **Failed – Must Repeat Term**.
   2. Students in their second 1A RLP term have a term decision of **Continue in 1A With Penalty**.
4. Students with a term average below 60% and/or one or more course grades below 50%, and whose previous term decision was Failed – Must Repeat Term or Continue in 1A with Penalty, the term decision is **Failed – Required to Withdraw**.
5. Students with a term average of 50% or greater but less than 60%, and whose previous term decision was neither Failed – Must Repeat Term nor Continue in 1A With Penalty, the term decision depends on the term.
   1. Students in their first 1A RLP term have a term decision of **Failed – Must Repeat Term**.
   2. Students in the second 1A RLP term have a term decision of **Continue in 1A With Penalty**.
6. Students with a term average less than 50%, and whose previous term decision was neither Failed – Must Repeat Term nor Continue in 1A With Penalty, are **Required to Withdraw from 1A**.

3. If an academic decision of Conditional is used in place of a Promoted or May Continue in 1A decision, the condition may be satisfied only by successfully clearing the failed course(s) (see the Introduction). Once the condition is satisfied, the Conditional is replaced with a decision of Promotion Granted or May Continue in 1A. No student may obtain the Bachelor of Applied Science (BASc) or Bachelor of Software Engineering (BSE) degree with an academic decision including (Conditional) remaining on their record.
4. (Aegrotat) is appended to Promoted, May Continue in 1A, and Proceed on Probation decisions if one or more courses are graded as AEG (Aegrotat, credit granted under extenuating circumstances) and the other conditions for the decision are met.
5. (No Penalty) may be appended to the decision to repeat a term. In this case, the requirement to stay out for two terms before repeating the term is waived and the term is not counted as a repeat term with regard to the number of times a term can be repeated or in the calculation of the total number of terms of full-time study in the plan. This condition is normally applied as a result of extenuating circumstances which significantly affect the student's performance in the failed term.
6. While repeating a term, a student shall be excused from repeating individual courses in which a grade of 70%or better has been achieved. If this occurs, substitute courses, as approved by the department, must be taken, such that the student takes at least a reduced load in the repeat term.
7. Normally, a student with an academic decision of May Not Proceed (MNP) will enrol in a non-degree term devoted to retaking or replacing all or as many as possible of the TBC courses. If some of the TBC courses are not available, the department may specify equivalent or appropriate alternative courses to be taken in their place. If the student is otherwise in good standing, the academic decision will be changed to Promoted when the number of TBC courses has been reduced to none. If the student is otherwise in good standing, the academic decision will be changed to Promoted (Conditional) when the number of TBC courses has been reduced to one. A student clearing TBC courses under this rule must achieve a minimum grade of 50% for failed courses and a minimum grade of 60% for dropped courses, otherwise the student will be Required to Withdraw from Engineering.
8. The plan must be completed in no more than 10 terms of full-time (full-load or reduced-load) study; that is, no more than two repeat terms are allowed. A student receiving a third failed term academic decision will be Required to Withdraw from Engineering. Both full-load and reduced-load students are in this category.

9. In extraordinary circumstances, a student with a term average below 60% may be allowed to Proceed on Probation or if any course grade is AEG (see Rule 3) may be allowed to Proceed on Probation (Aegrotat).
10. A student may be Required to Withdraw from Engineering at any time if in the opinion of the Faculty the student is unlikely to benefit from further participation in Engineering, the student leaves the plan without notification and fails to write examinations (receives a grade of DNW [Did not write examination, no credit granted, value 32] for some courses), or the student has made two or more unsuccessful attempts to clear the same failed course.
11. Courses taken by students during work terms will not be included in the average for any term. However, the grades for the courses taken at the University of Waterloo or at another university on a Letter of Permission will be reported on the student's transcript. Courses taken during work terms are eligible to be used towards a reduced-load term.
12. There are five types of courses applicable to Engineering undergraduate plans (BASc or BSE): depending on whether the course is part of the degree requirements, or not; whether the course will be included in term average calculations, or not; and whether the course is in the TBC count, or not. These courses are shown on the student record and transcripts as follows:

Description	**Designation**	**Degree Requirement**	**In Average**	**In To Be Cleared (TBC) Count**
Plan requirement, included in average	blank	Yes	Yes	Yes
Plan requirement, not included in average, in TBC count, supplemental exam (SUPP) not permitted	DRNA	Yes	No	Yes
Plan requirement, not in average, and not in TBC count	DRNC	Yes	No	No
Not required for plan, in average, not in TBC count	TRIA	No	Yes	No
Not required for plan, not in average	NRNA	No	No	No

With the exception of work-term reports (see Rule 18), a mixture of courses of type DRNA and courses of type TRIA will not be permitted in a single term. Grades for courses that are not included in the term average or not required for the plan will be reported on the student's transcript. Undergraduate students (BASc or BSE) are not permitted to enrol in any course in an audit category. The Faculty of Engineering does not permit other undergraduate students to enrol in Engineering courses in an audit category.
13. DRNC courses, while not in the TBC count, are normally associated with courses that must be completed by a certain point (i.e., must be completed before the end of 3A). That point is referred to as the completion date and is provided in the plan description portion of this Calendar for those plans that use DRNC courses. A student that has not completed the course successfully by the completion date will receive a May Not Proceed decision.
14. Although it is the Senate of the University that confers degrees, the Faculty of Engineering does recommend students for degrees in Engineering. A student who has successfully met all of the requirements will be Recommended for the BASc or BSE degree. The degree awarded will be the one associated with the plan of registration. A student who has demonstrated exceptional performance will be Recommended for the BASc or BSE Degree with Distinction. This recognition is granted to a student who has a cumulative average of 80% or greater, starting with their first enrolment in the 3A term, of those courses that are requirements for their plan, and that have been included in a corresponding term average (i.e., those courses of type blank above). Courses taken while on exchange, or terms for which the academic decision has Aegrotat added as a qualifier, do not contribute to the cumulative average. In such cases, the cumulative average will include the most recent four academic terms completed at Waterloo for which a numerical average is available.
15. Most courses at the University of Waterloo are assigned a numerical grade (between zero and 100) by the examiners. Any grade from zero to 32 is treated as having a value of 32 when averages (for promotions and awards) are calculated. Non-numerical grade definitions and university-level processes are included in the Grades section of this Calendar.
16. Changes to the set of courses included in the term average, which students take in a particular term, may be permitted at the discretion of the student's department. Such changes must normally be arranged and approved before the end of the Drop/Add Period, specified in the Calendar of Events and Academic Deadlines. After this period, only exceptional cases will be considered. Courses not included in the average in any academic term may be dropped at any time prior to the start of Drop with WF Period, and courses will be graded as WD (withdrew).
17. Students are expected to maintain a balance between the number of academic terms completed and the number of work-term credits earned. Situations that are defined as out of balance are characterized in the table below. For example: 1 (4) - meaning one work-term credit, four work-term opportunities, that would otherwise earn a decision permitting them to enrol in the next academic term, will receive a term decision of **May Not Proceed COOP** and will be unable to enrol in an academic term until they have completed at least two more work terms. Normally, this will require an absence from academic study for one year. During the one year following the academic term with this decision, the student is expected to find employment that can

be treated as (at least) two work terms, recovering the work-term credits required to continue academically.

May Not Proceed COOP

Number of Credited COOP courses (minimum number of opportunities)
Current Academic Term (Excellent, Good, Satisfactory, Conditional)

Stream	2B	3A	3B	4A	4B
4	0 (3)	1 (4)	2 (5)	3 (6)	3 (6)
8	not applicable	0 (3)	1 (4)	2 (5)	3 (6)
4D	0 (3)	1 (4)	1 (4)	3 (6)	3 (6)
8D	not applicable	0 (3)	2 (5)	3 (6)	3 (6)
4F	0 (3)	1 (4)	1 (4)	2 (5)	3 (6)
4S	0 (3)	1 (4)	2 (5)	2 (5)	3 (6)
8S	not applicable	0 (4)	1 (4)	3 (6)	3 (6)
8X	not applicable	0 (3)	1 (4)	3 (6)	3 (6)

Once the student has earned credit for two or more additional work terms, the term decision will be changed to the normal academic decision for the term.

18. Work-term report requirements are plan dependent and may be met through technical reports, reflective reports, presentations, or some alternative method. If the plan specifies its own courses then those courses may be included in the term average, or excluded from the average. Some plans may use the common work-term report courses (WKRPT 200 or WKRPT 201, WKRPT 300 or WKRPT 301, and WKRPT 400 or WKRPT 401). For the plans using the shared courses, the following regulations are in place.

Work-term reports submitted as one of the WKRPT courses are due seven days after the first official day of lectures of the academic term in which the report is required. Reports submitted after the deadline will receive grades of **Unacceptable (38)** and will be carried forward to the following academic term for evaluation, and are not eligible for prizes. Failed work-term reports are cleared by retaking the WKRPT course and passing it in a subsequent term.

Work-term report courses WKRPT 200, WKRPT 300, and WKRPT 400 are considered to be required courses of type DRNA: failed work-term report evaluations contribute to the accumulated failed course count (see Rule 6). For failed work-term reports, the original grade will appear in the grade field. The failed course will be corrected by retaking and passing the course in a subsequent term.

Work-term report courses WKRPT 201, WKRPT 301, and WKRPT 401 are considered to be required courses of type DRNC: failed work-term report evaluations do not contribute to the accumulated failed course count but will delay progress if not completed by the specified term (see Rule 13). For failed work-term reports, the original grade will appear in the grade field. The failed course will be cleared by retaking and passing the course in a subsequent term.

When a work-term report (submitted as one of the WKRPT courses) has been submitted and the grade obtained is **Resubmit**, the student must provide any subsequent submissions by the date lectures end for that term, as specified in this Calendar, in order for those submissions to be considered in that term. Failure to clear a **Resubmit** by the lectures end date will result in a grade of **Unacceptable (38)**. Any submissions after the lectures end date will be deemed to be new submissions and to have been submitted for consideration in the following term.

5. Academic Plans (Major)

5.1. Biomedical Engineering

Rationale:

Addition of Biomaterials and Tissues Specialization, Medical Artificial Intelligence Specialization, and Medical Devices Specialization.

New specializations are introduced in Biomaterials and Tissues, Medical Artificial Intelligence, and Medical Devices to help students develop greater depth in a particular area of biomedical engineering. There is strong interest from students in this group of specializations. (Units offering non-Engineering courses included in these specializations were consulted.)

Biomedical Engineering	CLEAN COPY

…….. Specializations

Students may choose to take their technical electives from a more restricted list to receive the Biomaterials and Tissues Specialization, the Medical Artificial Intelligence Specialization, the Medical Devices Specialization, the Neural Engineering Specialization, or the Sports Engineering Specialization.

Note: It is the student's responsibility to ensure that their course selection meets the Biomedical Engineering requirements as well as the CEAB requirements, which include a minimum number of instruction hours in the various CEAB categories.

Biomaterials and Tissues Specialization

The specialization consists of five courses, one required course and four elective courses. A minimum average of 60% in the five specialization courses and a grade of at least 50% in each of the courses is required. Students who satisfy the requirements for Faculty Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

Required course:

- BME 589 Special Topics in Biomedical Devices [Topic title: Biomaterials and Biomedical Design]

Two courses from the following list (biomaterial science and tissue mechanics):

- BME 499 Elective Biomedical Research Project (requires approval from the co-ordinator of the Biomaterials and Tissues Specialization)
- BME 588 Special Topics in Biomechanics [Topic title: Introductory Mechanics of Biomedical and Biological Materials]
- BME 588 Special Topics in Biomechanics [Topic title: Computational Biomechanics]
- BME 589 Special Topics in Biomedical Devices (requires approval from the co-ordinator of the Biomaterials and Tissues Specialization)
- NE 481 Introduction to Nanomedicine and Nanobiotechnology

One course from the following list (material engineering):

- CHE 541 Introduction to Polymer Science and Properties

- ME 526 Fatigue and Fracture Analysis
- ME 533 Non-metallic and Composite Materials
- ME 559 Finite Element Methods
- ME 598 Special Topics in Mechanical Engineering [Topic title: Smart Materials and Active Structures]
- SYDE 599 Special Topics in Systems Design Engineering [Topic title: Material Selection for Design]

One course from the following list (biology and physiology):

- BIOL 240 Fundamentals of Microbiology
- BIOL 302 Functional Histology
- BIOL 308 Principles of Molecular Biology
- BIOL 355 Biology of Human Aging
- BIOL 373 Principles of Human Physiology 2
- BIOL 376 Cellular Neurophysiology
- KIN 406 Physiology of Muscle Aging and Disease

Medical Artificial Intelligence Specialization

The Medical Artificial Intelligence Specialization consists of five courses, three required courses and two elective courses. Students are also required to do either their capstone design project (BME 461 or GENE 403 or SYDE 461 and BME 462 or GENE 404 or SYDE 462) or an elective research project (BME 499) with a focus on the use of artificial intelligence in healthcare. The project must be approved by the co-ordinator of the specialization. A minimum average of 60% in the specialization courses and a grade of at least 50% in each of the courses is required. Students who satisfy the requirements for Faculty Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

Required courses:

- BME 530 The Healthcare System
- SYDE 572 Introduction to Pattern Recognition
- SYDE 599 Special Topics in Systems Design Engineering [Topic title: Deep Learning]

One of the following, a capstone project or research project with a focus on medical artificial intelligence and approved by the specialization co-ordinator:

- BME 461 Biomedical Engineering Design Workshop 2 and BME 462 Biomedical Engineering Design Workshop 3, or
- BME 499 Elective Biomedical Research Project, or
- GENE 403 Interdisciplinary Design Project 1 and GENE 404 Interdisciplinary Design Project 2, or
- SYDE 461 Systems Design Capstone Project 1 and SYDE 462 Systems Design Capstone Project 2

List 1: One course that provides a survey of artificial intelligence methods from the following list:

- CS 486 Introduction to Artificial Intelligence
- ECE 457B Fundamentals of Computational Intelligence
- SYDE 522 Foundations of Artificial intelligence

List 2: One additional course from the following list:

- BME 499 Elective Biomedical Research Project (requires approval from the co-ordinator of the Medical Artificial Intelligence Specialization)
- CS 485 Statistical and Computational Foundations of Machine Learning

- ECE 457C Reinforcement Learning
- HLTH 230 Introduction to Health Informatics
- MSCI 446 Introduction to Machine Learning
- STV 208 Artificial Intelligence and Society: Impact, Ethics, and Equity
- SYDE 552 Computational Neuroscience
- SYDE 556 Simulating Neurobiological Systems

Alternatively, students can take zero courses from List 1 and two courses from List 2.

Medical Devices Specialization

The Medical Devices specialization consists of five technical elective courses. Students are also required to do either their capstone design project (BME 461 or GENE 403 or SYDE 461 and BME 462 or GENE 404 or SYDE 462) or an elective research project (BME 499) with a focus on medical devices. The project must be approved by the specialization co-ordinator. A minimum average of 60% in the five specialization courses and a grade of at least 50% in each of the courses is required. Students who satisfy the requirements for Faculty Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

One of the following, a capstone project or research project with a focus on biomedical devices and approved by the specialization co-ordinator:

- BME 461 Biomedical Engineering Design Workshop 2 and BME 462 Biomedical Engineering Design Workshop 3, or
- BME 499 Elective Biomedical Research Project, or
- GENE 403 Interdisciplinary Design Project 1 and GENE 404 Interdisciplinary Design Project 2, or
- SYDE 461 Systems Design Capstone Project 1 and SYDE 462 Systems Design Capstone Project 2

One course from the following list (biocompatibility or clinical assessment of medical devices):

- BME 540 Fundamentals in Neural and Rehabilitation Engineering
- BME 589 Special Topics in Biomedical Devices [Topic title: Biomaterials and Biomedical Design]
- BME 589 Special Topics in Biomedical Devices (biocompatibility topic approved by the specialization co-ordinator)

Two courses from the following list (elements of biomedical devices):

- BME 589 Special Topics in Biomedical Devices [Topic title: Biomedical Engineering Electronic Circuits]
- ME 598 Special Topics in Mechanical Engineering [Topic title: Smart Materials and Active Structures]
- MTE 545 Introduction to MEMS Fabrication
- NE 466 Tactile Sensors and Transducers
- NE 486 Biosensors
- NE 487 Microfluidic and Nanobiotechnological Systems

Two additional courses from either list above or among the following additional courses:

- BME 588 Special Topics in Biomechanics [Topic title: Introductory Mechanics of Biomedical and Biological Materials]
- SYDE 599 Special Topics in Systems Design Engineering [Topic title: Material Selection for Design]

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5.2. Civil Engineering

Rationale:

Add new specialization (Building Science Specialization). Many Civil Engineering students have expressed interest in Building Science courses.

Civil Engineering	CLEAN COPY

…….. **Specializations**

The Faculty of Engineering recognizes five specializations with the Civil Engineering BASc degree. Students who satisfy the specialization requirements (courses and grades) will have the specialization designation shown on their transcript and diploma. Specializations are intended to recognize success in a concentration of electives within the Civil Engineering degree specification. In other words, specializations focus the selection of electives required for the base degree and do not require extra courses.

Each specialization requires students to select TEs with a common theme. Students are responsible for meeting the TE requirements of the Civil Engineering plan when pursuing a specialization. Each specialization requires the successful completion of a minimum number of TEs specified by the specialization with a minimum average of 60%. Students must declare a specialization for it to be recognized as part of their degree and appear on the transcript and diploma.

The specialization course requirements are provided below.

Building Science Specialization

The Building Science Specialization requires a minimum of four TEs from the lists below.

- From TE List 1:
  - AE 405 Building Performance Measurement Lab
  - AE 450 Building Service Systems
  - AE 572 Building Energy Analysis
  - AE 573 HVAC Systems, Equipment, and Energy Efficiency
  - ME 452 HVAC Load Analysis and Design Fundamentals
- From TE List 2:
  - CIVE 507 Building Science and Technology
  - ENVE 277 Air Quality Engineering
  - ENVE 279 Energy and the Environment

……..

6. Academic Plans (Minor)

6.1. Architectural Engineering

Rationale:

Update program rules for Complementary Studies Electives due to the removal of Faculty-level rules. The new rules increase flexibility for students by allowing them to take a course from List A, C, or D instead of just List C.

Separate the Natural Science Elective (NSE) list from the TE lists. The current arrangement is confusing for students.

Rewrite the elective requirements for the 10 elective courses (2 CSE's, 1 NSE, 7 TEs). Also include a few new NSEs from Science and Geography (GEOG357, SCI206, SCI250). (Units offering these courses were consulted.)

AE392 is currently being taught in CEE department to different cohorts. The title, course description, and requisites for AE392 are being updated to match those of CIVE392/ENVE392/GEOE392; therefore, adding AE392 as a new cross-listing with existing CIVE392 (owner)/ENVE392/GEOE392 version.
In order to do so, the existing AE392 is being inactivated since two existing separate courses cannot be "combined" in the system without this manipulation.

Architectural Engineering MARK UP

The Architectural Engineering Academic Curriculum

~~A total of two approved Complementary Studies Electives (CSE), in addition to ENGL 191/SPCOM 191, AE 101, AE 392, and AE 491, and eight approved Technical Electives (TE) must be completed as detailed in the following sections.~~

The Architectural Engineering academic curriculum is detailed in the following sections. A total of 10 approved electives must be completed:

- **Two Complementary Studies Electives**
- **One Natural Science Elective**
- **Seven Technical Electives**

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- AE 100 Concepts Studio
- AE 101 History of the Built Environment ~~(List C-Humanities and Social Sciences CSE)~~
- AE 104 Mechanics 1
- AE 115 Linear Algebra
- CHE 102 Chemistry for Engineers
- MATH 116 Calculus 1 for Engineering

Term 1B (Spring)

- AE 105 Mechanics 2
- AE 121 Computational Methods
- AE 123 Electrical Circuits and Instrumentation
- AE 125 Structural Design Studio
- AE 199 Seminar
- MATH 118 Calculus 2 for Engineering

Term 2A (Winter)

- AE 200 Enclosure Design Studio
- AE 204 Solid Mechanics 1
- AE 221 Advanced Calculus
- AE 224 Probability and Statistics
- AE 280 Fluid Mechanics and Thermal Sciences
- AE 298 Seminar
- ENGL 191/SPCOM 191 Communication in the Engineering Profession ~~(List D-Other CSE)~~

Term 2B (Fall)

- AE 205 Solid Mechanics 2
- AE 223 Differential Equations and Balance Laws
- AE 225 Environmental Building Systems Studio
- AE 265 Structure and Properties of Materials
- AE 299 Seminar
- ~~CSE 3 or TE 1 Approved Complementary Studies Elective or Technical Elective~~
- WKRPT 200 Work-term Report
- **Approved elective**

Term 3A (Spring)

- AE 279 Energy and the Environment
- AE 300 Architectural Engineering Studio 1
- AE 303 Structural Analysis
- AE 353 Soil Mechanics and Foundations
- AE 377 Structural Timber Design
- AE 398 Seminar
- WKRPT 300 Work-term Report

Term 3B (Winter)

- AE 310 Introduction to Structural Design
- AE 325 Architectural Engineering Studio 2
- AE 392 Economics and Life Cycle **Cost** Analysis ~~(List B-Engineering Economics CSE)~~
- AE 399 Seminar
- CIVE 507 Building Science and Technology
- ~~CSE 3 or TE 1 Approved Complementary Studies Elective or Technical Elective~~
- WKRPT 400 Work-term Report
- **Approved Elective**

~~**Note:** Elective must be a Technical Elective (TE) if Complementary Studies Elective (CSE) is selected in a previous term, and vice versa.~~

Term 4A (Spring)

- AE 400 Project Studio 1
- AE 491 Engineering Law and Ethics ~~(List D-Other CSE)~~
- ~~AE 498 Seminar~~
- ~~TE 2 Approved Technical Elective~~
- ~~TE 3 Approved Technical Elective~~
- TE 4 Approved Technical Elective
- **Three Approved Electives**

Term 4B (Winter)

- AE 425 Project Studio 2
- AE 499 Seminar
- ~~CSE 6 Approved Complementary Studies Elective~~
- ~~TE 5 Approved Technical Elective~~
- ~~TE 6 Approved Technical Elective~~
- ~~TE 7 Approved Technical Elective~~
- TE 8 Approved Technical Elective
- **Five Approved Electives**

Electives

Students are responsible for selecting their own combination of electives, in keeping with their ultimate career objectives after graduation. The combination must satisfy the requirements of the Department of Civil and Environmental Engineering (CEE). This includes having to meet minimum requirements in mathematics, natural sciences, engineering sciences, engineering design, and complementary studies.

Exceptions to the electives ~~courses~~ and requirements listed in the following sections (and links) require approval of the **Architectural Engineering director, or Civil and Environmental Engineering associate chair, undergraduate studies** ~~CEE Department~~. Some courses of interest may require prerequisite knowledge that is not part of the core curriculum in Architectural Engineering. Students may require extra courses or may need to seek enrolment approval from the course instructor if the prerequisites have not been satisfied.

Complementary Studies Electives

~~All Engineering students are required to take complementary studies courses, as described in Complementary Studies Requirements for Engineering Students. Two Complementary Studies Elective (CSE) courses must be taken in approved non-technical subjects. The CSEs are in addition to those courses which are part of the core curriculum and contain complementary studies material, such as ENGL 191/SPCOM 191 (List D), AE 101 (List C), AE 392 (List B), and AE 491 (List D). The two CSE courses are to be chosen according to the following constraints:~~

- ~~One course from List A - Impact Courses~~
- ~~One course from List C - Humanities and Social Sciences Courses~~

Students are required to complete two Complementary Studies Electives (CSEs) from the Complementary Studies Course Lists for Engineering:

- **One course from List A**
- **One course from List A, C, or D**

List A CSEs concentrate on the impact of technology and/or engineering on society, List C CSEs are from the humanities and social sciences, and List D CSEs are humanities and social sciences courses that concentrate on the development of language or other skills.

Natural Science Electives

Students are required to complete one Natural Science Elective (NSE) from the following list:

- **BIOL 130 Introductory Cell Biology**
- **BIOL 150 Organismal and Evolutionary Ecology**
- **BIOL 240 Fundamentals of Microbiology**
- **BIOL 273 Principles of Human Physiology 1**
- **CHE 161 Engineering Biology**
- **CHEM 209 Introductory Spectroscopy and Structure**
- **CHEM 262 Organic Chemistry for Engineering**
- **EARTH 221 Introductory Geochemistry**
- **EARTH 270 Disasters and Natural Hazards**
- **EARTH 281 Geological Impacts on Human Health**
- **ENVS 200 Field Ecology**
- **GEOG 357 River Management**
- **KIN 100 Regional Human Anatomy and KIN 100L Regional Human Anatomy Laboratory**
- **SCI 206 The Physics of How Things Work**
- **SCI 207 Physics, the Universe, and Everything**

- SCI 238 Introductory Astronomy
- SCI 250 Environmental Geology

Technical Electives

Students are required to complete ~~eight~~ **seven** technical electives (TEs) ~~courses~~ within the following requirements:

1. ~~At least three TEs must be from TE List A (Architectural Engineering Technical Electives)~~
2. ~~At least two TEs must be from TE List B (Engineering Design Intensive Technical Electives)~~
3. ~~One TE must be from TE List D (Natural Science Technical Electives)~~

- **Three TEs must be from List 1**
- **Two TEs must be from List 2**
- **The remaining two TEs may be from either List 1, 2, or 3**

The Technical Elective lists for Architectural Engineering are provided below. Note that the offering of these courses is contingent upon sufficient demand and/or available teaching resources. There may be courses added and changes made to the content~~,~~ **or** term of offering~~, or meet times from what is listed below~~. Special Topics Courses (AE 495 and AE 497) are offered as resources and faculty availability permit. Further information is available from the CEE Undergraduate Office or CEE website.

~~**Legend for TE List A, B, C, and D**~~

~~Term courses are offered: F=fall term, W=winter term, S=spring term~~

TE List 1 ~~A~~ - Architectural Engineering Technical Electives

~~Choose at least three~~

- AE 301 Building Enclosure Systems ~~(W)~~
- AE 315 Building Structural Systems ~~(W)~~
- AE 405 Building Performance Measurement Lab ~~(S)~~
- AE 450 Building Service Systems ~~(S)~~
- AE 495 Design Intensive Special Topics in Architectural Engineering ~~(as offered)~~
- AE 572 Building Energy Analysis ~~(F,S)~~
- AE 573 HVAC Systems, Equipment, and Energy Efficiency ~~(W)~~
- ARCH 570 Special Topics in Building Technology and Environmental ~~(F,W,S)~~
- ME 452 HVAC Load Analysis and Design Fundamentals ~~(W)~~

TE List 2 ~~B~~ - Engineering Design Intensive Technical Electives

~~Choose at least two~~

- ARCH 463 Integrated Environmental Systems ~~(S)~~
- CIVE 413 Structural Steel Design ~~(S)~~
- CIVE 414 Structural Concrete Design ~~(S)~~
- CIVE 415 Structural System Design ~~(W)~~
- CIVE 460 Engineering Biomechanics ~~(W)~~
- CIVE 495 Design Intensive Special Topics in Civil Engineering ~~(as offered)~~
- CIVE 512 Rehabilitation of Structures ~~(W)~~

- CIVE 596 Construction Engineering ~~(S)~~

TE List 3 ~~C~~ - Engineering Technical Electives

- AE 497 Special Topics in Architectural Engineering ~~(as offered)~~
- CIVE 422 Finite Element Analysis ~~(W)~~
- CIVE 484 Physical Infrastructure Planning ~~(S)~~
- CIVE 497 Special Topics in Civil Engineering ~~(as offered)~~
- CIVE 505 Structural Dynamics ~~(S)~~

~~**List D - Natural Science Technical Electives**~~

~~Choose one~~

- ~~BIOL 130 Introductory Cell Biology (F,W)~~
- ~~BIOL 150 Organismal and Evolutionary Ecology (F)~~
- ~~BIOL 240 Fundamentals of Microbiology (F,W,S)~~
- ~~BIOL 273 Principles of Human Physiology 1 (F,W, and online S)~~
- ~~CHE 161 Engineering Biology (W,S)~~
- ~~CHEM 209 Introductory Spectroscopy and Structure (F)~~
- ~~CHEM 262 Organic Chemistry for Engineering (F,W)~~
- ~~EARTH 221 Introductory Geochemistry (W,S)~~
- ~~EARTH 270 Disasters and Natural Hazards (W)~~
- ~~EARTH 281 Geological Impacts on Human Health (W)~~
- ~~ENVS 200 Field Ecology (F,W,S)~~
- ~~KIN 100 Regional Human Anatomy and KIN 100L Regional Human Anatomy Laboratory (W)~~
- ~~SCI 207 Physics, the Universe, and Everything (W)~~
- ~~SCI 238 Introductory Astronomy (F,W,S)~~

Specializations

The Faculty of Engineering recognizes two specializations with the Architectural Engineering BASc degree. Students who satisfy the specialization requirements (courses and grades) will have the specialization designation shown on their transcript and diploma. Specializations are intended to recognize success in a concentration of electives within the Architectural Engineering degree specification. In other words, specializations focus the selection of electives required for the base degree and do not require extra courses.

Each specialization requires students to select **TEs** ~~technical electives~~ with a common theme. Students are responsible for meeting the TE requirements of the Architectural Engineering degree when pursuing a specialization. Each specialization requires the successful completion of a minimum number of TEs specified by the specialization with a minimum average of 60%. Students must declare a specialization for it to be recognized as part of their degree and appear on the transcript and diploma.

The specialization course requirements are provided below. ~~Exceptions to the listed courses require the approval of the CEE Department.~~

Building Structures Specialization

The Building Structures Specialization requires a minimum of five TEs from the list below, of which one must be CIVE 413 or CIVE 414.

- From TE List **1** ~~A~~:
  - AE 315 Building Structural Systems ~~(W)~~
- From TE List **2** ~~B~~:
  - CIVE 413 Structural Steel Design ~~(S)~~
  - CIVE 414 Structural Concrete Design ~~(S)~~
  - CIVE 415 Structural System Design ~~(W)~~
  - CIVE 460 Engineering Biomechanics ~~(W)~~
  - CIVE 512 Rehabilitation of Structures ~~(W)~~
  - CIVE 596 Construction Engineering ~~(S)~~
- From TE List **3** ~~C~~:
  - CIVE 422 Finite Element Analysis ~~(W)~~
  - CIVE 505 Structural Dynamics ~~(S)~~

Building Systems Specialization

The Building Systems Specialization requires a minimum of four TEs from the list below ~~(all are from TE List A)~~.

- **From TE List 1**:
  - AE 301 Building Enclosure Systems ~~(W)~~
  - AE 315 Building Structural Systems ~~(W)~~
  - AE 405 Building Performance Measurement Lab ~~(S)~~
  - AE 450 Building Service Systems ~~(S)~~
  - AE 572 Building Energy Analysis ~~(F,S)~~
  - AE 573 HVAC Systems, Equipment, and Energy Efficiency ~~(W)~~
  - ME 452 HVAC Load Analysis and Design Fundamentals ~~(W)~~

Architectural Engineering CLEAN COPY

The Architectural Engineering Academic Curriculum

The Architectural Engineering academic curriculum is detailed in the following sections. A total of 10 approved electives must be completed:

- Two Complementary Studies Electives
- One Natural Science Elective
- Seven Technical Electives

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- AE 100 Concepts Studio
- AE 101 History of the Built Environment
- AE 104 Mechanics 1
- AE 115 Linear Algebra
- CHE 102 Chemistry for Engineers

- MATH 116 Calculus 1 for Engineering

Term 1B (Spring)

- AE 105 Mechanics 2
- AE 121 Computational Methods
- AE 123 Electrical Circuits and Instrumentation
- AE 125 Structural Design Studio
- AE 199 Seminar
- MATH 118 Calculus 2 for Engineering

Term 2A (Winter)

- AE 200 Enclosure Design Studio
- AE 204 Solid Mechanics 1
- AE 221 Advanced Calculus
- AE 224 Probability and Statistics
- AE 280 Fluid Mechanics and Thermal Sciences
- AE 298 Seminar
- ENGL 191/SPCOM 191 Communication in the Engineering Profession

Term 2B (Fall)

- AE 205 Solid Mechanics 2
- AE 223 Differential Equations and Balance Laws
- AE 225 Environmental Building Systems Studio
- AE 265 Structure and Properties of Materials
- AE 299 Seminar
- WKRPT 200 Work-term Report
- Approved elective

Term 3A (Spring)

- AE 279 Energy and the Environment
- AE 300 Architectural Engineering Studio 1
- AE 303 Structural Analysis
- AE 353 Soil Mechanics and Foundations
- AE 377 Structural Timber Design
- AE 398 Seminar
- WKRPT 300 Work-term Report

Term 3B (Winter)

- AE 310 Introduction to Structural Design
- AE 325 Architectural Engineering Studio 2
- AE 392 Economics and Life Cycle Analysis
- AE 399 Seminar
- CIVE 507 Building Science and Technology
- WKRPT 400 Work-term Report
- Approved Elective

Term 4A (Spring)

- AE 400 Project Studio 1
- AE 491 Engineering Law and Ethics
- AE 498 Seminar
- Three Approved Electives

Term 4B (Winter)

- AE 425 Project Studio 2
- AE 499 Seminar
- Five Approved Electives

Electives

Students are responsible for selecting their own combination of electives, in keeping with their ultimate career objectives after graduation. The combination must satisfy the requirements of the Department of Civil and Environmental Engineering (CEE). This includes having to meet minimum requirements in mathematics, natural sciences, engineering sciences, engineering design, and complementary studies.

Exceptions to the electives and requirements listed in the following sections (and links) require approval of the Architectural Engineering director, or Civil and Environmental Engineering associate chair, undergraduate studies. Some courses of interest may require prerequisite knowledge that is not part of the core curriculum in Architectural Engineering. Students may require extra courses or may need to seek enrolment approval from the course instructor if the prerequisites have not been satisfied.

Complementary Studies Electives

Students are required to complete two Complementary Studies Electives (CSEs) from the Complementary Studies Course Lists for Engineering:

- One course from List A
- One course from List A, C, or D

List A CSEs concentrate on the impact of technology and/or engineering on society, List C CSEs are from the humanities and social sciences, and List D CSEs are humanities and social sciences courses that concentrate on the development of language or other skills.

Natural Science Electives

Students are required to complete one Natural Science Elective (NSE) from the following list:

- BIOL 130 Introductory Cell Biology
- BIOL 150 Organismal and Evolutionary Ecology
- BIOL 240 Fundamentals of Microbiology
- BIOL 273 Principles of Human Physiology 1
- CHE 161 Engineering Biology
- CHEM 209 Introductory Spectroscopy and Structure
- CHEM 262 Organic Chemistry for Engineering
- EARTH 221 Introductory Geochemistry
- EARTH 270 Disasters and Natural Disasters
- EARTH 281 Geological Impacts on Human Health
- ENVS 200 Field Ecology
- GEOG 357 River Management
- KIN 100 Regional Human Anatomy and KIN 100L Regional Human Anatomy Laboratory
- SCI 206 The Physics of How Things Work
- SCI 207 Physics, the Universe, and Everything
- SCI 238 Introductory Astronomy
- SCI 250 Environmental Geology

Technical Electives

Students are required to complete seven technical electives (TEs|) within the following requirements:

- Three TEs must be from List 1
- Two TEs must be from List 2
- The remaining two TEs may be from either List 1, 2, or 3

The Technical Elective lists for Architectural Engineering are provided below. Note that the offering of these courses is contingent upon sufficient demand and/or available teaching resources. There may be courses added and changes made to the content or term of offering. Special Topics Courses (AE 495 and AE 497) are offered as resources and faculty availability permit. Further information is available from the CEE Undergraduate Office or CEE website.

TE List 1 - Architectural Engineering Technical Electives

- AE 301 Building Enclosure Systems
- AE 315 Building Structural Systems
- AE 405 Building Performance Measurement Lab

- AE 450 Building Service Systems
- AE 495 Design Intensive Special Topics in Architectural Engineering
- AE 572 Building Energy Analysis
- AE 573 HVAC Systems, Equipment, and Energy Efficiency
- ARCH 570 Special Topics in Building Technology and Environmental
- ME 452 HVAC Load Analysis and Design Fundamentals

TE List 2 - Engineering Design Intensive Technical Electives

- ARCH 463 Integrated Environmental Systems
- CIVE 413 Structural Steel Design
- CIVE 414 Structural Concrete Design
- CIVE 415 Structural System Design
- CIVE 460 Engineering Biomechanics
- CIVE 495 Design Intensive Special Topics in Civil Engineering
- CIVE 512 Rehabilitation of Structures
- CIVE 596 Construction Engineering

TE List 3 - Engineering Technical Electives

- AE 497 Special Topics in Architectural Engineering
- CIVE 422 Finite Element Analysis
- CIVE 484 Physical Infrastructure Planning
- CIVE 497 Special Topics in Civil Engineering
- CIVE 505 Structural Dynamics

Specializations

The Faculty of Engineering recognizes two specializations with the Architectural Engineering BASc degree. Students who satisfy the specialization requirements (courses and grades) will have the specialization designation shown on their transcript and diploma. Specializations are intended to recognize success in a concentration of electives within the Architectural Engineering degree specification. In other words, specializations focus the selection of electives required for the base degree and do not require extra courses.

Each specialization requires students to select TEs with a common theme. Students are responsible for meeting the TE requirements of the Architectural Engineering degree when pursuing a specialization. Each specialization requires the successful completion of a minimum number of TEs specified by the specialization with a minimum average of 60%. Students must declare a specialization for it to be recognized as part of their degree and appear on the transcript and diploma.

The specialization course requirements are provided below.

Building Structures Specialization

The Building Structures Specialization requires a minimum of five TEs from the list below, of which one must be CIVE 413 or CIVE 414.

- From TE List 1:
  - AE 315 Building Structural Systems
- From TE List 2:

    - CIVE 413 Structural Steel Design
    - CIVE 414 Structural Concrete Design
    - CIVE 415 Structural System Design
    - CIVE 460 Engineering Biomechanics
    - CIVE 512 Rehabilitation of Structures
    - CIVE 596 Construction Engineering
- From TE List 3:
    - CIVE 422 Finite Element Analysis
    - CIVE 505 Structural Dynamics

Building Systems Specialization

The Building Systems Specialization requires a minimum of four TEs from the list below.

- From TE List 1:
    - AE 301 Building Enclosure Systems
    - AE 315 Building Structural Systems
    - AE 405 Building Performance Measurement Lab
    - AE 450 Building Service Systems
    - AE 572 Building Energy Analysis
    - AE 573 HVAC Systems, Equipment, and Energy Efficiency
    - ME 452 HVAC Load Analysis and Design Fundamentals

6.2 School of Architecture

Rationale:
A new and clearer presentation of the number and types of electives. There are no changes in program requirements.

Honours Bachelor of Architectural Studies MARK UP

Theme Areas

Courses in the Bachelor of Architectural Studies (BAS) degree are arranged in five main thematic groups:

1. Design: The practice of design and the understanding of its theories and methods.
2. Visual and digital media: The use of creative and analytical tools and techniques.
3. Cultural history and theory: The understanding of cultural and historical forces shaping the built world.
4. Technology and environment: The understanding of materials and methods, building technologies, and environmental issues and systems critical to the making of architecture.
5. Urbanism and landscape: An introduction to urbanism and landscape and the organization of natural and human ecologies.

Professional Practice

Students gain invaluable architectural professional experience through the co-op program which integrates two years of alternating paid work terms into the pre-professional course of study. Through co-op, Architecture students expand their professional education and opportunities as they apply their knowledge and skills within architectural firms all over the world.

Academic Requirements and Program Sequence

Pre-Professional Architecture

Term 1A (Fall)

- ARCH 110 Visual and Digital Media 1 [0.50 unit] *(Visual and Digital Media)*
- ARCH 120 An Introduction to Architectural Ideas and Communications [0.50 unit] *(Cultural History and Theory)*
- ARCH 142 Introduction to Cultural History [0.50 unit] *(Cultural History and Theory)*
- ARCH 172 Building Construction 1 [0.50 unit] *(Technology and Environment)*
- ARCH 192 Design Studio [1.50 units] *(Design)*

Term 1B (Winter)

- ARCH 113 Visual and Digital Media 2 [0.50 unit] *(Visual and Digital Media)*
- ARCH 126 Environmental Building Design [0.50 unit] *(Technology and Environment)*
- ARCH 143 Settlements, Sanctuaries, and Cities [1.00 unit] *(Cultural History and Theory)*
- ARCH 173 Building Construction 2 [0.50 unit] *(Technology and Environment)*
- ARCH 193 Design Studio [1.50 units] *(Design)*

Term 2A (Fall)

- ARCH 212 Digital Fabrication [0.50 unit] *(Visual and Digital Media)*
- ARCH 246 Cultural Encounters 600-1600 [1.00 unit] *(Cultural History and Theory)*
- ARCH 260 Principles of Structures [0.50 unit] *(Technology and Environment)*
- ARCH 292 Design Studio [1.50 units] *(Design)*

Term 2B (Spring)

- ARCH 225 Theory and Design of the Contemporary Landscape [0.50 unit] *(Urbanism and Landscape)*
- ARCH 243 Indigenous Practices [0.50 unit] *(Cultural History and Theory)*
- ARCH 248 Cultural Encounters 1600-1914 [1.00 unit] *(Cultural History and Theory)*
- ARCH 276 Timber: Design, Structure and Construction [0.50 unit] *(Technology and Environment)*
- ARCH 293 Design Studio [1.50 units] *(Design)*

Term 3A (Winter)

- ARCH 327 Architecture of the Urban Environment [0.50 unit] *(Urbanism and Landscape)*
- ARCH 342 Modernisms: Local and Global [1.00 unit] *(Cultural History and Theory)*
- ARCH 362 Steel and Concrete: Design, Structure and Construction [0.50 unit] *(Technology and Environment)*
- ARCH 364 Building Science [0.50 unit] *(Technology and Environment)*
- ARCH 392 Design Studio [1.50 units] *(Design)*

Term 3B (Fall)

- ARCH 393 Option Design Studio [1.50 units] *(Design)*
- ARCH 442 Contemporary Architectural Theory [0.50 unit] *(Cultural History and Theory)*
- ~~Two electives from: ARCH 510, ARCH 520, ARCH 540, ARCH 570, ARCH 580~~
- ~~Open elective (any discipline)~~
- **Two Technical Architecture Electives**
- **Open Elective**

Term 4A (Fall, Rome)

- ~~ARCH 428 Rome and the Campagna (Rome) or ARCH elective [0.50 unit] *(Urbanism and Landscape)*~~
- ~~ARCH 446 Italian Urban History (Rome) or ARCH elective [0.50 unit] *(Cultural History and Theory)*~~
- ~~ARCH 449 The Development of Modern Italian Architecture (Rome) or ARCH elective [0.50 unit]~~
- ARCH 492 Design Studio [1.50 units] *(Design)*
- ~~Three electives from: 400-level ARCH courses, ARCH 510, ARCH 520, ARCH 540, ARCH 570, ARCH 580~~
- **Any Architecture Elective (Technical or General)**

Note: The Rome 4A term is the only opportunity for students to take Rome elective offerings, and these courses are only offered on the Rome campus during the 4A term (ARCH 428, ARCH 446, ARCH 449). Students can enrol in a second ARCH 400-level elective to fulfil the open elective requirement.

Term 4B (Spring)

- ARCH 463 Integrated Environmental Systems [0.50 unit] *(Technology and Environment)*
- ARCH 473 Technical Report [0.50 unit] *(Technology and Environment)*
- ARCH 493 Design Studio/ Comprehensive Building Design [1.50 units] *(Design)*
- ~~One elective from: ARCH 510, ARCH 520, ARCH 540, ARCH 570, ARCH 580~~
- ~~Open elective (any discipline) [0.50 unit]~~
- **Any Architecture Elective (Technical or General)**

Electives

BAS program elective courses are organized into two primary groups: Architecture Electives (technical and general) and Open Electives.

Students must complete a minimum of five elective courses (0.5 unit each) as follows:

- **Four Architecture Electives where a minimum of two are Technical Architecture Electives**
- **One Open Elective**

Architecture Electives

The Architecture elective requirement gives students breadth of study and opportunities for research at the upper levels of the pre-professional program in relation to four curricular areas.~~: cultural history and theory (ARCH 540), technology and environment (ARCH 570), visual and digital media (ARCH 510), and urbanism and landscape (ARCH 520), as well as race, equity, and environmental justice (ARCH 580). A minimum of three and up to four architecture electives must be taken over the course of the BAS program. A minimum of two electives in the 4A term will be taken as ARCH 400-level cultural history electives offered in Rome, or as alternate Architecture upper-level electives. A minimum of two electives will be taken from the 500-level series in the third and fourth years (3A, 3B, 4A, 4B) of the BAS program.~~ **Architecture electives are organized into two groups: technical and general.**

Group 1: Technical Architecture Electives

Students must complete a minimum of two Technical Architecture Electives to meet graduation requirements.

- **ARCH 510 Special Topics in Visual and Digital Media**
- **ARCH 570 Special Topics in Building Technology and Environmental**
- **ARCH 580 Special Topics in Race, Equity, and Environmental Justice**

Group 2: General Architecture Electives

- **ARCH 428 Rome and the Campagna (Rome)**
- **ARCH 446 Italian Urban History (Rome)**
- **ARCH 449 The Development of Modern Italian Architecture (Rome)**
- **ARCH 520 Special Topics in Urbanism and Landscape**
- **ARCH 540 Special Topics in Architectural History and Theory**

Open Electives

~~The open elective requirement gives students some breadth of studies related to their role as educated professionals in society. A minimum of one and up to two electives from any discipline must be completed to satisfy the open elective requirement. These courses can be taken in any semester in the second to fourth years (2B, 3A, 3B, 4A, 4B) of the BAS program.~~

A minimum of one elective (0.50 unit) from any discipline, including architecture, must be completed to satisfy the open elective requirement. This course is nominally placed in the 3B term, but it can be taken in any term in the second to fourth years (2B, 3A, 3B, 4A, 4B) of the BAS program.

Honours Bachelor of Architectural Studies CLEAN COPY

Theme Areas

Courses in the Bachelor of Architectural Studies (BAS) degree are arranged in five main thematic groups:

1. Design: The practice of design and the understanding of its theories and methods.
2. Visual and digital media: The use of creative and analytical tools and techniques.
3. Cultural history and theory: The understanding of cultural and historical forces shaping the built world.
4. Technology and environment: The understanding of materials and methods, building technologies, and environmental issues and systems critical to the making of architecture.
5. Urbanism and landscape: An introduction to urbanism and landscape and the organization of natural and human ecologies.

Professional Practice

Students gain invaluable architectural professional experience through the co-op program which integrates two years of alternating paid work terms into the pre-professional course of study. Through co-op, Architecture students expand their professional education and opportunities as they apply their knowledge and skills within architectural firms all over the world.

Academic Requirements and Program Sequence

Pre-Professional Architecture

Term 1A (Fall)

- ARCH 110 Visual and Digital Media 1 [0.50 unit] *(Visual and Digital Media)*
- ARCH 120 An Introduction to Architectural Ideas and Communications [0.50 unit] *(Cultural History and Theory)*
- ARCH 142 Introduction to Cultural History [0.50 unit] *(Cultural History and Theory)*
- ARCH 172 Building Construction 1 [0.50 unit] *(Technology and Environment)*
- ARCH 192 Design Studio [1.50 units] *(Design)*

Term 1B (Winter)

- ARCH 113 Visual and Digital Media 2 [0.50 unit] *(Visual and Digital Media)*

- ARCH 126 Environmental Building Design [0.50 unit] *(Technology and Environment)*
- ARCH 143 Settlements, Sanctuaries, and Cities [1.00 unit] *(Cultural History and Theory)*
- ARCH 173 Building Construction 2 [0.50 unit] *(Technology and Environment)*
- ARCH 193 Design Studio [1.50 units] *(Design)*

Term 2A (Fall)

- ARCH 212 Digital Fabrication [0.50 unit] *(Visual and Digital Media)*
- ARCH 246 Cultural Encounters 600-1600 [1.00 unit] *(Cultural History and Theory)*
- ARCH 260 Principles of Structures [0.50 unit] *(Technology and Environment)*
- ARCH 292 Design Studio [1.50 units] *(Design)*

Term 2B (Spring)

- ARCH 225 Theory and Design of the Contemporary Landscape [0.50 unit] *(Urbanism and Landscape)*
- ARCH 243 Indigenous Practices [0.50 unit] *(Cultural History and Theory)*
- ARCH 248 Cultural Encounters 1600-1914 [1.00 unit] *(Cultural History and Theory)*
- ARCH 276 Timber: Design, Structure and Construction [0.50 unit] *(Technology and Environment)*
- ARCH 293 Design Studio [1.50 units] *(Design)*

Term 3A (Winter)

- ARCH 327 Architecture of the Urban Environment [0.50 unit] *(Urbanism and Landscape)*
- ARCH 342 Modernisms: Local and Global [1.00 unit] *(Cultural History and Theory)*
- ARCH 362 Steel and Concrete: Design, Structure and Construction [0.50 unit] *(Technology and Environment)*
- ARCH 364 Building Science [0.50 unit] *(Technology and Environment)*
- ARCH 392 Design Studio [1.50 units] *(Design)*

Term 3B (Fall)

- ARCH 393 Option Design Studio [1.50 units] *(Design)*
- ARCH 442 Contemporary Architectural Theory [0.50 unit] *(Cultural History and Theory)*
- Two Technical Architecture Electives
- Open Elective

Term 4A (Fall, Rome)

- ARCH 492 Design Studio [1.50] *(Design)*
- Any Architecture Elective (Technical or General)

Note: The Rome 4A term is the only opportunity for students to take Rome elective offerings, and these courses are only offered on the Rome campus during the 4A term (ARCH 428, ARCH 446, ARCH 449). Students can enrol in a second ARCH 400-level elective to fulfil the open elective requirement.

Term 4B (Spring)

- ARCH 463 Integrated Environmental Systems [0.50 unit] *(Technology and Environment)*
- ARCH 473 Technical Report [0.50 unit] *(Technology and Environment)*

- ARCH 493 Design Studio/ Comprehensive Building Design [1.50 units] *(Design)*
- Any Architecture Elective (Technical or General)

Electives

BAS program elective courses are organized into two primary groups: Architecture Electives (technical and general) and Open Electives.

Students must complete a minimum of five elective courses (0.5 unit each) as follows:

- Four Architecture Electives where a minimum of two are Technical Architecture Electives
- One Open Elective

Architecture Electives

The Architecture elective requirement gives students breadth of study and opportunities for research at the upper levels of the pre-professional program in relation to four curricular areas. Architecture electives are organized into two groups: technical and general.

Group 1: Technical Architecture Electives

Students must complete a minimum of two Technical Architecture Electives to meet graduation requirements.

- ARCH 510 Special Topics in Visual and Digital Media
- ARCH 570 Special Topics in Building Technology and Environment
- ARCH 580 Special Topics in Race, Equity, and Environmental Justice

Group 2: General Architecture Electives

- ARCH 428 Rome and the Campagna (Rome)
- ARCH 446 Italian Urban History (Rome)
- ARCH 449 The Development of Modern Italian Architecture (Rome)
- ARCH 520 Special Topics in Urbanism and Landscape
- ARCH 540 Special Topics in Architectural History and Theory

Open Elective

A minimum of one elective (0.50 unit) from any discipline, including architecture, must be completed to satisfy the open elective requirement. This course is nominally placed in the 3B term, but it can be taken in any term in the second to fourth years (2B, 3A, 3B, 4A, 4B) of the BAS program.

6.3 Biomedical Engineering

Rationale:

Update program rules for Complementary Studies Electives due to removal of Faculty-level rules. The changes will increase flexibility for students.

For the Sports Engineering and Neural Engineering specializations: currently, students must complete a capstone project in the specialization area, but this is challenging if the whole team does not pursue the same specialization. The change is to allow a research course (BME 499) in the specialization area as an alternative.

Modify unclear or unnecessary wording, and changed formatting of course lists to align with standard practice in the calendar.

Biomedical Engineering	MARK UP

The Biomedical Engineering Academic Curriculum

The Biomedical Engineering curriculum consists of two course groupings:

- Compulsory core courses that prepare the student for practice in engineering and comprise 70% to 80% of the course load.
- Elective courses that comprise 20% to 30% of the course load.

~~The following is the current core course curriculum with the course weight shown in square brackets [ ] next to each course.~~

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- BME 101 ~~[0.25]~~ Communications in Biomedical Engineering-Written and Oral ~~(2 LEC,1 TUT)~~
- BME 101L ~~[0.25]~~ Communications in Biomedical Engineering-Visualization ~~(1 LEC,3 LAB)~~
- BME 121 ~~[0.50]~~ Digital Computation ~~(3 LEC,1 TUT,3 LAB)~~
- BME 161 ~~[0.50]~~ Introduction to Biomedical Design ~~(3 LEC,1 TUT)~~
- BME 181 ~~[0.50]~~ Physics 1: ~~–~~Statics ~~(3 LEC,1 TUT)~~
- SYDE 111 ~~[0.50]~~ Calculus 1 ~~(3 LEC,3 TUT)~~
- SYDE 113 ~~[0.25]~~ Elementary Engineering Math**ematics** ~~(2 LEC,2 TUT)~~

Term 1B (Winter)

- BME 102 ~~[0.00]~~ Seminar ~~(1 SEM)~~
- BME 122 ~~[0.50]~~ Data Structures and Algorithms ~~(3 LEC,1 TUT)~~
- BME 162 ~~[0.50]~~ Human Factors in the Design of Biomedical and Health Systems ~~(3 LEC,1 TUT)~~
- BME 186 ~~[0.50]~~ Chemistry Principles ~~(3 LEC,1 TUT)~~
- SYDE 112 ~~[0.50]~~ Calculus 2 ~~(3 LEC,2 TUT)~~

- SYDE 114 ~~[0.25]~~ Matrices and Linear Systems ~~(2 LEC,2 TUT)~~
- One Complementary Studies Elective

Term 2A (Fall)

- BME 201 ~~[0.00]~~ Seminar ~~(1 SEM)~~
- BME 182 ~~[0.50]~~ Physics 2**:** ~~-~~ Dynamics ~~(3 LEC,1 TUT)~~
- BME 281 ~~[0.50]~~ Mechanics of Deformable Solids ~~(3 LEC,1 TUT)~~
- BME 281L ~~[0.25]~~ Mechanics of Deformable Solids Laboratory ~~(3 LAB)~~
- BME 282 ~~[0.50]~~ Materials Science for Biomedical Engineers ~~(3 LEC,1 TUT)~~
- BME 285 ~~[0.50]~~ Engineering Biology ~~(3 LEC,1 TUT)~~
- BME 285L ~~[0.25]~~ Engineering Biology Laboratory ~~(3 LAB)~~
- SYDE 211 ~~[0.50]~~ Calculus 3 ~~(3 LEC,1 TUT)~~

Term 2B (Spring)

- BME 202 ~~[0.00]~~ Seminar ~~(1 SEM)~~
- BME 213 ~~[0.50]~~ Statistics and Experimental Design ~~(3 LEC,1 TUT)~~
- BME 252 ~~[0.50]~~ Linear **Systems and Signals** ~~Signals and Systems~~ ~~(3 LEC,1 TUT)~~
- BME 261 ~~[0.50]~~ Prototyping, Simulation and Design ~~(3 LEC,1 TUT)~~
- BME 284 ~~[0.50]~~ Physiological and Biological Systems ~~(3 LEC,1 TUT)~~
- BME 284L ~~[0.25]~~ Physiology and Anatomy Laboratory ~~(3 LAB)~~
- BME 294 ~~[0.50]~~ Circuits, Instrumentation, and Measurements ~~(3 LEC,1 TUT)~~
- BME 294L ~~[0.25]~~ Circuits, Instrumentation, and Measurements Laboratory ~~(3 LAB)~~
- WKRPT 200 ~~[0.13]~~ Work-term Report

Term 3A (Winter)

- BME 301 ~~[0.00]~~ Seminar ~~(1 SEM)~~
- BME 355 ~~[0.50]~~ Physiological Systems Modelling ~~(3 LEC,1 TUT)~~
- BME 361 ~~[0.50]~~ Biomedical Engineering Design ~~(3 LEC,1 TUT,3 LAB)~~
- BME 381 ~~[0.50]~~ Biomedical Engineering Ethics ~~(3 LEC,1 TUT)~~
- BME 393 ~~[0.50]~~ Digital Systems ~~(3 LEC,1 TUT)~~
- BME 393L ~~[0.25]~~ Digital Systems Laboratory ~~(3 LAB)~~
- WKRPT 300 ~~[0.13]~~ Work-term Report
- One Technical Elective or One Complementary Studies Elective

Term 3B (Fall)

- BME 302 ~~[0.00]~~ Seminar ~~(1 SEM)~~
- BME 356 ~~[0.50]~~ Control Systems ~~(3 LEC,1 TUT)~~

- BME 356L ~~[0.25]~~ Control Systems Laboratory ~~(3 LAB)~~
- BME 362 ~~[0.50]~~ Biomedical Engineering Design Workshop 1 ~~(2 LEC,3 LAB)~~
- BME 364 ~~[0.50]~~ Engineering Biomedical Economics ~~(3 LEC,1 TUT)~~
- BME 384 ~~[0.50]~~ Biomedical Transport: Biofluids and Mass Transfer ~~(3 LEC,1 TUT)~~
- BME 386 ~~[0.50]~~ The Physics of Medical Imaging ~~(3 LEC,1 TUT)~~

Term 4A (Fall)

- BME 401 ~~[0.00]~~ Seminar ~~(1 SEM)~~
- BME 411 ~~[0.50]~~ Optimization and Numerical Methods ~~(3 LEC,1 TUT)~~
- BME 461 ~~[0.50]~~ Biomedical Engineering Design Workshop 2 ~~(2 LEC,3 LAB)~~
- WKRPT 400 ~~[0.13]~~ Work-term Report
- One Complementary Studies Elective
- Two Technical Electives

Term 4B (Winter)

- BME 402 ~~[0.00]~~ Seminar ~~(1 SEM)~~
- BME 462 ~~[0.50]~~ Biomedical Engineering Design Workshop 3 ~~(1 LEC,3 LAB)~~
- One Complementary Studies Elective
- Three Technical Electives

CEAB Requirements

Elective course selections must meet CEAB requirements, including a minimum number of instruction hours in the various CEAB categories. To determine the suitability of elective courses, students should complete the CEAB planner. In addition to meeting CEAB requirements, the student's course selections (as reported in their planner) should be logical and defensible. Two planners must be completed and submitted to the director of biomedical engineering, one planner for approval purposes in the student's 3A term, and one planner for graduation purposes at the end of the student's 4A term.

Students that have combinations of electives that result in a plan that does not meet CEAB criteria will not be permitted to graduate.

Complementary Studies Electives

In addition to the two courses in the core curriculum (BME 364 and BME 381), at least three **complementary studies** elective courses must be chosen ~~to satisfy the Complementary Studies Requirements for Engineering Students~~. Only courses noted in Lists A, ~~B~~, C, and D **in the Complementary Studies Course Lists for Engineering** are ~~Faculty~~ approved complementary studies elective courses. **Students must take at least one course from List C.** Students may arrange the sequencing of the complementary studies elective courses to suit their academic plan (and any course prerequisites).

Technical Electives

Each student in Biomedical Engineering must complete at least six approved technical electives (TEs) to meet graduation requirements. Students may arrange the sequencing of the technical elective courses to suit their plan (and any course prerequisites).

The Department of Systems Design Engineering offers a wide variety of technical elective courses in the third and fourth year. Biomedical Engineering students are encouraged to design their own elective package to develop expertise in their particular interest area. Approved technical elective courses are available from the Department of Systems Design Engineering (BME and SYDE TEs), from other Engineering departments, and from a wide list of technical courses in the faculties of Science and Mathematics. There are a variety of technical electives with biomedical content, but students can also take technical electives on other topics. Only courses from Engineering and Computer Science will contribute towards CEAB hours in the categories of "Engineering Science" and "Engineering Design~~.~~". Some examples are listed below.

Biomedical Engineering

- BME 499 Elective Biomedical Research Project
- **BME 540 Fundamentals of Neural and Rehabilitation Engineering**
- BME 550 Sports Engineering
- BME 551 Biomechanics of Human Movement
- BME 581 Ultrasound in Medicine and Biology
- BME 587 Special Topics in Biomedical Signals
- BME 588 Special Topics in Biomechanics
- BME 589 Special Topics in Biomedical Devices

Civil Engineering

- CIVE 460 Engineering Biomechanics

Electrical and Computer Engineering

- ECE 224 Embedded Microprocessor Systems
- ECE 252 Systems Programming and Concurrency
- ~~ECE 254 Operating Systems and Systems Programming~~
- **ECE 350 Real-Time Operating Systems**
- ECE 356 Database Systems
- ECE 358 Computer Networks
- ECE 406 Algorithm Design and Analysis
- ECE 457B Fundamentals of Computational Intelligence
- ECE 459 Programming for Performance
- ECE 484 Digital Control Applications

Management Sciences

- MSCI 343 Human-Computer Interaction
- MSCI 432 Production and Service Operations Management
- MSCI 446 Introduction to Machine Learning

- MSCI 555 Scheduling: Theory and Practice

Mechanical Engineering

- ME 574 Engineering Biomechanics

Mechatronics Engineering

- MTE 241 Introduction to Computer Structures & Real-Time Systems
- MTE 325 Microprocessor Systems and Interfacing for Mechatronics Engineering
- MTE 544 Autonomous Mobile Robots

Systems Design Engineering

- SYDE 322 Software Design
- SYDE 334 Applied Statistics
- SYDE 522 Foundations of Artificial Intelligence
- SYDE 531 Design Optimization Under Probabilistic Uncertainty
- SYDE 532 Introduction to Complex Systems
- SYDE 533 Conflict Resolution
- SYDE 542 Interface Design
- SYDE 543 Cognitive Ergonomics
- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 548 User Centred Design Methods
- SYDE 552 Computational Neuroscience
- SYDE 553 Advanced Dynamics
- SYDE 556 Simulating Neurobiological Systems
- SYDE 572 Introduction to Pattern Recognition
- SYDE 575 Image Processing
- SYDE 584 Physiological Systems and Biomedical Design
- SYDE 599 Special Topics in Systems Design Engineering

Specializations

Students may choose to take their technical electives from a more restricted list to receive the **Biomaterials and Tissues Specialization, the Medical Artificial Intelligence Specialization, the Medical Devices Specialization,** the Neural Engineering Specialization, or the Sports Engineering Specialization.

Note: It is the student's responsibility to ensure that their course selection meets the Biomedical Engineering requirements as well as the CEAB requirements, which include a minimum number of instruction hours in the various CEAB categories.

Biomaterials and Tissues Specialization

The specialization consists of five courses, one required course and four elective courses. A minimum average of 60% in the five specialization courses and a grade of at least 50% in each of the courses is required. Students who satisfy the requirements for Faculty Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and

transcript.

Required course:

- BME 589 Special Topics in Biomedical Devices [Topic title: Biomaterials and Biomedical Design]

Two courses from the following list (biomaterial science and tissue mechanics):

- BME 499 Elective Biomedical Research Project (requires approval from the co-ordinator of the Biomaterials and Tissues Specialization)
- BME 588 Special Topics in Biomechanics [Topic title: Introductory Mechanics of Biomedical and Biological Materials]
- BME 588 Special Topics in Biomechanics [Topic title: Computational Biomechanics]
- BME 589 Special Topics in Biomedical Devices (requires approval from the co-ordinator of the Biomaterials and Tissues Specialization)
- NE 481 Introduction to Nanomedicine and Nanobiotechnology

One course from the following list (material engineering):

- CHE 541 Introduction to Polymer Science and Properties
- ME 526 Fatigue and Fracture Analysis
- ME 533 Non-metallic and Composite Materials
- ME 559 Finite Element Methods
- ME 598 Special Topics in Mechanical Engineering [Topic title: Smart Materials and Active Structures]
- SYDE 599 Special Topics in Systems Design Engineering [Topic title: Material Selection for Design]

One course from the following list (biology and physiology):

- BIOL 240 Fundamentals of Microbiology
- BIOL 302 Functional Histology
- BIOL 308 Principles of Molecular Biology
- BIOL 355 Biology of Human Aging
- BIOL 373 Principles of Human Physiology 2
- BIOL 376 Cellular Neurophysiology
- KIN 406 Physiology of Muscle Aging and Disease

Medical Artificial Intelligence Specialization

The Medical Artificial Intelligence Specialization consists of five courses, three required courses and two elective courses. Students are also required to do either their capstone design project (BME 461 or GENE 403 or SYDE 461 and BME 462 or GENE 404 or SYDE 462) or an elective research project (BME 499) with a focus on the use of artificial intelligence in healthcare. The project must be approved by the co-ordinator of the specialization. A minimum average of 60% in the specialization courses and a grade of at least 50% in each of the courses is required. Students who satisfy the requirements for Faculty Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

Required courses:

- **BME 530 The Healthcare System**
- **SYDE 572 Introduction to Pattern Recognition**
- **SYDE 599 Special Topics in Systems Design Engineering [Topic title: Deep Learning]**

One of the following, a capstone project or research project with a focus on medical artificial intelligence and approved by the specialization co-ordinator:

- **BME 461 Biomedical Engineering Design Workshop 2 and BME 462 Biomedical Engineering Design Workshop 3, or**
- **BME 499 Elective Biomedical Research Project**
- **GENE 403 Interdisciplinary Design Project 1 and GENE 404 Interdisciplinary Design Project 2, or**
- **SYDE 461 Systems Design Capstone Project 1 and SYDE 462 Systems Design Capstone Project 2**

List 1: One course that provides a survey of artificial intelligence methods from the following list:

- **CS 486 Introduction to Artificial Intelligence**
- **ECE 457B Fundamentals of Computational Intelligence**
- **SYDE 522 Foundations of Artificial intelligence**

List 2: One additional course from the following list:

- **BME 499 Elective Biomedical Research Project (requires approval from the co-ordinator of the Medical Artificial Intelligence Specialization)**
- **CS 485 Statistical and Computational Foundations of Machine Learning**
- **ECE 457C Reinforcement Learning**
- **HLTH 230 Introduction to Health Informatics**
- **MSCI 446 Introduction to Machine Learning**
- **STV 208 Artificial Intelligence and Society: Impact, Ethics, and Equity**
- **SYDE 552 Computational Neuroscience**
- **SYDE 556 Simulating Neurobiological Systems**

Alternatively, students can take zero courses from List 1 and two courses from List 2.

Medical Devices Specialization

The Medical Devices specialization consists of five elective courses. Students are also required to do either their capstone design project (BME 461 or GENE 403 or SYDE 461 and BME 462 or GENE 404 or SYDE 462) or an elective research project (BME 499) with a focus on medical devices. The project must be approved by the specialization co-ordinator. A minimum average of 60% in the five specialization courses and a grade of at least 50% in each of the courses is required. Students who satisfy the requirements for Faculty Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

One of the following, a capstone project or research project with a focus on biomedical devices and approved by the specialization co-ordinator:

- **BME 461 Biomedical Engineering Design Workshop 2 and BME 462 Biomedical Engineering Design Workshop 3, or**
- **BME 499 Elective Biomedical Research Project, or**
- **GENE 403 Interdisciplinary Design Project 1 and GENE 404 Interdisciplinary Design Project 2, or**
- **SYDE 461 Systems Design Capstone Project 1 and SYDE 462 Systems Design Capstone Project 2**

One course from the following list (biocompatibility or clinical assessment of medical devices):

- **BME 540 Fundamentals in Neural and Rehabilitation Engineering**
- **BME 589 Special Topics in Biomedical Devices [Topic title: Biomaterials and Biomedical Design]**
- **BME 589 Special Topics in Biomedical Devices (biocompatibility topic approved by the specialization co-ordinator)**

Two courses from the following list (elements of biomedical devices):

- **BME 589 Special Topics in Biomedical Devices [Topic title: Biomedical Engineering Electronic Circuits]**
- **ME 598 Special Topics in Mechanical Engineering [Topic title: Smart Materials and Active Structures]**
- **MTE 545 Introduction to MEMS Fabrication**
- **NE 466 Tactile Sensors and Transducers**
- **NE 486 Biosensors**
- **NE 487 Microfluidic and Nanobiotechnological Systems**

Two additional courses from either list above or among the following additional courses:

- **BME 588 Special Topics in Biomechanics [Topic title: Introductory Mechanics of Biomedical and Biological Materials]**
- **SYDE 599 Special Topics in Systems Design Engineering [Topic title: Material Selection for Design]**

Neural Engineering Specialization

The Neural Engineering Specialization consists of ~~seven~~ **five** courses covering a wide range of neuroscience topics and computational applications in neuroscience. Students are also required to do **either** their capstone design project (BME 461 or GENE 403 or SYDE 461 and BME 462 or GENE 404 or SYDE 462) **or an elective research project (BME 499)** with a focus on neuroscience applications. The project must be approved by the co-ordinator of the Neural Engineering Specialization. A minimum average of 60% in the ~~seven~~ **five** specialization courses and a grade of at least 50% in each of the courses is required. Students who satisfy the requirements for Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

One course from the following list: ~~Required courses:~~

- ~~BME 461 Biomedical Engineering Design Workshop 2, or GENE 403 Interdisciplinary Design Project 1, or SYDE 461 Systems Design Capstone Project 1~~

- ~~BME 462 Biomedical Engineering Design Workshop 3, or GENE 404 Interdisciplinary Design Project 2, or SYDE 462 Systems Design Capstone Project 2~~
- SYDE 552 Computational Neuroscience
- SYDE 556 Simulating Neurobiological Systems

One of the following, capstone project or research project with a focus on neural engineering and approved by the specialization co-ordinator:

- **BME 461 Biomedical Engineering Design Workshop 2 and BME 462 Biomedical Engineering Design Workshop 3, or**
- **BME 499 Elective Biomedical Research Project, or**
- **GENE 403 Interdisciplinary Design Project 1 and GENE 404 Interdisciplinary Design Project 2, or**
- **SYDE 461 Systems Design Capstone Project 1 and SYDE 462 Systems Design Capstone Project 2**

Two courses from List ~~A~~ **1**: Anatomy and Physiology of the Nervous System)~~:~~

- BIOL 376 Cellular Neurophysiology (offered fall for odd years)
- KIN 255 Fundamentals of Neuroscience
- KIN 301 Human Anatomy of the Central Nervous System
- KIN 416 Neuromuscular Integration
- PHIL 256/PSYCH 256 Introduction to Cognitive Science
- PSYCH 261 Physiological Psychology
- PSYCH 307 Human Neuropsychology

One **additional** course from List ~~B~~ **2**: Computational ~~Applications~~ **Methods** in Neuroscience):~~-~~

- AMATH 382/BIOL 382 Computational Modelling of Cellular Systems
- AMATH 451 Introduction to Dynamical Systems
- BME 499 Elective Biomedical Research Project (requires approval from the co-ordinator of the Neural Engineering Specialization)
- BME 587 Special Topics in Biomedical Signals (requires approval from the co-ordinator of the Neural Engineering Specialization)
- STAT 441 Statistical Learning - Classification
- STAT 444 Statistical Learning - Advanced Regression
- SYDE 522 Foundations of Artificial Intelligence
- SYDE 552 Computational Neuroscience
- SYDE 556 Simulating Neurobiological Systems
- SYDE 572 Introduction to Pattern Recognition

One additional course from either List ~~A~~ **1**or List ~~B~~ **2**.

Notes

- ~~It is the student's responsibility to ensure that their course selection meets the Biomedical Engineering requirements as well as the CEAB requirements, which include a minimum number of instruction hours in the various CEAB categories.~~ Some courses in List ~~A~~ **1** (PHIL 256/PSYCH 256 ~~and PSYCH 307~~) can be counted towards Complementary Studies Requirements.

- Biomedical Engineering students may lack prerequisites for some of these courses and should ensure that they obtain the prerequisite courses prior to taking such courses. However, there are several courses in the list (BIOL 376, PHIL 256/PSYCH 256, SYDE 522, SYDE 552, SYDE 556, and SYDE 572) where students will have the appropriate prerequisites.

Sports Engineering Specialization

The Sports Engineering Specialization consists of five courses, two specific required ~~TE~~ courses~~, which provide the necessary background on the musculoskeletal dynamics and optimal performance of athletes as well as sports equipment design, training devices, and their interaction with the athlete~~, plus three additional courses drawn from the provided list. Students are also required to do **either** their capstone design project (BME 461 or GENE 403 or SYDE 461 and BME 462 or GENE 404 or SYDE 462) **or an elective research project (BME 499)** with a focus on ~~the design of~~ a new sport equipment or training device. The project must be approved by the co-ordinator of the Sports Engineering Specialization. A minimum average of 60% in the ~~seven~~ **five** specialization courses and a grade of at least 50% in each of the courses is required. Students who satisfy the requirements for Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

Required courses:

- ~~BME 461 Biomedical Engineering Design Workshop 2, or GENE 403 Interdisciplinary Design Project 1, or SYDE 461 Systems Design Capstone Project 1~~
- ~~BME 462 Biomedical Engineering Design Workshop 3, or GENE 404 Interdisciplinary Design Project 2, or SYDE 462 Systems Design Capstone Project 2~~
- BME 550 Sports Engineering
- BME 551 Biomechanics of Human Movement

One of the following, a capstone project or research project with a focus on sports engineering and approved by the specialization co-ordinator:

- **BME 461 Biomedical Engineering Design Workshop 2 and BME 462 Biomedical Engineering Design Workshop 3, or**
- **BME 499 Elective Biomedical Research Project**
- **GENE 403 Interdisciplinary Design Project 1 and GENE 404 Interdisciplinary Design Project 2, or**
- **SYDE 461 Systems Design Capstone Project 1 and SYDE 462 Systems Design Capstone Project 2**

Any three **additional** courses from the following list must also be taken:

- BME 499 Elective Biomedical Research Project (requires approval from the co-ordinator of the Sports Engineering Specialization)
- BME 588 Special Topics in Biomechanics
- CIVE 460 Engineering Biomechanics
- ECE 417 or SYDE 575 Image Processing
- KIN 340 Musculoskeletal Injuries in Sport and Activity
- ME 362 Fluid Mechanics 2
- ME 533 Non-metallic and Composite Materials
- ME 559 Finite Element Methods
- SYDE 544 Biomedical Measurement and Signal Processing

- SYDE 553 Advanced Dynamics

~~**Note**~~

~~It is the student's responsibility to ensure that their course selection meets the Biomedical Engineering requirements as well as the CEAB requirements, which include a minimum number of instruction hours in the various CEAB categories.~~

Biomedical Engineering CLEAN COPY

The Biomedical Engineering Academic Curriculum

The Biomedical Engineering curriculum consists of two course groupings:

1. Compulsory core courses that prepare the student for practice in engineering and comprise 70% to 80% of the course load.
2. Elective courses that comprise 20% to 30% of the course load.

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- BME 101 Communications in Biomedical Engineering-Written and Oral
- BME 101L Communications in Biomedical Engineering-Visualization
- BME 121 Digital Computation
- BME 161 Introduction to Biomedical Design
- BME 181 Physics 1: Statics
- SYDE 111 Calculus 1
- SYDE 113 Elementary Engineering Mathematics

Term 1B (Winter)

- BME 102 Seminar
- BME 122 Data Structures and Algorithms
- BME 162 Human Factors in the Design of Biomedical and Health Systems
- BME 186 Chemistry Principles
- SYDE 112 Calculus 2
- SYDE 114 Matrices and Linear Systems
- One Complementary Studies Elective

Term 2A (Fall)

- BME 201 Seminar
- BME 182 Physics 2: Dynamics
- BME 281 Mechanics of Deformable Solids
- BME 281L Mechanics of Deformable Solids Laboratory
- BME 282 Materials Science for Biomedical Engineers

- BME 285 Engineering Biology
- BME 285L Engineering Biology Laboratory
- SYDE 211 Calculus 3

Term 2B (Spring)

- BME 202 Seminar
- BME 213 Statistics and Experimental Design
- BME 252 Linear Systems and Signals
- BME 261 Prototyping, Simulation and Design
- BME 284 Physiological and Biological Systems
- BME 284L Physiology and Anatomy Laboratory
- BME 294 Circuits, Instrumentation, and Measurements
- BME 294L Circuits, Instrumentation, and Measurements Laboratory
- WKRPT 200 Work-term Report

Term 3A (Winter)

- BME 301 Seminar
- BME 355 Physiological Systems Modelling
- BME 361 Biomedical Engineering Design
- BME 381 Biomedical Engineering Ethics
- BME 393 Digital Systems
- BME 393L Digital Systems Laboratory
- WKRPT 300 Work-term Report
- One Technical Elective or One Complementary Studies Elective

Term 3B (Fall)

- BME 302 Seminar
- BME 356 Control Systems
- BME 356L Control Systems Laboratory
- BME 362 Biomedical Engineering Design Workshop 1
- BME 364 Engineering Biomedical Economics
- BME 384 Biomedical Transport: Biofluids and Mass Transfer
- BME 386 The Physics of Medical Imaging

Term 4A (Fall)

- BME 401 Seminar
- BME 411 Optimization and Numerical Methods
- BME 461 Biomedical Engineering Design Workshop 2
- WKRPT 400 Work-term Report

- One Complementary Studies Elective
- Two Technical Electives

Term 4B (Winter)

- BME 402 Seminar
- BME 462 Biomedical Engineering Design Workshop 3
- One Complementary Studies Elective
- Three Technical Electives

CEAB Requirements

Elective course selections must meet CEAB requirements, including a minimum number of instruction hours in the various CEAB categories. To determine the suitability of elective courses, students should complete the CEAB planner. In addition to meeting CEAB requirements, the student's course selections (as reported in their planner) should be logical and defensible. Two planners must be completed and submitted to the director of biomedical engineering, one planner for approval purposes in the student's 3A term, and one planner for graduation purposes at the end of the student's 4A term.

Students that have combinations of electives that result in a plan that does not meet CEAB criteria will not be permitted to graduate.

Complementary Studies Electives

In addition to the two courses in the core curriculum (BME 364 and BME 381), at least three complementary studies elective courses must be chosen. Only courses noted in Lists A, C, and D in the Complementary Studies Course Lists for Engineering are approved complementary studies elective courses. Students must take at least one course from List C. Students may arrange the sequencing of the complementary studies elective courses to suit their academic plan (and any course prerequisites).

Technical Electives

Each student in Biomedical Engineering must complete at least six approved technical electives (TEs) to meet graduation requirements. Students may arrange the sequencing of the technical elective courses to suit their plan (and any course prerequisites).

The Department of Systems Design Engineering offers a wide variety of technical elective courses in the third and fourth year. Biomedical Engineering students are encouraged to design their own elective package to develop expertise in their particular interest area. Approved technical elective courses are available from the Department of Systems Design Engineering (BME and SYDE TEs), from other Engineering departments, and from a wide list of technical courses in the faculties of Science and Mathematics. There are a variety of technical electives with biomedical content, but students can also take technical electives on other topics. Only courses from Engineering and Computer Science will contribute towards CEAB hours in the categories of "Engineering Science" and "Engineering Design". Some examples are listed below.

Biomedical Engineering

- BME 499 Elective Biomedical Research Project
- BME 540 Fundamentals in Neural and Rehabilitation Engineering
- BME 550 Sports Engineering
- BME 551 Biomechanics of Human Movement
- BME 581 Ultrasound in Medicine and Biology
- BME 587 Special Topics in Biomedical Signals
- BME 588 Special Topics in Biomechanics
- BME 589 Special Topics in Biomedical Devices

Civil Engineering

- CIVE 460 Engineering Biomechanics

Electrical and Computer Engineering

- ECE 224 Embedded Microprocessor Systems
- ECE 252 Systems Programming and Concurrency
- ECE 350 Real-Time Operating Systems
- ECE 356 Database Systems
- ECE 358 Computer Networks
- ECE 406 Algorithm Design and Analysis
- ECE 457B Fundamentals of Computational Intelligence
- ECE 459 Programming for Performance
- ECE 484 Digital Control Applications

Management Sciences

- MSCI 343 Human-Computer Interaction
- MSCI 432 Production and Service Operations Management
- MSCI 446 Introduction to Machine Learning
- MSCI 555 Scheduling: Theory and Practice

Mechanical Engineering

- ME 574 Engineering Biomechanics

Mechatronics Engineering

- MTE 241 Introduction to Computer Structures & Real-Time Systems
- MTE 325 Microprocessor Systems and Interfacing for Mechatronics Engineering
- MTE 544 Autonomous Mobile Robots

Systems Design Engineering

- SYDE 322 Software Design
- SYDE 334 Applied Statistics
- SYDE 522 Foundations of Artificial Intelligence
- SYDE 531 Design Optimization Under Probabilistic Uncertainty
- SYDE 532 Introduction to Complex Systems

- SYDE 533 Conflict Resolution
- SYDE 542 Interface Design
- SYDE 543 Cognitive Ergonomics
- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 548 User Centred Design Methods
- SYDE 552 Computational Neuroscience
- SYDE 553 Advanced Dynamics
- SYDE 556 Simulating Neurobiological Systems
- SYDE 572 Introduction to Pattern Recognition
- SYDE 575 Image Processing
- SYDE 584 Physiological Systems and Biomedical Design
- SYDE 599 Special Topics in Systems Design Engineering

Specializations

Students may choose to take their technical electives from a more restricted list to receive the Biomaterials and Tissues Specialization, the Medical Artificial Intelligence Specialization, the Medical Devices Specialization, the Neural Engineering Specialization, or the Sports Engineering Specialization.

Note: It is the student's responsibility to ensure that their course selection meets the Biomedical Engineering requirements as well as the CEAB requirements, which include a minimum number of instruction hours in the various CEAB categories.

Biomaterials and Tissues Specialization

The specialization consists of five courses, one required course and four elective courses. A minimum average of 60% in the five specialization courses and a grade of at least 50% in each of the courses is required. Students who satisfy the requirements for Faculty Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

Required course:

- BME 589 Special Topics in Biomedical Devices [Topic title: Biomaterials and Biomedical Design]

Two courses from the following list (biomaterial science and tissue mechanics):

- BME 499 Elective Biomedical Research Project (requires approval from the co-ordinator of the Biomaterials and Tissues Specialization)
- BME 588 Special Topics in Biomechanics [Topic title: Introductory Mechanics of Biomedical and Biological Materials]
- BME 588 Special Topics in Biomechanics [Topic title: Computational Biomechanics]
- BME 589 Special Topics in Biomedical Devices (requires approval from the co-ordinator of the Biomaterials and Tissues Specialization)
- NE 481 Introduction to Nanomedicine and Nanobiotechnology

One course from the following list (material engineering):

- CHE 541 Introduction to Polymer Science and Properties
- ME 526 Fatigue and Fracture Analysis
- ME 533 Non-metallic and Composite Materials

- ME 559 Finite Element Methods
- ME 598 Special Topics in Mechanical Engineering [Topic title: Smart Materials and Active Structures]
- SYDE 599 Special Topics in Systems Design Engineering [Topic title: Material Selection for Design]

One course from the following list (biology and physiology):

- BIOL 240 Fundamentals of Microbiology
- BIOL 302 Functional Histology
- BIOL 308 Principles of Molecular Biology
- BIOL 355 Biology of Human Aging
- BIOL 373 Principles of Human Physiology 2
- BIOL 376 Cellular Neurophysiology
- KIN 406 Physiology of Muscle Aging and Disease

Medical Artificial Intelligence Specialization

The Medical Artificial Intelligence Specialization consists of five courses, three required courses and two elective courses. Students are also required to do either their capstone design project (BME 461 or GENE 403 or SYDE 461 and BME 462 or GENE 404 or SYDE 462) or an elective research project (BME 499) with a focus on the use of artificial intelligence in healthcare. The project must be approved by the co-ordinator of the specialization. A minimum average of 60% in the specialization courses and a grade of at least 50% in each of the courses is required. Students who satisfy the requirements for Faculty Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

Required courses:

- BME 530 The Healthcare System
- SYDE 572 Introduction to Pattern Recognition
- SYDE 599 Special Topics in Systems Design Engineering [Topic title: Deep Learning]

One of the following, a capstone project or research project with a focus on medical artificial ingelligence and approved by the specialization co-ordinator:

- BME 461 Biomedical Engineering Design Workshop 2 and BME 462 Biomedical Engineering Design Workshop 3, or
- BME 499 Elective Biomedical Research Project, or
- GENE 403 Interdisciplinary Design Project 1 and GENE 404 Interdisciplinary Design Project 2, or
- SYDE 461 Systems Design Capstone Project 1 and SYDE 462 Systems Design Capstone Project 2

List 1: One course that provides a survey of artificial intelligence methods from the following list:

- CS 486 Introduction to Artificial Intelligence
- ECE 457B Fundamentals of Computational Intelligence
- SYDE 522 Foundations of Artificial intelligence

List 2: One additional course from the following list:

- BME 499 Elective Biomedical Research Project (requires approval from the co-ordinator of the Medical Artificial Intelligence Specialization)
- CS 485 Statistical and Computational Foundations of Machine Learning
- ECE 457C Reinforcement Learning
- HLTH 230 Introduction to Health Informatics
- MSCI 446 Introduction to Machine Learning
- STV 208 Artificial Intelligence and Society: Impact, Ethics, and Equity
- SYDE 552 Computational Neuroscience
- SYDE 556 Simulating Neurobiological Systems

Alternatively, students can take zero courses from List 1 and two courses from List 2.

Medical Devices Specialization

The Medical Devices specialization consists of five technical elective courses. Students are also required to do either their capstone design project (BME 461 or GENE 403 or SYDE 461 and BME 462 or GENE 404 or SYDE 462) or an elective research project (BME 499) with a focus on medical devices. The project must be approved by the specialization co-ordinator. A minimum average of 60% in the five specialization courses and a grade of at least 50% in each of the courses is required. Students who satisfy the requirements for Faculty Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

One of the following, a capstone project or research project with a focus on biomedical devices and approved by the specialization co-ordinator:

- BME 461 Biomedical Engineering Design Workshop 2 and BME 462 Biomedical Engineering Design Workshop 3, or
- BME 499 Elective Biomedical Research Project, or
- GENE 403 Interdisciplinary Design Project 1 and GENE 404 Interdisciplinary Design Project 2, or
- SYDE 461 Systems Design Capstone Project 1 and SYDE 462 Systems Design Capstone Project 2

One course from the following list (biocompatibility or clinical assessment of medical devices):

- BME 540 Fundamentals in Neural and Rehabilitation Engineering
- BME 589 Special Topics in Biomedical Devices [Topic title: Biomaterials and Biomedical Design]
- BME 589 Special Topics in Biomedical Devices (biocompatibility topic approved by the specialization co-ordinator)

Two courses from the following list (elements of biomedical devices):

- BME 589 Special Topics in Biomedical Devices [Topic title: Biomedical Engineering Electronic Circuits]
- ME 598 Special Topics in Mechanical Engineering [Topic title: Smart Materials and Active Structures]
- MTE 545 Introduction to MEMS Fabrication
- NE 466 Tactile Sensors and Transducers
- NE 486 Biosensors
- NE 487 Microfluidic and Nanobiotechnological Systems

Two additional courses from either list above or among the following additional courses:

- BME 588 Special Topics in Biomechanics [Topic title: Introductory Mechanics of Biomedical and Biological Materials]
- SYDE 599 Special Topics in Systems Design Engineering [Topic title: Material Selection for Design]

Neural Engineering Specialization

The Neural Engineering Specialization consists of five courses covering a wide range of neuroscience topics and computational applications in neuroscience. Students are also required to do either their capstone design project (BME 461 or GENE 403 or SYDE 461 and BME 462 or GENE 404 or SYDE 462) or an elective research project (BME 499) with a focus on neuroscience applications. The project must be approved by the co-ordinator of the Neural Engineering Specialization. A minimum average of 60% in the five specialization courses and a grade of at least 50% in each of the courses is required. Students who satisfy the requirements for Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

One course from the following list:

- SYDE 552 Computational Neuroscience
- SYDE 556 Simulating Neurobiological Systems

One of the following, capstone project or research project with a focus on neural engineering and approved by the specialization co-ordinator:

- BME 461 Biomedical Engineering Design Workshop 2 and BME 462 Biomedical Engineering Design Workshop 3, or
- BME 499 Elective Biomedical Research Project, or
- GENE 403 Interdisciplinary Design Project 1 and GENE 404 Interdisciplinary Design Project 2, or
- SYDE 461 Systems Design Capstone Project 1 and SYDE 462 Systems Design Capstone Project 2

Two courses from List 1: Anatomy and Physiology of the Nervous System:

- BIOL 376 Cellular Neurophysiology (offered fall for odd years)
- KIN 255 Fundamentals of Neuroscience
- KIN 301 Human Anatomy of the Central Nervous System
- KIN 416 Neuromuscular Integration
- PHIL 256/PSYCH 256 Introduction to Cognitive Science
- PSYCH 261 Physiological Psychology
- PSYCH 307 Human Neuropsychology

One additional course from List 2: Computational Methods in Neuroscience:

- AMATH 382/BIOL 382 Computational Modelling of Cellular Systems
- AMATH 451 Introduction to Dynamical Systems
- BME 499 Elective Biomedical Research Project (requires approval from the co-ordinator of the Neural Engineering Specialization)
- BME 587 Special Topics in Biomedical Signals (requires approval from the co-ordinator of the Neural Engineering Specialization)

- STAT 441 Statistical Learning - Classification
- STAT 444 Statistical Learning - Advanced Regression
- SYDE 522 Foundations of Artificial Intelligence
- SYDE 552 Computational Neuroscience
- SYDE 556 Simulating Neurobiological Systems
- SYDE 572 Introduction to Pattern Recognition

One additional course from either List 1 or List 2.

Notes

1. Some courses in List 1 (PHIL 256/PSYCH 256) can be counted towards Complementary Studies Requirements.
2. Biomedical Engineering students may lack prerequisites for some of these courses and should ensure that they obtain the prerequisite courses prior to taking such courses. However, there are several courses in the list (BIOL 376, PHIL 256/PSYCH 256, SYDE 522, SYDE 552, SYDE 556, and SYDE 572) where students will have the appropriate prerequisites.

Sports Engineering Specialization

The Sports Engineering Specialization consists of five courses, two specific required courses, plus three additional courses drawn from the provided list. Students are also required to do either their capstone design project (BME 461 or GENE 403 or SYDE 461 and BME 462 or GENE 404 or SYDE 462) or an elective research project (BME 499) with a focus on a new sport equipment or training device. The project must be approved by the co-ordinator of the Sports Engineering Specialization. A minimum average of 60% in the five specialization courses and a grade of at least 50% in each of the courses is required. Students who satisfy the requirements for Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

Required courses:

- BME 550 Sports Engineering
- BME 551 Biomechanics of Human Movement

One of the following, a capstone project or research project with a focus on sports engineering and approved by the specialization co-ordinator:

- BME 461 Biomedical Engineering Design Workshop 2 and BME 462 Biomedical Engineering Design Workshop 3, or
- BME 499 Elective Biomedical Research Project, or
- GENE 403 Interdisciplinary Design Project 1 and GENE 404 Interdisciplinary Design Project 2, or
- SYDE 461 Systems Design Capstone Project 1 and SYDE 462 Systems Design Capstone Project 2

Any three additional courses from the following list must also be taken:

- BME 499 Elective Biomedical Research Project (requires approval from the co-ordinator of the Sports Engineering Specialization)
- BME 588 Special Topics in Biomechanics
- CIVE 460 Engineering Biomechanics
- ECE 417 or SYDE 575 Image Processing

- KIN 340 Musculoskeletal Injuries in Sport and Activity
- ME 362 Fluid Mechanics 2
- ME 533 Non-metallic and Composite Materials
- ME 559 Finite Element Methods
- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 553 Advanced Dynamics

6.4 Chemical Engineering

Rationale:

Adding a short introduction just prior to stating the course lists.

Updating program rules for Complementary Studies Electives due to removal of Faculty-level rules. The changes increase flexibility for students.

Rewording the work term report section, the TE section, and the Specializations section to make them clearer.

Removed GENE412 from the Ethics and Equity milestone list because the course is being inactivated.

Chemical Engineering MARK UP

The Chemical Engineering Academic Curriculum

Chemical Engineering is a co-operative education plan. The academic curriculum comprises a set of core and elective courses taken in prescribed terms. The rules related to progress through the plan, and other important rules and regulations, can be found in the Engineering and Architecture, and Examinations and Promotions sections.

Further details of the co-operative education requirements can be found in the Co-operative Education Program Regulations and the Faculty of Engineering Work Terms sections.

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- CHE 100 Chemical Engineering Concepts 1 (3 LEC,2 TUT)
- CHE 102 Chemistry for Engineers (3 LEC,2 TUT)
- CHE 120 Computer Literacy and Programming for Chemical Engineers (2 LEC,2 LAB)
- CHE 180 Chemical Engineering Design Studio 1 (1 LEC,2 STU,1 SEM)
- MATH 115 Linear Algebra for Engineering (3 LEC,2 TUT)
- MATH 116 Calculus 1 for Engineering (3 LEC,2 TUT)

Term 1B (Winter Stream 8D/Spring Stream 4D)

- CHE 101 Chemical Engineering Concepts 2 (3 LEC,2 TUT,2 LAB)
- CHE 161 Engineering Biology (3 LEC,1 TUT)
- CHE 181 Chemical Engineering Design Studio 2 (2 LEC,2 STU,1 SEM)
- MATH 118 Calculus 2 for Engineering (3 LEC,2 TUT)
- PHYS 115 Mechanics (3 LEC,2 TUT)
- ~~Undergraduate Communication Requirement course~~
- **Communication Complementary Studies Elective**

Term 2A (Fall Stream 8D/Winter Stream 4D)

- CHE 200 Equilibrium Stage Operations (3 LEC,1 TUT)

- CHE 220 Process Data Analysis (3 LEC,1 TUT)
- CHE 230 Physical Chemistry 1 (3 LEC,1 TUT)
- CHE 290 Chemical Engineering Lab 1 (3 LAB)
- CHE 298 Directed Research Project (6 PRJ) (optional extra)
- CHEM 262 Organic Chemistry for Engineering (3 LEC,1 TUT)
- CHEM 262L Organic Chemistry Laboratory for Engineering Students (3 LAB)
- MATH 217 Calculus 3 for Chemical Engineering (3 LEC,1 TUT)

Term 2B (Spring Stream 8D/Fall Stream 4D)

- CHE 211 Fluid Mechanics (3 LEC,1 TUT)
- CHE 225 Strategies for Process Improvement and Product Development (3 LEC,1 TUT)
- CHE 231 Physical Chemistry 2 (3 LEC,1 TUT)
- CHE 241 Materials Science and Engineering (3 LEC,1 TUT)
- CHE 291 Chemical Engineering Lab 2 (3 LAB)
- CHE 299 Directed Research Project (6 PRJ) (optional extra)
- MATH 218 Differential Equations for Engineers (3 LEC,1 TUT)

Term 3A (Winter Stream 8D/Spring Stream 4D)

- CHE 312 Mathematics of Heat and Mass Transfer (3 LEC,1 TUT)
- CHE 314 Chemical Reaction Engineering (3 LEC,1 TUT)
- CHE 322 Numerical Methods for Process Analysis and Design (3 LEC,1 TUT)
- CHE 330 Chemical Engineering Thermodynamics (3 LEC,1 TUT)
- CHE 390 Chemical Engineering Lab 3 (3 LAB)
- CHE 398 Directed Research Project (6 PRJ) (optional extra)
- MSCI 261 Engineering Economics: Financial Management for Engineers (3 LEC,1 TUT)

Term 3B (Fall Stream 4D/Winter Stream 8D)

- CHE 313 Applications of Heat and Mass Transfer (3 LEC,1 TUT)
- CHE 331 Electrochemical Engineering (3 LEC,1 TUT)
- CHE 341 Introduction to Process Control (3 LEC,1 TUT)
- CHE 361 Bioprocess Engineering (3 LEC,1 TUT)
- CHE 383 Chemical Engineering Design Workshop (2 LEC)
- CHE 399 Directed Research Project (6 PRJ) (optional extra)
- One ~~TE Approved~~ Technical Elective or ~~CSE~~ Complementary Studies Elective

Term 4A (Fall)

- CHE 480 Process Analysis and Design (3 LEC,2 TUT)
- CHE 482 Group Design Project (1 SEM,9 PRJ)
- CHE 490 Chemical Engineering Lab 4 (4 LAB)

- CHE 450 Technical Work-term Report
- CHE 498 Directed Research Project (6 PRJ) (optional extra)
- Three ~~TE Approved~~ Technical Electives or ~~CSE~~ Complementary Studies Electives

Term 4B (Winter)

- CHE 483 Group Design Project and Symposium (1 SEM,9 PRJ)
- CHE 491 Chemical Engineering Lab 5 (4 LAB)
- Four ~~TE Approved~~ Technical Electives or ~~CSE~~ Complementary Studies Electives

Complementary Studies Electives

~~A total of f~~ **F**ive Complementary Studies Electives (CSEs)~~, not including MSCI 261,~~ must be taken~~,. The first of these courses must satisfy the Undergraduate Communication Requirement (see below). If some Complementary Studies Electives are satisfied online or from other institutions on a Letter of Permission, when not in an academic term, each term's minimum course load must be maintained by substituting an approved "free" elective (technical or non-technical). For further details see Complementary Studies Requirements for Engineering Students.~~ **selected from the Complementary Studies Course Lists for Engineering, Lists A, C, and D, that satisfy the following criteria:**

- **One communication course (CSE)**
- **At least one CSE selected from List A**
- **At least one CSE selected from List C**

~~**Undergraduate Communication Requirement**~~

Communication Course

~~Strong communication skills are essential to academic, professional, and personal success. To achieve the Undergraduate Communication Requirement, Chemical Engineering students must successfully complete a foundational course on communication. This course must be taken as the first Complementary Studies Elective course (CSE in the 1B term) and selected from the following list:~~

One communication course (CSE) must be taken from the following list (usually in the 1B term):

- ENGL 109 Introduction to Academic Writing
- ENGL 129R/EMLS 129R Written Academic English
- EMLS 101R Oral Communications for Academic Purposes
- EMLS 102R Clear Communication in English Writing
- SPCOM 100 Interpersonal Communication
- SPCOM 223 Public Speaking

~~Failure to achieve~~ **Completing a communication course (CSE) satisfies** the Undergraduate Communication Requirement**.** **If this is not achieved** before the end of the 2A term **then it** will result in a ~~term~~ **promotion** decision of May Not Proceed (MNP). ~~Communication skills are further developed and evaluated through work-term reports, as well as through design-focused (CHE 180, CHE 181, CHE 383,~~

~~CHE 482, CHE 483) and investigation-focused courses (CHE 390, CHE 490, CHE 491).~~

Work-term Reports and Reflection Milestone

~~Reflection is an integral part of work-integrated learning.~~ To achieve the Work-term Reflection Milestone, Chemical Engineering students must complete a minimum of four reflective work-term reports.~~, one associated with each work term. These are short, structured reports offering the opportunity to reflect on practical experience obtained in the context of their academic learning and the experience requirements for professional licensure.~~

Two technical work-term reports are required. The first is completed as part of ~~Students are expected to continue to develop technical communication skills in the workplace. To facilitate this, students must take~~ PD 11 Processes for Technical Report Writing **which must be selected** as **a** ~~one of their~~ PD elective~~s~~, and **the second through the** ~~also complete~~ CHE 450 Technical Work-term Report **course**.

Ethics and Equity Milestone

This degree milestone must be met by all graduating Chemical Engineering students by either completing one course from the following list (can be taken as a CSE):

- PHIL 215 Professional and Business Ethics
- PHIL 219J Practical Ethics
- PHIL 315/~~GENE 412~~ Ethics and The Engineering Profession

or by completing PD 22 Professionalism and Ethics in Engineering Practice **(can be taken as a PD elective)**.

Technical Electives

A total of four Technical Electives (TEs) courses must be taken~~,~~ **selected from the following lists.** ~~TEs for Chemical Engineering students~~ **The lists** are organized in three main thematic areas and **students selecting all four TEs from the same list may choose to register for a specialization (further information below).**~~may be selected from the following lists.~~ Only one non-CHE course (i.e., from other departments) is permitted if CHE 499 is chosen. Otherwise, students may select up to two non-CHE TEs. Non-CHE courses will likely require permission of the instructor and/or other prerequisites. In brackets are recommended minimum levels that CHE students should be enrolled in before attempting a given course. Variations from this course selection list must be approved by the Department.

List 1 - Energy and Environmental Systems and Processes

- CHE 499 Elective Research Project (3B)
- CHE 500 Special Topics in Chemical Engineering (contact Department)
- CHE 514 Fundamentals of Petroleum Production (3B)
- CHE 516 Energy Systems Engineering (3B)
- CHE 520 Process Flowsheet Analysis (4B)
- CHE 565 Synthetic Biology Project Design (3B)
- CHE 571 Industrial Ecology (3B)
- CHE 572 Air Pollution Control (3B)
- CHE 574 Industrial Wastewater Pollution Control (3B)
- EARTH 458 Physical Hydrogeology (4A)
- EARTH 459 Chemical Hydrogeology (4B)

- ENVE 376 Biological Processes (3B)
- ENVE 573 Contaminant Transport (4B)
- ENVE 577 Engineering for Solid Waste Management (4B)
- ME 452 ~~Energy Transfer in Buildings~~ **HVAC Load Analysis and Design Fundamentals** (4B)
- ME 459 Energy Conversion (3B)
- ME 571 Air Pollution (4B)

List 2 - Materials and Manufacturing Processes

- CHE 499 Elective Research Project (3B)
- CHE 500 Special Topics in Chemical Engineering (contact Department)
- CHE 520 Process Flowsheet Analysis (4B)
- CHE 541 Introduction to Polymer Science and Properties (3B)
- CHE 543 Polymer Production: Polymer Reaction Engineering (4B)
- CHE 561 Biomaterials and Biomedical Design (4B)
- CHE 562 Advanced Bioprocess Engineering (4B)
- CHE 564 Food Process Engineering (4B)
- CHE 565 Synthetic Biology Project Design (3B)
- CHE 571 Industrial Ecology (3B)
- ME 435 Industrial Metallurgy (4A)
- ME 531 Physical Metallurgy Applied to Manufacturing (4B)
- ME 533 Non-metallic and Composite Materials (4B)
- MSCI 432 Production and Service Operations Management (3B)
- MSCI 551 Quality Management and Control (3B)
- NE 352 Surfaces and Interfaces (4A)
- NE 481 Nanomedicine and Nanobiotechnology (4A)

List 3 - Chemical Process Modelling, Optimization, and Control

- CHE 499 Elective Research Project (3B)
- CHE 500 Special Topics in Chemical Engineering (contact Department)
- CHE 520 Process Flowsheet Analysis (4B)
- CHE 521 Process Optimization (3B)
- CHE 522 Advanced Process Dynamics and Control (4B)
- CHE 524 Process Control Laboratory (4B)
- CHE 565 Synthetic Biology Project Design (3B)
- EARTH 456 Numerical Methods in Hydrogeology (4A)
- ME 362 Fluid Mechanics 2 (3B)
- ME 559 Finite Element Methods (3B)
- ME 566 Computational Fluid Dynamics for Engineering Design (4A)
- MSCI 332 Deterministic Optimization Models and Methods (3B)
- MSCI 431 Stochastic Models and Methods (4B)
- MSCI 432 Production and Service Operations Management (3B)
- MSCI 551 Quality Management and Control (3B)
- NE 451 Simulation Methods (4A)
- SYDE 531 Design Optimization Under Probabilistic Uncertainty (4B)

Information for all undergraduate courses, including Chemical Engineering, can be found in the Course Descriptions section of this Calendar.

Specializations

The Faculty of Engineering recognizes three designated specializations within the BASc degree in Chemical Engineering:

- **The Energy and Environmental Systems and Processes Specialization**
- **The Materials and Manufacturing Processes Specialization**
- **The Chemical Process Modelling, Optimization and Control Specialization**

~~Energy and Environmental Systems and Processes Specialization, Materials and Manufacturing Processes Specialization, and Chemical Process Modelling, Optimization and Control Specialization.~~ Students interested in pursuing one of these specializations must take four required technical elective courses from the corresponding list of approved technical electives (List 1, List 2, or List 3). A minimum average of 60% in the four specialization courses and a grade of at least 50% in each of the four courses is required. Students who satisfy the requirements for Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

1. ~~The Energy and Environmental Systems and Processes Specialization (List 1).~~
2. ~~The Materials and Manufacturing Processes Specialization (List 2).~~
3. ~~The Chemical Process Modelling, Optimization and Control Specialization (List 3).~~

Chemical Engineering CLEAN COPY

The Chemical Engineering Academic Curriculum

Chemical Engineering is a co-operative education plan. The academic curriculum comprises a set of core and elective courses taken in prescribed terms. The rules related to progress through the plan, and other important rules and regulations, can be found in the Engineering and Architecture, and Examinations and Promotions sections.

Further details of the co-operative education requirements can be found in the Co-operative Education Program Regulations, and the Faculty of Engineering Work Terms sections.

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- CHE 100 Chemical Engineering Concepts 1 (3 LEC,2 TUT)
- CHE 102 Chemistry for Engineers (3 LEC,2 TUT)
- CHE 120 Computer Literacy and Programming for Chemical Engineers (2 LEC,2 LAB)
- CHE 180 Chemical Engineering Design Studio 1 (1 LEC,2 STU,1 SEM)
- MATH 115 Linear Algebra for Engineering (3 LEC,2 TUT)
- MATH 116 Calculus 1 for Engineering (3 LEC,2 TUT)

Term 1B (Winter Stream 8D/Spring Stream 4D)

- CHE 101 Chemical Engineering Concepts 2 (3 LEC,2 TUT,2 LAB)

- CHE 161 Engineering Biology (3 LEC,1 TUT)
- CHE 181 Chemical Engineering Design Studio 2 (2 LEC,2 STU,1 SEM)
- MATH 118 Calculus 2 for Engineering (3 LEC,2 TUT)
- PHYS 115 Mechanics (3 LEC,2 TUT)
- Communication Complementary Studies Elective

Term 2A (Fall Stream 8D/Winter Stream 4D)

- CHE 200 Equilibrium Stage Operations (3 LEC,1 TUT)
- CHE 220 Process Data Analysis (3 LEC,1 TUT)
- CHE 230 Physical Chemistry 1 (3 LEC,1 TUT)
- CHE 290 Chemical Engineering Lab 1 (3 LAB)
- CHE 298 Directed Research Project (6 PRJ) (optional extra)
- CHEM 262 Organic Chemistry for Engineering (3 LEC,1 TUT)
- CHEM 262L Organic Chemistry Laboratory for Engineering Students (3 LAB)
- MATH 217 Calculus 3 for Chemical Engineering (3 LEC,1 TUT)

Term 2B (Spring Stream 8D/Fall Stream 4D)

- CHE 211 Fluid Mechanics (3 LEC,1 TUT)
- CHE 225 Strategies for Process Improvement and Product Development (3 LEC,1 TUT)
- CHE 231 Physical Chemistry 2 (3 LEC,1 TUT)
- CHE 241 Materials Science and Engineering (3 LEC,1 TUT)
- CHE 291 Chemical Engineering Lab 2 (3 LAB)
- CHE 299 Directed Research Project (6 PRJ) (optional extra)
- MATH 218 Differential Equations for Engineers (3 LEC,1 TUT)

Term 3A (Winter Stream 8D/Spring Stream 4D)

- CHE 312 Mathematics of Heat and Mass Transfer (3 LEC,1 TUT)
- CHE 314 Chemical Reaction Engineering (3 LEC,1 TUT)
- CHE 322 Numerical Methods for Process Analysis and Design (3 LEC,1 TUT)
- CHE 330 Chemical Engineering Thermodynamics (3 LEC,1 TUT)
- CHE 390 Chemical Engineering Lab 3 (3 LAB)
- CHE 398 Directed Research Project (6 PRJ) (optional extra)
- MSCI 261 Engineering Economics: Financial Management for Engineers (3 LEC,1 TUT)

Term 3B (Fall Stream 4D/Winter Stream 8D)

- CHE 313 Applications of Heat and Mass Transfer (3 LEC,1 TUT)
- CHE 331 Electrochemical Engineering (3 LEC,1 TUT)
- CHE 341 Introduction to Process Control (3 LEC,1 TUT)
- CHE 361 Bioprocess Engineering (3 LEC,1 TUT)

- CHE 383 Chemical Engineering Design Workshop (2 LEC)
- CHE 399 Directed Research Project (6 PRJ) (optional extra)
- One Technical Elective or Complementary Studies Elective

Term 4A (Fall)

- CHE 480 Process Analysis and Design (3 LEC,2 TUT)
- CHE 482 Group Design Project (1 SEM,9 PRJ)
- CHE 490 Chemical Engineering Lab 4 (4 LAB)
- CHE 450 Technical Work-term Report
- CHE 498 Directed Research Project (6 PRJ) (optional extra)
- Three Technical Electives or Complementary Studies Electives

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Term 4B (Winter)

- CHE 483 Group Design Project and Symposium (1 SEM,9 PRJ)
- CHE 491 Chemical Engineering Lab 5 (4 LAB)
- Four Technical Electives or Complementary Studies Electives

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Complementary Studies Electives

Five Complementary Studies Electives (CSEs) must be taken, selected from the Complementary Studies Course Lists for Engineering, Lists A, C, and D, that satisfy the following criteria:

- One communication course (CSE)
- At least one CSE selected from List A
- At least one CSE selected from List C

Communication Course

One communication course (CSE) must be taken from the following list (usually in the 1B term):

- ENGL 109 Introduction to Academic Writing
- ENGL 129R/EMLS 129R Written Academic English
- EMLS 101R Oral Communications for Academic Purposes
- EMLS 102R Clear Communication in English Writing
- SPCOM 100 Interpersonal Communication
- SPCOM 223 Public Speaking

Completing a communication course (CSE) satisfies the Undergraduate Communication Requirement. If this is not achieved before the end of the 2A term then it will result in a promotion decision of May Not Proceed (MNP).

Work-term Reports and Reflection Milestone

To achieve the Work-term Reflection Milestone, Chemical Engineering students must complete a minimum of four reflective work-term reports.

Two technical work-term reports are required. The first is completed as part of PD 11 Processes for Technical Report Writing which must be selected as a PD elective, and the second through the CHE 450 Technical Work-term Report course.

Ethics and Equity Milestone

This degree milestone must be met by all graduating Chemical Engineering students by either completing one course from the following list (can be taken as a CSE):

- PHIL 215 Professional and Business Ethics
- PHIL 219J Practical Ethics
- PHIL 315 Ethics and The Engineering Profession

or by completing PD 22 Professionalism and Ethics in Engineering Practice (can be taken as a PD elective).

Technical Electives

A total of four Technical Electives (TEs) courses must be taken, selected from the following lists. The lists are organized in three main thematic areas and students selecting all four TEs from the same list may choose to register for a specialization (further information below). Only one non-CHE course (i.e., from other departments) is permitted if CHE 499 is chosen. Otherwise, students may select up to two non-CHE TEs. Non-CHE courses will likely require permission of the instructor and/or other prerequisites. In brackets are recommended minimum levels that CHE students should be enrolled in before attempting a given course. Variations from this course selection list must be approved by the Department.

List 1 - Energy and Environmental Systems and Processes

- CHE 499 Elective Research Project (3B)
- CHE 500 Special Topics in Chemical Engineering (contact Department)
- CHE 514 Fundamentals of Petroleum Production (3B)
- CHE 516 Energy Systems Engineering (3B)
- CHE 520 Process Flowsheet Analysis (4B)
- CHE 565 Synthetic Biology Project Design (3B)
- CHE 571 Industrial Ecology (3B)
- CHE 572 Air Pollution Control (3B)
- CHE 574 Industrial Wastewater Pollution Control (3B)
- EARTH 458 Physical Hydrogeology (4A)
- EARTH 459 Chemical Hydrogeology (4B)
- ENVE 376 Biological Processes (3B)
- ENVE 573 Contaminant Transport (4B)
- ENVE 577 Engineering for Solid Waste Management (4B)
- ME 452 HVAC Load Analysis and Design Fundamentals (4B)
- ME 459 Energy Conversion (3B)
- ME 571 Air Pollution (4B)

List 2 - Materials and Manufacturing Processes

- CHE 499 Elective Research Project (3B)
- CHE 500 Special Topics in Chemical Engineering (contact Department)
- CHE 520 Process Flowsheet Analysis (4B)
- CHE 541 Introduction to Polymer Science and Properties (3B)
- CHE 543 Polymer Production: Polymer Reaction Engineering (4B)
- CHE 561 Biomaterials and Biomedical Design (4B)
- CHE 562 Advanced Bioprocess Engineering (4B)
- CHE 564 Food Process Engineering (4B)
- CHE 565 Synthetic Biology Project Design (3B)
- CHE 571 Industrial Ecology (3B)
- ME 435 Industrial Metallurgy (4A)
- ME 531 Physical Metallurgy Applied to Manufacturing (4B)
- ME 533 Non-metallic and Composite Materials (4B)
- MSCI 432 Production and Service Operations Management (3B)
- MSCI 551 Quality Management and Control (3B)
- NE 352 Surfaces and Interfaces (4A)
- NE 481 Nanomedicine and Nanobiotechnology (4A)

List 3 - Chemical Process Modelling, Optimization, and Control

- CHE 499 Elective Research Project (3B)
- CHE 500 Special Topics in Chemical Engineering (contact Department)
- CHE 520 Process Flowsheet Analysis (4B)
- CHE 521 Process Optimization (3B)
- CHE 522 Advanced Process Dynamics and Control (4B)
- CHE 524 Process Control Laboratory (4B)
- CHE 565 Synthetic Biology Project Design (3B)
- EARTH 456 Numerical Methods in Hydrogeology (4A)
- ME 362 Fluid Mechanics 2 (3B)
- ME 559 Finite Element Methods (3B)
- ME 566 Computational Fluid Dynamics for Engineering Design (4A)
- MSCI 332 Deterministic Optimization Models and Methods (3B)
- MSCI 431 Stochastic Models and Methods (4B)
- MSCI 432 Production and Service Operations Management (3B)
- MSCI 551 Quality Management and Control (3B)
- NE 451 Simulation Methods (4A)
- SYDE 531 Design Optimization Under Probabilistic Uncertainty (4B)

Information for all undergraduate courses, including Chemical Engineering, can be found in the Course Descriptions section of this Calendar.

Specializations

The Faculty of Engineering recognizes three designated specializations within the BASc degree in Chemical Engineering:

- The Energy and Environmental Systems and Processes Specialization
- The Materials and Manufacturing Processes Specialization

- The Chemical Process Modelling, Optimization and Control Specialization

Students interested in pursuing one of these specializations must take four required technical elective courses from the corresponding list of approved technical electives (List 1, List 2, or List 3). A minimum average of 60% in the four specialization courses and a grade of at least 50% in each of the four courses is required. Students who satisfy the requirements for Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

6.5 Civil Engineering

Rationale:

Updating program rules for Complementary Studies Electives due to removal of Faculty-level rules. The changes increase flexibility for students. Rewriting elective requirements for the 11 elective courses (3 CSEs, 1 NSE, 7 TEs).

Adding courses to Technical Elective list to provide more choice for students. (AE572, AE573, BIOL462, GEOG453/PLAN453, PLAN483) (Units offering the courses were consulted.)

Adding new courses from Science and Geography to the NSE list. (GEOG357, SCI206, SCI250). (Units offering the courses were consulted.)

Removing statements that are confusing, non-contractual, or unnecessary.

Civil Engineering	MARK UP

The Civil Engineering Academic Curriculum

~~A total of three approved Complementary Studies Electives (CSE), in addition to ENGL 191/SPCOM 191, CIVE 392, and CIVE 491, and eight approved Technical Electives (TE) must be completed as detailed in the following sections.~~

The Civil Engineering academic curriculum is detailed in the following sections. A total of eleven approved electives must be completed:

- **Three Complementary Studies Electives**
- **One Natural Science Elective**
- **Seven Technical Electives**

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- CHE 102 Chemistry for Engineers
- CIVE 100 Civil Engineering Concepts
- CIVE 104 Mechanics 1
- CIVE 115 Linear Algebra
- ENGL 191/SPCOM 191 Communication in the Engineering Profession ~~(List D-Other CSE)~~
- MATH 116 Calculus 1 for Engineering

Term 1B (Winter)

- CIVE 105 Mechanics 2
- CIVE 121 Computational Methods
- CIVE 123 Electrical Circuits and Instrumentation
- CIVE 153 Earth Engineering

- CIVE 199 Seminar
- MATH 118 Calculus 2 for Engineering

Term 2A (Fall)

- CIVE 204 Solid Mechanics 1
- CIVE 221 Advanced Calculus
- CIVE 224 Probability and Statistics
- CIVE 241 Transport Principles and Applications
- CIVE 265 Structure and Properties of Materials
- CIVE 298 Seminar

Term 2B (Spring)

- CIVE 205 Solid Mechanics 2
- CIVE 222 Differential Equations
- CIVE 230 Engineering and Sustainable Development
- CIVE 280 Fluid Mechanics
- CIVE 299 Seminar
- CIVE 392 Economics and Life Cycle Cost Analysis ~~(List B-Engineering Economics CSE)~~

Term 3A (Winter)

- CIVE 303 Structural Analysis
- CIVE 332 Civil Systems and Project Management
- CIVE 341 Transportation Engineering Applications
- CIVE 353 Geotechnical Engineering 1
- CIVE 382 Hydrology and Open Channel Flow
- CIVE 398 Seminar
- ~~CSE 1 Approved Complementary Studies Elective~~
- WKRPT 200 Work-term Report
- **Approved Elective**

Term 3B (Fall)

- CIVE 310 Introduction to Structural Design
- CIVE 375 Environmental Engineering Principles
- CIVE 399 Seminar
- ~~TE 1 Approved Technical Elective~~
- ~~TE 2 Approved Technical Elective~~
- ~~CSE 2 or TE 3 Approved Complementary Studies Elective or Technical~~ Elective
- WKRPT 300 Work-term Report
- **Three Approved Electives**

~~**Note:** Elective must be a Technical Elective (TE) if Complementary Studies Elective (CSE) is selected in a previous term, and vice versa.~~

Term 4A (Spring)

- CIVE 400 Civil Engineering Design Project 1
- CIVE 491 Engineering Law and Ethics ~~(List D-Other CSE)~~
- CIVE 498 Seminar
- ~~TE 3 or CSE 2 Approved Technical Elective or Complementary Studies Elective~~
- ~~TE 4 Approved Technical Elective~~
- CSE 3 or TE 5 Approved Complementary Studies Elective or Technical Elective
- WKRPT 400 Work-term Report
- **Three Approved Electives**

~~**Note:** Elective must be a Technical Elective (TE) if Complementary Studies Elective (CSE) is selected in a previous term, and vice versa.~~

Term 4B (Winter)

- CIVE 401 Civil Engineering Design Project 2
- CIVE 499 Seminar
- **Four Approved Electives**
- CSE 3 or TE 5 Approved Complementary Studies Elective or Technical Elective
- TE 6 Approved Technical Elective
- ~~TE 7 Approved Technical Elective~~
- ~~TE 8 Approved Technical Elective~~

~~**Note:** Elective must be a Technical Elective (TE) if Complementary Studies Elective (CSE) is selected in a previous term, and vice versa.~~

Electives

Students are responsible for selecting their own combination of electives, in keeping with their ultimate career objectives after graduation. The combination must satisfy the requirements of the Department of Civil and Environmental Engineering (CEE). ~~, which meet engineering accreditation requirements such that students are eligible to count their undergraduate education towards a professional engineering license.~~ This includes having to meet minimum requirements in mathematics, natural sciences, engineering sciences, engineering design, and complementary studies.

~~Exceptions to courses on the Faculty CSE lists and the Civil Engineering TE and Specialization Lists require the approval of the CEE associate chair undergraduate studies.~~ **Exceptions to the electives and requirements listed in the following sections (and links) require approval of the Civil and Environmental Engineering associate chair, undergraduate studies.** Some courses of interest may require prerequisite knowledge that is not part of the core curriculum in Civil Engineering. Students may require extra courses or may need to seek enrolment approval from the course instructor if the prerequisites have not been satisfied.

Complementary Studies Electives

~~All engineering students are required to take complementary studies courses, as described in Complementary Studies Requirements for Engineering Students. Three complementary studies electives (CSEs) in approved non-technical subjects, must be taken. The CSEs are in addition to those courses which are part of the core curriculum and contain complementary studies material, such as ENGL 191/SPCOM 191 (List D), CIVE 392 (List B), and CIVE 491 (List D). The three CSE courses are to be chosen according to the following constraints:~~

- ~~One course from List A - Impact Courses~~
- ~~Two courses from List C - Humanities and Social Sciences Courses~~

Students are required to complete three Complementary Studies Electives (CSEs) from the Complementary Studies Course Lists for Engineering:

- **One course from List A**
- **One course from List C**
- **One course from List A, C, or D**

List A CSEs concentrate on the impact of technology and/or engineering on society, List C CSEs are from the humanities and social sciences, and List D CSEs are humanities and social sciences courses that concentrate on the development of language or other skills.

Natural Science Electives

Students are required to complete one Natural Science Elective (NSE) from the following list:

- **BIOL 130 Introductory Cell Biology**
- **BIOL 150 Organismal and Evolutionary Ecology**
- **BIOL 240 Fundamentals of Microbiology**
- **BIOL 273 Principles of Human Physiology 1**
- **CHE 161 Engineering Biology**
- **CHEM 209 Introductory Spectroscopy and Structure**
- **CHEM 262 Organic Chemistry for Engineering**
- **EARTH 221 Introductory Geochemistry**
- **EARTH 270 Disasters and Natural Hazards**
- **EARTH 281 Geological Impacts on Human Health**
- **ENVS 200 Field Ecology**
- **GEOG 357 River Management**
- **KIN 100 Regional Human Anatomy and KIN 100L Regional Human Anatomy Laboratory**

- **SCI 206 The Physics of How Things Work**
- **SCI 207 Physics, the Universe, and Everything**
- **SCI 238 Introductory Astronomy**
- **SCI 250 Environmental Geology**

Technical Electives

Students are required to complete ~~eight~~ **seven** technical electives (TEs) ~~courses~~ within the following requirements:

1. ~~At least t~~**T**hree TEs must be from TE List ~~A~~ **1** ~~(Engineering Design Intensive Technical Electives)~~
2. ~~Up to~~ **The remaining** four TEs may be from TE List **1 or 2** ~~B (Technical Electives)~~
3. ~~One TE must be from TE List C (Natural Science Technical Electives)~~

The Technical Elective Lists for Civil Engineering are provided below. Note that the offering of these courses is contingent upon sufficient demand and/or available teaching resources. There may be courses added and changes made to the content~~,~~ **or** term of offering~~, or meet times from what is listed below~~. Special Topics courses (CIVE 495 and CIVE 497) are offered as resources and faculty availability permit. Further information is available from the CEE Undergraduate Office or CEE website.

~~**Legend for TE List A, B, and C**~~

~~Term courses are offered: F=fall term, W=winter term, S=spring term~~

TE List ~~A~~ 1 - Engineering Design Intensive Technical Electives

~~Choose at least three~~

- **AE 572 Building Energy Analysis**
- **AE 573 HVAC Systems, Equipment, and Energy Efficiency**
- CIVE 343 Traffic Simulation Modelling and Applications ~~(F)~~
- CIVE 354 Geotechnical Engineering 2 ~~(F)~~
- CIVE 413 Structural Steel Design ~~(S)~~
- CIVE 414 Structural Concrete Design ~~(S)~~
- CIVE 415 Structural System Design ~~(W)~~
- CIVE 460 Engineering Biomechanics ~~(W)~~
- CIVE 495 Design Intensive Special Topics in Civil Engineering ~~(as offered)~~
- CIVE 512 Rehabilitation of Structures ~~(W)~~
- CIVE 542 Pavement Structural Design ~~(W)~~
- CIVE 554 Geotechnical Engineering 3 ~~(W)~~
- CIVE 583 Design of Urban Water Systems ~~(W)~~
- CIVE 596 Construction Engineering ~~(S)~~
- EARTH 438 Engineering Geology ~~(W)~~
- ENVE 577 Engineering for Solid Waste Management ~~(W)~~
- SYDE 533 Conflict Resolution ~~(F)~~

TE List ~~B~~ 2 - Technical Electives

~~Choose a maximum of four~~

- CIVE 306 ~~Mechanics of Solids 3~~ **Solid Mechanics 3** ~~(F)~~

- CIVE 422 Finite Element Analysis ~~(W)~~
- CIVE 440 Transit Planning and Operations ~~(W)~~
- CIVE 484 Physical Infrastructure Planning ~~(S)~~
- CIVE 497 Special Topics in Civil Engineering ~~(as offered)~~
- CIVE 505 Structural Dynamics ~~(S)~~
- CIVE 507 Building Science and Technology ~~(W)~~
- EARTH 444/**BIOL 462** Applied Wetland Science ~~(F)~~
- EARTH 458 Physical Hydrogeology ~~(F,S)~~
- ENVE 277 Air Quality Engineering ~~(F)~~
- ENVE 279 Energy and the Environment ~~(F)~~
- ENVE 376 Biological Processes ~~(W)~~
- ENVE 383 Advanced Hydrology and Hydraulics ~~(W)~~
- ENVE 573 Contaminant Transport ~~(W)~~
- GEOG 209 Hydrogeology ~~(W,S)~~
- GEOG 305 Fluvial Geomorphology ~~(F)~~
- GEOG 371 Advanced Remote Sensing Techniques ~~(F)~~
- GEOG 381 Advanced Geographic Information Systems ~~(W,S)~~
- ME 559 Finite Element Methods ~~(F,S)~~
- PLAN 416 Modelling the City ~~(W)~~
- **PLAN 453/GEOG 453 Urban Stormwater Management**
- PLAN 477 Freight Planning and Policy ~~(W)~~
- **PLAN 483 Land Development Planning**

~~**TE List C - Natural Science Technical Electives**~~

~~Choose one~~

- ~~BIOL 130 Introductory Cell Biology (F,W)~~
- ~~BIOL 150 Organismal and Evolutionary Ecology (F)~~
- ~~BIOL 240 Fundamentals of Microbiology (F)~~
- ~~BIOL 273 Principles of Human Physiology 1 (F,W, and online S)~~
- ~~CHE 161 Engineering Biology (W,S)~~
- ~~CHEM 209 Introductory Spectroscopy and Structure (F)~~
- ~~CHEM 262 Organic Chemistry for Engineering (F,W)~~
- ~~EARTH 221 Introductory Geochemistry (W,S)~~
- ~~EARTH 270 Disasters and Natural Hazards (W)~~
- ~~EARTH 281 Geological Impacts on Human Health (W)~~
- ~~ENVS 200 Field Ecology (F,W,S)~~
- ~~KIN 100 Regional Human Anatomy and KIN 100L Regional Human Anatomy Laboratory (W)~~
- ~~SCI 207 Physics, the Universe, and Everything (W)~~
- ~~SCI 238 Introductory Astronomy (F,W,S)~~

Specializations

The Faculty of Engineering recognizes ~~four~~ **five** specializations with the Civil Engineering BASc degree. Students who satisfy the specialization requirements (courses and grades) will have the specialization designation shown on their transcript and diploma. Specializations are intended to recognize success in a concentration of electives within the Civil Engineering degree specification. In other words, specializations focus the selection of electives required for the base degree and do not require extra courses.

Each specialization requires students to select ~~technical electives~~ **TEs** with a common theme. Students are responsible for meeting the TE requirements of the Civil Engineering plan when pursuing a specialization. Each specialization requires the successful completion of a minimum number of TEs specified by the specialization with a minimum average of 60%. Students must declare a specialization for it to be recognized as part of their degree and appear on the transcript and diploma.

The specialization course requirements are provided below. ~~Exceptions to the listed courses require the approval of the CEE associate chair, undergraduate studies.~~

Building Science Specialization

The Building Science Specialization requires a minimum of four TEs from the lists below.

- **From TE List 1:**
  - **AE 405 Building Performance Measurement Lab**
  - **AE 450 Building Service Systems**
  - **AE 572 Building Energy Analysis**
  - **AE 573 HVAC Systems, Equipment, and Energy Efficiency**
  - **ME 452 HVAC Load Analysis and Design Fundamentals**
- **From TE List 2:**
  - **CIVE 507 Building Science and Technology**
  - **ENVE 277 Air Quality Engineering**
  - **ENVE 279 Energy and the Environment**

Geotechnical Specialization

The Geotechnical Specialization ~~course requirements are~~ **requires a minimum of four TEs from the lists below**:

- **Two required courses:**
  - CIVE 354 Geotechnical Engineering 2 ~~(F, TE List A)~~
  - CIVE 554 Geotechnical Engineering 3 ~~(W, TE List A)~~
- At least two additional TEs from the list below.
  - From TE List ~~A~~ **1**:
    - CIVE 414 Structural Concrete Design ~~(S)~~
    - CIVE 542 Pavement Structural Design ~~(W)~~
  - From TE List ~~B~~ **2**:
    - CIVE 422 Finite Element Analysis ~~(W)~~ or ME 559 Finite Element Methods ~~(F,S)~~
    - EARTH 438 Engineering Geology ~~(W)~~

Structural Specialization

The Structural Specialization ~~course requirements are~~ **requires a minimum of five TEs from the lists below**:

- ~~At least five TEs from the list below, of which~~ one must be CIVE 413 or CIVE 414.
  - From TE List ~~A~~ **1**:
    - CIVE 413 Structural Steel Design ~~(S)~~
    - CIVE 414 Structural Concrete Design ~~(S)~~
    - CIVE 415 Structural System Design ~~(W)~~
    - CIVE 460 Engineering Biomechanics ~~(W)~~

        - CIVE 512 Rehabilitation of Structures ~~(W)~~
        - CIVE 596 Construction Engineering ~~(S)~~
    - From TE List ~~B~~ **2**:
        - CIVE 306 ~~Mechanics of Solids 3~~ **Solid Mechanics 3** ~~(F)~~
        - CIVE 422 Finite Element Analysis ~~(W)~~
        - CIVE 505 Structural Dynamics ~~(S)~~
        - ~~CIVE 507 Building Science and Technology (W)~~

Transportation Specialization

The Transportation Specialization ~~course requirements are~~ **requires a minimum of four TEs from the lists below**:

- At ~~least four TEs from the list below, of which at~~ least three must be CIVE courses.
    - From TE List ~~A~~ **1**:
        - CIVE 343 Traffic Simulation Modelling and Applications ~~(F)~~
        - CIVE 542 Pavement Structural Design ~~(W)~~
    - From TE List ~~B~~ **2**:
        - CIVE 440 Transit Planning and Operations ~~(W)~~
        - CIVE 484 Physical Infrastructure Planning ~~(S)~~
        - GEOG 381 Advanced Geographic Information Systems ~~(W,S)~~
        - PLAN 416 Modelling the City ~~(W)~~
        - PLAN 477 Freight Planning and Policy ~~(W)~~

Water Resources Specialization

The Water Resources Specialization ~~course requirements are~~ **requires a minimum of four TEs from the lists below**:

- **One required course:**
    - ENVE 383 Advanced Hydrology and Hydraulics (~~W~~, TE List ~~B~~ **2**)
- At least three TEs from the list below.
    - From TE List ~~A~~ **1**:
        - CIVE 583 Design of Urban Water Systems ~~(W)~~
        - SYDE 533 Conflict Resolution ~~(F)~~
    - From TE List ~~B~~ **2**:
        - EARTH 444/**BIOL 462** Applied Wetland Science
        - EARTH 458 Physical Hydrogeology ~~(F,S)~~
        - ENVE 376 Biological Processes ~~(W)~~
        - ENVE 573 Contaminant Transport ~~(W)~~
        - GEOG 209 Hydroclimatology ~~(W,S)~~
        - GEOG 305 Fluvial Geomorphology ~~(F)~~
        - GEOG 371 Advanced Remote Sensing Techniques ~~(F)~~
        - GEOG 381 Advanced Geographic Information Systems ~~(W,S)~~
        - **PLAN 453/GEOG 453 Urban Stormwater Management**

Civil Engineering — CLEAN COPY

The Civil Engineering Academic Curriculum

The Civil Engineering academic curriculum is detailed in the following sections. A total of eleven approved electives must be completed:

- Three Complementary Studies Electives
- One Natural Science Elective
- Seven Technical Electives

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- CHE 102 Chemistry for Engineers
- CIVE 100 Civil Engineering Concepts
- CIVE 104 Mechanics 1
- CIVE 115 Linear Algebra
- ENGL 191/SPCOM 191 Communication in the Engineering Profession
- MATH 116 Calculus 1 for Engineering

Term 1B (Winter)

- CIVE 105 Mechanics 2
- CIVE 121 Computational Methods
- CIVE 123 Electrical Circuits and Instrumentation
- CIVE 153 Earth Engineering
- CIVE 199 Seminar
- MATH 118 Calculus 2 for Engineering

Term 2A (Fall)

- CIVE 204 Solid Mechanics 1
- CIVE 221 Advanced Calculus
- CIVE 224 Probability and Statistics
- CIVE 241 Transport Principles and Applications
- CIVE 265 Structure and Properties of Materials
- CIVE 298 Seminar

Term 2B (Spring)

- CIVE 205 Solid Mechanics 2
- CIVE 222 Differential Equations
- CIVE 230 Engineering and Sustainable Development
- CIVE 280 Fluid Mechanics
- CIVE 299 Seminar
- CIVE 392 Economics and Life Cycle Cost Analysis

Term 3A (Winter)

- CIVE 303 Structural Analysis
- CIVE 332 Civil Systems and Project Management
- CIVE 341 Transportation Engineering Applications
- CIVE 353 Geotechnical Engineering 1
- CIVE 382 Hydrology and Open Channel Flow
- CIVE 398 Seminar
- WKRPT 200 Work-term Report
- Approved Elective

Term 3B (Fall)

- CIVE 310 Introduction to Structural Design
- CIVE 375 Environmental Engineering Principles
- CIVE 399 Seminar
- WKRPT 300 Work-term Report
- Three Approved Electives

Term 4A (Spring)

- CIVE 400 Civil Engineering Design Project 1
- CIVE 491 Engineering Law and Ethics
- CIVE 498 Seminar
- WKRPT 400 Work-term Report
- Three Approved Electives

Term 4B (Winter)

- CIVE 401 Civil Engineering Design Project 2
- CIVE 499 Seminar
- Four Approved Electives

Electives

Students are responsible for selecting their own combination of electives, in keeping with their ultimate career objectives after graduation. The combination must satisfy the requirements of the Department of Civil and Environmental Engineering (CEE). This includes having to meet minimum requirements in mathematics, natural sciences, engineering sciences, engineering design, and complementary studies.

Exceptions to the electives and requirements listed in the following sections (and links) require approval of the Civil and Environmental Engineering associate chair, undergraduate studies. Some courses of interest may require prerequisite knowledge that is not part of the core curriculum in Civil Engineering. Students may require extra courses or may need to seek enrolment approval from the course instructor if the prerequisites have not been satisfied.

Complementary Studies Electives

Students are required to complete three Complementary Studies Electives (CSEs) from the Complementary Studies Course Lists for Engineering:

- One course from List A
- One course from List C
- One course from List A, C, or D

List A CSEs concentrate on the impact of technology and/or engineering on society, List C CSEs are from the humanities and social sciences, and List D CSEs are humanities and social sciences courses that concentrate on the development of language or other skills.

Natural Science Electives

Students are required to complete one Natural Science Elective (NSE) from the following list:

- BIOL 130 Introductory Cell Biology
- BIOL 150 Organismal and Evolutionary Ecology
- BIOL 240 Fundamentals of Microbiology
- BIOL 273 Principles of Human Physiology 1
- CHE 161 Engineering Biology
- CHEM 209 Introductory Spectroscopy and Structure
- CHEM 262 Organic Chemistry for Engineering
- EARTH 221 Introductory Geochemistry
- EARTH 270 Disasters and Natural Hazards
- EARTH 281 Geological Impacts on Human Health
- ENVS 200 Field Ecology
- GEOG 357 River Management
- KIN 100 Regional Human Anatomy and KIN 100L Regional Human Anatomy Laboratory
- SCI 206 The Physics of How Things Work
- SCI 207 Physics, the Universe, and Everything
- SCI 238 Introductory Astronomy
- SCI 250 Environmental Geology

Technical Electives

Students are required to complete seven technical electives (TEs) within the following requirements:

1. Three TEs must be from TE List 1
2. The remaining four TEs may be from TE List 1 or 2

The Technical Elective Lists for Civil Engineering are provided below. Note that the offering of these courses is contingent upon sufficient demand and/or available teaching resources. There may be courses added and changes made to the content or term of offering. Special Topics courses (CIVE 495 and CIVE 497) are offered as resources and faculty availability permit. Further information is available from the CEE Undergraduate Office or CEE website.

TE List 1 - Engineering Design Intensive Technical Electives

- AE 572 Building Energy Analysis
- AE 573 HVAC Systems, Equipment, and Energy Efficiency
- CIVE 343 Traffic Simulation Modelling and Applications
- CIVE 354 Geotechnical Engineering 2
- CIVE 413 Structural Steel Design
- CIVE 414 Structural Concrete Design
- CIVE 415 Structural System Design
- CIVE 460 Engineering Biomechanics
- CIVE 495 Design Intensive Special Topics in Civil Engineering
- CIVE 512 Rehabilitation of Structures
- CIVE 542 Pavement Structural Design
- CIVE 554 Geotechnical Engineering 3
- CIVE 583 Design of Urban Water Systems
- CIVE 596 Construction Engineering
- EARTH 438 Engineering Geology
- ENVE 577 Engineering for Solid Waste Management
- SYDE 533 Conflict Resolution

TE List 2 - Technical Electives

- CIVE 306 Solid Mechanics 3
- CIVE 422 Finite Element Analysis
- CIVE 440 Transit Planning and Operations
- CIVE 484 Physical Infrastructure Planning
- CIVE 497 Special Topics in Civil Engineering
- CIVE 505 Structural Dynamics
- CIVE 507 Building Science and Technology
- EARTH 444/BIOL 462 Applied Wetland Science
- EARTH 458 Physical Hydrogeology
- ENVE 277 Air Quality Engineering
- ENVE 279 Energy and the Environment
- ENVE 376 Biological Processes
- ENVE 383 Advanced Hydrology and Hydraulics
- ENVE 573 Contaminant Transport
- GEOG 209 Hydrogeology
- GEOG 305 Fluvial Geomorphology
- GEOG 371 Advanced Remote Sensing Techniques
- GEOG 381 Advanced Geographic Information Systems

- ME 559 Finite Element Methods
- PLAN 416 Modelling the City
- PLAN 453/GEOG 453 Urban Stormwater Management
- PLAN 477 Freight Planning and Policy
- PLAN 483 Land Development Planning

Specializations

The Faculty of Engineering recognizes five specializations with the Civil Engineering BASc degree. Students who satisfy the specialization requirements (courses and grades) will have the specialization designation shown on their transcript and diploma. Specializations are intended to recognize success in a concentration of electives within the Civil Engineering degree specification. In other words, specializations focus the selection of electives required for the base degree and do not require extra courses.

Each specialization requires students to select TEs with a common theme. Students are responsible for meeting the TE requirements of the Civil Engineering plan when pursuing a specialization. Each specialization requires the successful completion of a minimum number of TEs specified by the specialization with a minimum average of 60%. Students must declare a specialization for it to be recognized as part of their degree and appear on the transcript and diploma.

The specialization course requirements are provided below.

Building Science Specialization

The Building Science Specialization requires a minimum of four TEs from the lists below.

- From TE List 1:
  - AE 405 Building Performance Measurement Lab
  - AE 450 Building Service Systems
  - AE 572 Building Energy Analysis
  - AE 573 HVAC Systems, Equipment, and Energy Efficiency
  - ME 452 HVAC Load Analysis and Design Fundamentals
- From TE List 2:
  - CIVE 507 Building Science and Technology
  - ENVE 277 Air Quality Engineering
  - ENVE 279 Energy and the Environment

Geotechnical Specialization

The Geotechnical Specialization requires a minimum of four TEs from the lists below:

- Two required courses:
  - CIVE 354 Geotechnical Engineering 2
  - CIVE 554 Geotechnical Engineering 3
- At least two additional TEs from the list below.
  - From TE List 1:
    - CIVE 414 Structural Concrete Design
    - CIVE 542 Pavement Structural Design
  - From TE List 2:
    - CIVE 422 Finite Element Analysis or ME 559 Finite Element Methods

        - EARTH 438 Engineering Geology

Structural Specialization

The Structural Specialization requires a minimum of five TEs from the lists below:

- One must be CIVE 413 or CIVE 414
    - From TE List 1:
        - CIVE 413 Structural Steel Design
        - CIVE 414 Structural Concrete Design
        - CIVE 415 Structural System Design
        - CIVE 460 Engineering Biomechanics
        - CIVE 512 Rehabilitation of Structures
        - CIVE 596 Construction Engineering
    - From TE List 2:
        - CIVE 306 Solid Mechanics 3
        - CIVE 422 Finite Element Analysis
        - CIVE 505 Structural Dynamics

Transportation Specialization

The Transportation Specialization requires a minimum of four TEs from the lists below:

- At least three must be CIVE courses.
    - From TE List 1:
        - CIVE 343 Traffic Simulation Modelling and Applications
        - CIVE 542 Pavement Structural Design
    - From TE List 2:
        - CIVE 440 Transit Planning and Operations
        - CIVE 484 Physical Infrastructure Planning
        - GEOG 381 Advanced Geographic Information Systems
        - PLAN 416 Modelling the City
        - PLAN 477 Freight Planning and Policy

Water Resources Specialization

The Water Resources Specialization requires a minimum of four TEs from the lists below:

- One required course:
    - ENVE 383 Advanced Hydrology and Hydraulics
- At least three TEs from the list below.
    - From TE List 1:
        - CIVE 583 Design of Urban Water Systems
        - SYDE 533 Conflict Resolution
    - From TE List 2:
        - EARTH 444 /BIOL 462 Applied Wetland Science
        - EARTH 458 Physical Hydrogeology
        - ENVE 376 Biological Processes
        - ENVE 573 Contaminant Transport
        - GEOG 209 Hydroclimatology
        - GEOG 305 Fluvial Geomorphology

- GEOG 371 Advanced Remote Sensing Techniques
- GEOG 381 Advanced Geographic Information Systems
- PLAN 453/GEOG 453 Urban Stormwater Management

6.6. Computer Engineering

Rationale:

Add courses to the Natural Sciences Elective list to provide students with a wider choice of courses: BIOL120, BIOL239, CHE102, PHYS124, PHYS233, PSYCH207, PSYCH261, PSYCH306, SCI250. Units offering these courses were consulted.

Edit the "Notes" section to remove redundant and unnecessary language. Similarly, remove the WHMIS paragraph.

Update the Complementary Studies Electives section to reflect the removal Faculty-level rules.

ECE405 (Introduction to Quantum Mechanics): Add MATH213 as an allowable substitute for ECE205 or MATH211 in the pre-requisite list; this will make the course more accessible to Software Engineering students. Also, remove AMATH373 as an anti-requisite since the course is sufficiently different from ECE405 that it is reasonable for a student to take both courses.

ECE457C (Reinforcement Learning): Add STAT230 and STAT240 as allowable substitutes for the other statistics/probability courses in the prerequisite list; this will make the course more accessible to Computer Science and Software Engineering students. Also, remove the anti-requisite which was put there by mistake.

Update prerequisites and anti-requisites (ECE 405, ECE457C).
For ECE405 (Introduction to Quantum Mechanics): Add MATH213 as an allowable substitute for ECE205 or MATH211 in the pre-requisite list; this will make the course more accessible to Software Engineering students. Also, remove AMATH373 as an anti-requisite since the course is sufficiently different from ECE405 that it is reasonable for a student to take both courses.
For ECE457C (Reinforcement Learning): Add STAT230 and STAT240 as allowable substitutes for the other statistics/probability courses in the prerequisite list; this will make the course more accessible to Computer Science and Software Engineering students. Also, remove the anti-requisite which was put there by mistake.

Remove ECE101A, ECE101B, ECE101C, ECE101D, ECE101E. The PD courses now have embedded reflective reports (all except PD 11) making the program work-term reflection courses unnecessary. The removal of ECE101A, ECE101B, ECE101C, ECE101D, and ECE101E as required courses will be applied retroactively to students who started in 2019 onwards.

Computer Engineering	MARK UP

The Computer Engineering Academic Curriculum

The curriculum involves a prescribed course load in each term ~~along with some academic milestones, which must be completed at or before specified times~~. Laboratory sessions are compulsory where they form part of a course. Approval from the Electrical and Computer Engineering (ECE) Undergraduate Office is required for all changes from the specified plan. Permission to carry more than the normal load in any term is at the discretion of the ECE Undergraduate Office and is dependent on both the student's previous term average and their cumulative average.

There are six co-operative work terms and the normal rules of Co-operative Education apply, as further described in the Faculty of Engineering Work Terms page of this Calendar. ~~With permission and co-ordination through the ECE Undergraduate Office, it is possible to create eight-month co-operative work~~

~~terms by rearranging the term sequence.~~ At least five successful work terms are required to meet the degree requirements.

The promotion criteria used to determine progression through the plan are described in the Engineering Examinations and Promotions section of this Calendar. These include term-average requirements, course-grade requirements, and milestone requirements.

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- ECE 105 Classical Mechanics
- ECE 150 Fundamentals of Programming
- ECE 190 Engineering Profession and Practice
- ECE 198 Project Studio
- ENGL 192/SPCOM 192 Communication in the Engineering Profession
- MATH 115 Linear Algebra for Engineering
- MATH 117 Calculus 1 for Engineering
- ~~Workplace Hazardous Materials Milestone (see Note 1)~~

Term 1B (Winter Stream 8/Spring Stream 4F)

- ~~ECE 101A (stream 4F) Work-term Reflections (see Note 1)~~
- ECE 102 Information Session
- ECE 106 Electricity and Magnetism
- ECE 108 Discrete Mathematics and Logic 1
- ECE 124 Digital Circuits and Systems
- ECE 140 Linear Circuits
- ECE 192 Engineering Economics and Impact on Society
- MATH 119 Calculus 2 for Engineering

Term 2A (Fall Stream 8/Winter Stream 4F)

- ~~ECE 101B (stream 4F) or ECE 101A (stream 8) Work-term Reflections (see Note 1)~~
- ECE 109 Materials Chemistry for Engineers
- ECE 201 Information Session
- ECE 204 Numerical Methods
- ECE 205 Advanced Calculus 1 for Electrical and Computer Engineers
- ECE 222 Digital Computers
- ECE 240 Electronic Circuits 1
- ECE 250 Algorithms and Data Structures

Term 2B (Spring Stream 8/Fall Stream 4F)

- ~~ECE 101C (stream 4F) or ECE 101B (stream 8) Work-term Reflections (see Note 1)~~
- ECE 202 Information Session
- ECE 203 Probability Theory and Statistics 1
- ECE 207 Signals and Systems
- ECE 208 Discrete Mathematics and Logic 2
- ECE 224 Embedded Microprocessor Systems
- ECE 252 Systems Programming and Concurrency
- ECE 298 Instrumentation and Prototyping Laboratory

Term 3A (Winter Stream 8/Spring Stream 4F)

- ~~ECE 101D (stream 4) or ECE 101C (stream 8) Work-term Reflections (see Note 1)~~
- ECE 301 Information Session
- ECE 318 Communication Systems
- ECE 327 Digital Hardware Systems
- ECE 350 Real-Time Operating Systems
- ECE 380 Analog Control Systems
- One CSE, NSE, or TE (see Note ~~2~~ **1**)

Term 3B (Fall)

- ~~ECE 101D (stream 8) Work-term Reflections (see Note 1)~~
- ECE 302 Information Session
- ECE 307 Probability Theory and Statistics 2
- One CSE, NSE, or TE (see Note ~~2~~ **1**)
- Choose two of the following four courses (see Note ~~4~~ **2**)
  - ECE 320 Computer Architecture
  - ECE 351 Compilers
  - ECE 356 Database Systems
  - ECE 358 Computer Networks
- Choose one additional course from ECE 313, ECE 320, ECE 331, ECE 351, ECE 356, ECE 358, ECE 360, ECE 373 that has not already been selected above provided prerequisites are met and subject to scheduling constraints.

Term 4A (Spring)

- ~~ECE 101E Work-term Reflections (see Note 1)~~
- ECE 401 Information Session
- ECE 498A Engineering Design Project or GENE 403 Interdisciplinary Design Project 1 ~~(see Notes 5 and 6)~~
- Four elective courses, CSE, NSE, or TE, as necessary (see Note ~~2~~ **1**)

Term 4B (Winter)

- ECE 402 Information Session ~~(1 SEM)~~
- ECE 498B Engineering Design Project or GENE 404 Interdisciplinary Design Project 2 ~~(see Notes 5 and 6)~~
- Four elective courses, CSE, NSE, or TE, as necessary (see Note ~~2~~ **1**)

Notes

~~1. Milestones have deadlines for successful completion and are shown in the terms (such as WHMIS in the 1A term) where they are normally completed. Work-term Reflections courses (ECE 101A, ECE 101B, ECE 101C, ECE 101D, and ECE 101E) are credit/no credit (CR/NCR). Further information is provided in the Work-term Reflections section.~~

~~2.~~ **1.** There are a total of 13 electives: eight technical electives (TEs), including three in the 3B term which must be chosen from a list, three complementary studies electives (CSEs), and two natural science electives (NSEs). Constraints on the selection of TEs, CSEs, and NSEs are explained below. As per the Engineering Examinations and Promotions rules, these electives form part of a regular course load.

~~3. Students may take any Professional Development (PD) course approved by the Faculty of Engineering. Students must complete PD 19 and PD 20, as well as three PD elective courses to satisfy degree requirements. Among the three PD elective courses, students can take PD 22 to satisfy the Ethics Requirement as explained below.~~

~~4.~~ **2.** During the 3B term, students must select three technical courses from a list. These courses cannot be dropped for a reduced-load term.

~~5. In their 4A and 4B terms, students must enrol in the ECE 498A and ECE 498B sequence or the GENE 403 and GENE 404 sequence. ECE 498A and GENE 404, and ECE 498B and GENE 403 combinations are not allowed.~~

~~6. Students in the Biomechanics Option or the Mechatronics Option must choose a compatible topic for their design project sequence in ECE 498A and ECE 498B. See the option description or option co-ordinator for details.~~

~~7.~~ **3.** Special topics courses (ECE 493) are offered as resources and faculty interests permit. Students should consult the ECE Undergraduate Office or ECE website for upcoming topics. Some offerings may have laboratory meets.

~~**Work-term Reflections**~~

~~For each of the Work-term Reflections courses ECE 101A, ECE 101B, ECE 101C, ECE 101D, and ECE 101E, students write a short two-page report (from an online template available on the ECE website) reflecting on their work experience during the previous co-op term. Students submit it for grading in the academic term that follows the work term. If a student did not secure a co-op position, they are to reflect on what skills they used to improve their chances of a co-op position in future work terms. These courses are graded as credit/no credit (CR/NCR).~~

Elective Courses

Complementary Studies Electives

Students must complete three complementary studies electives (CSEs) ~~to satisfy~~ **from** the Complementary

Studies ~~Requirements~~ Course Lists for Engineering ~~Students~~. These are in addition to those courses that are part of the core curriculum and contain complementary studies material, such as ECE 190, ECE 192, **ENGL 192/SPCOM 192**, and the Professional Development (PD) sequence.

The three CSE courses are to be chosen according to the following constraints:

- Two **courses** from List C ~~(~~Humanities and Social Sciences ~~Courses~~ (**excluding courses concentrated on development of language or other skills)**
- One **course** from any of List A ~~(~~Impact ~~Courses~~ **of Technology and/or Engineering on Society**)~~,~~, List C ~~(~~Humanities and Social Sciences ~~Courses~~ **(excluding courses concentrated on development of language or other skills**), or List D ~~(Other Permissible Complementary Studies Courses)~~ **Humanities and Social Sciences (courses concentrated on development of language or other skills)**

~~Students may take up to one technique course (i.e., learning a skill or language) as part of List D. Technique courses need ECE Undergraduate Office approval to be considered as complementary studies electives.~~

~~Students may take GENE 412/PHIL 315 as a List C CSE in which case the course will also satisfy the Ethics Requirement.~~

Ethics Requirement

To meet the Ethics Requirement, students must pass one of PD 22 or ~~GENE 412~~/PHIL 315. **PHIL 315 satisfies both the ethics requirement, and one of the List C CSE requirements described above.**

Natural Science Electives

Students are required to complete two natural science electives (NSEs) and are responsible for ensuring they meet the minimum academic units. The two NSE courses must be primarily concerned with natural science and are in addition to the science components of the core curriculum, such as ECE 105, ECE 106, and ECE 109.

- BIOL 110 Introductory Zoology
- **BIOL 120 Introduction to Plant Structure and Function**
- BIOL 130 Introductory Cell Biology and BIOL 130L Cell Biology Laboratory
- BIOL 150 Organismal and Evolutionary Ecology
- BIOL 165 Diversity of Life
- BIOL 211 Introductory Vertebrate Zoology
- **BIOL 239 Genetics**
- BIOL 240 Fundamentals of Microbiology and BIOL 240L Microbiology Laboratory
- BIOL 241 Introduction to Applied Microbiology
- BIOL 273 Principles of Human Physiology 1
- BIOL 373 Principles of Human Physiology 2 and BIOL 373L Human Physiology Laboratory
- **CHE 102 Chemistry for Engineers**
- CHE 161 Engineering Biology
- CHEM 123 General Chemistry 2 and CHEM 123L General Chemistry Laboratory 2
- CHEM 209 Introductory Spectroscopy and Structure
- CHEM 237 Introductory Biochemistry, and CHEM 237L Introductory Biochemistry Laboratory
- CHEM 254 Introductory Chemical Thermodynamics

- CHEM 262 Organic Chemistry for Engineering and CHEM 262L Organic Chemistry Laboratory for Engineering Students
- CHEM 266 Basic Organic Chemistry 1
- CHEM 356 Introductory Quantum Mechanics
- CHEM 404 Physiochemical Aspects of Natural Waters
- EARTH 121 Introductory Earth Sciences
- EARTH 122 Introductory Environmental Sciences
- EARTH 123 Introductory Hydrology
- EARTH 221 Introductory Geochemistry
- EARTH 270 Disasters and Natural Hazards
- EARTH 281 Geological Impacts on Human Health
- ECE 231 Semiconductor Physics and Devices
- ECE 403 Thermal Physics
- ECE 404 Geometrical and Physical Optics
- ECE 405 Introduction to Quantum Mechanics
- ENVE 275 Environmental Chemistry
- ENVS 200 Field Ecology
- NE 222 Organic Chemistry for Nanotechnology Engineers
- **PHYS 124 Modern Physics**
- **PHYS 233 Introduction to Quantum Mechanics**
- PHYS 234 Quantum Physics 1
- PHYS 263 Classical Mechanics and Special Relativity
- PHYS 275 Planets
- PHYS 280 Introduction to Biophysics
- PHYS 334 Quantum Physics 2
- PHYS 335 Condensed Matter Physics
- PHYS 375 Stars
- PHYS 380 Molecular and Cellular Biophysics
- **PSYCH 207 Cognitive Processes**
- **PSYCH 261 Physiological Psychology**
- **PSYCH 306 Perception**
- SCI 238 Introductory Astronomy
- **SCI 250 Environmental Geology**

Technical Electives

Students are required to complete a total of eight technical electives (TEs), subject to the following conditions:

1. All of the technical courses from the 3B term (i.e., ECE 313, ECE 320, ECE 331, ECE 351, ECE 356, ECE 358, ECE 360, and ECE 373) count as TEs. At least three of these courses must be taken in the 3B term, as specified in the curriculum above.
2. At least three TEs must be courses chosen from ECE 406 through ECE 495 or ECE 499, normally taken during the 4A and 4B terms. A list of current 4A and 4B TEs is provided below.
3. At least one TE, to a maximum of two, must be from another engineering (other than Electrical or Computer Engineering) plan; such courses must have sufficiently advanced engineering science or engineering design content to be allowed, and must be approved by the ECE Undergraduate Office. Some courses of interest may require prerequisite knowledge that is not part of the core curriculum in Computer Engineering. Students may require extra courses or may need to seek enrolment approval from the course instructor if the prerequisite knowledge was acquired by other means.

4. The following courses are offered in the core curriculum in Electrical Engineering but are considered TE courses for Computer Engineering: ECE 260, ECE 340, and ECE 375. Some of these courses have prerequisites that must be met in order to enrol.
5. In all terms, elective availability is subject to scheduling constraints.

The following TE courses are normally offered for the spring (4A) term. The list is subject to change from year to year.

- ECE 414 Wireless Communications
- ECE 433 Fabrication Technologies for Micro and Nano Devices
- ECE 445 Integrated Digital Electronics
- ECE 452 Software Design and Architectures
- ECE 454 Distributed Computing
- ECE 455 Embedded Software
- ECE 457A Co-operative and Adaptive Algorithms
- ECE 457C Reinforcement Learning
- ECE 458 Computer Security
- ECE 462 Electrical Distribution Systems
- ECE 463 Design & Applications of Power Electronic Converters
- ECE 475 Radio-Wave Systems
- ECE 481 Digital Control Systems
- ECE 486 Robot Dynamics and Control
- ECE 493 Special Topics in Electrical and Computer Engineering (see Note ~~7~~ **3**)

The following TE courses are normally offered for the winter (4B) term. The list is subject to change from year to year.

- ECE 406 Algorithm Design and Analysis
- ECE 409 Cryptography and System Security
- ECE 416 Advanced Topics in Networking
- ECE 417 Image Processing
- ECE 423 Embedded Computer Systems
- ECE 432 Radio Frequency Integrated Devices and Circuits
- ECE 444 Integrated Analog Electronics
- ECE 451 Software Requirements Specification and Analysis
- ECE 453 Software Testing, Quality Assurance and Maintenance
- ECE 457B Fundamentals of Computational Intelligence
- ECE 459 Programming for Performance
- ECE 464 High Voltage Engineering and Power System Protection
- ECE 467 Power Systems Analysis, Operations and Markets
- ECE 474 Radio and Wireless Systems
- ECE 477 Photonic Devices and Systems
- ECE 488 Multivariable Control Systems
- ECE 493 Special Topics in Electrical and Computer Engineering (see Note ~~7~~ **3**)
- ECE 495 Autonomous Vehicle

The following project elective is offered every term. Students may take it, at most, once as a TE course.

- ECE 499 Engineering Project

~~**Workplace Hazardous Materials Information System (WHMIS)**~~

~~All students must take WHMIS training. Details are described in the WHMIS Requirements section of this Calendar. Students must meet this milestone in order to remain enrolled in 1A or to enrol in any academic term beyond 1A.~~

Communications and Signal Processing Specialization

Students interested in pursuing this Specialization must achieve a minimum average of 60% in the specialization courses, and a minimum grade of 50% in each of the courses. Students who satisfy the requirements for Faculty Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

Required courses:

- ECE 313 Digital Signal Processing
- ECE 318 Communication Systems

Any three courses from the following list:

- ECE 358 Computer Networks
- ECE 414 Wireless Communications
- ECE 416 Advanced Topics in Networking
- ECE 417 Image Processing
- ECE 474 Radio and Wireless Systems

Computer Engineering CLEAN COPY

The Computer Engineering Academic Curriculum

The curriculum involves a prescribed course load in each term. Laboratory sessions are compulsory where they form part of a course. Approval from the Electrical and Computer Engineering (ECE) Undergraduate Office is required for all changes from the specified plan. Permission to carry more than the normal load in any term is at the discretion of the ECE Undergraduate Office and is dependent on both the student's previous term average and their cumulative average.

There are six co-operative work terms and the normal rules of Co-operative Education apply, as further described in the Faculty of Engineering Work Terms page of this Calendar. At least five successful work terms are required to meet the degree requirements.

The promotion criteria used to determine progression through the plan are described in the Engineering Examinations and Promotions section of this Calendar. These include term-average requirements, course-grade requirements, and milestone requirements.

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- ECE 105 Classical Mechanics
- ECE 150 Fundamentals of Programming
- ECE 190 Engineering Profession and Practice
- ECE 198 Project Studio
- ENGL 192/SPCOM 192 Communication in the Engineering Profession
- MATH 115 Linear Algebra for Engineering
- MATH 117 Calculus 1 for Engineering

Term 1B (Winter Stream 8/Spring Stream 4F)

- ECE 102 Information Session
- ECE 106 Electricity and Magnetism
- ECE 108 Discrete Mathematics and Logic 1
- ECE 124 Digital Circuits and Systems
- ECE 140 Linear Circuits
- ECE 192 Engineering Economics and Impact on Society
- MATH 119 Calculus 2 for Engineering

Term 2A (Fall Stream 8/Winter Stream 4F)

- ECE 109 Materials Chemistry for Engineers
- ECE 201 Information Session
- ECE 204 Numerical Methods
- ECE 205 Advanced Calculus 1 for Electrical and Computer Engineers
- ECE 222 Digital Computers
- ECE 240 Electronic Circuits 1
- ECE 250 Algorithms and Data Structures

Term 2B (Spring Stream 8/Fall Stream 4F)

- ECE 202 Information Session
- ECE 203 Probability Theory and Statistics 1
- ECE 207 Signals and Systems
- ECE 208 Discrete Mathematics and Logic 2
- ECE 224 Embedded Microprocessor Systems
- ECE 252 Systems Programming and Concurrency
- ECE 298 Instrumentation and Prototyping Laboratory

Term 3A (Winter Stream 8/Spring Stream 4F)

- ECE 301 Information Session
- ECE 318 Communication Systems
- ECE 327 Digital Hardware Systems

- ECE 350 Real-Time Operating Systems
- ECE 380 Analog Control Systems
- One CSE, NSE, or TE (see Note 1)

Term 3B (Fall)

- ECE 302 Information Session
- ECE 307 Probability Theory and Statistics 2
- One CSE, NSE, or TE (see Note 1)
- Choose two of the following four courses (see Note 2)
    - ECE 320 Computer Architecture
    - ECE 351 Compilers
    - ECE 356 Database Systems
    - ECE 358 Computer Networks
- Choose one additional course from ECE 313, ECE 320, ECE 331, ECE 351, ECE 356, ECE 358, ECE 360, ECE 373 that has not already been selected above provided prerequisites are met and subject to scheduling constraints.

Term 4A (Spring)

- ECE 401 Information Session
- ECE 498A Engineering Design Project or GENE 403 Interdisciplinary Design Project 1
- Four elective courses, CSE, NSE, or TE, as necessary (see Note 1)

Term 4B (Winter)

- ECE 402 Information Session
- ECE 498B Engineering Design Project or GENE 404 Interdisciplinary Design Project 2
- Four elective courses, CSE, NSE, or TE, as necessary (see Note 1)

Notes

1. There are a total of 13 electives: eight technical electives (TEs), including three in the 3B term which must be chosen from a list, three complementary studies electives (CSEs), and two natural science electives (NSEs). Constraints on the selection of TEs, CSEs, and NSEs are explained below. As per the Engineering Examinations and Promotions rules, these electives form part of a regular course load.
2. During the 3B term, students must select three technical courses from a list. These courses cannot be dropped for a reduced-load term.
3. Special topics courses (ECE 493) are offered as resources and faculty interests permit. Students should consult the ECE Undergraduate Office or ECE website for upcoming topics. Some offerings may have laboratory meets.

Elective Courses

Complementary Studies Electives

Students must complete three complementary studies electives (CSEs) from the Complementary Studies Course Lists for Engineering. These are in addition to those courses that are part of the core curriculum and contain complementary studies material, such as ECE 190, ECE 192, ENGL 192/SPCOM 192, and the Professional Development (PD) sequence. The three CSE courses are to be chosen according to the following constraints:

- Two courses from List C Humanities and Social Sciences (excluding courses concentrated on development of language or other skills)
- One course from any of List A Impact of Technology and/or Engineering on Society, List C Humanities and Social Sciences (excluding courses concentrated on development of language or other skills), or List D Humanities and Social Sciences (courses concentrated on development of language or other skills)

Ethics Requirement

To meet the Ethics Requirement, students must pass one of PD 22 or PHIL 315. PHIL 315 satisfies both the ethics requirement, and one of the List C CSE requirements described above.

Natural Science Electives

Students are required to complete two natural science electives (NSEs) and are responsible for ensuring they meet the minimum academic units. The two NSE courses must be primarily concerned with natural science and are in addition to the science components of the core curriculum, such as ECE 105, ECE 106, and ECE 109.

- BIOL 110 Introductory Zoology
- BIOL 120 Introduction to Plant Structure and Function
- BIOL 130 Introductory Cell Biology and BIOL 130L Cell Biology Laboratory
- BIOL 150 Organismal and Evolutionary Ecology
- BIOL 165 Diversity of Life
- BIOL 211 Introductory Vertebrate Zoology
- BIOL 239 Genetics
- BIOL 240 Fundamentals of Microbiology and BIOL 240L Microbiology Laboratory
- BIOL 241 Introduction to Applied Microbiology
- BIOL 273 Principles of Human Physiology 1
- BIOL 373 Principles of Human Physiology 2 and BIOL 373L Human Physiology Laboratory
- CHE 102 Chemistry for Engineers
- CHE 161 Engineering Biology
- CHEM 123 General Chemistry 2 and CHEM 123L General Chemistry Laboratory 2
- CHEM 209 Introductory Spectroscopy and Structure
- CHEM 237 Introductory Biochemistry, and CHEM 237L Introductory Biochemistry Laboratory
- CHEM 254 Introductory Chemical Thermodynamics
- CHEM 262 Organic Chemistry for Engineering and CHEM 262L Organic Chemistry Laboratory for Engineering Students
- CHEM 266 Basic Organic Chemistry 1
- CHEM 356 Introductory Quantum Mechanics
- CHEM 404 Physiochemical Aspects of Natural Waters

- EARTH 121 Introductory Earth Sciences
- EARTH 122 Introductory Environmental Sciences
- EARTH 123 Introductory Hydrology
- EARTH 221 Introductory Geochemistry
- EARTH 270 Disasters and Natural Hazards
- EARTH 281 Geological Impacts on Human Health
- ECE 231 Semiconductor Physics and Devices
- ECE 403 Thermal Physics
- ECE 404 Geometrical and Physical Optics
- ECE 405 Introduction to Quantum Mechanics
- ENVE 275 Environmental Chemistry
- ENVS 200 Field Ecology
- NE 222 Organic Chemistry for Nanotechnology Engineers
- PHYS 124 Modern Physics
- PHYS 233 Introduction to Quantum Mechanics
- PHYS 234 Quantum Physics 1
- PHYS 263 Classical Mechanics and Special Relativity
- PHYS 275 Planets
- PHYS 280 Introduction to Biophysics
- PHYS 334 Quantum Physics 2
- PHYS 335 Condensed Matter Physics
- PHYS 375 Stars
- PHYS 380 Molecular and Cellular Biophysics
- PSYCH 207 Cognitive Processes
- PSYCH 261 Physiological Psychology
- PSYCH 306 Perception
- SCI 238 Introductory Astronomy
- SCI 250 Environmental Geology

Technical Electives

Students are required to complete a total of eight technical electives (TEs), subject to the following conditions:

1. All of the technical courses from the 3B term (i.e., ECE 313, ECE 320, ECE 331, ECE 351, ECE 356, ECE 358, ECE 360, and ECE 373) count as TEs. At least three of these courses must be taken in the 3B term, as specified in the curriculum above.
2. At least three TEs must be courses chosen from ECE 406 through ECE 495 or ECE 499, normally taken during the 4A and 4B terms. A list of current 4A and 4B TEs is provided below.
3. At least one TE, to a maximum of two, must be from another engineering (other than Electrical or Computer Engineering) plan; such courses must have sufficiently advanced engineering science or engineering design content to be allowed, and must be approved by the ECE Undergraduate Office. Some courses of interest may require prerequisite knowledge that is not part of the core curriculum in Computer Engineering. Students may require extra courses or may need to seek enrolment approval from the course instructor if the prerequisite knowledge was acquired by other means.
4. The following courses are offered in the core curriculum in Electrical Engineering but are considered TE courses for Computer Engineering: ECE 260, ECE 340, and ECE 375. Some of these courses have prerequisites that must be met in order to enrol.
5. In all terms, elective availability is subject to scheduling constraints.

The following TE courses are normally offered for the spring (4A) term. The list is subject to change from year to year.

- ECE 414 Wireless Communications
- ECE 433 Fabrication Technologies for Micro and Nano Devices
- ECE 445 Integrated Digital Electronics
- ECE 452 Software Design and Architectures
- ECE 454 Distributed Computing
- ECE 455 Embedded Software
- ECE 457A Co-operative and Adaptive Algorithms
- ECE 457C Reinforcement Learning
- ECE 458 Computer Security
- ECE 462 Electrical Distribution Systems
- ECE 463 Design & Applications of Power Electronic Converters
- ECE 475 Radio-Wave Systems
- ECE 481 Digital Control Systems
- ECE 486 Robot Dynamics and Control
- ECE 493 Special Topics in Electrical and Computer Engineering (see Note 3)

The following TE courses are normally offered for the winter (4B) term. The list is subject to change from year to year.

- ECE 406 Algorithm Design and Analysis
- ECE 409 Cryptography and System Security
- ECE 416 Advanced Topics in Networking
- ECE 417 Image Processing
- ECE 423 Embedded Computer Systems
- ECE 432 Radio Frequency Integrated Devices and Circuits
- ECE 444 Integrated Analog Electronics
- ECE 451 Software Requirements Specification and Analysis
- ECE 453 Software Testing, Quality Assurance and Maintenance
- ECE 457B Fundamentals of Computational Intelligence
- ECE 459 Programming for Performance
- ECE 464 High Voltage Engineering and Power System Protection
- ECE 467 Power Systems Analysis, Operations and Markets
- ECE 474 Radio and Wireless Systems
- ECE 477 Photonic Devices and Systems
- ECE 488 Multivariable Control Systems
- ECE 493 Special Topics in Electrical and Computer Engineering (see Note 3)
- ECE 495 Autonomous Vehicle

The following project elective is offered every term. Students may take it, at most, once as a TE course.

- ECE 499 Engineering Project

Communications and Signal Processing Specialization

Students interested in pursuing this Specialization must achieve a minimum average of 60% in the specialization courses, and a minimum grade of 50% in each of the courses. Students who satisfy the requirements for Faculty Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

Required courses:

- ECE 313 Digital Signal Processing
- ECE 318 Communication Systems

Any three courses from the following list:

- ECE 358 Computer Networks
- ECE 414 Wireless Communications
- ECE 416 Advanced Topics in Networking
- ECE 417 Image Processing
- ECE 474 Radio and Wireless Systems

6.7 Electrical Engineering

Rationale:

Add courses to the Natural Sciences Elective list to provide students with a wider choice of courses: BIOL120, BIOL239, CHE102, PHYS124, PHYS233, PSYCH207, PSYCH261, PSYCH306, SCI250. Units offering these courses were consulted.

Edit the "Notes" section to remove redundant and unnecessary language. Similarly, remove the WHMIS paragraph.

Update the Complementary Studies Electives section to reflect the removal Faculty-level rules.

ECE405 (Introduction to Quantum Mechanics): Add MATH213 as an allowable substitute for ECE205 or MATH211 in the pre-requisite list; this will make the course more accessible to Software Engineering students. Also, remove AMATH373 as an anti-requisite since the course is sufficiently different from ECE405 that it is reasonable for a student to take both courses.

ECE457C (Reinforcement Learning): Add STAT230 and STAT240 as allowable substitutes for the other statistics/probability courses in the prerequisite list; this will make the course more accessible to Computer Science and Software Engineering students. Also, remove the anti-requisite which was put there by mistake.

Update prerequisites and anti-requisites (ECE 405, ECE457C).
For ECE405 (Introduction to Quantum Mechanics): Add MATH213 as an allowable substitute for ECE205 or MATH211 in the pre-requisite list; this will make the course more accessible to Software Engineering students. Also, remove AMATH373 as an anti-requisite since the course is sufficiently different from ECE405 that it is reasonable for a student to take both courses.
For ECE457C (Reinforcement Learning): Add STAT230 and STAT240 as allowable substitutes for the other statistics/probability courses in the prerequisite list; this will make the course more accessible to Computer Science and Software Engineering students. Also, remove the anti-requisite which was put there by mistake.

Remove ECE101A, ECE101B, ECE101C, ECE101D, ECE101E. The PD courses now have embedded reflective reports (all except PD 11) making the program work-term reflection courses unnecessary. The removal of ECE101A, ECE101B, ECE101C, ECE101D, and ECE101E as required courses will be applied retroactively to students who started in 2019 onwards.

Electrical Engineering MARK UP

The Electrical Engineering Academic Curriculum

The curriculum involves a prescribed course load in each term ~~along with some academic milestones, which must be completed at or before specified times~~. Laboratory sessions are compulsory where they form part of a course. Approval from the Electrical and Computer Engineering (ECE) Undergraduate Office is required for all changes from the specified plan. Permission to carry more than the normal load in any term is at the discretion of the ECE Undergraduate Office and is dependent on both the student's previous term average and their cumulative average.

There are six co-operative work terms and the normal rules of Co-operative Education apply, as further described in the Faculty of Engineering Work Terms page of this Calendar.

At least five successful work terms are required to meet the degree requirements.

The promotion criteria used to determine progression through the plan are described in the Engineering Examinations and Promotions section of this Calendar. These include term-average requirements, course-grade requirements, and milestone requirements.

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- ECE 105 Classical Mechanics
- ECE 150 Fundamentals of Programming
- ECE 190 Engineering Profession and Practice
- ECE 198 Project Studio
- ENGL 192/SPCOM 192 Communication in the Engineering Profession
- MATH 115 Linear Algebra for Engineering
- MATH 117 Calculus 1 for Engineering
- ~~Workplace Hazardous Materials Milestone (see Note 1)~~

Term 1B (~~Winter Stream 8/~~Spring ~~Stream 4F~~)

- ~~ECE 101A (stream 4F) Work-term Reflections (see Note 1)~~
- ECE 102 Information Session
- ECE 106 Electricity and Magnetism
- ECE 108 Discrete Mathematics and Logic 1
- ECE 124 Digital Circuits and Systems
- ECE 140 Linear Circuits
- ECE 192 Engineering Economics and Impact on Society
- MATH 119 Calculus 2 for Engineering

Term 2A (~~Fall Stream 8/~~Winter ~~Stream 4F~~)

- ~~ECE 101B (stream 4F) or ECE 101A (stream 8) Work-term Reflections (see Note 1)~~
- ECE 109 Materials Chemistry for Engineers
- ECE 201 Information Session
- ECE 204 Numerical Methods
- ECE 205 Advanced Calculus 1 for Electrical and Computer Engineers
- ECE 222 Digital Computers
- ECE 240 Electronic Circuits 1
- ECE 250 Algorithms and Data Structures

Term 2B (~~Spring Stream 8/~~Fall ~~Stream 4F~~)

- ~~ECE 101C (stream 4F) or ECE 101B (stream 8) Work-term Reflections (see Note 1)~~
- ECE 202 Information Session

- ECE 203 Probability Theory and Statistics 1
- ECE 206 Advanced Calculus 2 for Electrical Engineers
- ECE 207 Signals and Systems
- ECE 231 Semiconductor Physics and Devices
- ECE 260 Electromechanical Energy Conversion
- ECE 298 Instrumentation and Prototyping Laboratory

Term 3A (~~Winter Stream 8/~~Spring ~~Stream 4F~~)

- ~~ECE 101D (stream 4F) or ECE 101C (stream 8) Work-term Reflections (see Note 1)~~
- ECE 301 Information Session
- ECE 318 Communication Systems
- ECE 340 Electronic Circuits 2
- ECE 375 Electromagnetic Fields and Waves
- ECE 380 Analog Control Systems
- One CSE, NSE, or TE (see Note ~~2~~ **1**)

Term 3B (Fall)

- ~~ECE 101D (stream 8) Work-term Reflections (see Note 1)~~
- ECE 302 Information Session
- ECE 307 Probability Theory and Statistics 2
- One CSE, NSE, or TE (see Note ~~2~~ **1**)
- Choose two of the following four courses (see Note 4 **2**)
  - ECE 313 Digital Signal Processing
  - ECE 331 Electronic Devices
  - ECE 360 Power Systems and Smart Grids
  - ECE 373 Radio Frequency and Microwave Circuits
- Choose one additional course from ECE 313, ECE 320, ECE 331, ECE 351, ECE 356, ECE 358, ECE 360, ECE 373 that has not already been selected above provided prerequisites are met and subject to scheduling constraints.

Term 4A (Spring)

- ~~ECE 101E Work-term Reflections (see Note 1)~~
- ECE 401 Information Session
- ECE 498A Engineering Design Project or GENE 403 Interdisciplinary Design Project 1 ~~(see Notes 5 and 6)~~
- Four elective courses, CSE, NSE, or TE, as necessary (see Note ~~2~~ **1**)

Term 4B (Winter)

- ECE 402 Information Session
- ECE 498B Engineering Design Project or GENE 404 Interdisciplinary Design Project 2 ~~(see Notes 5 and 6)~~
- Four elective courses, CSE, NSE, or TE, as necessary (see Note ~~2~~ **1**)

Notes

1. ~~Milestones have deadlines for successful completion and are shown in the terms (such as WHMIS in the 1A term) where they are normally completed. Work-term Reflections courses (ECE 101A, ECE 101B, ECE 101C, ECE 101D, and ECE 101E) are credit/no credit (CR/NCR). Further information is provided in the Work-term Reflections section.~~
2. ~~2.~~ **1.** There are a total of 13 electives: eight technical electives (TEs), including three in the 3B term which must be chosen from a list, three complementary studies electives (CSEs), and two natural science electives (NSEs). Constraints on the selection of TEs, CSEs, and NSEs are explained below. As per the Engineering Examinations and Promotions rules, these electives form part of a regular course load.
3. ~~Students may take any Professional Development (PD) course approved by the Faculty of Engineering. Students must complete PD 19 and PD 20, as well as three PD elective courses to satisfy degree requirements. Among the three PD elective courses, students can take PD 22 to satisfy the Ethics Requirement as explained below.~~
4. ~~4.~~ **2**. During the 3B term, students must select three technical courses from a list. These courses cannot be dropped for a reduced-load term.
5. ~~In their 4A and 4B terms, students must enrol in the ECE 498A and ECE 498B sequence or the GENE 403 and GENE 404 sequence. ECE 498A and GENE 404, and ECE 498B and GENE 403 combinations are not allowed.~~
6. ~~Students in the Biomechanics Option or the Mechatronics Option must choose a compatible topic for their design project sequence in ECE 498A, ECE 498B. See the option description or option co-ordinator for details.~~
7. ~~7.~~ **3.** Special topics courses (ECE 493) are offered as resources and faculty interests permit. Students should consult the ECE Undergraduate Office or ECE website for upcoming topics. Some offerings may have laboratory meets.

~~Work-term Reflections~~

~~For each of the Work-term Reflections courses ECE 101A, ECE 101B, ECE 101C, ECE 101D, and ECE 101E, students write a short two-page report (from an online template available on the ECE website) reflecting on their work experience during the previous co-op term. Students submit it for grading in the academic term that follows the work term. If a student did not secure a co-op position, they are to reflect on what skills they used to improve their chances of a co-op position in future work terms. These courses are graded as credit/no credit (CR/NCR).~~

Elective Courses

Complementary Studies Electives

Students must complete three complementary studies electives (CSEs) ~~to satisfy~~ **from** the Complementary Studies ~~Requirements~~ **Course Lists** for Engineering ~~Students~~. These are in addition to those courses that are part of the core curriculum and contain complementary studies material, such as ECE 190, ECE 192, **ENGL 192/SPCOM 192**, and the Professional Development (PD) sequence. The three CSE courses are to be chosen according to the following constraint:

- Two **courses** from List C ~~(~~Humanities and Social Sciences ~~Courses~~ (**excluding courses concentrated on development of language or other skills)**
- One **course** from any of List A ~~(~~Impact ~~Courses~~ **of Technology and/or Engineering on Society**)~~,~~ List C ~~(~~Humanities and Social Sciences ~~Courses~~ **(excluding courses concentrated on development of**

language or other skills), or List D ~~(Other Permissible Complementary Studies Courses)~~ **Humanities and Social Sciences (courses concentrated on development of language or other skills)**

~~Students may take up to one technique course (i.e., learning a skill or language) as part of List D. Technique courses need ECE Undergraduate Office approval to be considered as complementary studies electives.~~

~~Students may take GENE 412/PHIL 315 as a List C CSE in which case the course will also satisfy the Ethics Requirement.~~

Ethics Requirement

To meet the Ethics Requirement, students must pass one of PD 22 or ~~GENE 412/~~PHIL 315. **PHIL 315 satisfies both the ethics requirement, and one of the List C CSE requirements described above.**

Natural Science Electives

Students are required to complete two natural science electives (NSEs) and are responsible for ensuring they meet the minimum academic units. The two NSE courses must be primarily concerned with natural science and are in addition to the science components of the core curriculum, such as ECE 105, ECE 106, ECE 109, and ECE 231.

- BIOL 110 Introductory Zoology
- **BIOL 120 Introduction to Plant Structure and Function**
- BIOL 130 Introductory Cell Biology and BIOL 130L Cell Biology Laboratory
- BIOL 150 Organismal and Evolutionary Ecology
- BIOL 165 Diversity of Life
- BIOL 211 Introductory Vertebrate Zoology
- **BIOL 239 Genetics**
- BIOL 240 Fundamentals of Microbiology and BIOL 240L Microbiology Laboratory
- BIOL 241 Introduction to Applied Microbiology
- BIOL 273 Principles of Human Physiology 1
- BIOL 373 Principles of Human Physiology 2 and BIOL 373L Human Physiology Laboratory
- **CHE 102 Chemistry for Engineers**
- CHE 161 Engineering Biology
- CHEM 123 General Chemistry 2 and CHEM 123L General Chemistry Laboratory 2
- CHEM 209 Introductory Spectroscopy and Structure
- CHEM 237 Introductory Biochemistry and CHEM 237L Introductory Biochemistry Laboratory
- CHEM 254 Introductory Chemical Thermodynamics
- CHEM 262 Organic Chemistry for Engineering and CHEM 262L Organic Chemistry Laboratory for Engineering Students
- CHEM 266 Basic Organic Chemistry 1
- CHEM 356 Introductory Quantum Mechanics
- CHEM 404 Physiochemical Aspects of Natural Waters
- EARTH 121 Introductory Earth Sciences
- EARTH 122 Introductory Environmental Sciences
- EARTH 123 Introductory Hydrology
- EARTH 221 Introductory Geochemistry
- EARTH 270 Disasters and Natural Hazards
- EARTH 281 Geological Impacts on Human Health
- ECE 403 Thermal Physics
- ECE 404 Geometrical and Physical Optics
- ECE 405 Introduction to Quantum Mechanics

- ENVE 275 Environmental Chemistry
- ENVS 200 Field Ecology
- NE 222 Organic Chemistry for Nanotechnology Engineers
- **PHYS 124 Modern Physics**
- **PHYS 233 Introduction to Quantum Mechanics**
- PHYS 234 Quantum Physics 1
- PHYS 263 Classical Mechanics and Special Relativity
- PHYS 275 Planets
- PHYS 280 Introduction to Biophysics
- PHYS 334 Quantum Physics 2
- PHYS 335 Condensed Matter Physics
- PHYS 375 Stars
- PHYS 380 Molecular and Cellular Biophysics
- **PSYCH 207 Cognitive Processes**
- **PSYCH 261 Physiological Psychology**
- **PSYCH 306 Perception**
- SCI 238 Introductory Astronomy
- **SCI 250 Environmental Geology**

Technical Electives

Students are required to complete a total of eight technical electives (TEs), subject to the following conditions:

1. All of the technical courses from the 3B term (i.e., ECE 313, ECE 320, ECE 331, ECE 351, ECE 356, ECE 358, ECE 360, and ECE 373) count as TEs. At least three of these courses must be taken in the 3B term, as specified in the curriculum table above.
2. At least three TEs must be courses chosen from ECE 406 through ECE 495 or ECE 499, normally taken during the 4A and 4B terms. A list of current 4A and 4B TEs is provided below.
3. At least one TE, to a maximum of two, must be from another engineering (other than Electrical or Computer Engineering) plan; such courses must have sufficiently advanced engineering science or engineering design content to be allowed, and must be approved by the ECE Undergraduate Office. Some courses of interest may require prerequisite knowledge that is not part of the core curriculum in Electrical Engineering. Students may require extra courses or may need to seek enrolment approval from the course instructor if the prerequisite knowledge was acquired by other means.
4. The following courses are offered in the core curriculum in Computer Engineering but are considered TE courses for Electrical Engineering: ECE 224, ECE 252, ECE 327, and ECE 350. Some of these courses have prerequisites that must be met in order to enrol.
5. In all terms, elective availability is subject to scheduling constraints.

The following TE courses are normally offered for the spring (4A) term. The list is subject to change from year to year.

- ECE 414 Wireless Communications
- ECE 433 Fabrication Technologies for Micro and Nano Devices
- ECE 445 Integrated Digital Electronics
- ECE 452 Software Design and Architectures
- ECE 454 Distributed Computing
- ECE 455 Embedded Software
- ECE 457A Co-operative and Adaptive Algorithms
- ECE 457C Reinforcement Learning
- ECE 458 Computer Security
- ECE 462 Electrical Distribution Systems

- ECE 463 Design & Applications of Power Electronic Converters
- ECE 475 Radio-Wave Systems
- ECE 481 Digital Control Systems
- ECE 486 Robot Dynamics and Control
- ECE 493 Special Topics in Electrical and Computer Engineering (see Note ~~7~~ **3**)

The following TE courses are normally offered for the winter (4B) term. The list is subject to change from year to year.

- ECE 406 Algorithm Design and Analysis
- ECE 409 Cryptography and System Security
- ECE 416 Advanced Topics in Networking
- ECE 417 Image Processing
- ECE 423 Embedded Computer Systems
- ECE 432 Radio Frequency Integrated Devices and Circuits
- ECE 444 Integrated Analog Electronics
- ECE 451 Software Requirements Specification and Analysis
- ECE 453 Software Testing, Quality Assurance and Maintenance
- ECE 457B Fundamentals of Computational Intelligence
- ECE 459 Programming for Performance
- ECE 464 High Voltage Engineering and Power System Protection
- ECE 467 Power Systems Analysis, Operations and Markets
- ECE 474 Radio and Wireless Systems
- ECE 477 Photonic Devices and Systems
- ECE 488 Multivariable Control Systems
- ECE 493 Special Topics in Electrical and Computer Engineering (see Note ~~7~~ **3**)
- ECE 495 Autonomous Vehicle

The following project elective is offered every term. Students may take it, at most, once as a TE course.

- ECE 499 Engineering Project

~~**Workplace Hazardous Materials Information System (WHMIS)**~~

~~All students must take WHMIS training. Details are described in the WHMIS Requirements section of this Calendar. Students must meet this milestone in order to remain enrolled in 1A or to enrol in any academic term beyond 1A.~~

Communications and Signal Processing Specialization

Students interested in pursuing this Specialization must achieve a minimum average of 60% in the specialization courses, and a minimum grade of 50% in each of the courses. Students who satisfy the requirements for Faculty Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

Required courses:

- ECE 313 Digital Signal Processing
- ECE 318 Communication Systems

Any three courses from the following list:

- ECE 358 Computer Networks
- ECE 414 Wireless Communications
- ECE 416 Advanced Topics in Networking
- ECE 417 Image Processing
- ECE 474 Radio and Wireless Systems

Electrical Engineering CLEAN COPY

The Electrical Engineering Academic Curriculum

The curriculum involves a prescribed course load in each term. Laboratory sessions are compulsory where they form part of a course. Approval from the Electrical and Computer Engineering (ECE) Undergraduate Office is required for all changes from the specified plan. Permission to carry more than the normal load in any term is at the discretion of the ECE Undergraduate Office and is dependent on both the student's previous term average and their cumulative average.

There are six co-operative work terms and the normal rules of Co-operative Education apply, as further described in the Faculty of Engineering Work Terms page of this Calendar. At least five successful work terms are required to meet the degree requirements.

The promotion criteria used to determine progression through the plan are described in the Engineering Examinations and Promotions section of this Calendar. These include term-average requirements, course-grade requirements, and milestone requirements.

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- ECE 105 Classical Mechanics
- ECE 150 Fundamentals of Programming
- ECE 190 Engineering Profession and Practice
- ECE 198 Project Studio
- ENGL 192/SPCOM 192 Communication in the Engineering Profession
- MATH 115 Linear Algebra for Engineering
- MATH 117 Calculus 1 for Engineering

Term 1B (Spring)

- ECE 102 Information Session
- ECE 106 Electricity and Magnetism
- ECE 108 Discrete Mathematics and Logic 1
- ECE 124 Digital Circuits and Systems
- ECE 140 Linear Circuits
- ECE 192 Engineering Economics and Impact on Society

- MATH 119 Calculus 2 for Engineering

Term 2A (Winter)

- ECE 109 Materials Chemistry for Engineers
- ECE 201 Information Session
- ECE 204 Numerical Methods
- ECE 205 Advanced Calculus 1 for Electrical and Computer Engineers
- ECE 222 Digital Computers
- ECE 240 Electronic Circuits 1
- ECE 250 Algorithms and Data Structures

Term 2B (Fall)

- ECE 202 Information Session
- ECE 203 Probability Theory and Statistics 1
- ECE 206 Advanced Calculus 2 for Electrical Engineers
- ECE 207 Signals and Systems
- ECE 231 Semiconductor Physics and Devices
- ECE 260 Electromechanical Energy Conversion
- ECE 298 Instrumentation and Prototyping Laboratory

Term 3A (Spring)

- ECE 301 Information Session
- ECE 318 Communication Systems
- ECE 340 Electronic Circuits 2
- ECE 375 Electromagnetic Fields and Waves
- ECE 380 Analog Control Systems
- One CSE, NSE, or TE (see Note 1)

Term 3B (Fall)

- ECE 302 Information Session
- ECE 307 Probability Theory and Statistics 2
- One CSE, NSE, or TE (see Note 1)
- Choose two of the following four courses (see Note 2)
    - ECE 313 Digital Signal Processing
    - ECE 331 Electronic Devices
    - ECE 360 Power Systems and Smart Grids
    - ECE 373 Radio Frequency and Microwave Circuits
- Choose one additional course from ECE 313, ECE 320, ECE 331, ECE 351, ECE 356, ECE 358, ECE 360, ECE 373 that has not already been selected above provided prerequisites are met and subject to scheduling constraints.

Term 4A (Spring)

- ECE 401 Information Session
- ECE 498A Engineering Design Project or GENE 403 Interdisciplinary Design Project 1
- Four elective courses, CSE, NSE, or TE, as necessary (see Note 1)

Term 4B (Winter)

- ECE 402 Information Session
- ECE 498B Engineering Design Project or GENE 404 Interdisciplinary Design Project 2
- Four elective courses, CSE, NSE, or TE, as necessary (see Note 1)

Notes

1. There are a total of 13 electives: eight technical electives (TEs), including three in the 3B term which must be chosen from a list, three complementary studies electives (CSEs), and two natural science electives (NSEs). Constraints on the selection of TEs, CSEs, and NSEs are explained below. As per the Engineering Examinations and Promotions rules, these electives form part of a regular course load.
2. During the 3B term, students must select three technical courses from a list. These courses cannot be dropped for a reduced-load term.
3. Special topics courses (ECE 493) are offered as resources and faculty interests permit. Students should consult the ECE Undergraduate Office or ECE website for upcoming topics. Some offerings may have laboratory meets.

Elective Courses

Complementary Studies Electives

Students must complete three complementary studies electives (CSEs) from the Complementary Studies Course Lists for Engineering. These are in addition to those courses that are part of the core curriculum and contain complementary studies material, such as ECE 190, ECE 192, ENGL 192/SPCOM 192, and the Professional Development (PD) sequence. The three CSE courses are to be chosen according to the following constraint:

- Two courses from List C Humanities and Social Sciences (excluding courses concentrated on development of language or other skills)
- One course from any of List A Impact of Technology and/or Engineering on Society, List C Humanities and Social Sciences (excluding courses concentrated on development of language or other skills), or List D Humanities and Social Sciences (courses concentrated on development of language or other skills)

Ethics Requirement

To meet the Ethics Requirement, students must pass one of PD 22 or PHIL 315. PHIL 315 satisfies both the ethics requirement, and one of the List C CSE requirements described above.

Natural Science Electives

Students are required to complete two natural science electives (NSEs) and are responsible for ensuring they meet the minimum academic units. The two NSE courses must be primarily concerned with natural science and are in addition to the science components of the core curriculum, such as ECE 105, ECE 106, ECE 109, and ECE 231.

- BIOL 110 Introductory Zoology
- BIOL 120 Introduction to Plant Structure and Function
- BIOL 130 Introductory Cell Biology and BIOL 130L Cell Biology Laboratory
- BIOL 150 Organismal and Evolutionary Ecology
- BIOL 165 Diversity of Life
- BIOL 211 Introductory Vertebrate Zoology
- BIOL 239 Genetics
- BIOL 240 Fundamentals of Microbiology and BIOL 240L Microbiology Laboratory
- BIOL 241 Introduction to Applied Microbiology
- BIOL 273 Principles of Human Physiology 1
- BIOL 373 Principles of Human Physiology 2 and BIOL 373L Human Physiology Laboratory
- CHE 102 Chemistry for Engineers
- CHE 161 Engineering Biology
- CHEM 123 General Chemistry 2 and CHEM 123L General Chemistry Laboratory 2
- CHEM 209 Introductory Spectroscopy and Structure
- CHEM 237 Introductory Biochemistry and CHEM 237L Introductory Biochemistry Laboratory
- CHEM 254 Introductory Chemical Thermodynamics
- CHEM 262 Organic Chemistry for Engineering and CHEM 262L Organic Chemistry Laboratory for Engineering Students
- CHEM 266 Basic Organic Chemistry 1
- CHEM 356 Introductory Quantum Mechanics
- CHEM 404 Physiochemical Aspects of Natural Waters
- EARTH 121 Introductory Earth Sciences
- EARTH 122 Introductory Environmental Sciences
- EARTH 123 Introductory Hydrology
- EARTH 221 Introductory Geochemistry
- EARTH 270 Disasters and Natural Hazards
- EARTH 281 Geological Impacts on Human Health
- ECE 403 Thermal Physics
- ECE 404 Geometrical and Physical Optics
- ECE 405 Introduction to Quantum Mechanics
- ENVE 275 Environmental Chemistry
- ENVS 200 Field Ecology
- NE 222 Organic Chemistry for Nanotechnology Engineers
- PHYS 124 Modern Physics
- PHYS 233 Introduction to Quantum Mechanics
- PHYS 234 Quantum Physics 1
- PHYS 263 Classical Mechanics and Special Relativity
- PHYS 275 Planets
- PHYS 280 Introduction to Biophysics
- PHYS 334 Quantum Physics 2
- PHYS 335 Condensed Matter Physics

- PHYS 375 Stars
- PHYS 380 Molecular and Cellular Biophysics
- PSYCH 207 Cognitive Processes
- PSYCH 261 Physiological Psychology
- PSYCH 306 Perception
- SCI 238 Introductory Astronomy
- SCI 250 Environmental Geology

Technical Electives

Students are required to complete a total of eight technical electives (TEs), subject to the following conditions:

1. All of the technical courses from the 3B term (i.e., ECE 313, ECE 320, ECE 331, ECE 351, ECE 356, ECE 358, ECE 360, and ECE 373) count as TEs. At least three of these courses must be taken in the 3B term, as specified in the curriculum table above.
2. At least three TEs must be courses chosen from ECE 406 through ECE 495 or ECE 499, normally taken during the 4A and 4B terms. A list of current 4A and 4B TEs is provided below.
3. At least one TE, to a maximum of two, must be from another engineering (other than Electrical or Computer Engineering) plan; such courses must have sufficiently advanced engineering science or engineering design content to be allowed, and must be approved by the ECE Undergraduate Office. Some courses of interest may require prerequisite knowledge that is not part of the core curriculum in Electrical Engineering. Students may require extra courses or may need to seek enrolment approval from the course instructor if the prerequisite knowledge was acquired by other means.
4. The following courses are offered in the core curriculum in Computer Engineering but are considered TE courses for Electrical Engineering: ECE 224, ECE 252, ECE 327, and ECE 350. Some of these courses have prerequisites that must be met in order to enrol.
5. In all terms, elective availability is subject to scheduling constraints.

The following TE courses are normally offered for the spring (4A) term. The list is subject to change from year to year.

- ECE 414 Wireless Communications
- ECE 433 Fabrication Technologies for Micro and Nano Devices
- ECE 445 Integrated Digital Electronics
- ECE 452 Software Design and Architectures
- ECE 454 Distributed Computing
- ECE 455 Embedded Software
- ECE 457A Co-operative and Adaptive Algorithms
- ECE 457C Reinforcement Learning
- ECE 458 Computer Security
- ECE 462 Electrical Distribution Systems
- ECE 463 Design & Applications of Power Electronic Converters
- ECE 475 Radio-Wave Systems
- ECE 481 Digital Control Systems
- ECE 486 Robot Dynamics and Control
- ECE 493 Special Topics in Electrical and Computer Engineering (see Note 3)

The following TE courses are normally offered for the winter (4B) term. The list is subject to change from year to year.

- ECE 406 Algorithm Design and Analysis
- ECE 409 Cryptography and System Security
- ECE 416 Advanced Topics in Networking
- ECE 417 Image Processing
- ECE 423 Embedded Computer Systems
- ECE 432 Radio Frequency Integrated Devices and Circuits
- ECE 444 Integrated Analog Electronics
- ECE 451 Software Requirements Specification and Analysis
- ECE 453 Software Testing, Quality Assurance and Maintenance
- ECE 457B Fundamentals of Computational Intelligence
- ECE 459 Programming for Performance
- ECE 464 High Voltage Engineering and Power System Protection
- ECE 467 Power Systems Analysis, Operations and Markets
- ECE 474 Radio and Wireless Systems
- ECE 477 Photonic Devices and Systems
- ECE 488 Multivariable Control Systems
- ECE 493 Special Topics in Electrical and Computer Engineering (see Note 3)
- ECE 495 Autonomous Vehicle

The following project elective is offered every term. Students may take it, at most, once as a TE course.

- ECE 499 Engineering Project

Communications and Signal Processing Specialization

Students interested in pursuing this Specialization must achieve a minimum average of 60% in the specialization courses, and a minimum grade of 50% in each of the courses. Students who satisfy the requirements for Faculty Options, Specializations and Electives for Engineering Students will have the appropriate designation shown on their diploma and transcript.

Required courses:

- ECE 313 Digital Signal Processing
- ECE 318 Communication Systems

Any three courses from the following list:

- ECE 358 Computer Networks
- ECE 414 Wireless Communications
- ECE 416 Advanced Topics in Networking
- ECE 417 Image Processing
- ECE 474 Radio and Wireless Systems

6.8 Environmental Engineering

Rationale:

Update Complementary Studies Elective rules due to removal of the Faculty-level rules.

Rewriting elective requirements for the 9 elective courses (2 CSEs, 7 TEs).

Updating Technical Electives list: Removing the special-topics course CIVE 495 (Design Intensive Special Topics in Civil Engineering) and replacing with AE 572 (Building Energy Analysis) and AE 573 (HVAC Systems, Equipment, and Energy Efficiency). Also removing courses from the Technical Elective list courses that have low to no enrolment over the past 5 years, or that have no Engineering Science or Engineering Design components: BIOL 364, CHE 516, CHEM 237, 262, EARTH 221, 421, 440, ME 559, and SYDE 411, 575. BIOL 462 is also being removed as a separate entry in the TE list and included with EARTH 444 since the courses are cross-listed.

Removing statements that are confusing, non-contractual, or unnecessary

Environmental Engineering	MARK UP

The Environmental Engineering Academic Curriculum

~~A total of two approved Complementary Studies Electives (CSE) in addition to ENGL 191/SPCOM 191, ERS 215, ENVE 391, and ENVE 392, and seven approved Technical Electives (TE) must be completed as detailed in the following sections.~~

The Environmental Engineering academic curriculum is detailed in the following sections. A total of nine approved electives must be completed:

- **Two Complementary Studies Electives**
- **Seven Technical Electives**

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- CHE 102 Chemistry for Engineers
- CIVE 104 Mechanics 1
- ENVE 100 Environmental and Geological Engineering Concepts
- ENVE 115 Linear Algebra
- ENGL 191/SPCOM 191 Communication in the Engineering Profession ~~(List D-Other CSE)~~
- MATH 116 Calculus 1 for Engineering

Term 1B (Spring)

- CIVE 105 Mechanics 2
- ENVE 121 Computational Methods
- ENVE 123 Electrical Circuits and Instrumentation

- ENVE 153 Earth Engineering
- MATH 118 Calculus 2 for Engineering

Term 2A (Winter)

- ENVE 223 Differential Equations and Balance Laws
- ENVE 224 Probability and Statistics
- ENVE 275 Environmental Chemistry
- ENVE 280 Fluid Mechanics
- ENVE 298 Seminar
- ERS 215 Environmental and Sustainability Assessment 1 ~~(List A-Impact Courses CSE)~~

Term 2B (Fall)

- BIOL 240 Fundamentals of Microbiology
- ENVE 225 Environmental Modelling
- ENVE 277 Air Quality Engineering
- ENVE 279 Energy and the Environment
- ENVE 299 Seminar
- ENVE 382 Hydrology and Open Channel Flow
- WKRPT 200 Work-term Report

Term 3A (Spring)

- EARTH 458 Physical Hydrogeology
- EARTH 458L Field Methods in Hydrogeology
- ENVE 330 Lab Analysis and Field Sampling Techniques
- ENVE 375 Physico-Chemical Processes
- ENVE 392 Economics and Life Cycle Cost Analysis ~~(List B-Engineering Economics CSE)~~
- ENVE 398 Seminar
- GEOE 353 Geotechnical Engineering 1
- WKRPT 300 Work-term Report

Term 3B (Winter)

- ENVE 335 Decision Making for Environmental Engineers
- ENVE 376 Biological Processes
- ENVE 383 Advanced Hydrology and Hydraulics
- ENVE 391 Law and Ethics for Environmental and Geological Engineers ~~(List D-Other CSE)~~
- ENVE 399 Seminar
- ~~TE 1 Approved Technical Elective~~
- **Approved Elective**

Term 4A (Fall)

- ENVE 400 Environmental Engineering Design Project 1
- ENVE 498 Seminar
- ~~TE 2 Approved Technical Elective~~
- ~~TE 3 Approved Technical Elective~~
- ~~TE 4 Approved Technical Elective~~
- ~~CSE 1 Approved Complementary Studies Elective~~
- WKRPT 400 Work-term Report
- **Four Approved Electives**

Term 4B (Winter)

- ENVE 401 Environmental Engineering Design Project 2
- ENVE 499 Seminar
- ~~TE 5 Approved Technical Elective~~
- ~~TE 6 Approved Technical Elective~~
- ~~TE 7 Approved Technical Elective~~
- ~~CSE 2 Approved Complementary Studies Elective~~
- **Four Approved Electives**

Electives

Students are responsible for selecting their own combination of electives, in keeping with their ultimate career objectives after graduation. The combination must satisfy the requirements of the Department of Civil and Environmental Engineering (CEE)~~, which meet engineering accreditation requirements such that students are eligible to count their undergraduate education towards a professional engineering license.~~ This includes having to meet minimum requirements in mathematics, natural sciences, engineering sciences, engineering design, and complementary studies.

~~Exceptions to courses on the Faculty of Engineering CSE lists and the Environmental Engineering TE and Specialization Lists require the approval of the CEE associate chair undergraduate studies.~~ **Exceptions to the electives and requirements listed in the following sections (and links) require approval of the Civil and Environmental Engineering associate chair, undergraduate studies.** Some courses of interest may require prerequisite knowledge that is not part of the core curriculum in Environmental Engineering. Students may require extra courses or may need to seek enrolment approval from the course instructor if the prerequisites have not been satisfied.

Complementary Studies Electives

~~All engineering students are required to take complementary studies electives (CSEs), as described in Complementary Studies Requirements for Engineering Students. Two complementary studies elective courses in approved non-technical subjects must be taken. The CSEs are in addition to those courses which are part of the core curriculum and contain complementary studies material, such as ENGL 191/SPCOM 191 (List D), ERS 215 (List A), ENVE 391 (List D), and ENVE 392 (List B).~~

~~The two CSE courses must be chosen from List C-Humanities and Social Sciences Courses.~~

Students are required to complete two Complementary Studies Electives (CSEs) from the Complementary Studies Course Lists for Engineering:

- **One course from List C**
- **One course from List A, C, or D**

List A CSEs concentrate on the impact of technology and/or engineering on society, List C CSEs are from the humanities and social sciences, and List D CSEs are humanities and social sciences courses that concentrate on the development of language or other skills.

Technical Electives

Students are required to complete seven technical electives (TEs) ~~courses~~ with the following restrictions:

- ~~At least f~~Four TEs must be from TE List ~~A~~ **1** ~~(Engineering Design Intensive Technical Electives)~~
- The remaining three TEs may be from TE List ~~A~~ **1** or ~~B~~ **2**

The Technical Elective Lists for Environmental Engineering are provided below. Note that the offering of these courses is contingent upon sufficient demand and/or available teaching resources. There may be courses added and changes made to the content~~,~~ **or** term of offering, ~~or meet times from what is listed below~~. Special Topics Courses (ENVE 495 and ENVE 497) are offered as resources and faculty availability permit. Further information is available from the CEE Undergraduate Office or CEE website.

~~**Legend for TE List A and B**~~

~~Term courses are offered: F=fall term, W=winter term, S=spring term~~

TE List ~~A~~ 1 - Engineering Design Intensive Technical Electives

~~Choose at least four~~

- **AE 572 Building Energy Analysis**
- **AE 573 HVAC Systems, Equipment, and Energy Efficiency**
- CHE 361 Bioprocess Engineering ~~(F,W)~~
- CHE 514 Fundamentals of Petroleum Production ~~(F)~~
- ~~CHE 516 Energy Systems Engineering (F)~~
- CHE 571 Industrial Ecology ~~(F)~~
- CHE 572 Air Pollution Control ~~(W)~~
- CHE 574 Industrial Wastewater Pollution Control ~~(W)~~
- CIVE 241 Transport Principles and Applications ~~(F)~~
- CIVE 341 Transportation Engineering Applications ~~(W)~~

- ~~CIVE 495 Design Intensive Special Topics in Civil Engineering (as offered)~~
- EARTH 438 Engineering Geology ~~(W)~~
- ENVE 495 Design Intensive Special Topics in Environmental Engineering ~~(as offered)~~
- ENVE 577 Engineering for Solid Waste Management ~~(W)~~
- ENVE 583 Design of Urban Water Systems ~~(W)~~
- GEOE 354 Geotechnical Engineering 2 ~~(F)~~
- GEOE 554 Geotechnical Engineering 3 ~~(W)~~
- ME 452 Energy Transfer in Buildings ~~(W)~~
- ME 571 Air Pollution ~~(W)~~
- SYDE 532 Introduction to Complex Systems ~~(W)~~
- SYDE 533 Conflict Resolution ~~(F)~~
- ~~SYDE 575 Image Processing (F)~~

TE List ~~B~~ 2 - Technical Electives

~~Choose a maximum of three~~

- BIOL 354 Environmental Toxicology 1 ~~(F,S)~~
- ~~BIOL 364 Mathematical Modelling in Biology (F)~~
- BIOL 447 Environmental Microbiology ~~(F)~~
- BIOL 455 Ecological Risk Assessment and Management ~~(F)~~
- ~~BIOL 462 Applied Wetland Science (F)~~
- BIOL 470 Methods of Aquatic Ecology ~~(F)~~
- ~~CHEM 237 Introductory Biochemistry (W,S)~~
- ~~CHEM 262 Organic Chemistry for Engineering (F,W)~~
- CIVE 422 Finite Element Analysis ~~(W)~~
- CIVE 440 Transit Planning and Operations ~~(W)~~
- CIVE 507 Building Science and Technology ~~(W)~~
- ~~EARTH 221 Introductory Geochemistry (W,S)~~
- EARTH 342 Geomorphology and GIS Applications ~~(F)~~
- ~~EARTH 421 Advanced Geochemistry (F)~~
- EARTH 439 Flow and Transport Through Fractured Rocks ~~(W)~~
- ~~EARTH 440 Quaternary Geology (F)~~
- EARTH 444/**BIOL 462** Applied Wetland Science ~~(F)~~
- EARTH 456 Numerical Methods in Hydrogeology ~~(W)~~
- EARTH 459 Chemical Hydrogeology ~~(W)~~
- ENVE 497 Special Topics in Environmental Engineering ~~(as offered)~~
- ENVE 573 Contaminant Transport ~~(W)~~
- GEOG 209 Hydroclimatology ~~(W,S)~~
- GEOG 305 Fluvial Geomorphology ~~(F)~~
- GEOG 371 Advanced Remote Sensing Techniques ~~(F)~~
- GEOG 381 Advanced Geographic Information Systems ~~(W,S)~~
- GEOG 409 Energy Balance Climatology ~~(W)~~
- GEOG 471 Remote Sensing Project ~~(W)~~
- ME 354 Thermodynamics 2 ~~(W,S)~~
- ME 459 Energy Conversion ~~(F,S)~~
- ~~ME 559 Finite Element Methods (F,S)~~
- **PLAN 453/GEOG 453 Urban Stormwater Management**
- ~~SYDE 411 Optimization and Numerical Methods (F)~~
- SYDE 531 Design Optimization Under Probabilistic Uncertainty ~~(W)~~

Specializations

The Faculty of Engineering recognizes three specializations with the Environmental Engineering BASc degree. Students who satisfy the specialization requirements (courses and grades) will have the specialization designation shown on their transcript and diploma. Specializations are intended to recognize success in a concentration of electives within the Environmental Engineering degree specification. In other words, specializations focus the selection of electives required for the base degree and do not require extra courses.

Each specialization requires students to select **TEs** ~~technical electives~~ with a common theme. Students are responsible for meeting the TE requirements of the Environmental Engineering degree when pursuing a specialization. Each specialization requires the successful completion of a minimum number of TEs specified by the specialization with a minimum average of 60%. Students must declare a specialization for it to be recognized as part of their degree and appear on the transcript and diploma.

The specialization course requirements are provided below. ~~Exceptions to the listed courses require the approval of the CEE associate chair, undergraduate studies~~.

Energy Specialization

The Energy Specialization requires a minimum of four TEs from the list below.

- From TE List ~~A~~ 1:
  - **AE 572 Building Energy Analysis**
  - **AE 573 HVAC Systems, Equipment, and Energy Efficiency**
  - ~~CHE 516 Energy Systems Engineering (F)~~
  - ~~CIVE 495 Design Intensive Special Topics in Civil Engineering~~
~~Topic: Building Energy Analysis (F,S), or~~
~~Topic: HVAC Energy Efficiency (Low-Energy Building System) (W)~~
  - ME 452 ~~Energy Transfer in Buildings (W)~~ **HVAC Load Analysis and Design Fundamentals**
- From TE List ~~B~~ 2:
  - CIVE 507 Building Science and Technology ~~(W)~~
  - GEOG 409 Energy Balance Climatology ~~(W)~~
  - ME 354 Thermodynamics 2 ~~(W,S)~~
  - ME 459 Energy Conversion ~~(F,S)~~

Hydrology Specialization

The Hydrology Specialization requires a minimum of four TEs from the list below.

- From TE List ~~A~~ 1:
  - ENVE 583 Design of Urban Water Systems ~~(W)~~
  - SYDE 532 Introduction to Complex Systems ~~(W)~~
  - SYDE 533 Conflict Resolution ~~(F)~~
- From TE List ~~B~~ 2:
  - BIOL 470 Methods of Aquatic Ecology ~~(F)~~
  - EARTH 439 Flow and Transport Through Fractured Rocks ~~(W)~~
  - EARTH 444/**BIOL 462** Applied Wetland Science ~~(F)~~
  - EARTH 459 Chemical Hydrogeology ~~(W)~~
  - ENVE 573 Contaminant Transport ~~(W)~~

- GEOG 209 Hydroclimatology ~~(W,S)~~
- GEOG 305 Fluvial Geomorphology ~~(F)~~
- GEOG 371 Advanced Remote Sensing Techniques ~~(F)~~
- GEOG 381 Advanced Geographic Information Systems ~~(W,S)~~
- **PLAN 453/GEOG 453 Urban Stormwater Management**

Pollution Treatment and Control Specialization

The Pollution Treatment and Control Specialization requires a minimum of four TEs from the list below.

- From TE List ~~A~~ 1:
  - CHE 361 Bioprocess Engineering ~~(F,W)~~
  - CHE 571 Industrial Ecology ~~(F)~~
  - CHE 572 Air Pollution Control ~~(W)~~
  - CHE 574 Industrial Wastewater Pollution Control ~~(W)~~
  - ENVE 577 Engineering for Solid Waste Management ~~(W)~~
  - ME 571 Air Pollution ~~(W)~~
- From TE List ~~B~~ 2:
  - ENVE 573 Contaminant Transport ~~(W)~~

Environmental Engineering CLEAN COPY

The Environmental Engineering Academic Curriculum

The Environmental Engineering academic curriculum is detailed in the following sections. A total of nine approved electives must be completed:

- Two Complementary Studies Electives
- Seven Technical Electives

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- CHE 102 Chemistry for Engineers
- CIVE 104 Mechanics 1
- ENVE 100 Environmental and Geological Engineering Concepts
- ENVE 115 Linear Algebra
- ENGL 191/SPCOM 191 Communication in the Engineering Profession
- MATH 116 Calculus 1 for Engineering

Term 1B (Spring)

- CIVE 105 Mechanics 2
- ENVE 121 Computational Methods
- ENVE 123 Electrical Circuits and Instrumentation
- ENVE 153 Earth Engineering

- MATH 118 Calculus 2 for Engineering

Term 2A (Winter)

- ENVE 223 Differential Equations and Balance Laws
- ENVE 224 Probability and Statistics
- ENVE 275 Environmental Chemistry
- ENVE 280 Fluid Mechanics
- ENVE 298 Seminar
- ERS 215 Environmental and Sustainability Assessment 1

Term 2B (Fall)

- BIOL 240 Fundamentals of Microbiology
- ENVE 225 Environmental Modelling
- ENVE 277 Air Quality Engineering
- ENVE 279 Energy and the Environment
- ENVE 299 Seminar
- ENVE 382 Hydrology and Open Channel Flow
- WKRPT 200 Work-term Report

Term 3A (Spring)

- EARTH 458 Physical Hydrogeology
- EARTH 458L Field Methods in Hydrogeology
- ENVE 330 Lab Analysis and Field Sampling Techniques
- ENVE 375 Physico-Chemical Processes
- ENVE 392 Economics and Life Cycle Cost Analysis
- ENVE 398 Seminar
- GEOE 353 Geotechnical Engineering 1
- WKRPT 300 Work-term Report

Term 3B (Winter)

- ENVE 335 Decision Making for Environmental Engineers
- ENVE 376 Biological Processes
- ENVE 383 Advanced Hydrology and Hydraulics
- ENVE 391 Law and Ethics for Environmental and Geological Engineers
- ENVE 399 Seminar
- Approved Elective

Term 4A (Fall)

- ENVE 400 Environmental Engineering Design Project 1
- ENVE 498 Seminar
- WKRPT 400 Work-term Report
- Four Approved Electives

Term 4B (Winter)

- ENVE 401 Environmental Engineering Design Project 2
- ENVE 499 Seminar
- Four Approved Electives

Electives

Students are responsible for selecting their own combination of electives, in keeping with their ultimate career objectives after graduation. The combination must satisfy the requirements of the Department of Civil and Environmental Engineering (CEE). This includes having to meet minimum requirements in mathematics, natural sciences, engineering sciences, engineering design, and complementary studies.

Exceptions to the electives and requirements listed in the following sections (and links) require approval of the Civil and Environmental Engineering associate chair, undergraduate studies. Some courses of interest may require prerequisite knowledge that is not part of the core curriculum in Environmental Engineering. Students may require extra courses or may need to seek enrolment approval from the course instructor if the prerequisites have not been satisfied.

Complementary Studies Electives

Students are required to complete two Complementary Studies Electives (CSEs) from the Complementary Studies Course Lists for Engineering:

- One course from List C
- One course from List A, C, or D

List A CSEs concentrate on the impact of technology and/or engineering on society, List C CSEs are from the humanities and social sciences, and List D CSEs are humanities and social sciences courses that concentrate on the development of language or other skills.

Technical Electives

Students are required to complete seven technical electives (TEs) with the following restrictions:

- Four TEs must be from TE List 1
- The remaining three TEs may be from TE List 1 or 2

The Technical Elective Lists for Environmental Engineering are provided below. Note that the offering of these courses is contingent upon sufficient demand and/or available teaching resources. There may be courses added and changes made to the content or term of offering. Special Topics Courses (ENVE 495 and ENVE 497) are offered as resources and faculty availability permit. Further information is available from the CEE Undergraduate Office or CEE website.

TE List 1 - Engineering Design Intensive Technical Electives

- AE 572 Building Energy Analysis
- AE 573 HVAC Systems, Equipment, and Energy Efficiency
- CHE 361 Bioprocess Engineering
- CHE 514 Fundamentals of Petroleum Production
- CHE 571 Industrial Ecology
- CHE 572 Air Pollution Control
- CHE 574 Industrial Wastewater Pollution Control
- CIVE 241 Transport Principles and Applications
- CIVE 341 Transportation Engineering Applications
- EARTH 438 Engineering Geology
- ENVE 495 Design Intensive Special Topics in Environmental Engineering
- ENVE 577 Engineering for Solid Waste Management
- ENVE 583 Design of Urban Water Systems
- GEOE 354 Geotechnical Engineering 2
- GEOE 554 Geotechnical Engineering 3
- ME 452 Energy Transfer in Buildings
- ME 571 Air Pollution
- SYDE 532 Introduction to Complex Systems
- SYDE 533 Conflict Resolution

TE List 2 - Technical Electives

- BIOL 354 Environmental Toxicology 1
- BIOL 447 Environmental Microbiology
- BIOL 455 Ecological Risk Assessment and Management
- BIOL 470 Methods of Aquatic Ecology
- CIVE 422 Finite Element Analysis
- CIVE 440 Transit Planning and Operations
- CIVE 507 Building Science and Technology
- EARTH 342 Geomorphology and GIS Applications
- EARTH 439 Flow and Transport Through Fractured Rocks
- EARTH 444/BIOL 462 Applied Wetland Science
- EARTH 456 Numerical Methods in Hydrogeology
- EARTH 459 Chemical Hydrogeology
- ENVE 497 Special Topics in Environmental Engineering
- ENVE 573 Contaminant Transport
- GEOG 209 Hydroclimatology
- GEOG 305 Fluvial Geomorphology

- GEOG 371 Advanced Remote Sensing Techniques
- GEOG 381 Advanced Geographic Information Systems
- GEOG 409 Energy Balance Climatology
- GEOG 471 Remote Sensing Project
- ME 354 Thermodynamics 2
- ME 459 Energy Conversion
- PLAN 453/GEOG 453 Urban Stormwater Management
- SYDE 531 Design Optimization Under Probabilistic Uncertainty

Specializations

The Faculty of Engineering recognizes three specializations with the Environmental Engineering BASc degree. Students who satisfy the specialization requirements (courses and grades) will have the specialization designation shown on their transcript and diploma. Specializations are intended to recognize success in a concentration of electives within the Environmental Engineering degree specification. In other words, specializations focus the selection of electives required for the base degree and do not require extra courses.

Each specialization requires students to select TEs with a common theme. Students are responsible for meeting the TE requirements of the Environmental Engineering degree when pursuing a specialization. Each specialization requires the successful completion of a minimum number of TEs specified by the specialization with a minimum average of 60%. Students must declare a specialization for it to be recognized as part of their degree and appear on the transcript and diploma.

The specialization course requirements are provided below.

Energy Specialization

The Energy Specialization requires a minimum of four TEs from the list below.

- From TE List 1:
  - AE 572 Building Energy Analysis
  - AE 573 HVAC Systems, Equipment, and Energy Efficiency
  - ME 452 HVAC Load Analysis and Design Fundamentals
- From TE List 2:
  - CIVE 507 Building Science and Technology
  - GEOG 409 Energy Balance Climatology
  - ME 354 Thermodynamics 2
  - ME 459 Energy Conversion

Hydrology Specialization

The Hydrology Specialization requires a minimum of four TEs from the list below.

- From TE List 1:
  - ENVE 583 Design of Urban Water Systems
  - SYDE 532 Introduction to Complex Systems
  - SYDE 533 Conflict Resolution
- From TE List 2:
  - BIOL 470 Methods of Aquatic Ecology
  - EARTH 439 Flow and Transport Through Fractured Rocks

    - EARTH 444/BIOL 462 Applied Wetland Science
    - EARTH 459 Chemical Hydrogeology
    - ENVE 573 Contaminant Transport
    - GEOG 209 Hydroclimatology
    - GEOG 305 Fluvial Geomorphology
    - GEOG 371 Advanced Remote Sensing Techniques
    - GEOG 381 Advanced Geographic Information Systems
    - PLAN 453/GEOG 453 Urban Stormwater Management

Pollution Treatment and Control Specialization

The Pollution Treatment and Control Specialization requires a minimum of four TEs from the list below.

- From TE List 1:
    - CHE 361 Bioprocess Engineering
    - CHE 571 Industrial Ecology
    - CHE 572 Air Pollution Control
    - CHE 574 Industrial Wastewater Pollution Control
    - ENVE 577 Engineering for Solid Waste Management
    - ME 571 Air Pollution
- From TE List 2:
    - ENVE 573 Contaminant Transport

6.9. Geological Engineering

Rationale:

Update program rules for Complementary Studies Electives due to removal of Faculty-level rules. The changes increase flexibility for students.

Rewrite of elective requirements for the 9 elective courses (3 CSEs, 6 TEs).

Merge TE lists to simplify presentation of permissible technical electives for the main degree and the specializations.

Removing statements that are confusing, non-contractual, or unnecessary.

Allow ENVE 383 as an elective in the Soil, Rock, and Structures Specialization

Geological Engineering	MARK UP

The Geological Engineering Academic Curriculum

~~A total of three approved Complementary Studies Electives (CSE), in addition to ENGL 191/SPCOM 191, GEOE 391, and GEOE 392, and six approved Technical Electives (TE) must be completed as detailed in the following sections.~~

The Geological Engineering academic curriculum is detailed in the following sections. A total of nine approved electives must be completed:

- **Three Complementary Studies Electives**
- **Six Technical Electives**

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- CHE 102 Chemistry for Engineers
- CIVE 104 Mechanics 1
- ENGL 191/SPCOM 191 Communication in the Engineering Profession ~~(List D-Other CSE)~~
- GEOE 100 Environmental and Geological Engineering Concepts
- GEOE 115 Linear Algebra
- MATH 116 Calculus 1 for Engineering

Term 1B (Spring)

- CIVE 105 Mechanics 2
- GEOE 121 Computational Methods
- GEOE 123 Electrical Circuits and Instrumentation
- GEOE 153 Earth Engineering

- MATH 118 Calculus 2 for Engineering

Term 2A (Winter)

- EARTH 238 Introductory Structural Geology
- GEOE 223 Differential Equations and Balance Laws
- GEOE 224 Probability and Statistics
- GEOE 280 Fluid Mechanics
- GEOE 298 Seminar
- ~~CSE 1 Approved Complementary Studies Elective~~
- **Approved Elective**

Term 2B (Fall)

- CIVE 204 Solid Mechanics 1
- EARTH 231 Mineralogy
- EARTH 235 Stratigraphic Approaches to Understanding Earth's History
- EARTH 260 Introductory Applied Geophysics
- GEOE 221 Advanced Calculus
- GEOE 299 Seminar
- WKRPT 200 Work-term Report
- ~~CSE 2 Approved Complementary Studies Elective~~
- **Approved Elective**

Term 3A (Spring)

- EARTH 232 Introductory Petrography
- EARTH 458 Physical Hydrogeology
- EARTH 458L Field Methods in Hydrogeology
- GEOE 353 Geotechnical Engineering 1
- GEOE 392 Economics and Life Cycle Cost Analysis ~~(List B-Engineering Economics CSE)~~
- GEOE 398 Seminar
- WKRPT 300 Work-term Report
- ~~TE 1 Approved Technical Elective~~
- **Approved Elective**

~~**3A Technical Elective List**~~

- ~~CIVE 205 Solid Mechanics 2~~
- ~~EARTH 221 Introductory Geochemistry~~

Term 3B (Winter)

- EARTH 333 Introductory Sedimentology
- EARTH 390 Methods in Geological Mapping (see Note)
- EARTH 437 Rock Mechanics
- EARTH 438 Engineering Geology
- ENVE 382 Hydrology and Open Channel Flow
- GEOE 399 Seminar
- ~~CSE 3 Approved Complementary Studies Elective~~
- **Approved Elective**

Note: EARTH 390 is offered after winter term exams are finished in April. It is two weeks long, finishing before the spring term begins. Additional field trip fees will apply.

Term 4A (Fall)

- GEOE 354 Geotechnical Engineering 2
- GEOE 400 Geological Engineering Design Project 1
- GEOE 498 Seminar
- WKRPT 400 Work-term Report
- ~~TE 2 Approved Technical Elective~~
- ~~TE 3 Approved Technical Elective~~
- ~~TE 4 Approved Technical Elective~~
- **Three Approved Electives**

~~**4A Technical Elective List**~~

- ~~CHE 514 Fundamentals of Petroleum Production~~
- ~~CIVE 306 Mechanics of Solids 3~~
- ~~CIVE 310 Introduction to Structural Design~~
- ~~CIVE 375 Environmental Engineering Principles~~
- ~~EARTH 331 Volcanology and Igneous Petrology~~
- ~~EARTH 342 Geomorphology and GIS Applications~~
- ~~EARTH 421 Advanced Geochemistry~~
- ~~EARTH 440 Quaternary Geology~~
- ~~EARTH 444 Applied Wetland Science~~
- ~~EARTH 461 Near-Surface Geophysics~~
- ~~GEOE 495 Design Intensive Special Topics in Geological Engineering~~
- ~~GEOE 497 Special Topics in Geological Engineering~~
- ~~ME 559 Finite Element Methods~~

Term 4B (Winter)

- GEOE 391 Law and Ethics for Environmental and Geological Engineers ~~(List D-Other CSE)~~
- GEOE 401 Geological Engineering Design Project 2
- GEOE 499 Seminar
- GEOE 554 Geotechnical Engineering 3

- ~~TE 5 Approved Technical Elective~~
- ~~TE 6 Approved Technical Elective~~
- **Two Approved Electives**

~~**4B Technical Elective List**~~

- ~~CIVE 303 Structural Analysis~~
- ~~CIVE 332 Civil Systems and Project Management~~
- ~~CIVE 422 Finite Element Analysis~~
- ~~CIVE 460 Engineering Biomechanics~~
- ~~CIVE 507 Building Science and Technology~~
- ~~CIVE 542 Pavement Structural Design~~
- ~~EARTH 332 Metamorphic Petrology~~
- ~~EARTH 435 Advanced Structural Geology~~
- ~~EARTH 439 Flow and Transport Through Fractured Rocks~~
- ~~EARTH 444 Applied Wetland Science~~
- ~~EARTH 456 Numerical Methods in Hydrogeology~~
- ~~EARTH 459 Chemical Hydrogeology~~
- ~~EARTH 460 Geophysical Data Analysis~~
- ~~EARTH 471 Mineral Deposits~~
- ~~ENVE 383 Advanced Hydrology and Hydraulics~~
- ~~ENVE 573 Contaminant Transport~~
- ~~ENVE 577 Engineering for Solid Waste Management~~
- ~~ENVE 583 Design of Urban Water Systems~~
- ~~GEOE 495 Design Intensive Special Topics in Geological Engineering~~
- ~~GEOE 497 Special Topics in Geological Engineering~~

Electives

Students are responsible for selecting their own combination of electives, in keeping with their ultimate career objectives after graduation. The combination must satisfy the requirements of the Department of Civil and Environmental Engineering (CEE)~~, which meet engineering accreditation requirements such that students are eligible to count their undergraduate education towards a professional engineering license.~~ This includes having to meet minimum requirements in mathematics, natural sciences, engineering sciences, engineering design, and complementary studies.

~~Exceptions to courses on the Faculty of Engineering CSE lists and the Geological Engineering TE and Specialization lists require the approval of the CEE associate chair undergraduate studies.~~ **Exceptions to the electives and requirements listed in the following sections (and links) require approval of the Geological Engineering director, or Civil and Environmental Engineering associate chair, undergraduate studies.** Some courses of interest may require prerequisite knowledge that is not part of the core curriculum in Geological Engineering. Students may require extra courses or may need to seek enrolment approval from the course instructor if the prerequisites have not been satisfied.

Complementary Studies Electives

~~All engineering students are required to take complementary studies electives (CSEs), as described in Complementary Studies Requirements for Engineering Students. Three complementary studies elective~~

~~courses must be taken in approved non-technical subjects. The CSEs are in addition to those courses which are part of the core curriculum and contain complementary studies material, such as ENGL 191/SPCOM 191 (List D), GEOE 391 (List D), and GEOE 392 (List B). The three CSE courses are to be chosen according to the following constraints:~~

- ~~One course from List A-Impact Courses~~
- ~~Two courses from List C-Humanities and Social Sciences Courses~~

Students are required to complete three Complementary Studies Electives (CSEs) from the Complementary Studies Course Lists for Engineering:

- **One course from List A**
- **One course from List C**
- **One course from List A, C, or D**

List A CSEs concentrate on the impact of technology and/or engineering on society, List C CSEs are from the humanities and social sciences, and List D CSEs are humanities and social sciences courses that concentrate on the development of language or other skills.

Technical Electives

Students are required to complete six technical electives (TEs) by choosing from the ~~3A, 4A, and 4B TE~~ list~~s~~ provided ~~above~~ **below**. Note that the offering of these courses is contingent upon sufficient demand and/or available teaching resources. There may be courses added and changes made to the content or term of offering ~~from what is listed~~. Special Topics Courses (GEOE 495 and GEOE 497) are offered as resources and faculty availability permit. Further information is available from the CEE Undergraduate Office or CEE website.

- **CHE 514 Fundamentals of Petroleum Production**
- **CIVE 205 Solid Mechanics 2**
- **CIVE 303 Structural Analysis**
- **CIVE 306 Solid Mechanics 3**
- **CIVE 310 Introduction to Structural Design**
- **CIVE 332 Civil Systems and Project Management**
- **CIVE 375 Environmental Engineering Principles**
- **CIVE 422 Finite Element Analysis**
- **CIVE 460 Engineering Biomechanics**
- **CIVE 507 Building Science and Technology**
- **CIVE 542 Pavement Structural Design**
- **EARTH 221 Introductory Geochemistry**
- **EARTH 331 Volcanology and Igneous Petrology**
- **EARTH 332 Metamorphic Petrology**
- **EARTH 342 Geomorphology and GIS Applications**
- **EARTH 421 Advanced Geochemistry**
- **EARTH 435 Advanced Structural Geology**
- **EARTH 439 Flow and Transport Through Fractured Rocks**
- **EARTH 440 Quaternary Geology**
- **EARTH 444 Applied Wetland Science**
- **EARTH 456 Numerical Methods in Hydrogeology**
- **EARTH 459 Chemical Hydrogeology**
- **EARTH 460 Geophysical Data Analysis**

- EARTH 461 Near-Surface Geophysics
- EARTH 471 Mineral Deposits
- ENVE 383 Advanced Hydrology and Hydraulics
- ENVE 573 Contaminant Transport
- ENVE 577 Engineering for Solid Waste Management
- ENVE 583 Design of Urban Water Systems
- GEOE 495 Design Intensive Special Topics in Geological Engineering
- GEOE 497 Special Topics in Geological Engineering
- ME 559 Finite Element Methods

Specializations

The Faculty of Engineering recognizes three specializations with the Geological Engineering BASc degree. Students who satisfy the specialization requirements (courses and grades) will have the specialization designation shown on their transcript and diploma. Specializations are intended to recognize success in a concentration of electives within the Geological Engineering degree specification. In other words, specializations focus the selection of electives required for the base degree and do not require extra courses.

Each specialization requires students to select ~~technical electives~~ TEs with a common theme. Students are responsible for meeting the TE requirements of the Geological Engineering degree when pursuing a specialization. Each specialization requires the successful completion of a minimum number of TEs specified by the specialization with a minimum average of 60%. Students must declare a specialization for it to be recognized as part of their degree and appear on the transcript and diploma.

The specialization course requirements are provided below. ~~Exceptions to the listed courses require the approval of the CEE associate chair, undergraduate studies.~~

Geology Specialization

The Geology Specialization ~~course requirements are:~~ requires:

- EARTH 221 Introductory Geochemistry
- EARTH 471 Mineral Deposits
- Minimum of two TEs from the list below

- ~~EARTH 221 Introductory Geochemistry (3A TE) and EARTH 471 Mineral Deposits (4B TE)~~
- ~~At least two TEs from the list below.~~
    - ~~From the 4A TE List:~~
        - ~~EARTH 331 Volcanology and Igneous Petrology (F)~~
        - ~~EARTH 332 Metamorphic Petrology (W)~~
        - ~~EARTH 342 Geomorphology and GIS Application (F)~~
        - ~~EARTH 421 Advanced Geochemistry (F)~~
    - ~~From the 4B TE List:~~
        - ~~EARTH 435 Advanced Structural Geology (W)~~
    - EARTH 331 Volcanology and Igneous Petrology
    - EARTH 332 Metamorphic Petrology
    - EARTH 342 Geomorphology and GIS Application
    - EARTH 421 Advanced Geochemistry
    - EARTH 435 Advanced Structural Geology

Hydrogeology Specialization

The Hydrogeology Specialization ~~course requirements are~~ **requires**:

- EARTH 221 Introductory Geochemistry ~~(3A TE)~~
- At least **A minimum of** three TEs from the list below
  - ~~From the 4A TE List (F):~~
    - ~~EARTH 342 Geomorphology and GIS Applications~~
    - ~~EARTH 421 Advanced Geochemistry~~
    - ~~EARTH 440 Quaternary Geology~~
    - ~~EARTH 444 Applied Wetland Science~~
    - ~~EARTH 461 Near-Surface Geophysics~~
  - ~~From the 4B TE List (W):~~
    - ~~EARTH 439 Flow and Transport Through Fractured Rocks~~
    - ~~EARTH 456 Numerical Methods in Hydrogeology~~
    - ~~EARTH 459 Chemical Hydrogeology~~
    - ~~EARTH 460 Geophysical Data Analysis~~
    - ~~ENVE 383 Advanced Hydrology and Hydraulics~~
  - **EARTH 342 Geomorphology and GIS Applications**
  - **EARTH 421 Advanced Geochemistry**
  - **EARTH 439 Flow and Transport Through Fractured Rocks**
  - **EARTH 440 Quaternary Geology**
  - **EARTH 444 Applied Wetland Science**
  - **EARTH 456 Numerical Methods in Hydrogeology**
  - **EARTH 459 Chemical Hydrogeology**
  - **EARTH 460 Geophysical Data Analysis**
  - **EARTH 461 Near-Surface Geophysics**
  - **ENVE 383 Advanced Hydrology and Hydraulics**

Soil, Rock and Structures Specialization

The Soil, Rock and Structures Specialization ~~course requirements are~~ **requires**:

- CIVE 205 Solid Mechanics 2 ~~(3A TE)~~
- ~~At least~~ **A minimum of** three TEs from the list below
  - ~~From the 4A TE List (F):~~
    - ~~CIVE 306 Mechanics of Solids 3~~
    - ~~CIVE 310 Introduction to Structural Design~~
  - ~~From the 4B TE List (W):~~
    - ~~CIVE 303 Structural Analysis~~
    - ~~CIVE 422 Finite Element Analysis or ME 559 Finite Element Methods (F,S; 4A TE List)~~
    - ~~CIVE 542 Pavement Structural Design~~
    - ~~EARTH 435 Advanced Structural Geology~~
  - **ENVE 383 Advanced Hydrology and Hydraulics**
  - **CIVE 303 Structural Analysis**
  - **CIVE 306 Solid Mechanics 3**
  - **CIVE 310 Introduction to Structural Design**
  - **CIVE 422 Finite Element Analysis or ME 559 Finite Element Methods**
  - **CIVE 542 Pavement Structural Design**

- EARTH 435 Advanced Structural Geology

Geological Engineering CLEAN COPY

The Geological Engineering Academic Curriculum

The Geological Engineering academic curriculum is detailed in the following sections. A total of nine approved electives must be completed:

- Three Complementary Studies Electives
- Six Technical Electives

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- CHE 102 Chemistry for Engineers
- CIVE 104 Mechanics 1
- ENGL 191/SPCOM 191 Communication in the Engineering Profession
- GEOE 100 Environmental and Geological Engineering Concepts
- GEOE 115 Linear Algebra
- MATH 116 Calculus 1 for Engineering

Term 1B (Spring)

- CIVE 105 Mechanics 2
- GEOE 121 Computational Methods
- GEOE 123 Electrical Circuits and Instrumentation
- GEOE 153 Earth Engineering
- MATH 118 Calculus 2 for Engineering

Term 2A (Winter)

- EARTH 238 Introductory Structural Geology
- GEOE 223 Differential Equations and Balance Laws
- GEOE 224 Probability and Statistics
- GEOE 280 Fluid Mechanics
- GEOE 298 Seminar
- Approved Elective

Term 2B (Fall)

- CIVE 204 Solid Mechanics 1
- EARTH 231 Mineralogy

- EARTH 235 Stratigraphic Approaches to Understanding Earth's History
- EARTH 260 Introductory Applied Geophysics
- GEOE 221 Advanced Calculus
- GEOE 299 Seminar
- WKRPT 200 Work-term Report
- Approved Elective

Term 3A (Spring)

- EARTH 232 Introductory Petrography
- EARTH 458 Physical Hydrogeology
- EARTH 458L Field Methods in Hydrogeology
- GEOE 353 Geotechnical Engineering 1
- GEOE 392 Economics and Life Cycle Cost Analysis
- GEOE 398 Seminar
- WKRPT 300 Work-term Report
- Approved Elective

Term 3B (Winter)

- EARTH 333 Introductory Sedimentology
- EARTH 390 Methods in Geological Mapping (see Note)
- EARTH 437 Rock Mechanics
- EARTH 438 Engineering Geology
- ENVE 382 Hydrology and Open Channel Flow
- GEOE 399 Seminar
- Approved Elective

Note: EARTH 390 is offered after winter term exams are finished in April. It is two weeks long, finishing before the spring term begins. Additional field trip fees will apply.

Term 4A (Fall)

- GEOE 354 Geotechnical Engineering 2
- GEOE 400 Geological Engineering Design Project 1
- GEOE 498 Seminar
- WKRPT 400 Work-term Report
- Three Approved Electives

Term 4B (Winter)

- GEOE 391 Law and Ethics for Environmental and Geological Engineers
- GEOE 401 Geological Engineering Design Project 2
- GEOE 499 Seminar
- GEOE 554 Geotechnical Engineering 3
- Two Approved Electives

Electives

Students are responsible for selecting their own combination of electives, in keeping with their ultimate career objectives after graduation. The combination must satisfy the requirements of the Department of Civil and Environmental Engineering (CEE). This includes having to meet minimum requirements in mathematics, natural sciences, engineering sciences, engineering design, and complementary studies.

Exceptions to the electives and requirements listed in the following sections (and links) require approval of the Geological Engineering director, or Civil and Environmental Engineering associate chair, undergraduate studies. Some courses of interest may require prerequisite knowledge that is not part of the core curriculum in Geological Engineering. Students may require extra courses or may need to seek enrolment approval from the course instructor if the prerequisites have not been satisfied.

Complementary Studies Electives

Students are required to complete three Complementary Studies Electives (CSEs) from the Complementary Studies Course Lists for Engineering:

- One course from List A
- One course from List C
- One course from List A, C, or D

List A CSEs concentrate on the impact of technology and/or engineering on society, List C CSEs are from the humanities and social sciences, and List D CSEs are humanities and social sciences courses that concentrate on the development of language or other skills.

Technical Electives

Students are required to complete six technical electives (TEs) by choosing from the lists provided below. Note that the offering of these courses is contingent upon sufficient demand and/or available teaching resources. There may be courses added and changes made to the content or term of offering. Special Topics Courses (GEOE 495 and GEOE 497) are offered as resources and faculty availability permit. Further information is available from the CEE Undergraduate Office or CEE website.

- CHE 514 Fundamentals of Petroleum Production
- CIVE 205 Solid Mechanics 2
- CIVE 303 Structural Analysis
- CIVE 306 Solid Mechanics 3
- CIVE 310 Introduction to Structural Design
- CIVE 332 Civil Systems and Project Management
- CIVE 375 Environmental Engineering Principles
- CIVE 422 Finite Element Analysis

- CIVE 460 Engineering Biomechanics
- CIVE 507 Building Science and Technology
- CIVE 542 Pavement Structural Design
- EARTH 221 Introductory Geochemistry
- EARTH 331 Volcanology and Igneous Petrology
- EARTH 332 Metamorphic Petrology
- EARTH 342 Geomorphology and GIS Application
- EARTH 421 Advance Geochemistry
- EARTH 435 Advanced Structural Geology
- EARTH 439 Flow and Transport Through Fractured Rocks
- EARTH 440 Quaternary Geology
- EARTH 444 Applied Wetland Science
- EARTH 456 Numerical Methods in Hydrogeology
- EARTH 459 Chemical Hydrogeology
- EARTH 460 Geophysical Data Analysis
- EARTH 461 Near-Surface Geophysics
- EARTH 471 Mineral Deposits
- ENVE 383 Advanced Hydrology and Hydraulics
- ENVE 573 Contaminant Transport
- ENVE 577 Engineering for Solid Waste Management
- ENVE 583 Design of Urban Water Systems
- GEOE 495 Design Intensive Special Topics in Geological Engineering
- GEOE 497 Special Topics in Geological Engineering
- ME 559 Finite Element Methods

Specializations

The Faculty of Engineering recognizes three specializations with the Geological Engineering BASc degree. Students who satisfy the specialization requirements (courses and grades) will have the specialization designation shown on their transcript and diploma. Specializations are intended to recognize success in a concentration of electives within the Geological Engineering degree specification. In other words, specializations focus the selection of electives required for the base degree and do not require extra courses.

Each specialization requires students to select TEs with a common theme. Students are responsible for meeting the TE requirements of the Geological Engineering degree when pursuing a specialization. Each specialization requires the successful completion of a minimum number of TEs specified by the specialization with a minimum average of 60%. Students must declare a specialization for it to be recognized as part of their degree and appear on the transcript and diploma.

The specialization course requirements are provided below.

Geology Specialization

The Geology Specialization requires:

- EARTH 221 Introductory Geochemistry
- EARTH 471 Mineral Deposits
- Minimum of two TEs from the list below
    - EARTH 331 Volcanology and Igneous Petrology
    - EARTH 332 Metamorphic Petrology

- EARTH 342 Geomorphology and GIS Application
    - EARTH 421 Advanced Geochemistry
    - EARTH 435 Advanced Structural Geology

Hydrogeology Specialization

The Hydrogeology Specialization requires:

- EARTH 221 Introductory Geochemistry
- A minimum of three TEs from the list below
    - EARTH 342 Geomorphology and GIS Applications
    - EARTH 421 Advanced Geochemistry
    - EARTH 439 Flow and Transport Through Fractured Rocks
    - EARTH 440 Quaternary Geology
    - EARTH 444 Applied Wetland Science
    - EARTH 456 Numerical Methods in Hydrogeology
    - EARTH 459 Chemical Hydrogeology
    - EARTH 460 Geophysical Data Analysis
    - EARTH 461 Near-Surface Geophysics
    - ENVE 383 Advanced Hydrology and Hydraulics

Soil, Rock and Structures Specialization

The Soil, Rock and Structures Specialization requires:

- CIVE 205 Solid Mechanics 2
- A minimum of three TEs from the list below
    - CIVE 303 Structural Analysis
    - CIVE 306 Solid Mechanics 3
    - CIVE 310 Introduction to Structural Design
    - CIVE 422 Finite Element Analysis or ME 559 Finite Element Methods
    - CIVE 542 Pavement Structural Design
    - EARTH 435 Advanced Structural Geology
    - ENVE 383 Advanced Hydrology and Hydraulics

6.10 Management Engineering

Rationale:

Remove existing paragraph that explains how Faculty-level CSE rules are satisfied since the Faculty-level CSE rules are being removed. There are no changes to CSE requirements (students still have to take one List A CSE course).

A few small editorial changes to improve clarity.

Management Engineering	MARK UP

The Management Engineering Academic Curriculum

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- CHE 102 Chemistry for Engineers ~~(3 LEC,2 TUT)~~
- MSCI 100 Management Engineering Concepts ~~(3 LEC,2 TUT,3 LAB)~~
- MATH 115 Linear Algebra for Engineering ~~(3 LEC,2 TUT)~~
- MATH 116 Calculus 1 for Engineering ~~(3 LEC,2 TUT)~~
- PHYS 115 Mechanics ~~(3 LEC,2 TUT)~~

Term 1B (Winter)

- ENGL 192/SPCOM 192 Communication in the Engineering Profession ~~(3 LEC)~~
- GENE 123 Electrical Circuits and Instrumentation ~~(3 LEC,1 TUT,1.5 LAB)~~
- MSCI 100B Seminar ~~(1 LEC)~~
- MSCI 121 Introduction to Computer Programming ~~(3 LEC,2 TUT)~~
- MSCI 131 Work Design and Facilities Planning ~~(3 LEC,1 TUT,1.5 LAB)~~
- MATH 118 Calculus 2 for Engineering ~~(3 LEC,2 TUT)~~
- PHYS 125 Physics for Engineers ~~(3 LEC,2 TUT)~~

Term 2A (Fall)

- MSCI 200A Seminar ~~(1 LEC)~~
- MSCI 240 Algorithms and Data Structures ~~(3 LEC,1 TUT)~~
- MSCI 251 Probability and Statistics 1 ~~(3 LEC,1 TUT,1.5 LAB)~~
- MSCI 261 Engineering Economics: Financial Management for Engineers ~~(3 LEC,1 TUT)~~
- MSCI 271 Advanced Calculus and Numerical Methods ~~(3 LEC,2 TUT)~~
- Natural Science Elective (see Note 4)

Term 2B (Spring)

- MSCI 200B Seminar ~~(1 LEC)~~
- MSCI 245 Databases and Software Design ~~(3 LEC,1 TUT,1.5 LAB)~~
- MSCI 253 Probability and Statistics 2 ~~(3 LEC,1 TUT, 1.5 LAB)~~
- MSCI 263 Managerial Economics ~~(3 LEC,1 TUT)~~
- MSCI 331 Introduction to Optimization ~~(3 LEC,1 TUT)~~
- Natural Science Elective (see Note 4)

Term 3A (Winter)

- MSCI 211 Organizational Behaviour ~~(3 LEC)~~
- MSCI 300A Seminar ~~(1 LEC)~~
- MSCI 334 Operations Planning and Inventory Control ~~(3 LEC,1 TUT,1.5 LAB)~~
- MSCI 342 Principles of Software Engineering ~~(3 LEC,3 LAB)~~
- MSCI 391 Work-term Report
- MSCI 431 Stochastic Models and Methods ~~(3 LEC,1 TUT)~~
- Elective

Term 3B (Fall)

- MSCI 300B Seminar ~~(1 LEC)~~
- MSCI 302 Engineering Design Methods ~~(3 LEC,1 LAB)~~
- MSCI 332 Deterministic Optimization Models and Methods ~~(3 LEC,1 TUT)~~
- MSCI 333 Simulation Analysis and Design ~~(3 LEC,1 TUT,1.5 LAB)~~
- MSCI 343 Human-Computer Interaction ~~(3 LEC,1 TUT,1.5 LAB)~~
- MSCI 392 Work-term Report
- Elective

Term 4A (Spring)

- MSCI 400A Seminar ~~(1 LEC)~~
- MSCI 401 Management Engineering Design Project 1 ~~(3 LEC,3 PRJ)~~
- MSCI 434 Supply Chain Management ~~(3 LEC,1 TUT,1.5 LAB)~~
- MSCI 436 Decision Support Systems ~~(3 LEC,1 TUT)~~
- MSCI 491 Work-term Report
- Two electives

Term 4B (Winter)

- MSCI 311 Organizational Design and Technology ~~(3 LEC)~~
- MSCI 400B Seminar ~~(1 LEC)~~

- MSCI 402 Management Engineering Design Project 2 ~~(3 LEC,3 PRJ)~~
- Three electives

Notes

1. MSCI 401 and MSCI 402 may be replaced by GENE 403 and GENE 404.
2. Some of the elective courses have prerequisites that are not met by core courses in Management Engineering; see their course descriptions in the current Calendar before planning elective choices.
3. Course offerings may vary from term to term; check course offerings before planning elective choices.
4. If a student cannot find a natural science elective for this term, they may take another course towards their degree requirements with the permission of their academic advisor. Taking another course does not reduce the requirement of two natural science electives.

Rules Restricting Choice of the Nine Elective Courses

1. Six of the nine electives must be from the list of approved technical electives (see below). Students can count other Engineering courses towards this requirement subject to associate chair approval.
2. One of the nine electives must be from List A of the Complementary Studies ~~Requirements~~ **Course Lists for Engineering** ~~Students~~, (i.e., a course on the impact of technology **and/or engineering** on society).
3. Two of the nine electives must be from the list of approved natural science electives (see below). Students can count other natural science courses towards this requirement subject to associate chair approval.

Technical Electives ~~with Large Engineering Science and Design Content~~

~~**Note:** F=fall term, W=winter term, S=spring term~~

Six courses from the following list:

- MSCI 433 Applications of Management Engineering ~~(W)~~
- MSCI 435 Advanced Optimization Techniques ~~(W)~~
- MSCI 446 Introduction to Machine Learning ~~(W)~~
- MSCI 452 Decision Making Under Uncertainty ~~(S)~~
- MSCI 531 Stochastic Processes and Decision Making ~~(S)~~
- MSCI 541 Search Engines ~~(F)~~
- MSCI 543 Analytics and User Experience ~~(S)~~
- MSCI 546 Advanced Machine Learning ~~(W)~~
- MSCI 551 Quality Management and Control ~~(F)~~
- MSCI 555 Scheduling: Theory and Practice ~~(W)~~
- MSCI 598 Special Topics in Management Engineering ~~(F,W,S)~~

~~Complementary Studies Electives~~

~~All Engineering students are required to take complementary studies electives (CSEs) as described in Complementary Studies Requirements for Engineering Students. Most of these requirements are satisfied in the core curriculum: ENGL 192 or SPCOM 192, MSCI 211, MSCI 261, MSCI 263, MSCI 311, together with satisfactory evaluations on three work-term reports. The requirement for studies on the impact of~~

~~technology on society is met by rule 2.~~

Natural Science Electives

Two courses from **the following list** ~~this list of natural science courses~~:

- BIOL 110, BIOL 120, BIOL 130, BIOL 150, BIOL 165, BIOL 211, BIOL 239, BIOL 240, BIOL 273
- CHE 161
- CHEM 262
- EARTH 121, EARTH 122, EARTH 123, EARTH 221
- ENVS 200
- PHYS 124, PHYS 175, PHYS 233, PHYS 275
- PSYCH 207, PSYCH 261
- SCI 238, SCI 250

Professional Development Courses

Professional development (PD) courses are required as described in the BASc and BSE Specific Degree Requirements section on Work Terms. Management Engineering students are also required to take PD 11 Processes for Technical Report Writing and PD 22 Professionalism and Ethics in Engineering Practice. These courses replace two of the PD electives such that for Management Engineering students, PD 11 and PD 22 are additional core PD courses, and the number of PD electives required is reduced by two. Management Engineering students are automatically enrolled in the required core PD courses, PD 11 and PD 22, but must enrol in the elective.

Management Engineering CLEAN COPY

The Management Engineering Academic Curriculum

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- CHE 102 Chemistry for Engineers
- MSCI 100 Management Engineering Concepts
- MATH 115 Linear Algebra for Engineering
- MATH 116 Calculus 1 for Engineering
- PHYS 115 Mechanics

Term 1B (Winter)

- ENGL 192/SPCOM 192 Communication in the Engineering Profession
- GENE 123 Electrical Circuits and Instrumentation
- MSCI 100B Seminar
- MSCI 121 Introduction to Computer Programming
- MSCI 131 Work Design and Facilities Planning
- MATH 118 Calculus 2 for Engineering

- PHYS 125 Physics for Engineers

Term 2A (Fall)

- MSCI 200A Seminar
- MSCI 240 Algorithms and Data Structures
- MSCI 251 Probability and Statistics 1
- MSCI 261 Engineering Economics: Financial Management for Engineers
- MSCI 271 Advanced Calculus and Numerical Methods
- Natural Science Elective (see Note 4)

Term 2B (Spring)

- MSCI 200B Seminar
- MSCI 245 Databases and Software Design
- MSCI 253 Probability and Statistics 2
- MSCI 263 Managerial Economics
- MSCI 331 Introduction to Optimization
- Natural Science Elective (see Note 4)

Term 3A (Winter)

- MSCI 211 Organizational Behaviour
- MSCI 300A Seminar
- MSCI 334 Operations Planning and Inventory Control
- MSCI 342 Principles of Software Engineering
- MSCI 391 Work-term Report
- MSCI 431 Stochastic Models and Methods
- Elective

Term 3B (Fall)

- MSCI 300B Seminar
- MSCI 302 Engineering Design Methods
- MSCI 332 Deterministic Optimization Models and Methods
- MSCI 333 Simulation Analysis and Design
- MSCI 343 Human-Computer Interaction
- MSCI 392 Work-term Report
- Elective

Term 4A (Spring)

- MSCI 400A Seminar
- MSCI 401 Management Engineering Design Project 1
- MSCI 434 Supply Chain Management
- MSCI 436 Decision Support Systems
- MSCI 491 Work-term Report
- Two electives

Term 4B (Winter)

- MSCI 311 Organizational Design and Technology
- MSCI 400B Seminar
- MSCI 402 Management Engineering Design Project 2
- Three electives

Notes

1. MSCI 401 and MSCI 402 may be replaced by GENE 403 and GENE 404.
2. Some of the elective courses have prerequisites that are not met by core courses in Management Engineering; see their course descriptions in the current Calendar before planning elective choices.
3. Course offerings may vary from term to term; check course offerings before planning elective choices.
4. If a student cannot find a natural science elective for this term, they may take another course towards their degree requirements with the permission of their academic advisor. Taking another course does not reduce the requirement of two natural science electives.

Rules Restricting Choice of the Nine Elective Courses

1. Six of the nine electives must be from the list of approved technical electives (see below). Students can count other Engineering courses towards this requirement subject to associate chair approval.
2. One of the nine electives must be from List A of the Complementary Studies Course Lists for Engineering, (i.e., a course on the impact of technology and/or engineering on society).
3. Two of the nine electives must be from the list of approved natural science electives (see below). Students can count other natural science courses towards this requirement subject to associate chair approval.

Technical Electives

Six courses from the following list:

- MSCI 433 Applications of Management Engineering
- MSCI 435 Advanced Optimization Techniques
- MSCI 446 Introduction to Machine Learning
- MSCI 452 Decision Making Under Uncertainty
- MSCI 531 Stochastic Processes and Decision Making
- MSCI 541 Search Engines

- MSCI 543 Analytics and User Experience
- MSCI 546 Advanced Machine Learning
- MSCI 551 Quality Management and Control
- MSCI 555 Scheduling: Theory and Practice
- MSCI 598 Special Topics in Management Engineering

Natural Science Electives

Two courses from the following list:

- BIOL 110, BIOL 120, BIOL 130, BIOL 150, BIOL 165, BIOL 211, BIOL 239, BIOL 240, BIOL 273
- CHE 161
- CHEM 262
- EARTH 121, EARTH 122, EARTH 123, EARTH 221
- ENVS 200
- PHYS 124, PHYS 175, PHYS 233, PHYS 275
- PSYCH 207, PSYCH 261
- SCI 238, SCI 250

Professional Development Courses

Professional development (PD) courses are required as described in the BASc and BSE Specific Degree Requirements section on Work Terms. Management Engineering students are also required to take PD 11 Processes for Technical Report Writing and PD 22 Professionalism and Ethics in Engineering Practice. These courses replace two of the PD electives such that for Management Engineering students, PD 11 and PD 22 are additional core PD courses, and the number of PD electives required is reduced by two. Management Engineering students are automatically enrolled in the required core PD courses, PD 11 and PD 22, but must enrol in the elective.

6.11 Mechanical Engineering

Rationale:

Update program rules for Complementary Studies Electives due to removal of Faculty-level rules. The changes will increase flexibility for students.

Course lists now follow the standard calendar format, including course titles.

Reword the Technical Electives section to clarify requirements.

Make it more explicit that there are PD and work report requirements. A new ethics requirement is being introduced.

In lieu of ME481 and ME482 students may choose MTE 481 and 482 if they are pursuing the Mechatronics Option, or GENE 403 and GENE 404 if they are participating in a multi-disciplinary design project.

Include special topics courses within each TE theme group. (Each special topics course will be restricted to special topics in the associated theme area.)

Simplify the description of the Welding and Joining Specialization

Mechanical Engineering	MARK UP

The Mechanical Engineering Academic Curriculum

The Mechanical Engineering undergraduate curriculum contains a core of basic subjects that must be taken by all students. The second and third years provide courses in mechanical engineering and electrical engineering with further development in mathematics and physics. In fourth year, a significant two-term capstone design project will be undertaken that will facilitate and promote integration of the knowledge and skills acquired in previous years of study and development of project management skills. Opportunities for more in-depth study in theme areas exist during the fourth year, where a choice of technical elective courses arranged into five different theme areas of expertise is available. Students may also choose to take the Welding and Joining Specialization. ~~Five~~ **Four** required non-technical Complementary Studies Elective (CSE) courses are distributed throughout the curriculum but do not appear in all terms.

~~The following is the Mechanical Engineering core curriculum, excluding first year.~~

~~Credit Courses~~

- ~~ME 201 Advanced Calculus~~
- ~~ME 202 Statistics for Engineers~~
- ~~ME 203 Ordinary Differential Equations~~
- ~~ME 212 Dynamics~~
- ~~ME 219 Mechanics of Deformable Solids 1~~
- ~~ME 220 Mechanics of Deformable Solids 2~~
- ~~ME 230 Control of Properties of Materials~~
- ~~ME 250 Thermodynamics 1~~
- ~~ME 262 Introduction to Microprocessors and Digital Logic~~
- ~~ME 269 Electromechanical Devices and Power Processing~~
- ~~ME 303 Advanced Engineering Mathematics~~
- ~~ME 321 Kinematics and Dynamics of Machines~~

- ~~ME 322 Mechanical Design 1~~
- ~~ME 340 Manufacturing Processes~~
- ~~ME 351 Fluid Mechanics 1~~
- ~~ME 353 Heat Transfer 1~~
- ~~ME 354 Thermodynamics 2~~
- ~~ME 360 Introduction to Control Systems~~
- ~~ME 362 Fluid Mechanics 2~~
- ~~ME 380 Mechanical Engineering Design Workshop~~
- ~~ME 481 Mechanical Engineering Design Project 1~~
- ~~ME 482 Mechanical Engineering Design Project 2~~

~~Non-Credit Courses~~

- ~~ME 200A and ME 200B Seminar~~
- ~~ME 300A and ME 300B Seminar~~
- ~~ME 400A and ME 400B Seminar~~

~~Note~~

~~In fourth year, a two-term Mechanical Engineering capstone design project must be undertaken under the auspices of ME 481 in the 4A term and ME 482 in the 4B term. This project may include involvement in either an inter-varsity student design competition team, or small group design project of the student's choosing.~~

~~Term-by-Term Curriculum~~

- ~~Term 1A (Fall):~~
  - ~~CHE 102, MATH 115, MATH 116, ME 100, PHYS 115~~
- ~~Term 1B (Winter/Spring):~~
  - ~~MATH 118, ME 100B, ME 101, ME 115, ME 123~~
  - ~~One CSE~~
- ~~Term 2A (Fall/Winter):~~
  - ~~ME 200A, ME 201, ME 202, ME 219, ME 230, ME 269~~
  - ~~One CSE~~
  - ~~WKRPT 100 (stream 4)~~
- ~~Term 2B (Fall/Spring):~~
  - ~~ME 200B, ME 203, ME 212, ME 220, ME 250, ME 262~~
  - ~~WKRPT 100 (stream 8) or WKRPT 200 (stream 4)~~
- ~~Term 3A (Winter/Spring):~~
  - ~~ME 300A, ME 303, ME 321, ME 340, ME 351, ME 354~~
  - ~~WKRPT 200 (stream 8) or WKRPT 300 (stream 4)~~
- ~~Term 3B (Fall/Winter):~~
  - ~~ME 300B, ME 322, ME 353, ME 360, ME 362, ME 380~~
  - ~~MSCI 261 or, if taken in Term 1B, one CSE~~
  - ~~WKRPT 300 (stream 8)~~
- ~~Term 4A (Fall/Spring):~~
  - ~~ME 400A, ME 481~~
  - ~~Three Technical Electives~~
  - ~~One CSE~~
- ~~Term 4B (Winter):~~

- ~~ME 400B, ME 482~~
- ~~Four Technical Electives~~
- ~~One CSE~~

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- **CHE 102 Chemistry for Engineers**
- **MATH 115 Linear Algebra for Engineering**
- **MATH 116 Calculus 1 for Engineering**
- **ME 100 Introduction to Mechanical Engineering Practice 1**
- **PHYS 115 Mechanics**

Term 1B (Winter Stream 8/Spring Stream 4)

- **MATH 118 Calculus 2 for Engineering**
- **ME 100B Seminar**
- **ME 101 Introduction to Mechanical Engineering Practice 2**
- **ME 115 Structure and Properties of Materials**
- **ME 123 Electrical Engineering for Mechanical Engineers**
- **One CSE**

Term 2A (Fall Stream 8/ Winter Stream 4)

- **ME 200A Seminar**
- **ME 201 Advanced Calculus**
- **ME 202 Statistics for Engineers**
- **ME 219 Mechanics of Deformable Solids 1**
- **ME 230 Control of Properties of Materials**
- **ME 269 Electromechanical Devices and Power Processing**
- **One CSE**
- **WKRPT 100 (stream 4)**

Term 2B (Fall Stream 4/Spring Stream 8)

- **ME 200B Seminar**
- **ME 203 Ordinary Differential Equations**
- **ME 212 Dynamics**
- **ME 220 Mechanics of Deformable Solids 2**
- **ME 250 Thermodynamics 1**
- **ME 262 Introduction to Microprocessors and Digital Logic**

- WKRPT 100 (stream 8) or WKRPT 200 (stream 4)

Term 3A (Winter Stream 8/Spring Stream 4)

- ME 300A Seminar
- ME 303 Advanced Engineering Mathematics
- ME 321 Kinematics and Dynamics of Machines
- ME 340 Manufacturing Processes
- ME 351 Fluid Mechanics 1
- ME 354 Thermodynamics 2
- WKRPT 200 (stream 8) or WKRPT 300 (stream 4)

Term 3B (Fall Stream 8/Winter Stream 4)

- ME 300B Seminar
- ME 322 Mechanical Design 1
- ME 353 Heat Transfer 1
- ME 360 Introduction to Control Systems
- ME 362 Fluid Mechanics 2
- ME 380 Mechanical Engineering Design Workshop
- MSCI 261 Engineering Economics: Financial Management for Engineers
- WKRPT 300 (stream 8)

Term 4A (Fall Stream 4/Spring Stream 8)

- ME 400A Seminar
- ME 481 Mechanical Engineering Design Project 1
- Three or four Technical Electives
- One CSE

Term 4B (Winter)

- ME 400B Seminar
- ME 482 Mechanical Engineering Design Project 2
- Four or three Technical Electives
- One CSE

Note: The course load in 4A and 4B is five and six courses or six and five courses, respectively.

Non-Credit Courses

- **ME 100B Seminar**
- **ME 200A and ME 200B Seminar**
- **ME 300A and ME 300B Seminar**
- **ME 400A and ME 400B Seminar**

Capstone Design Project

In fourth year, a two-term Mechanical Engineering capstone design project must be undertaken under the auspices of ME 481 in the 4A term and ME 482 in the 4B term. This project may include involvement in either an inter-varsity student design competition team, or small group design project of the student's choosing. **In lieu of ME 481 and ME 482, students may take MTE 481 and MTE 482 if they are pursuing the Mechatronics Option or GENE 403 and GENE 404 if they are part of a multi-disciplinary design project.**

Work Reports

Work reports are based on work-term experience and are intended to develop skills in technical report writing. Three work-term reports are required – WKRPT 100, WKRPT 200, and WKRPT 300. Further information on work-term reports can be found in the section on Examinations and Promotions.

Professional Development

Professional development courses are required as described in the BASc and BSE Specific Degree Requirements section on Work Terms.

Ethics Requirement

To meet the Ethics Requirement, students must pass one of PD 22 or PHIL 315. PD 22 will fulfil one of the PD requirements while PHIL 315 will fulfil one of the List C CSE requirements.

Electives

Complementary Studies Electives

~~All Engineering students are required to take complementary studies electives (CSEs), as described in Complementary Studies Requirements for Engineering Students. Students entering this plan will take MSCI 261 - Engineering Economics: Financial Management for Engineers (a List B CSE course) plus four Complementary Studies Elective courses in other non-technical subjects. The grades obtained in these courses will be included in the calculation of term averages. Credit for an additional complementary studies elective is earned by obtaining satisfactory evaluations for the required work-term reports. These reports are based on work-term experience and are intended to develop skill in technical report writing; further information on work-term reports can be found in the section on Examinations and Promotions.~~ **Beyond the core courses, mechanical engineering students must take four additional complementary studies elective courses. Eligible courses are given on the Complementary Studies Course Lists for Engineering Students. One course must be chosen from List A (Impact of Technology and/or Engineering on Society), one from List C (Humanities and Social Sciences, excluding courses concentrated on development of language or other skills), and each of the remaining two courses from any of Lists A, C, or D (Humanities and Social Sciences, courses concentrated on development of language or other skills). The grades obtained in these**

courses will be included in the calculation of term averages.

Technical Electives

Seven technical electives (TEs) are required in addition to the core courses listed above to fulfil the requirements of the Mechanical Engineering curriculum. **A minimum of four of the seven TEs must be 400 or 500-level ME or MTE technical elective courses. A maximum of three TEs can be 400 or 500-level TEs from other University of Waterloo engineering plans or a graduate-level course as discussed below. Students may require instructor and department permission to enrol in courses from another department. Technical electives may have prerequisites that have to be taken first. Some 400 and 500-level courses are not TEs but are CSEs. Courses listed as a CSE cannot be counted towards the TE requirement.**

~~It is possible to combine courses from different theme areas or specialization, to take courses from other departments, and in some circumstances to take graduate-level courses. Students who are contemplating graduate study are particularly urged to discuss their study plans with a faculty member.~~

Mechanical Engineering technical electives are grouped into five different themes: Automation and Control, Fluid Mechanics, Machine Design and Solid Mechanics, Materials Engineering and Processing, and Thermal Engineering. It is possible to combine courses from different theme areas. Students are responsible for selecting their own combination of electives, in keeping with their ultimate career objective after graduation. To assist in ensuring that course selections satisfy all academic requirements, students ~~(as well as students who have an unusual career goal in mind)~~ are encouraged to discuss and obtain approval ~~by~~ **from** the Department of Mechanical **and Mechatronics** Engineering's undergraduate advisor and/or the associate chair. ~~Students may take any desired combination of technical electives or they may take a majority of their technical electives from one of the theme areas or specialization listed below.~~

~~As a guide, typical lists of technical elective courses for the five theme areas and the Welding and Joining Specialization within the Department of Mechanical and Mechatronics Engineering are given below. Students may take any desired combination of technical electives or they may choose to take a majority of their technical electives from one of the theme areas or specialization. Note that undergraduate students who complete the basic courses in each theme area or the Welding and Joining Specialization (see below) will be permitted and encouraged to take relevant Mechanical Engineering graduate courses in that area.~~

Students who are contemplating graduate studies, or who complete the majority of their TEs from one theme, or who complete the Welding and Joining Specialization, can request permission to take a graduate-level course. It is recommended that students discuss their study plans with a faculty member.

Automation and Control

- ME 435 Industrial Metallurgy
- ME 538 Welding Design, Fabrication and Quality Control
- **ME 540 Fundamentals in Neural and Rehabilitation Engineering**
- ME 547 Robot Manipulators: Kinematics, Dynamics, Control
- ME 548 Numerical Control of Machine Tools 1
- ME 555 Computer-Aided Design
- ME 559 Finite Element Methods
- ME 561 Fluid Power Control Systems

- **ME 597 Special Topics in Mechanical Engineering**

Fluid Mechanics

- ME 562 Experimental Methods in Fluids
- ME 563 Turbomachines
- ME 564 Aerodynamics
- ME 566 Computational Fluid Dynamics for Engineering Design
- ME 567 Fire Safety Engineering
- ME 571 Air Pollution
- **ME 595 Special Topics in Mechanical Engineering**

Machine Design and Solid Mechanics

- ME 423 Mechanical Design 2
- ME 435 Industrial Metallurgy
- ME 524 Advanced Dynamics and Vibrations
- ME 526 Fatigue and Fracture Analysis
- ME 538 Welding Design, Fabrication and Quality Control
- ME 555 Computer-Aided Design
- ME 559 Finite Element Methods
- ME 574 Engineering Biomechanics
- **ME 598 Special Topics in Mechanical Engineering**

Materials Engineering and Processing

- ME 435 Industrial Metallurgy
- ME 436 Welding and Joining Processes
- ME 526 Fatigue and Fracture Analysis
- ME 531 Physical Metallurgy Applied to Manufacturing
- ME 533 Non-metallic and Composite Materials
- ME 535 Welding Metallurgy
- ME 538 Welding Design, Fabrication and Quality Control
- **ME 596 Special Topics in Mechanical Engineering**

Thermal Engineering

- ME 452 HVAC Load Analysis and Design Fundamentals
- ME 456 Heat Transfer 2
- ME 459 Energy Conversion
- ME 557 Combustion 1
- ME 559 Finite Element Methods
- ME 567 Fire Safety Engineering
- ME 571 Air Pollution
- ME 572 Building Energy Analysis
- ME 573 HVAC Systems, Equipment, and Energy Efficiency
- **ME 599 Special Topics in Mechanical Engineering**

Welding and Joining Specialization

Students may also choose to take the Welding and Joining Specialization. ~~The normal sequence of~~

~~courses for this specialization is outlined below. Only Mechanical Engineering students may take the Welding and Joining Specialization.~~ **This specialization is restricted to Mechanical Engineering students only.** To earn the Welding and Joining Specialization designation, students must take five specific technical electives in their 4A and 4B terms **as part of the required TE and CSE load**:

- **Term 4A (Fall/Spring):** ME 435, ME 436
- **Term 4B (Winter):** ME 526, ME 535, ME 538

A minimum average of 60% in the five specialization courses and a minimum grade of 50% in each of the five courses is required. For students that take and meet the specialization requirements, the credential is recognized on both the diploma and the transcript.

~~**Specialization Sequence**~~

- ~~Term 4A (Fall/Spring): ME 400A, ME 481, ME 435, ME 436, TE, one CSE~~
- ~~Term 4B (Winter): ME 400B, ME 482, ME 526, ME 535, ME 538, TE, one CSE~~

Mechanical Engineering CLEAN COPY

The Mechanical Engineering Academic Curriculum

The Mechanical Engineering undergraduate curriculum contains a core of basic subjects that must be taken by all students. The second and third years provide courses in mechanical engineering and electrical engineering with further development in mathematics and physics. In fourth year, a significant two-term capstone design project will be undertaken that will facilitate and promote integration of the knowledge and skills acquired in previous years of study and development of project management skills. Opportunities for more in-depth study in theme areas exist during the fourth year, where a choice of technical elective courses arranged into five different theme areas of expertise is available. Students may also choose to take the Welding and Joining Specialization. Four required non-technical Complementary Studies Elective (CSE) courses are distributed throughout the curriculum but do not appear in all terms.

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- CHE 102 Chemistry for Engineers
- MATH 115 Linear Algebra for Engineering
- MATH 116 Calculus 1 for Engineering
- ME 100 Introduction to Mechanical Engineering Practice 1
- PHYS 115 Mechanics

Term 1B (Winter Stream 8/Spring Stream 4)

- MATH 118 Calculus 2 for Engineering
- ME 100B Seminar
- ME 101 Introduction to Mechanical Engineering Practice 2
- ME 115 Structure and Properties of Materials

- ME 123 Electrical Engineering for Mechanical Engineers
- One CSE

Term 2A (Fall Stream 8/Winter Stream 4)

- ME 200A Seminar
- ME 201 Advanced Calculus
- ME 202 Statistics for Engineers
- ME 219 Mechanics of Deformable Solids 1
- ME 230 Control of Properties of Materials
- ME 269 Electromechanical Devices and Power Processing
- One CSE
- WKRPT 100 (stream 4)

Term 2B (Fall Stream 4/Spring Stream 8)

- ME 200B Seminar
- ME 203 Ordinary Differential Equations
- ME 212 Dynamics
- ME 220 Mechanics of Deformable Solids 2
- ME 250 Thermodynamics 1
- ME 262 Introduction to Microprocessors and Digital Logic
- WKRPT 100 (stream 8) or WKRPT 200 (stream 4)

Term 3A (Winter Stream 8/Spring Stream 4)

- ME 300A Seminar
- ME 303 Advanced Engineering Mathematics
- ME 321 Kinematics and Dynamics of Machines
- ME 340 Manufacturing Processes
- ME 351 Fluid Mechanics 1
- ME 354 Thermodynamics 2
- WKRPT 200 (stream 8) or WKRPT 300 (stream 4)

Term 3B (Fall Stream 8/Winter Stream 4)

- ME 300B Seminar
- ME 322 Mechanical Design 1
- ME 353 Heat Transfer 1
- ME 360 Introduction to Control Systems
- ME 362 Fluid Mechanics 2
- ME 380 Mechanical Engineering Design Workshop
- MSCI 261 Engineering Economics: Financial Management for Engineers

- WKRPT 300 (stream 8)

Term 4A (Fall Stream 4/Spring Stream 8)

- ME 400A Seminar
- ME 481 Mechanical Engineering Design Project 1
- Three or four Technical Electives
- One CSE

Term 4B (Winter)

- ME 400B Seminar
- ME 482 Mechanical Engineering Design Project 2
- Four or three Technical Electives
- One CSE

Note: The course load in 4A and 4B is five and six courses or six and five courses, respectively.

Non-Credit Courses

- ME 100B Seminar
- ME 200A and ME 200B Seminar
- ME 300A and ME 300B Seminar
- ME 400A and ME 400B Seminar

Capstone Design Project

In fourth year, a two-term Mechanical Engineering capstone design project must be undertaken under the auspices of ME 481 in the 4A term and ME 482 in the 4B term. This project may include involvement in either an inter-varsity student design competition team, or small group design project of the student's choosing. In lieu of ME 481 and ME 482, students may take MTE 481 and MTE 482 if they are pursuing the Mechatronics Option or GENE 403 and GENE 404 if they are part of a multi-disciplinary design project.

Work Reports

Work reports are based on work-term experience and are intended to develop skills in technical report writing. Three work-term reports are required – WKRPT 100, WKRPT 200, and WKRPT 300. Further information on work-term reports can be found in the section on Examinations and Promotions.

Professional Development

Professional development courses are required as described in the BASc and BSE Specific Degree Requirements section on Work Terms.

Ethics Requirement

To meet the Ethics Requirement, students must pass one of PD 22 or PHIL 315. PD 22 will fulfil one of the PD requirements while PHIL 315 will fulfil one of the List C CSE requirements.

Electives

Complementary Studies Electives

Beyond the core courses, mechanical engineering students must take four additional complementary studies elective courses. Eligible courses are given on the Complementary Studies Course Lists for Engineering Students. One course must be chosen from List A (Impact of Technology and/or Engineering on Society), one from List C (Humanities and Social Sciences, excluding courses concentrated on development of language or other skills), and each of the remaining two courses from any of Lists A, C, or D (Humanities and Social Sciences, courses concentrated on development of language or other skills). The grades obtained in these courses will be included in the calculation of term averages.

Technical Electives

Seven technical electives (TEs) are required in addition to the core courses listed above to fulfil the requirements of the Mechanical Engineering curriculum. A minimum of four of the seven TEs must be 400 or 500-level ME or MTE technical elective courses. A maximum of three TEs can be 400 or 500-level TEs from other University of Waterloo engineering plans or a graduate-level course as discussed below. Students may require instructor and department permission to enrol in courses from another department. Technical electives may have prerequisites that have to be taken first. Some 400 and 500-level courses are not TEs but are CSEs. Courses listed as a CSE cannot be counted towards the TE requirement.

Mechanical Engineering technical electives are grouped into five different themes: Automation and Control, Fluid Mechanics, Machine Design and Solid Mechanics, Materials Engineering and Processing, and Thermal Engineering. It is possible to combine courses from different theme areas. Students are responsible for selecting their own combination of electives, in keeping with their ultimate career objective after graduation. To assist in ensuring that course selections satisfy all academic requirements, students are encouraged to discuss and obtain approval from the Department of Mechanical and Mechatronics Engineering's undergraduate advisor and/or the associate chair.

Students who are contemplating graduate studies, or who complete the majority of their TEs from one theme, or who complete the Welding and Joining Specialization, can request permission to take a graduate-level course. It is recommended that students discuss their study plans with a faculty member.

Automation and Control

- ME 435 Industrial Metallurgy
- ME 538 Welding Design, Fabrication and Quality Control
- ME 540 Fundamentals in Neural and Rehabilitation Engineering
- ME 547 Robot Manipulators: Kinematics, Dynamics, Control
- ME 548 Numerical Control of Machine Tools 1
- ME 555 Computer-Aided Design
- ME 559 Finite Element Methods
- ME 561 Fluid Power Control Systems
- ME 597 Special Topics in Mechanical Engineering

Fluid Mechanics

- ME 562 Experimental Methods in Fluids
- ME 563 Turbomachines
- ME 564 Aerodynamics
- ME 566 Computational Fluid Dynamics for Engineering Design
- ME 567 Fire Safety Engineering
- ME 571 Air Pollution
- ME 595 Special Topics in Mechanical Engineering

Machine Design and Solid Mechanics

- ME 423 Mechanical Design 2
- ME 435 Industrial Metallurgy
- ME 524 Advanced Dynamics and Vibrations
- ME 526 Fatigue and Fracture Analysis
- ME 538 Welding Design, Fabrication and Quality Control
- ME 555 Computer-Aided Design
- ME 559 Finite Element Methods
- ME 574 Engineering Biomechanics
- ME 598 Special Topics in Mechanical Engineering

Materials Engineering and Processing

- ME 435 Industrial Metallurgy
- ME 436 Welding and Joining Processes
- ME 526 Fatigue and Fracture Analysis
- ME 531 Physical Metallurgy Applied to Manufacturing
- ME 533 Non-metallic and Composite Materials
- ME 535 Welding Metallurgy
- ME 538 Welding Design, Fabrication and Quality Control
- ME 596 Special Topics in Mechanical Engineering

Thermal Engineering

- ME 452 HVAC Load Analysis and Design Fundamentals
- ME 456 Heat Transfer 2
- ME 459 Energy Conversion
- ME 557 Combustion 1
- ME 559 Finite Element Methods
- ME 567 Fire Safety Engineering
- ME 571 Air Pollution
- ME 572 Building Energy Analysis
- ME 573 HVAC Systems, Equipment, and Energy Efficiency
- ME 599 Special Topics in Mechanical Engineering

Welding and Joining Specialization

Students may also choose to take the Welding and Joining Specialization. This specialization is restricted to Mechanical Engineering students only. To earn the Welding and Joining Specialization designation, students must take five specific technical electives in their 4A and 4B terms as part of the required course load:

- Term 4A (Fall/Spring): ME 435, ME 436
- Term 4B (Winter): ME 526, ME 535, ME 538

A minimum average of 60% in the five specialization courses and a minimum grade of 50% in each of the five courses is required. For students that take and meet the specialization requirements, the credential is recognized on both the diploma and the transcript.

6.12 Mechatronics Engineering

Rationale:

Update rules for Complementary Studies Electives due to the removal of Faculty-level rules. The program will increase flexibility by requiring one course from List C (Humanities and Social Sciences), whereas previously the Faculty required two.

Add ethics requirement to plan. This change adds an ethics requirement that is in line with other Faculty of Engineering programs: students must pass one of PD 22 or PHIL 315. PD 22 fulfills one PD requirements, while PHIL 315 fulfills one List C CSE requirements.

Biomedical Engineering students have the necessary background to succeed in MTE 544, MTE 545, and MTE 546, so pre-requisites for these courses are being updated to allows these students to enroll in the courses without a course override.

Mechatronics Engineering MARK UP

The Mechatronics Engineering Academic Curriculum

~~The table below lists the courses and technical electives for Mechatronics Engineering. In addition to the courses listed, all engineering students are required to take complementary studies courses, as described in Complementary Studies Requirements for Engineering Students. Also, see the technical elective list below.~~

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- CHE 102 Chemistry for Engineers ~~(3 LEC,2 LAB)~~
- MATH 115 Linear Algebra for Engineering ~~(3 LEC,2 LAB)~~
- MATH 116 Calculus 1 for Engineering ~~(3 LEC,2 LAB)~~
- MTE 100 Mechatronics Engineering ~~(3 LEC,2 TUT,4 LAB)~~
- MTE 121 Digital Computation ~~(3 LEC,2 TUT)~~

Term 1B (Spring Stream 4/Winter Stream 8X)

- MATH 118 Calculus 2 For Engineering ~~(3 LEC,2 LAB)~~
- MTE 100B Seminar ~~(1 SEM)~~
- MTE 111 Structure and Properties of Materials ~~(3 LEC,3 TUT,3 LAB)~~
- MTE 119 Statics ~~(3 LEC,1 TUT)~~
- MTE 120 Circuits ~~(4 LEC,2 TUT,1.5 LAB)~~
- MTE 140 Algorithms and Data Structures ~~(3 LEC,1 TUT,1.5 LAB)~~

Term 2A (Winter Stream 4/Fall Stream 8X)

- MTE 200A Seminar ~~(3 SEM)~~
- MTE 201 Experimental Measurement & Statistical Analysis ~~(3 LEC,1 TUT,1 LAB)~~
- MTE 202 Ordinary Differential Equations ~~(3 LEC,1 TUT)~~

- MTE 219 Mechanics of Deformable Solids ~~(3 LEC,1 TUT)~~
- MTE 262 Introduction to Microprocessors and Digital Logic ~~(3 LEC,1 TUT,3 LAB)~~
- SYDE 182 ~~Physics 2 (Dynamics)~~ **Physics 2: Dynamics** ~~(3 LEC,1 TUT)~~
- CSE Complementary Studies Elective
- WKRPT 100 (stream 4) Work-term Report

Term 2B (Fall Stream 4/Spring Stream 8X)

- MTE 200B Seminar ~~(3 SEM)~~
- MTE 203 Advanced Calculus ~~(3 LEC,1 TUT,1 LAB)~~
- MTE 204 Numerical Methods ~~(3 LEC,1 TUT)~~
- MTE 220 Sensors and Instrumentation ~~(3 LEC,1 TUT,3 LAB)~~
- MTE 241 Introduction to Computer Structures & Real-Time Systems ~~(3 LEC,1 TUT,1.5 LAB)~~
- SYDE 252 Linear Systems and Signals ~~(3 LEC,1 TUT)~~
- WKRPT 100 (stream 8X) or WKRPT 200 (stream 4) Work-term Report

Term 3A (Spring Stream 4/Winter Stream 8X)

- MTE 300A Seminar ~~(3 SEM)~~
- MTE 309 Introduction to Thermodynamics and Heat Transfer ~~(3 LEC,1 TUT)~~
- MTE 320 Actuators and Power Electronics ~~(3 LEC,1 TUT,2 LAB)~~
- MTE 321 Design and Dynamics of Machines ~~(3 LEC,1 TUT)~~
- MTE 325 Microprocessor Systems and Interfacing for Mechatronics Engineering ~~(3 LEC,1 TUT,1.5 LAB)~~
- SYDE 351 Systems Models 1 ~~(3 LEC,1 TUT)~~
- WKRPT 200 (stream 8X) or WKRPT 300 (stream 4) Work-term Report

Term 3B (Winter Stream 4/Fall Stream 8X)

- MTE 300B Seminar ~~(3 SEM)~~
- ME 351 Fluid Mechanics 1 ~~(3 LEC,1 TUT,1 LAB)~~
- MTE 322 Electromechanical Machine Design ~~(3 LEC,1 TUT,2 LAB)~~
- MTE 360 Automatic Control Systems ~~(3 LEC,1 TUT,1 LAB)~~
- MTE 380 Mechatronics Engineering Design Workshop ~~(1 LEC,9 PRJ)~~
- MSCI 261 Engineering Economics: Financial Management for Engineers ~~(3 LEC,1 TUT)~~
- CSE Complementary Studies Elective
- WKRPT 300 (stream 8X) Work-term Report

Term 4A (Fall)

- ECE 484 Digital Control Applications ~~(2 LEC,1 TUT,1.5 LAB)~~
- MTE 400A Seminar ~~(1 SEM)~~
- MTE 481 Mechatronics Engineering Design Project ~~(9 PRJ)~~

- CSE Complementary Studies Elective
- Two TE Technical Electives

Term 4B (Winter)

- MTE 400B Seminar ~~(1 SEM)~~
- MTE 482 Mechatronics Engineering Project ~~(9 PRJ)~~
- CSE Complementary Studies Elective
- Three TE Technical Electives

Complementary Studies Electives

Four ~~of the five~~ complementary studies electives (CSEs) are to be chosen **from the Complementary Studies Course Lists for Engineering Students.** ~~to include at least one from List A and at least two from List C in the lists that are part of the description of Complementary Studies Requirements.~~ **One CSE must be chosen from List A, one from List C, and each of the remaining two from any of Lists A, C, or D.**

Ethics Requirement

To meet the Ethics Requirement, students must pass one of PD 22 or PHIL 315. PD 22 fulfils one PD requirement, while PHIL 315 fulfils one List C CSE requirement.

Technical Electives

The five technical electives (TEs) are to be chosen from the list below; in some cases, it may be necessary to verify that all of the prerequisites have been met. Note that courses are available in only one of the fourth-year terms. It is possible to exchange one of the fourth-year CSEs with a TE and thus have three technical electives in 4A (and two CSEs in 4B) or to have four technical electives in 4B (and two CSEs in 4A).

Courses Offered in the 4A (Fall) Term

Choose two:

- ME 362 Fluid Mechanics 2
- ME 436 Welding and Joining Processes
- ME 459 Energy Conversion
- ME 524 Advanced Dynamics and Vibrations or SYDE 553 Advanced Dynamics
- ME 548 Numerical Control of Machine Tools 1
- ME 559 Finite Element Methods
- ME 561 Fluid Power Control Systems
- MTE 420 Power Electronics and Motor Drives or ECE 463 Design & Applications of Power Electronic Converters (offered Spring)
- MTE 421 Linear and Nonlinear Electronics
- MTE 460 Mechatronic System Integration
- MTE 544 Autonomous Mobile Robots

- MTE 545 Introduction to MEMS Fabrication
- SYDE 533 Conflict Resolution
- SYDE 543 Cognitive Ergonomics
- SYDE 556 Simulating Neurobiological Systems
- SYDE 575 Image Processing
- SYDE 584 Physiological Systems and Biomedical Design

Courses Offered in the 4B (Winter) Term

Choose three:

- ECE 327 Digital Hardware Systems
- ECE 358 Computer Networks
- ECE 457B Fundamentals of Computational Intelligence
- ECE 488 Multivariable Control Systems
- ME 452 ~~Energy Transfer in Buildings~~ **HVAC Load Analysis and Design Fundamentals**
- ME 547 Robotic Manipulators: Kinematics, Dynamics, Control or ECE 486 Robotic Dynamics and Control
- ME 555 Computer-Aided Design
- ME 563 Turbomachines
- ME 564 Aerodynamics
- MTE 460 Mechatronic System Integration
- MTE 546 Multi-sensor Data Fusion
- SYDE 522 Foundations of Artificial Intelligence
- SYDE 542 Interface Design
- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 548 User Centred Design Methods
- SYDE 572 Introduction to Pattern Recognition

Mechatronics Engineering CLEAN COPY

The Mechatronics Engineering Academic Curriculum

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- CHE 102 Chemistry for Engineers
- MATH 115 Linear Algebra for Engineering
- MATH 116 Calculus 1 for Engineering
- MTE 100 Mechatronics Engineering
- MTE 121 Digital Computation

Term 1B (Spring Stream 4/Winter Stream 8X)

- MATH 118 Calculus 2 For Engineering
- MTE 100B Seminar

- MTE 111 Structure and Properties of Materials
- MTE 119 Statics
- MTE 120 Circuits
- MTE 140 Algorithms and Data Structures

Term 2A (Winter Stream 4/Fall Stream 8X)

- MTE 200A Seminar (3 SEM)
- MTE 201 Experimental Measurement & Statistical Analysis
- MTE 202 Ordinary Differential Equations
- MTE 219 Mechanics of Deformable Solids
- MTE 262 Introduction to Microprocessors and Digital Logic
- SYDE 182 Physics 2: Dynamics
- CSE Complementary Studies Elective
- WKRPT 100 (stream 4) Work-term Report

Term 2B (Fall Stream 4/Spring Stream 8X)

- MTE 200B Seminar
- MTE 203 Advanced Calculus
- MTE 204 Numerical Methods
- MTE 220 Sensors and Instrumentation
- MTE 241 Introduction to Computer Structures & Real-Time Systems
- SYDE 252 Linear Systems and Signals
- WKRPT 100 (stream 8X) or WKRPT 200 (stream 4) Work-term Report

Term 3A (Spring Stream 4/Winter Stream 8X)

- MTE 300A Seminar
- MTE 309 Introduction to Thermodynamics and Heat Transfer
- MTE 320 Actuators and Power Electronics
- MTE 321 Design and Dynamics of Machines
- MTE 325 Microprocessor Systems and Interfacing for Mechatronics Engineering
- SYDE 351 Systems Models 1
- WKRPT 200 (stream 8X) or WKRPT 300 (stream 4) Work-term Report

Term 3B (Winter Stream 4/Fall Stream 8X)

- MTE 300B Seminar
- ME 351 Fluid Mechanics 1
- MTE 322 Electromechanical Machine Design
- MTE 360 Automatic Control Systems
- MTE 380 Mechatronics Engineering Design Workshop

- MSCI 261 Engineering Economics: Financial Management for Engineers
- CSE Complementary Studies Elective
- WKRPT 300 (stream 8X) Work-term Report

Term 4A (Fall)

- ECE 484 Digital Control Applications
- MTE 400A Seminar
- MTE 481 Mechatronics Engineering Design Project
- CSE Complementary Studies Elective
- Two TE Technical Electives

Term 4B (Winter)

- MTE 400B Seminar
- MTE 482 Mechatronics Engineering Project
- CSE Complementary Studies Elective
- Three TE Technical Electives

Complementary Studies Electives

Four complementary studies electives (CSEs) are to be chosen from the Complementary Studies Course Lists for Engineering Students. One CSE must be chosen from List A, one from List C, and each of the remaining two from any of Lists A, C, or D.

Ethics Requirement

To meet the Ethics Requirement, students must pass one of PD 22 or PHIL 315. PD 22 fulfils one PD requirement, while PHIL 315 fulfils one List C CSE requirement.

Technical Electives

The five technical electives (TEs) are to be chosen from the list below; in some cases, it may be necessary to verify that all of the prerequisites have been met. Note that courses are available in only one of the fourth-year terms. It is possible to exchange one of the fourth-year CSEs with a TE and thus have three technical electives in 4A (and two CSEs in 4B) or to have four technical electives in 4B (and two CSEs in 4A).

Courses Offered in the 4A (Fall) Term

Choose two:

- ME 362 Fluid Mechanics 2
- ME 436 Welding and Joining Processes
- ME 459 Energy Conversion

- ME 524 Advanced Dynamics and Vibrations or SYDE 553 Advanced Dynamics
- ME 548 Numerical Control of Machine Tools 1
- ME 559 Finite Element Methods
- ME 561 Fluid Power Control Systems
- MTE 420 Power Electronics and Motor Drives or ECE 463 Design & Applications of Power Electronic Converters (offered Spring)
- MTE 421 Linear and Nonlinear Electronics
- MTE 460 Mechatronic System Integration
- MTE 544 Autonomous Mobile Robots
- MTE 545 Introduction to MEMS Fabrication
- SYDE 533 Conflict Resolution
- SYDE 543 Cognitive Ergonomics
- SYDE 556 Simulating Neurobiological Systems
- SYDE 575 Image Processing
- SYDE 584 Physiological Systems and Biomedical Design

Courses Offered in the 4B (Winter) Term

Choose three:

- ECE 327 Digital Hardware Systems
- ECE 358 Computer Networks
- ECE 457B Fundamentals of Computational Intelligence
- ECE 488 Multivariable Control Systems
- ME 452 HVAC Load Analysis and Design Fundamentals
- ME 547 Robotic Manipulators: Kinematics, Dynamics, Control or ECE 486 Robotic Dynamics and Control
- ME 555 Computer-Aided Design
- ME 563 Turbomachines
- ME 564 Aerodynamics
- MTE 460 Mechatronic System Integration
- MTE 546 Multi-sensor Data Fusion
- SYDE 522 Foundations of Artificial Intelligence
- SYDE 542 Interface Design
- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 548 User Centred Design Methods
- SYDE 572 Introduction to Pattern Recognition

6.13 Nanotechnology Engineering

Rationale:
Inactivate work-term report and reflective milestone and add PD courses section.
The PD courses now have embedded reflective reports (all except PD 11) making the program milestone unnecessary. Adding a PD course section to the calendar clarifies for students exactly which and how many PD courses are required, simplifying language around reflective reports.

Note: The changes to the work-term report and reflective milestone will appear in the 2023 calendar but will be retroactively applied to the students who are following the 2018-2022 calendars.

Update Complementary Studies Electives due to removal of Faculty-level rules. The new rules increase flexibility for students by requiring one course from List C (Humanities and Social Sciences), whereas the Faculty-level rules previously required two.

Inactivation of class professor seminar courses (NE101, 102B, 201A, 202B, 301A, 302) will allow for greater flexibility in student schedules.

Nanotechnology Engineering	MARK UP

The Nanotechnology Engineering Academic Curriculum

The curriculum in Nanotechnology Engineering consists of a set of core courses complemented by eight technical elective courses.

The normal recommended curriculum shown below typically involves a course load (excluding seminars) of five to six lecture courses per term. Permission from the associate director of nanotechnology engineering (students), will be required for departures from the normal load in any given term. Permission to carry more than the regular load in any given term will normally be approved only for students who have attained an 80% or higher average in the preceding term.

The sequence of co-op work terms for Nanotechnology Engineering students comprises of two four-month work terms following the 1B and 2A terms, and two eight-month work terms following the 2B and 3B terms. The Co-operative Education Program Regulations apply.~~, as further described in the Engineering Work Terms section. Three credited work reports are required for graduation.~~

The promotion criteria used to determine progression through the Nanotechnology Engineering plan is described in the Engineering Examinations and Promotions section of this Calendar.

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- MATH 117 Calculus 1 for Engineering ~~(3 LEC,2 TUT)~~
- NE 100 Introduction to Nanotechnology Engineering ~~(3 LEC,1 TUT,2 LAB)~~
- ~~NE 101 Nanotechnology Engineering Practice (1 SEM)~~
- NE 109 Societal and Environmental Impacts of Nanotechnology ~~(3 LEC,1 TUT)~~
- NE 111 Introduction to Programming for Engineers ~~(2 LEC)~~
- NE 112 Linear Algebra for Nanotechnology Engineers~~ing (3 LEC,1 TUT)~~
- NE 121 Chemical Principles ~~(3 LEC,1 TUT)~~

Term 1B (Winter)

- MATH 119 Calculus 2 for Engineering ~~(3 LEC,2 TUT)~~
- ~~NE 102B Nanotechnology Engineering Practice (1 SEM)~~
- NE 110 Introduction to Nanomaterials Health Risks ~~(3 LEC)~~
- NE 113 Introduction to Computational Methods ~~(3 LEC,1 TUT,2 LAB)~~
- NE 125 Introduction to Materials Science and Engineering ~~(3 LEC,1 TUT)~~
- NE 131 Physics for Nanotechnology Engineering ~~(4 LEC,1 TUT)~~
- NE 140 Linear Circuits ~~(3 LEC,2 TUT,1.5 LAB)~~

Term 2A (Fall)

- ~~NE 201A Nanotechnology Engineering Practice (1 SEM)~~
- NE 215 Probability and Statistics ~~(3 LEC,1 TUT)~~
- NE 216 Advanced Calculus and Numerical Methods 1 ~~(3 LEC,1 TUT,2 LAB)~~
- NE 220L Materials Science and Engineering Laboratory ~~(1.5 LAB)~~
- NE 222 Organic Chemistry for Nanotechnology Engineers ~~(3 LEC,1 TUT,1.5 LAB)~~
- NE 241 Electromagnetism ~~(3 LEC,2 TUT,1.5 LAB)~~
- Undergraduate Communication Requirement

Term 2B (Spring)

- ~~NE 202B Nanotechnology Engineering Practice (1 SEM)~~
- NE 217 Advanced Calculus and Numerical Methods 2 ~~(3 LEC,1 TUT,2 LAB)~~
- NE 225 Structure and Properties of Nanomaterials ~~(3 LEC,1 TUT)~~
- NE 226 Characterization of Materials ~~(3 LEC,1 TUT)~~
- NE 226L Laboratory Characterization Methods ~~(1.5 LAB)~~
- NE 242 Semiconductor Physics and Devices ~~(3 LEC,2 TUT,1.5 LAB)~~
- NE 281 Biology for Nanotechnology Engineers ~~(3 LEC,1 TUT,1.5 LAB)~~

Term 3A (Spring)

- MSCI 261 Engineering Economics: Financial Management for Engineers ~~(3 LEC,1 TUT)~~
- ~~NE 301A Nanotechnology Engineering Practice (1 SEM)~~
- NE 318 Continuum Mechanics for Nanotechnology Engineering ~~(3 LEC,1 TUT)~~
- NE 320L Characterization of Materials Laboratory ~~(1.5 LAB)~~
- NE 332 Quantum Mechanics ~~(3 LEC,1 TUT)~~
- NE 333 Macromolecular Science ~~(3 LEC,1 TUT)~~
- NE 343 Microfabrication and Thin-film Technology ~~(3 LEC,1 TUT)~~

Term 3B (Fall)

- ~~NE 302 Nanotechnology Engineering Practice (1 SEM)~~
- NE 307 Introduction to Nanosystems Design ~~(2 LEC)~~
- NE 330L Macromolecular Science Laboratory ~~(1.5 LAB)~~
- NE 334 Statistical Thermodynamics ~~(3 LEC,1 TUT)~~
- NE 336 Micro and Nanosystem Computer-aided Design ~~(3 LEC,1 TUT,1.5 LAB)~~
- NE 340L Microfabrication and Thin-film Technology Laboratory ~~(1.5 LAB)~~
- NE 352 Surfaces and Interfaces ~~(3 LEC)~~
- Two Technical Electives

Term 4A (Fall)

- NE 408 Nanosystems Design Project ~~(10 PRJ)~~
- ~~CSE~~ Complementary Studies Elective
- Three Technical Electives
- Two senior laboratory course electives selected from:
  - NE 454A Nano-electronics Laboratory 1 ~~(1.5 LAB)~~
  - NE 454B Nano-instrumentation Laboratory 1 ~~(1.5 LAB)~~
  - NE 454C Nanobiosystems Laboratory 1 ~~(1.5 LAB)~~
  - NE 454D Nanostructured Materials Laboratory 1 ~~(1.5 LAB)~~

Term 4B (Winter)

- NE 409 Nanosystems Design Project and Symposium ~~(10 PRJ)~~
- ~~CSE~~ Complementary Studies Elective
- Three Technical Electives
- Two senior laboratory course electives selected from:
  - NE 455A Nano-electronics Laboratory 2 ~~(1.5 LAB)~~
  - NE 455B Nano-instrumentation Laboratory 2 ~~(1.5 LAB)~~
  - NE 455C Nanobiosystems Laboratory 2 ~~(1.5 LAB)~~
  - NE 455D Nanostructured Materials Laboratory 2 ~~(1.5 LAB)~~

Complementary Studies Electives *<<this section to move below UCR>>*

In addition to the Undergraduate Communication Requirement, Nanotechnology Eengineering ~~All Engineering~~ students are required to take **five** complementary studies electives (CSEs), ~~as described in Complementary Studies Requirements for Engineering Students. A total of five (CSEs), in addition to the Undergraduate Communication Requirement, must be taken.~~ **to develop non-technical knowledge and skills.** Two of the CSE**s are** ~~choices must be~~ NE 109 and MSCI 261**, which are taken as core courses in 1A and 3A, respectively. One CSE must be from List C. For each of the two remaining CSEs, students are free to choose from Lists A, C, or D**.

Undergraduate Communication Requirement

Strong communication skills are essential to academic, professional, and personal success. To satisfy the Undergraduate Communication Requirement, Nanotechnology Engineering students must successfully complete a foundational course on communication. This course is scheduled into the 2A term, must be completed prior to enrolling in the 3A term, and can be selected from the following list below. These courses cannot be taken online.

- ENGL 109 Introduction to Academic Writing
- ENGL 129R/EMLS 129R Written Academic English
- EMLS 101R Oral Communications for Academic Purposes
- EMLS 102R Clear Communication in English Writing
- SPCOM 100 Interpersonal Communication
- SPCOM 223 Public Speaking

~~Work-term Reports and Reflection Milestone~~

~~Reflection is an integral part of work-integrated learning. To achieve the Work-term Reports and Reflection Milestone, Nanotechnology Engineering students must complete four reflective reports. These reflective reports are to be associated with each work-term, and are to be submitted immediately following the work-term. Alternately, students can clear this requirement with credit in a PD course requiring a reflective report, with the approval of their academic advisor, and if that PD course was taken during the work term. Reflective reports are typically short, structured reports offering the opportunity to reflect on experience obtained in the context of their academic learning or work.~~

~~Students are also required to submit one technical communication report by taking PD 11 Processes for Technical Report Writing as one of their PD electives.~~

Professional Development Courses

Professional development (PD) courses are required as described in the BASc and BSE Specific Degree Requirements section on Work Terms. In addition to the two core PD courses, Nanotechnology Engineering students are required to take PD 11 Processes for Technical Report Writing. This course counts as one of the three elective PD courses.

Technical Electives

The Nanotechnology Engineering plan may be divided broadly into four areas of concentration, identified herein as micro and nano-instrumentation, nano-electronics, nanobiosystems, and nanomaterials. A set of eight technical elective course choices is provided in the curriculum to enable students to focus upon at least two of these areas of concentration. Students may choose up to four courses from outside the Nanotechnology Engineering plan to complement their studies. Approved technical electives are listed below. For a list of courses available in a specific term, consult the nanotechnology engineering undergraduate co-ordinator. The associate director (program) has the right, where the number of students enrolled in a course at the end of the Course Selection Period is 10 or less, to cancel the course.

Note: For NE 453, more than one course may be offered simultaneously under this course number.

- NE 335 Soft Nanomaterials ~~(3 LEC)~~
- NE 344 Electronic Circuits ~~(3 LEC)~~
- NE 345 Photonic Materials and Devices ~~(3 LEC)~~
- NE 353 Nanoprobing and Lithography ~~(3 LEC)~~
- NE 381 Introduction to Nanoscale Biosystems ~~(3 LEC)~~
- NE 451 Simulation Methods ~~(3 LEC)~~
- NE 452 Special Topics in Nanoscale Simulations ~~(3 LEC)~~
- NE 453 Special Topics in Nanotechnology Engineering ~~(3 LEC)~~
- NE 459 Nanotechnology Engineering Research Project ~~(9 PRJ)~~

- NE 461 Micro and Nano-instrumentation ~~(3 LEC)~~
- NE 466 Tactile Sensors and Transducers~~(3 LEC)~~
- NE 471 Nano-electronics ~~(3 LEC)~~
- NE 476 Organic Electronics ~~(3 LEC)~~
- NE 481 Nanomedicine and Nanobiotechnology ~~(3 LEC)~~
- NE 486 Biosensors ~~(3 LEC)~~
- NE 487 Microfluidic and Nanobiotechnological Systems ~~(3 LEC)~~
- NE 488 Biomaterials and Biomedical Design ~~(3 LEC)~~
- NE 491 Nanostructured Materials ~~(3 LEC)~~
- NE 496 Nanomaterials for Electrochemical Energy Systems ~~(3 LEC)~~

Students may choose up to a maximum of four non-NE technical elective courses from the lists below.

List 1 - 200-level

Maximum of one technical elective from the following list.

- CHE 225 Strategies for Process Improvement and Product Development
- CIVE 204 Solid Mechanics 1
- ECE 222 Digital Computers
- ECE 224 Embedded Microprocessor Systems
- ECE 250 Algorithms and Data Structures
- ECE 252 Systems Programming and Concurrency
- ECE 254 Operating Systems and Systems Programming
- ECE 260 Electromechanical Energy Conversion
- ME 262 Introduction to Microprocessors and Digital Logic
- MSCI 240 Algorithms and Data Structures
- MSCI 245 Databases and Software Design
- MTE 241 Introduction to Computer Structures & Real-Time Systems
- MTE 262 Introduction to Microprocessors and Digital Logic
- SYDE 223 Data Structures and Algorithms

List 2 - Non-NE

- BME 386 The Physics of Medical Imaging
- BME 393 Digital Systems
- BME 550 Sports Engineering
- BME 587 Special Topics in Biomedical Signals
- CHE 331 Electrochemical Engineering
- CHE 361 Bioprocess Engineering
- CHE 480 Process Analysis and Design
- CHE 514 Fundamentals of Petroleum Production
- CHE 516 Energy Systems Engineering
- CHE 521 Process Optimization
- CHE 543 Polymer Production: Polymer Reaction Engineering
- CHE 571 Industrial Ecology
- CHE 572 Air Pollution Control
- CHE 574 Industrial Wastewater Pollution Control
- CIVE 310 Introduction to Structural Design
- CIVE 460 Engineering Biomechanics
- CIVE 512 Rehabilitation of Structures
- ECE 327 Digital Hardware Systems

- ECE 340 Electronic Circuits 2
- ECE 350 Real-Time Operating Systems
- ECE 356 Database Systems
- ECE 358 Computer Networks
- ECE 360 Power Systems and Smart Grids
- ECE 373 Radio Frequency and Microwave Circuits
- ECE 375 Electromagnetic Fields and Waves
- ECE 406 Algorithm Design and Analysis
- ECE 409 Cryptography and System Security
- ECE 416 Advanced Topics in Networking
- ECE 417 Image Processing
- ECE 423 Embedded Computer Systems
- ECE 444 Integrated Analog Electronics
- ECE 457A Co-operative and Adaptive Algorithms
- ECE 457B Fundamentals of Computational Intelligence
- ECE 459 Programming for Performance
- ECE 474 Radio and Wireless Systems
- ECE 477 Photonic Devices and Systems
- ECE 484 Digital Control Applications
- ECE 488 Multivariable Control Systems
- ME 340 Manufacturing Processes
- ME 435 Industrial Metallurgy
- ME 459 Energy Conversion
- ME 526 Fatigue and Fracture Analysis
- ME 531 Physical Metallurgy Applied to Manufacturing
- ME 533 Non-metallic and Composite Materials
- MSCI 331 Introduction to Optimization
- MSCI 332 Deterministic Optimization Models and Methods
- MSCI 342 Principles of Software Engineering
- MSCI 343 Human-Computer Interaction
- MSCI 431 Stochastic Models and Methods
- MSCI 432 Production and Service Operations Management
- MSCI 435 Advanced Optimization Techniques
- MSCI 446 Introduction to Machine Learning
- MSCI 452 Decision Making Under Uncertainty
- MTE 322 Electromechanical Machine Design
- MTE 325 Microprocessor Systems and Interfacing for Mechatronics Engineering
- MTE 360 Automatic Control Systems
- MTE 420 Power Electronics and Motor Drives
- MTE 544 Autonomous Mobile Robots
- MTE 545 Introduction to MEMS Fabrication
- SE 464 Software Design and Architectures
- SYDE 322 Software Design
- SYDE 334 Applied Statistics
- SYDE 522 Foundations of Artificial Intelligence
- SYDE 531 Design Optimization Under Probabilistic Uncertainty
- SYDE 533 Conflict Resolution
- SYDE 542 Interface Design
- SYDE 543 Cognitive Ergonomics
- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 548 User Centred Design Methods
- SYDE 552 Computational Neuroscience

- SYDE 556 Simulating Neurobiological Systems
- SYDE 572 Introduction to Pattern Recognition

SYDE 584 Physiological Systems and Biomedical Design

Nanotechnology Engineering CLEAN COPY

The Nanotechnology Engineering Academic Curriculum

The curriculum in Nanotechnology Engineering consists of a set of core courses complemented by eight technical elective courses.

The normal recommended curriculum shown below typically involves a course load (excluding seminars) of five to six lecture courses per term. Permission from the associate director of nanotechnology engineering (students), will be required for departures from the normal load in any given term. Permission to carry more than the regular load in any given term will normally be approved only for students who have attained an 80% or higher average in the preceding term.

The sequence of co-op work terms for Nanotechnology Engineering students comprises of two four-month work terms following the 1B and 2A terms, and two eight-month work terms following the 2B and 3B terms. The Co-operative Education Program Regulations apply.

The promotion criteria used to determine progression through the Nanotechnology Engineering plan is described in the Engineering Examinations and Promotions section of this Calendar.

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- MATH 117 Calculus 1 for Engineering
- NE 100 Introduction to Nanotechnology Engineering
- NE 109 Societal and Environmental Impacts of Nanotechnology
- NE 111 Introduction to Programming for Engineers
- NE 112 Linear Algebra for Nanotechnology Engineers
- NE 121 Chemical Principles

Term 1B (Winter)

- MATH 119 Calculus 2 for Engineering
- NE 110 Introduction to Nanomaterials Health Risks
- NE 113 Introduction to Computational Methods
- NE 125 Introduction to Materials Science and Engineering
- NE 131 Physics for Nanotechnology Engineering
- NE 140 Linear Circuits

Term 2A (Fall)

- NE 215 Probability and Statistics
- NE 216 Advanced Calculus and Numerical Methods 1
- NE 220L Materials Science and Engineering Laboratory
- NE 222 Organic Chemistry for Nanotechnology Engineers
- NE 241 Electromagnetism
- Undergraduate Communication Requirement

Term 2B (Spring)

- NE 217 Advanced Calculus and Numerical Methods 2
- NE 225 Structure and Properties of Nanomaterials
- NE 226 Characterization of Materials
- NE 226L Laboratory Characterization Methods
- NE 242 Semiconductor Physics and Devices
- NE 281 Biology for Nanotechnology Engineers

Term 3A (Spring)

- MSCI 261 Engineering Economics: Financial Management for Engineers
- NE 318 Continuum Mechanics for Nanotechnology Engineering
- NE 320L Characterization of Materials Laboratory
- NE 332 Quantum Mechanics
- NE 333 Macromolecular Science
- NE 343 Microfabrication and Thin-film Technology

Term 3B (Fall)

- NE 307 Introduction to Nanosystems Design
- NE 330L Macromolecular Science Laboratory
- NE 334 Statistical Thermodynamics
- NE 336 Micro and Nanosystem Computer-aided Design
- NE 340L Microfabrication and Thin-film Technology Laboratory
- NE 352 Surfaces and Interfaces
- Two Technical Electives

Term 4A (Fall)

- NE 408 Nanosystems Design Project
- Complementary Studies Elective
- Three Technical Electives
- Two senior laboratory course electives selected from:
    - NE 454A Nano-electronics Laboratory 1
    - NE 454B Nano-instrumentation Laboratory 1

- NE 454C Nanobiosystems Laboratory 1
- NE 454D Nanostructured Materials Laboratory 1

Term 4B (Winter)

- NE 409 Nanosystems Design Project and Symposium
- Complementary Studies Elective
- Three Technical Electives
- Two senior laboratory course electives selected from:
  - NE 455A Nano-electronics Laboratory 2
  - NE 455B Nano-instrumentation Laboratory 2
  - NE 455C Nanobiosystems Laboratory 2
  - NE 455D Nanostructured Materials Laboratory 2

Undergraduate Communication Requirement

Strong communication skills are essential to academic, professional, and personal success. To satisfy the Undergraduate Communication Requirement, Nanotechnology Engineering students must successfully complete a foundational course on communication. This course is scheduled into the 2A term, must be completed prior to enrolling in the 3A term, and can be selected from the following list below. These courses cannot be taken online.

- ENGL 109 Introduction to Academic Writing
- ENGL 129R/EMLS 129R Written Academic English
- EMLS 101R Oral Communications for Academic Purposes
- EMLS 102R Clear Communication in English Writing
- SPCOM 100 Interpersonal Communication
- SPCOM 223 Public Speaking

Complementary Studies Electives

In addition to the Undergraduate Communication Requirement, Nanotechnology Engineering students are required to take five complementary studies electives (CSEs), to develop non-technical knowledge and skills. Two of the CSEs are NE 109 and MSCI 261, which are taken as core courses in 1A and 3A, respectively. Once CSE must be from List C. For each of the two remaining CSEs, students are free to choose from Lists A, C, or D.

Professional Development Courses

Professional development (PD) courses are required as described in the BASc and BSE Specific Degree Requirements section on Work Terms. In addition to the two core PD courses, Nanotechnology Engineering students are required to take PD 11 Processes for Technical Report Writing. This course counts as one of the three elective PD courses.

Technical Electives

The Nanotechnology Engineering plan may be divided broadly into four areas of concentration, identified herein as micro and nano-instrumentation, nano-electronics, nanobiosystems, and nanomaterials. A set of eight technical elective course choices is provided in the curriculum to enable students to focus upon at least two of these areas of concentration. Students may choose up to four courses from outside the Nanotechnology Engineering plan to complement their studies. Approved technical electives are listed below. For a list of courses available in a specific term, consult the nanotechnology engineering undergraduate co-ordinator. The associate director (program) has the right, where the number of students enrolled in a course at the end of the Course Selection Period is 10 or less, to cancel the course.

Note: For NE 453, more than one course may be offered simultaneously under this course number.

- NE 335 Soft Nanomaterials
- NE 344 Electronic Circuits
- NE 345 Photonic Materials and Devices
- NE 353 Nanoprobing and Lithography
- NE 381 Introduction to Nanoscale Biosystems
- NE 451 Simulation Methods
- NE 452 Special Topics in Nanoscale Simulations
- NE 453 Special Topics in Nanotechnology Engineering
- NE 459 Nanotechnology Engineering Research Project
- NE 461 Micro and Nano-instrumentation
- NE 466 Tactile Sensors and Transducers
- NE 471 Nano-electronics
- NE 476 Organic Electronics
- NE 481 Nanomedicine and Nanobiotechnology
- NE 486 Biosensors
- NE 487 Microfluidic and Nanobiotechnological Systems
- NE 488 Biomaterials and Biomedical Design
- NE 491 Nanostructured Materials
- NE 496 Nanomaterials for Electrochemical Energy Systems

Students may choose up to a maximum of four non-NE technical elective courses from the lists below.

List 1 - 200-level

Maximum of one technical elective from the following list.

- CHE 225 Strategies for Process Improvement and Product Development
- CIVE 204 Solid Mechanics 1
- ECE 222 Digital Computers
- ECE 224 Embedded Microprocessor Systems
- ECE 250 Algorithms and Data Structures
- ECE 252 Systems Programming and Concurrency
- ECE 254 Operating Systems and Systems Programming
- ECE 260 Electromechanical Energy Conversion
- ME 262 Introduction to Microprocessors and Digital Logic
- MSCI 240 Algorithms and Data Structures
- MSCI 245 Databases and Software Design
- MTE 241 Introduction to Computer Structures & Real-Time Systems
- MTE 262 Introduction to Microprocessors and Digital Logic
- SYDE 223 Data Structures and Algorithms

List 2 - Non-NE

- BME 386 The Physics of Medical Imaging
- BME 393 Digital Systems
- BME 550 Sports Engineering
- BME 587 Special Topics in Biomedical Signals
- CHE 331 Electrochemical Engineering
- CHE 361 Bioprocess Engineering
- CHE 480 Process Analysis and Design
- CHE 514 Fundamentals of Petroleum Production
- CHE 516 Energy Systems Engineering
- CHE 521 Process Optimization
- CHE 543 Polymer Production: Polymer Reaction Engineering
- CHE 571 Industrial Ecology
- CHE 572 Air Pollution Control
- CHE 574 Industrial Wastewater Pollution Control
- CIVE 310 Introduction to Structural Design
- CIVE 460 Engineering Biomechanics
- CIVE 512 Rehabilitation of Structures
- ECE 327 Digital Hardware Systems
- ECE 340 Electronic Circuits 2
- ECE 350 Real-Time Operating Systems
- ECE 356 Database Systems
- ECE 358 Computer Networks
- ECE 360 Power Systems and Smart Grids
- ECE 373 Radio Frequency and Microwave Circuits
- ECE 375 Electromagnetic Fields and Waves
- ECE 406 Algorithm Design and Analysis
- ECE 409 Cryptography and System Security
- ECE 416 Advanced Topics in Networking
- ECE 417 Image Processing
- ECE 423 Embedded Computer Systems
- ECE 444 Integrated Analog Electronics
- ECE 457A Co-operative and Adaptive Algorithms
- ECE 457B Fundamentals of Computational Intelligence
- ECE 459 Programming for Performance
- ECE 474 Radio and Wireless Systems
- ECE 477 Photonic Devices and Systems
- ECE 484 Digital Control Applications
- ECE 488 Multivariable Control Systems
- ME 340 Manufacturing Processes
- ME 435 Industrial Metallurgy
- ME 459 Energy Conversion
- ME 526 Fatigue and Fracture Analysis
- ME 531 Physical Metallurgy Applied to Manufacturing
- ME 533 Non-metallic and Composite Materials
- MSCI 331 Introduction to Optimization
- MSCI 332 Deterministic Optimization Models and Methods
- MSCI 342 Principles of Software Engineering
- MSCI 343 Human-Computer Interaction
- MSCI 431 Stochastic Models and Methods

- MSCI 432 Production and Service Operations Management
- MSCI 435 Advanced Optimization Techniques
- MSCI 446 Introduction to Machine Learning
- MSCI 452 Decision Making Under Uncertainty
- MTE 322 Electromechanical Machine Design
- MTE 325 Microprocessor Systems and Interfacing for Mechatronics Engineering
- MTE 360 Automatic Control Systems
- MTE 420 Power Electronics and Motor Drives
- MTE 544 Autonomous Mobile Robots
- MTE 545 Introduction to MEMS Fabrication
- SE 464 Software Design and Architectures
- SYDE 322 Software Design
- SYDE 334 Applied Statistics
- SYDE 522 Foundations of Artificial Intelligence
- SYDE 531 Design Optimization Under Probabilistic Uncertainty
- SYDE 533 Conflict Resolution
- SYDE 542 Interface Design
- SYDE 543 Cognitive Ergonomics
- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 548 User Centred Design Methods
- SYDE 552 Computational Neuroscience
- SYDE 556 Simulating Neurobiological Systems
- SYDE 572 Introduction to Pattern Recognition
- SYDE 584 Physiological Systems and Biomedical Design

6.14. Systems Design Engineering

Rationale:

Update Complementary Studies Electives due to removal of Faculty-level rules. The new rules increase flexibility for students by requiring one course from List C (Humanities and Social Sciences), whereas the Faculty-level rules previously required two.

Systems Design Engineering	MARK UP

The Systems Design Engineering Academic Curriculum

The Systems Design curriculum consists of two course groupings:

1. Compulsory core courses that prepare the student for practice in engineering and comprise 70% to 80% of the course load.
2. Elective courses that comprise 20% to 30% of the course load.

~~The following is the current core course curriculum with the course weight shown in square brackets [ ] next to each course. For those s~~**S**tudents who began in an earlier year, **should** ~~consult~~ **refer to** an earlier Calendar. Students should contact the Systems Design Engineering website for more details on the transition.

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- SYDE 101 ~~[0.25]~~ Communications in Systems Design Engineering-Written and Oral
- SYDE 101L ~~[0.25]~~ Communications in Systems Design Engineering-Visualization
- SYDE 111 ~~[0.50]~~ Calculus 1
- SYDE 113 ~~[0.25]~~ Elementary Engineering Math**ematics**
- SYDE 121 ~~[0.50]~~ Digital Computation
- SYDE 161 ~~[0.50]~~ Introduction to Design
- SYDE 181 ~~[0.50] Physics 1 (Statics)~~ **Physics 1: Statics**

Term 1B (Spring)

- SYDE 102 ~~[0.00]~~ Seminar
- SYDE 112 ~~[0.50]~~ Calculus 2
- SYDE 114 ~~[0.25]~~ Matrices and Linear Systems
- SYDE 162 ~~[0.50]~~ Human Factors in Design
- SYDE 192 ~~[0.50]~~ Digital Systems
- SYDE 192L ~~[0.25]~~ Digital Systems Laboratory
- SYDE 223 ~~[0.50]~~ Data Structures and Algorithms
- One Complementary Studies Elective

Term 2A (Winter)

- SYDE 201 ~~[0.00]~~ Seminar
- SYDE 182 ~~[0.50] Physics 2 (Dynamics)~~ **Physics 2: Dynamics**
- SYDE 211 ~~[0.50]~~ Calculus 3
- SYDE 261 ~~[0.50]~~ Design, Systems, and Society
- SYDE 263 ~~[0.25]~~ Engineering Prototyping
- SYDE 283 ~~[0.50] Physics 3 (Electricity, Magnetism and Optics)~~ **Physics 3: Electricity, Magnetism and Optics**
- SYDE 285 ~~[0.50]~~ Materials Chemistry

Term 2B (Fall)

- SYDE 202 ~~[0.00]~~ Seminar
- SYDE 212 [~~0.50]~~ Probability and Statistics
- SYDE 252 ~~[0.50]~~ Linear Systems and Signals
- SYDE 262 ~~[0.50]~~ Engineering Economics of Design
- SYDE 286 ~~[0.50]~~ Mechanics of Deformable Solids
- SYDE 292 ~~[0.50]~~ Circuits, Instrumentation, and Measurements
- SYDE 292L ~~[0.25]~~ Circuits, Instrumentation, and Measurements Laboratory
- WKRPT 200 ~~[0.13]~~ Work-term Report

Term 3A (Spring)

- SYDE 301 ~~[0.00]~~ Seminar
- SYDE 311 ~~[0.50]~~ Advanced Engineering Math 2
- SYDE 351 ~~[0.50]~~ Systems Models 1
- SYDE 361 ~~[0.50]~~ Systems Design Methods 1: Needs Analysis and Prototyping
- SYDE 381 ~~[0.50]~~ Thermodynamics
- SYDE 383 ~~[0.50]~~ Fluid Mechanics
- WKRPT 300 ~~[0.13]~~ Work-term Report

Term 3B (Winter)

- SYDE 302 ~~[0.00]~~ Seminar
- SYDE 312 ~~[0.50]~~ Applied Linear Algebra
- SYDE 352 ~~[0.50]~~ Introduction to Control Systems
- SYDE 352L ~~[0.25]~~ Control Systems Laboratory
- SYDE 362 ~~[0.50]~~ Systems Design Methods 2: Testing, Verification, and Validation
- One Technical Elective
- One Complementary Studies Elective

Term 4A (Fall)

- SYDE 401 ~~[0.00]~~ Seminar

- SYDE 411 ~~[0.50]~~ Optimization and Numerical Methods
- SYDE 461 ~~[0.50]~~ Systems Design Capstone Project 1
- Two Technical Electives
- One Technical or Complementary Studies Elective
- WKRPT 400 ~~[0.13]~~ Work-term Report

4B (Winter)

- SYDE 402 ~~[0.00]~~ Seminar
- SYDE 462 ~~[0.50]~~ Systems Design Capstone Project 2
- Three Technical Electives
- One Complementary Studies Elective

Canadian Engineering Accreditation Board (CEAB) Requirements

Students must pass a minimum of ten electives. To determine the suitability of elective courses, students should complete the CEAB planner located on the Systems Design Engineering website. In addition to meeting CEAB requirements, the student's course selections (as reported in their planner) should be logical and defensible. Two CEAB planners must be completed and submitted to the associate chair for undergraduate studies, one planner for approval purposes in the student's 3A term, and one planner for graduation purposes at the end of the student's 4A term.

Students with combinations of electives that result in a plan that does not meet the CEAB criteria will not be permitted to graduate.

Complementary Studies Electives

In addition to the two courses in the core curriculum (SYDE 261 and SYDE 262), **a minimum of three complementary studies** elective courses must be chosen~~. to satisfy the Complementary Studies Requirements for Engineering Students~~. Only courses noted in Lists A, B, C, and D **in the Complementary Studies Course Lists for Engineering** are ~~Faculty-~~approved complementary studies elective courses. **Students must take at least one course from List C.** Students may arrange the sequencing of the complementary studies elective courses to suit their academic plan (and any course prerequisites).

Technical Electives

Students must complete a minimum of six department-approved technical electives (TEs) to meet graduation requirements. Students may arrange the sequencing of the technical elective courses to suit their plan (and any course prerequisites).

The Department of Systems Design Engineering offers a wide variety of technical elective courses in the third and fourth year. Students are encouraged to design their own elective package to develop expertise in their particular interest area (see the Technical Elective Package section below). Approved technical elective courses are available from Systems Design Engineering, from other Engineering departments, and from a wide list of technical courses in the faculties of Science and Mathematics. Only courses from Engineering and Computer Science will contribute towards CEAB hours in the categories of "Engineering

Science" and "Engineering Design". Some examples are listed below.

Biomedical Engineering

- BME 499 Elective Biomedical Research Project
- BME 550 Sports Engineering
- BME 551 Biomechanics of Human Movement
- BME 581 Ultrasound in Medicine and Biology
- BME 587 Special Topics in Biomedical Signals
- BME 588 Special Topics in Biomechanics
- BME 589 Special Topics in Biomedical Devices

Civil Engineering

- CIVE 440 Transit Planning and Operations
- CIVE 460 Engineering Biomechanics

Electrical and Computer Engineering

- ECE 254 Operating Systems and Systems Programming
- ECE 356 Database Systems
- ECE 358 Computer Networks
- ECE 406 Algorithm Design and Analysis
- ECE 457B Fundamentals of Computational Intelligence
- ECE 459 Programming for Performance
- ECE 484 Digital Control Applications

Management Sciences

- MSCI 343 Human-Computer Interaction
- MSCI 432 Production and Service Operations Management
- MSCI 446 Introduction to Machine Learning
- MSCI 555 Scheduling: Theory and Practice

Mechanical Engineering

- ME 321 Kinematics and Dynamics of Machines
- ME 574 Engineering Biomechanics

Mechatronics Engineering

- MTE 241 Introduction to Computer Structures & Real-Time Systems
- MTE 325 Microprocessor Systems and Interfacing for Mechatronics Engineering
- MTE 544 Autonomous Mobile Robots

Systems Design Engineering

- SYDE 322 Software Design
- SYDE 334 Applied Statistics
- SYDE 522 Foundations of Artificial Intelligence
- SYDE 531 Design Optimization Under Probabilistic Uncertainty

- SYDE 532 Introduction to Complex Systems
- SYDE 533 Conflict Resolution
- SYDE 542 Interface Design
- SYDE 543 Cognitive Ergonomics
- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 548 User Centred Design Methods
- SYDE 552 Computational Neuroscience
- SYDE 553 Advanced Dynamics
- SYDE 556 Simulating Neurobiological Systems
- SYDE 572 Introduction to Pattern Recognition
- SYDE 575 Image Processing
- SYDE 584 Physiological Systems and Biomedical Design
- SYDE 599 Special Topics in Systems Design Engineering

Technical Elective Packages

The Department has identified four technical elective areas within its current offerings. Additional information regarding elective packages may be obtained from the associate chair for undergraduate studies. Students may choose a technical elective package from the four areas identified below to help them in their selection of technical electives. Choosing a specific elective package is not mandatory. Students do not receive any official notification on their transcript for completing an elective package.

Human Systems Engineering

The elective courses in this package are as follows:

3B (Winter)

- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 548 User Centred Design Methods

4A (Fall)

- SYDE 543 Cognitive Ergonomics
- SYDE 575 Image Processing
- SYDE 584 Physiological Systems and Biomedical Design

4B (Winter)

- SYDE 542 Interface Design
- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 572 Introduction to Pattern Recognition

Intelligent Systems

The elective courses in this package are as follows:

3B (Winter)

- SYDE 322 Software Design
- SYDE 531 Design Optimization Under Probabilistic Uncertainty

- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 552 Computational Neuroscience
- SYDE 572 Introduction to Pattern Recognition

4A (Fall)

- SYDE 543 Cognitive Ergonomics
- SYDE 556 Simulating Neurobiological Systems
- SYDE 575 Image Processing

4B (Winter)

- SYDE 522 Foundations of Artificial Intelligence
- SYDE 531 Design Optimization Under Probabilistic Uncertainty
- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 548 User Centred Design Methods
- SYDE 552 Computational Neuroscience
- SYDE 572 Introduction to Pattern Recognition

Societal and Environmental Systems

Note: Additional experience can be gained by doing related workshop projects in SYDE 362, SYDE 461, and SYDE 462.

The elective courses in this package are as follows:

3B (Winter)

- SYDE 334 Applied Statistics
- SYDE 531 Design Optimization Under Probabilistic Uncertainty
- SYDE 532 Introduction to Complex Systems
- SYDE 572 Introduction to Pattern Recognition

4A (Fall)

- SYDE 533 Conflict Resolution
- SYDE 575 Image Processing

4B (Winter)

- SYDE 334 Applied Statistics
- SYDE 522 Foundations of Artificial Intelligence
- SYDE 531 Design Optimization Under Probabilistic Uncertainty
- SYDE 532 Introduction to Complex Systems
- SYDE 572 Introduction to Pattern Recognition

Systems Modelling and Analysis

Note: The elective package structure is such that the students enrolled in this elective package can take additional courses~~, possibly~~ from other departments, in order to focus ~~in~~ **on** any specific engineering discipline and at the same time obtain a strong systems modelling and design foundation.

The elective courses in this package are as follows:

3B (Winter)

- SYDE 552 Computational Neuroscience
- SYDE 572 Introduction to Pattern Recognition

4A (Fall)

- SYDE 553 Advanced Dynamics
- SYDE 556 Simulating Neurobiological Systems
- SYDE 575 Image Processing
- SYDE 584 Physiological Systems and Biomedical Design

4B (Winter)

- SYDE 532 Introduction to Complex Systems
- SYDE 552 Computational Neuroscience
- SYDE 572 Introduction to Pattern Recognition

Systems Design Engineering CLEAN COPY

The Systems Design Engineering Academic Curriculum

The Systems Design curriculum consists of two course groupings:

1. Compulsory core courses that prepare the student for practice in engineering and comprise 70% to 80% of the course load.
2. Elective courses that comprise 20% to 30% of the course load.

Students who began in an earlier year, should refer to an earlier Calendar. Students should contact the Systems Design Engineering website for more details on the transition.

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- SYDE 101 Communications in Systems Design Engineering-Written and Oral
- SYDE 101L Communications in Systems Design Engineering-Visualization
- SYDE 111 Calculus 1
- SYDE 113 Elementary Engineering Mathematics
- SYDE 121 Digital Computation
- SYDE 161 Introduction to Design
- SYDE 181 Physics 1: Statics

Term 1B (Spring)

- SYDE 102 Seminar
- SYDE 112 Calculus 2
- SYDE 114 Matrices and Linear Systems
- SYDE 162 Human Factors in Design
- SYDE 192 Digital Systems
- SYDE 192L Digital Systems Laboratory
- SYDE 223 Data Structures and Algorithms
- One Complementary Studies Elective

Term 2A (Winter)

- SYDE 201 Seminar
- SYDE 182 Physics 2: Dynamics
- SYDE 211 Calculus 3
- SYDE 261 Design, Systems, and Society
- SYDE 263 Engineering Prototyping
- SYDE 283 Physics 3: Electricity, Magnetism and Optics
- SYDE 285 Materials Chemistry

Term 2B (Fall)

- SYDE 202 Seminar
- SYDE 212 Probability and Statistics
- SYDE 252 Linear Systems and Signals
- SYDE 262 Engineering Economics of Design
- SYDE 286 Mechanics of Deformable Solids
- SYDE 292 Circuits, Instrumentation, and Measurements
- SYDE 292L Circuits, Instrumentation, and Measurements Laboratory
- WKRPT 200 Work-term Report

Term 3A (Spring)

- SYDE 301 Seminar
- SYDE 311 Advanced Engineering Math 2
- SYDE 351 Systems Models 1
- SYDE 361 Systems Design Methods 1: Needs Analysis and Prototyping
- SYDE 381 Thermodynamics
- SYDE 383 Fluid Mechanics
- WKRPT 300 Work-term Report

Term 3B (Winter)

- SYDE 302 Seminar
- SYDE 312 Applied Linear Algebra
- SYDE 352 Introduction to Control Systems
- SYDE 352L Control Systems Laboratory
- SYDE 362 Systems Design Methods 2: Testing, Verification, and Validation
- One Technical Elective
- One Complementary Studies Elective

Term 4A (Fall)

- SYDE 401 Seminar
- SYDE 411 Optimization and Numerical Methods
- SYDE 461 Systems Design Capstone Project 1
- Two Technical Electives
- One Technical or Complementary Studies Elective
- WKRPT 400 Work-term Report

4B (Winter)

- SYDE 402 Seminar
- SYDE 462 Systems Design Capstone Project 2
- Three Technical Electives
- One Complementary Studies Elective

Canadian Engineering Accreditation Board (CEAB) Requirements

Students must pass a minimum of ten electives. To determine the suitability of elective courses, students should complete the CEAB planner located on the Systems Design Engineering website. In addition to meeting CEAB requirements, the student's course selections (as reported in their planner) should be logical and defensible. Two CEAB planners must be completed and submitted to the associate chair for undergraduate studies, one planner for approval purposes in the student's 3A term, and one planner for graduation purposes at the end of the student's 4A term.

Students with combinations of electives that result in a plan that does not meet the CEAB criteria will not be permitted to graduate.

Complementary Studies Electives

In addition to the two courses in the core curriculum (SYDE 261 and SYDE 262), a minimum of three complementary studies elective courses must be chosen. Only courses noted in Lists A, B, C, and D in the Complementary Studies Course Lists for Engineering are approved complementary studies elective courses. Students must take at least one course from List C. Students may arrange the sequencing of the complementary studies elective courses to suit their academic plan (and any course prerequisites).

Technical Electives

Students must complete a minimum of six department-approved technical electives (TEs) to meet graduation requirements. Students may arrange the sequencing of the technical elective courses to suit their plan (and any course prerequisites).

The Department of Systems Design Engineering offers a wide variety of technical elective courses in the third and fourth year. Students are encouraged to design their own elective package to develop expertise in their particular interest area (see the Technical Elective Package section below). Approved technical elective courses are available from Systems Design Engineering, from other Engineering departments, and from a wide list of technical courses in the faculties of Science and Mathematics. Only courses from Engineering and Computer Science will contribute towards CEAB hours in the categories of "Engineering Science" and "Engineering Design". Some examples are listed below.

Biomedical Engineering

- BME 499 Elective Biomedical Research Project
- BME 550 Sports Engineering
- BME 551 Biomechanics of Human Movement
- BME 581 Ultrasound in Medicine and Biology
- BME 587 Special Topics in Biomedical Signals
- BME 588 Special Topics in Biomechanics
- BME 589 Special Topics in Biomedical Devices

Civil Engineering

- CIVE 440 Transit Planning and Operations
- CIVE 460 Engineering Biomechanics

Electrical and Computer Engineering

- ECE 254 Operating Systems and Systems Programming
- ECE 356 Database Systems
- ECE 358 Computer Networks
- ECE 406 Algorithm Design and Analysis
- ECE 457B Fundamentals of Computational Intelligence
- ECE 459 Programming for Performance
- ECE 484 Digital Control Applications

Management Sciences

- MSCI 343 Human-Computer Interaction
- MSCI 432 Production and Service Operations Management
- MSCI 446 Introduction to Machine Learning
- MSCI 555 Scheduling: Theory and Practice

Mechanical Engineering

- ME 321 Kinematics and Dynamics of Machines

- ME 574 Engineering Biomechanics

Mechatronics Engineering

- MTE 241 Introduction to Computer Structures & Real-Time Systems
- MTE 325 Microprocessor Systems and Interfacing for Mechatronics Engineering
- MTE 544 Autonomous Mobile Robots

Systems Design Engineering

- SYDE 322 Software Design
- SYDE 334 Applied Statistics
- SYDE 522 Foundations of Artificial Intelligence
- SYDE 531 Design Optimization Under Probabilistic Uncertainty
- SYDE 532 Introduction to Complex Systems
- SYDE 533 Conflict Resolution
- SYDE 542 Interface Design
- SYDE 543 Cognitive Ergonomics
- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 548 User Centred Design Methods
- SYDE 552 Computational Neuroscience
- SYDE 553 Advanced Dynamics
- SYDE 556 Simulating Neurobiological Systems
- SYDE 572 Introduction to Pattern Recognition
- SYDE 575 Image Processing
- SYDE 584 Physiological Systems and Biomedical Design
- SYDE 599 Special Topics in Systems Design Engineering

Technical Elective Packages

The Department has identified four technical elective areas within its current offerings. Additional information regarding elective packages may be obtained from the associate chair for undergraduate studies. Students may choose a technical elective package from the four areas identified below to help them in their selection of technical electives. Choosing a specific elective package is not mandatory. Students do not receive any official notification on their transcript for completing an elective package.

Human Systems Engineering

The elective courses in this package are as follows:

3B (Winter)

- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 548 User Centred Design Methods

4A (Fall)

- SYDE 543 Cognitive Ergonomics
- SYDE 575 Image Processing
- SYDE 584 Physiological Systems and Biomedical Design

4B (Winter)

- SYDE 542 Interface Design
- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 572 Introduction to Pattern Recognition

Intelligent Systems

The elective courses in this package are as follows:

3B (Winter)

- SYDE 322 Software Design
- SYDE 531 Design Optimization Under Probabilistic Uncertainty
- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 552 Computational Neuroscience
- SYDE 572 Introduction to Pattern Recognition

4A (Fall)

- SYDE 543 Cognitive Ergonomics
- SYDE 556 Simulating Neurobiological Systems
- SYDE 575 Image Processing

4B (Winter)

- SYDE 522 Foundations of Artificial Intelligence
- SYDE 531 Design Optimization Under Probabilistic Uncertainty
- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 548 User Centred Design Methods
- SYDE 552 Computational Neuroscience
- SYDE 572 Introduction to Pattern Recognition

Societal and Environmental Systems

Note: Additional experience can be gained by doing related workshop projects in SYDE 362, SYDE 461, and SYDE 462.

The elective courses in this package are as follows:

3B (Winter)

- SYDE 334 Applied Statistics
- SYDE 531 Design Optimization Under Probabilistic Uncertainty
- SYDE 532 Introduction to Complex Systems
- SYDE 572 Introduction to Pattern Recognition

4A (Fall)

- SYDE 533 Conflict Resolution

- SYDE 575 Image Processing

4B (Winter)

- SYDE 334 Applied Statistics
- SYDE 522 Foundations of Artificial Intelligence
- SYDE 531 Design Optimization Under Probabilistic Uncertainty
- SYDE 532 Introduction to Complex Systems
- SYDE 572 Introduction to Pattern Recognition

Systems Modelling and Analysis

Note: The elective package structure is such that the students enrolled in this elective package can take additional courses, from other departments, in order to focus on any specific engineering discipline and at the same time obtain a strong systems modelling and design foundation.

The elective courses in this package are as follows:

3B (Winter)

- SYDE 552 Computational Neuroscience
- SYDE 572 Introduction to Pattern Recognition

4A (Fall)

- SYDE 553 Advanced Dynamics
- SYDE 556 Simulating Neurobiological Systems
- SYDE 575 Image Processing
- SYDE 584 Physiological Systems and Biomedical Design

4B (Winter)

- SYDE 532 Introduction to Complex Systems
- SYDE 552 Computational Neuroscience
- SYDE 572 Introduction to Pattern Recognition

6.15. Artificial Intelligence Option

Rationale:
The Artificial Intelligence Option is being overhauled to reflect changes in the AI field and to give more flexibility for students. Units delivering the courses have been consulted.

Artificial Intelligence (Engineering) Option	MARK UP

The Artificial Intelligence (AI) Option is available for students in all undergraduate Engineering plans at the University of Waterloo. The requirements for completion of the AI Option are:

~~All of~~ **List 1: One of**

- ~~ECE 457A Co-operative and Adaptive Algorithms or MSCI 435 Advanced Optimization Techniques~~
- MSCI 442 Impact of Information Systems on Organizations and Society
- **STV 205 Cybernetics and Society**
- **STV 208 Artificial Intelligence and Society: Impact, Ethics, and Equity**
- **STV 210 The Computing Society**

~~One of~~ **List 2: Two of**

- CS 480 Introduction to Machine Learning
- **CS 485 Statistical and Computational Foundations of Machine Learning**
- **CS 486 Introduction to Artificial Intelligence**
- **ECE 457A Co-operative and Adaptive Algorithms**
- ECE 457B Fundamentals of Computational Intelligence
- **ECE 457C Reinforcement Learning**
- **MSCI 435 Advanced Optimization Techniques**
- MSCI 446 Introduction to Machine Learning
- **SYDE 522 Foundations of Artificial Intelligence**

~~One of~~ **List 3: Three additional courses, which may be from either List 2 or List 3**

- ~~BME 356 Control Systems~~
- ~~CHE 341 Introduction to Process Control~~
- **BIOL 487/SYDE 552 Computational Neuroscience**
- **CHE 521 Process Optimization**
- **CHE 522 Advanced Process Dynamics and Control**
- **CHE 524 Process Control Laboratory**
- **CO 367 Nonlinear Optimization**
- **CO 456 Introduction to Game Theory**
- **CO 463 Convex Optimization and Analysis**
- **CO 466 Continuous Optimization**
- **CS 452 Real-time Programming**
- **CS 479 Neural Networks**
- **CS 484 Computational Vision**
- ~~ECE 380 Analog Control Systems~~

- ECE 423 Embedded Computer Systems
- ECE 455 Embedded Software
- ECE 481 Digital Control Systems
- ECE 484 Digital Control Applications
- ECE 486 Robot Dynamics and Control
- ECE 488 Multivariable Control Systems
- ECE 495 Autonomous Vehicles
- MSCI 546 Advanced Machine Learning
- ~~MTE 360 Automatic Control Systems~~
- MTE 544 Autonomous Mobile Robots
- MTE 546 Multi-sensor Data Fusion
- ~~SE 380 Introduction to Feedback Control~~
- STAT 341 Computational Statistics and Data Analysis
- STAT 440 Computational Inference
- STAT 441 Statistical Learning - Classification
- STAT 444 Statistical Learning - Advanced Regression
- ~~SYDE 352 Introduction to Control Systems~~
- ~~SYDE 522 Foundations of Artificial Intelligence~~
- SYDE 556 Simulating Neurobiological Systems
- SYDE 572 Introduction to Pattern Recognition

~~Three additional courses, at least one of which must be from Mathematics and at least one from Engineering, from the following list.~~

- ~~CHE 522 Advanced Process Dynamics and Control~~
- ~~CHE 524 Process Control Laboratory~~
- ~~CO 456 Introduction to Game Theory~~
- ~~CO 463 Convex Optimization and Analysis~~
- ~~CO 466 Continuous Optimization~~
- ~~CS 480 Introduction to Machine Learning~~
- ~~CS 484 Computational Vision~~
- ~~CS 485 Statistical and Computational Foundations of Machine Learning~~
- ~~ECE 423 Embedded Computer Systems~~
- ~~ECE 455 Embedded Software~~
- ~~ECE 481 Digital Control Systems~~
- ~~ECE 486 Robot Dynamics and Control~~
- ~~ECE 488 Multivariable Control Systems~~
- ~~MSCI 446 Introduction to Machine Learning~~
- ~~MTE 544 Autonomous Mobile Robots~~
- ~~STAT 341 Computational Statistics and Data Analysis~~
- ~~STAT 440 Computational Inference~~
- ~~STAT 441 Statistical Learning - Classification~~
- ~~STAT 444 Statistical Learning - Advanced Regression~~
- ~~SYDE 522 Foundations of Artificial Intelligence~~
- ~~SYDE 556 Simulating Neurobiological Systems~~
- ~~SYDE 572 Introduction to Pattern Recognition~~

Notes

- The selected courses for the option should include at last one course from Mathematics and at least one course from Engineering. Exceptions to this rule may be granted by the option co-ordinator if it is logistically infeasible to be satisfied.
- Five of the courses must be considered elective (that is, not core requirements) in the student's academic plan. For the purposes of this Option, a course that a student could choose to graduate without will be considered elective.
- Special topics courses, independent project courses, and the capstone project courses may sometimes be appropriate for this Option, with approval of the AI option co-ordinator and the course instructor.
- ~~Special topics courses may sometimes be appropriate for this Option; interested students should see the option co-ordinator for confirmation.~~

Artificial Intelligence (Engineering) Option CLEAN COPY

The Artificial Intelligence (AI) Option is available for students in all undergraduate Engineering plans at the University of Waterloo. The requirements for completion of the AI Option are:

List 1: One of

- MSCI 442 Impact of Information Systems on Organizations and Society
- STV 205 Cybernetics and Society
- STV 208 Artificial Intelligence and Society: Impact, Ethics, and Equity
- STV 210 The Computing Society

List 2: Two of

- CS 480 Introduction to Machine Learning
- CS 485 Statistical and Computational Foundations of Machine Learning
- CS 486 Introduction to Artificial Intelligence
- ECE 457A Co-operative and Adaptive Algorithms
- ECE 457B Fundamentals of Computational Intelligence
- ECE 457C Reinforcement Learning
- MSCI 435 Advanced Optimization Techniques
- MSCI 446 Introduction to Machine Learning
- SYDE 522 Foundations of Artificial Intelligence

List 3: Three additional courses, which may be from either List 2 or List 3

- BIOL 487/SYDE 552 Computational Neuroscience
- CHE 521 Process Optimization
- CHE 522 Advanced Process Dynamics and Control
- CHE 524 Process Control Laboratory

- CO 367 Nonlinear Optimization
- CO 456 Introduction to Game Theory
- CO 463 Convex Optimization and Analysis
- CO 466 Continuous Optimization
- CS 452 Real-time Programming
- CS 479 Neural Networks
- CS 484 Computational Vision
- ECE 423 Embedded Computer Systems
- ECE 455 Embedded Software
- ECE 481 Digital Control Systems
- ECE 484 Digital Control Applications
- ECE 486 Robot Dynamics and Control
- ECE 488 Multivariable Control Systems
- ECE 495 Autonomous Vehicles
- MSCI 546 Advanced Machine Learning
- MTE 544 Autonomous Mobile Robots
- MTE 546 Multi-sensor Data Fusion
- STAT 341 Computational Statistics and Data Analysis
- STAT 440 Computational Inference
- STAT 441 Statistical Learning - Classification
- STAT 444 Statistical Learning - Advanced Regression
- SYDE 556 Simulating Neurobiological Systems
- SYDE 572 Introduction to Pattern Recognition

Notes

- The selected courses for the Option should include at least one course from Mathematics and at least one course from Engineering. Exceptions to this rule may be granted by the option co-ordinator if it is logistically infeasible to be satisfied.
- Five of the courses must be considered elective (that is, not core requirements) in the student's academic plan. For the purposes of this Option, a course that a student could choose to graduate without will be considered elective.
- Special topics courses, independent project courses, and the capstone project courses may sometimes be appropriate for this Option, with approval of the AI option co-ordinator and the course instructor.

6.16 Biomechanics Option

Rationale:

To give students more flexibility, add BME 588 Special topics in Biomechanics as a permissible course in List 1 and NE 336 Micro and Nano-systems computer-aided Design as a permissible course in List 4.

Biomechanics Option MARK UP

The Biomechanics Option is available to all Engineering students.

The Option consists of seven courses selected from specified lists. At least one course must be taken as an "extra." An extra can be a course taken during a work term. Individual department requirements must be satisfied and thus the precise number of courses that need to be taken as extras (normally DRNA - see Rules for description) may vary. Contact the associate chair, option co-ordinator, or director for the plan for information regarding the number of extras as well as any other restrictions that may apply.

Option Requirements

The courses listed below may have prerequisites, and it is the student's responsibility to satisfy the requirements or otherwise obtain permission to enrol.

To satisfy the Option, students must successfully complete:

- **List 1**: **one course from: Foundational Biomechanics**:
  - CIVE 460/ME 574 Engineering Biomechanics
  - **BME 588 Special Topics in Biomechanics [Topic title: Introductory Mechanics of Biomedical and Biological Materials]**
- **List 2**: one course from ~~List A~~ : Anatomy and Physiology (see Note 1)
  - BIOL 201 Human Anatomy
  - BIOL 273 Principles of Human Physiology 1, and a limited number of spaces may be available online
  - BME 284 Physiological and Biological Systems
  - KIN 100 Regional Human Anatomy and KIN 100L Regional Human Anatomy Laboratory
  - SYDE 584 Physiological Systems and Biomedical Design
- **List 3**: one course from ~~List B~~: Ergonomics
  - KIN 121 Biomechanics of Human Movement and KIN 121L Biomechanics of Human Movement Laboratory
  - KIN 320 Task Analysis
  - KIN 420 Occupational Biomechanics (see Note 2)
  - SYDE 162 Human Factors in Design
  - SYDE 543 Cognitive Ergonomics
  - SYDE 548 User Centred Design Methods
- **List 4**: one course from ~~List C~~: Techniques of Biomechanics
  - CHE 341 Introduction to Process Control
  - CIVE 306 ~~Mechanics of Solids 3~~ **Solid Mechanics 3**
  - CIVE 422 Finite Element Analysis
  - ECE 380 Analog Control Systems
  - ECE 486 Robot Dynamics and Control

- ME 322 Mechanical Design 1
- ME 360 Introduction to Control Systems
- ME 423 Mechanical Design 2
- ME 547 Robot Manipulators: Kinematics, Dynamics, Control
- ME 555 Computer-Aided Design
- ME 559 Finite Element Methods
- ME 566 Computational Fluid Dynamics for Engineering Design
- MTE 360 Automatic Control Systems
- **NE 336 Micro and Nanosystem Computer-aided Design**
- PHYS 395 Biophysics of Therapeutic Methods
- SYDE 352 Introduction to Control Systems
- SYDE 543 Cognitive Ergonomics
- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 553 Advanced Dynamics
- SYDE 572 Introduction to Pattern Recognition
- SYDE 575 Image Processing

- **List 5**: one course from ~~List D~~: Kinesiology
  - BME 551 Biomechanics and Human Movement
  - KIN 221 Advanced Biomechanics of Human Movement and KIN 221L Advanced Biomechanics of Human Movement Laboratory
  - KIN 255 Fundamentals of Neuroscience and KIN 255L Fundamentals of Neuroscience Laboratory
  - KIN 312 Introduction to Neurological Disorders
  - KIN 340 Muskuloskeletal Injuries in Sport and Activity
  - KIN 356 Sensory Systems Neuroscience
  - KIN 416 Neuromuscular Integration
  - KIN 420 Occupational Biomechanics (see Note 2)
  - KIN 422 Human Posture, Balance and Gait
  - KIN 425 Biomechanics Modelling
  - KIN 472 Directed Study in Special Topics
- **List 6**: plus a two-term project from ~~List E~~: Project (see Note 3)
  - CHE 482 Group Design Project and CHE 483 Group Design Project and Symposium
  - CIVE 400 Civil Engineering Design Project 1 and CIVE 401 Civil Engineering Design Project 2
  - ECE 498A and ECE 498B Engineering Design Project
  - ENVE 400 Environmental Engineering Design Project 1 and ENVE 401 Environmental Engineering Design Project 2
  - GENE 401 and GENE 402 Special Directed Studies
  - **GENE 403 Interdisciplinary Design Project 1 and GENE 404 Interdisciplinary Design Project 2**
  - ME 481 Mechanical Engineering Design Project 1 and ME 482 Mechanical Engineering Design Project 2
  - **MTE 481 Mechatronics Engineering Design Project and MTE 482 Mechatronics Engineering Project**
  - NE 408 Nanosystems Design Project and NE 409 Nanosystems Design Project and Symposium
  - SYDE 461 Systems Design Capstone Project 1 and SYDE 462 Systems Design Capstone Project 2

Notes

1. List ~~A~~ **2** course is to be taken by the end of the student's 3B term.
2. KIN 420 may count towards List ~~B~~ **3** or List ~~D~~ **5**, but not both.
3. The project topic must be in the area of biomechanics and students are encouraged to have their projects supervised or co-supervised by a faculty member outside of their home department.

Biomechanics Option CLEAN COPY

The Biomechanics Option is available to all Engineering students.

The Option consists of seven courses selected from specified lists. At least one course must be taken as an "extra." An extra can be a course taken during a work term. Individual department requirements must be satisfied and thus the precise number of courses that need to be taken as extras (normally DRNA - see Rules for description) may vary. Contact the associate chair, option co-ordinator, or director for the plan for information regarding the number of extras as well as any other restrictions that may apply.

Option Requirements

The courses listed below may have prerequisites, and it is the student's responsibility to satisfy the requirements or otherwise obtain permission to enrol.

To satisfy the Option, students must successfully complete:

- List 1: one course from: Foundational Biomechanics
  - CIVE 460/ME 574 Engineering Biomechanics
  - BME 588 Special Topics in Biomechanics [Topic title: Introductory Mechanics of Biomedical and Biological Materials]
- List 2: one course from: Anatomy and Physiology (see Note 1)
  - BIOL 201 Human Anatomy
  - BIOL 273 Principles of Human Physiology 1, and a limited number of spaces may be available online
  - BME 284 Physiological and Biological Systems
  - KIN 100 Regional Human Anatomy and KIN 100L Regional Human Anatomy Laboratory
  - SYDE 584 Physiological Systems and Biomedical Design
- List 3: one course from: Ergonomics
  - KIN 121 Biomechanics of Human Movement and KIN 121L Biomechanics of Human Movement Laboratory
  - KIN 320 Task Analysis
  - KIN 420 Occupational Biomechanics (see Note 2)
  - SYDE 162 Human Factors in Design
  - SYDE 543 Cognitive Ergonomics
  - SYDE 548 User Centred Design Methods
- List 4: one course from: Techniques of Biomechanics
  - CHE 341 Introduction to Process Control
  - CIVE 306 Solid Mechanics 3
  - CIVE 422 Finite Element Analysis
  - ECE 380 Analog Control Systems
  - ECE 486 Robot Dynamics and Control
  - ME 322 Mechanical Design 1

- ME 360 Introduction to Control Systems
- ME 423 Mechanical Design 2
- ME 547 Robot Manipulators: Kinematics, Dynamics, Control
- ME 555 Computer-Aided Design
- ME 559 Finite Element Methods
- ME 566 Computational Fluid Dynamics for Engineering Design
- MTE 360 Automatic Control Systems
- NE 336 Micro and Nanosystem Computer-aided Design
- PHYS 395 Biophysics of Therapeutic Methods
- SYDE 352 Introduction to Control Systems
- SYDE 543 Cognitive Ergonomics
- SYDE 544 Biomedical Measurement and Signal Processing
- SYDE 553 Advanced Dynamics
- SYDE 572 Introduction to Pattern Recognition
- SYDE 575 Image Processing

- List 5: one course from: Kinesiology
  - BME 551 Biomechanics and Human Movement
  - KIN 221 Advanced Biomechanics of Human Movement and KIN 221L Advanced Biomechanics of Human Movement Laboratory
  - KIN 255 Fundamentals of Neuroscience and KIN 255L Fundamentals of Neuroscience Laboratory
  - KIN 312 Introduction to Neurological Disorders
  - KIN 340 Muskuloskeletal Injuries in Sport and Activity
  - KIN 356 Sensory Systems Neuroscience
  - KIN 416 Neuromuscular Integration
  - KIN 420 Occupational Biomechanics (see Note 2)
  - KIN 422 Human Posture, Balance and Gait
  - KIN 425 Biomechanics Modelling
  - KIN 472 Directed Study in Special Topics
- List 6: plus a two-term project from: Project (see Note 3)
  - CHE 482 Group Design Project and CHE 483 Group Design Project and Symposium
  - CIVE 400 Civil Engineering Design Project 1 and CIVE 401 Civil Engineering Design Project 2
  - ECE 498A and ECE 498B Engineering Design Project
  - ENVE 400 Environmental Engineering Design Project 1 and ENVE 401 Environmental Engineering Design Project 2
  - GENE 401 and GENE 402 Special Directed Studies
  - GENE 403 Interdisciplinary Design Project 1 and GENE 404 Interdisciplinary Design Project 2
  - ME 481 Mechanical Engineering Design Project 1 and ME 482 Mechanical Engineering Design Project 2
  - MTE 481 Mechatronics Engineering Design Project and MTE 482 Mechatronics Engineering Project
  - NE 408 Nanosystems Design Project and NE 409 Nanosystems Design Project and Symposium
  - SYDE 461 Systems Design Capstone Project 1 and SYDE 462 Systems Design Capstone Project 2

Notes

1. List 2 course is to be taken by the end of the student's 3B term.

2. KIN 420 may count towards List 3 or List 5, but not both.
3. The project topic must be in the area of biomechanics and students are encouraged to have their projects supervised or co-supervised by a faculty member outside of their home department.

6.17. Management Sciences Option

Rationale:
Updating CSE list names to be consistent with the new Faculty-level names, and adding a link to the new Faculty CSE page.

Updating identifier to MSCI 454 which is now a List C CSE and no longer a List D CSE.

Management Sciences Option	MARK UP

The Management Sciences Option is not available to Management Engineering students.

Legend

Key	Description
~~F,W,S~~	~~F=fall term, W=winter term, S=spring term~~
A,B,C,~~D~~	These courses count toward Complementary Studies **Course Lists** Requirements for Engineering ~~Students~~: A- Impact **of Technology and/or Engineering on Society**, B- Engineering Economics, C- Humanities and Social Sciences **(excluding courses concentrated on development of language or other skills)**, ~~D- Other~~.
†	These courses may count towards technical elective (or technical breadth elective) requirements. Engineering students should consult the academic advisor in their home department for specific rules that apply to their academic plan.

Requirements

The Option consists of six courses, including two required courses (or their equivalents) and four elective courses (or equivalents).

- The two required courses and equivalents are:
  - MSCI 211[C] Organizational Behaviour ~~(F,W,S)~~ or MSCI 311[C] Organizational Design and Technology ~~(F,W,S)~~; or PSYCH 238 Organizational Psychology
  - MSCI 331[†] Introduction to Optimization ~~(F,W,S)~~; or one of BME 411, CHE 521, CIVE 332, CO 250, ENVE 335, or SYDE 411
- Four of the following elective courses or equivalents:
  - MSCI 211[C] Organizational Behaviour ~~(F,W,S)~~; or PSYCH 238 Organizational Psychology
  - MSCI 261[B] Engineering Economics: Financial Management for Engineers ~~(F,W,S)~~; or one of AE 392/CIVE 392/ENVE 392/GEOE 392, BME 364, or SYDE 262
  - MSCI 263[C] Managerial Economics ~~(S)~~; or ECON 201 Microeconomic Theory for Business and Policy
  - MSCI 311[C] Organizational Design and Technology ~~(F,W,S)~~
  - MSCI 332[†] Deterministic Optimization Models and Methods ~~(F)~~
  - MSCI 411[C] Leadership and Influence ~~(S)~~; or BET 450 Leadership

- MSCI 422[A] Economic Impact of Technological Change and Entrepreneurship ~~(F)~~
- MSCI 431[†] Stochastic Models and Methods ~~(W)~~
- MSCI 432[†] Production and Service Operations Management ~~(F,W)~~
- MSCI 433[†] Applications of Management Engineering ~~(W)~~
- MSCI 435[†] Advanced Optimization Techniques ~~(W)~~
- MSCI 442[A] Impact of Information Systems on Organizations and Society ~~(W,S)~~
- MSCI 446[†] Introduction to Machine Learning ~~(W)~~; or one of CS 480, ECE 457B, or SYDE 522
- MSCI 452[†] Decision Making Under Uncertainty ~~(S)~~
- MSCI 454[D] ~~[C]~~ Technical Entrepreneurship ~~(W)~~
- MSCI 531[†] Stochastic Processes and Decision Making ~~(S)~~
- MSCI 541[†] Search Engines ~~(F)~~
- MSCI 543[†] Analytics and User Experience
- MSCI 546[†] Advanced Machine Learning
- MSCI 551[†] Quality Management and Control ~~(F)~~
- MSCI 555[†] Scheduling: Theory and Practice ~~(W)~~
- MSCI 597 Complementary Studies Topics in Management Sciences
- MSCI 598[†] Special Topics in Management Engineering
- CIVE 596 Construction Engineering ~~(S)~~
- ECON 371 Business Finance 1 ~~(F,W,S)~~
- HRM 200[C] Basic Human Resources Management ~~(F,W,S)~~
- SYDE 531[†] Design Optimization Under Probabilistic Uncertainty ~~(W)~~
- SYDE 533 Conflict Resolution ~~(F)~~

Notes

1. At least three of the six courses must be MSCI courses from the Department of Management Sciences.
2. A maximum of one course from outside the approved list may be counted toward the Option, subject to approval of the option co-ordinator.
3. Students may take both MSCI 211 and MSCI 311, in which case, one will count toward the required courses and the other toward the elective courses.
4. ~~For the designation of Management Sciences Option to be shown on the transcript, the student must achieve a minimum cumulative average of 60% in the six courses.~~
5. ~~Refer to the University of Waterloo's official Schedule of Classes for confirmation of actual course offerings each term~~.

For further information about the Management Sciences Option, contact the option co-ordinator in the Management Sciences Department.

Management Sciences Option CLEAN COPY

The Management Sciences Option is not available to Management Engineering students.

Legend

Key	Description
A,B,C	These courses count toward Complementary Studies Course Lists for Engineering: A- Impact of Technology and/or Engineering on Society, B- Engineering Economics, C- Humanities and Social Sciences (excluding courses concentrated on development of language or other skills).
†	These courses may count towards technical elective (or technical breadth elective) requirements. Engineering students should consult the academic advisor in their home department for specific rules that apply to their academic plan.

Requirements

The Option consists of six courses, including two required courses (or their equivalents) and four elective courses (or equivalents).

- The two required courses and equivalents are:
  - MSCI 211^{C} Organizational Behaviour or MSCI 311^{C} Organizational Design and Technology; or PSYCH 238 Organizational Psychology
  - MSCI 331† Introduction to Optimization; or one of BME 411, CHE 521, CIVE 332, CO 250, ENVE 335, or SYDE 411
- Four of the following elective courses or equivalents:
  - MSCI 211^{C} Organizational Behaviour; or PSYCH 238 Organizational Psychology
  - MSCI 261^{B} Engineering Economics: Financial Management for Engineers; or one of AE 392/CIVE 392/ENVE 392/GEOE 392, BME 364, or SYDE 262
  - MSCI 263^{C} Managerial Economics; or ECON 201 Microeconomic Theory for Business and Policy
  - MSCI 311^{C} Organizational Design and Technology
  - MSCI 332† Deterministic Optimization Models and Methods
  - MSCI 411^{C} Leadership and Influence; or BET 450 Leadership
  - MSCI 422^{A} Economic Impact of Technological Change and Entrepreneurship
  - MSCI 431† Stochastic Models and Methods
  - MSCI 432† Production and Service Operations Management
  - MSCI 433† Applications of Management Engineering
  - MSCI 435† Advanced Optimization Techniques
  - MSCI 442^{A} Impact of Information Systems on Organizations and Society
  - MSCI 446† Introduction to Machine Learning; or one of CS 480, ECE 457B, or SYDE 522
  - MSCI 452† Decision Making Under Uncertainty
  - MSCI 454^{C} Technical Entrepreneurship

- MSCI 531† Stochastic Processes and Decision Making
- MSCI 541† Search Engines
- MSCI 543† Analytics and User Experience
- MSCI 546† Advanced Machine Learning
- MSCI 551† Quality Management and Control
- MSCI 555† Scheduling: Theory and Practice
- MSCI 597 Complementary Studies Topics in Management Sciences
- MSCI 598† Special Topics in Management Engineering
- CIVE 596 Construction Engineering
- ECON 371 Business Finance 1
- HRM 200C Basic Human Resources Management
- SYDE 531† Design Optimization Under Probabilistic Uncertainty
- SYDE 533 Conflict Resolution

Notes

1. At least three of the six courses must be MSCI courses from the Department of Management Sciences.
2. A maximum of one course from outside the approved list may be counted toward the Option, subject to approval of the option co-ordinator.
3. Students may take both MSCI 211 and MSCI 311, in which case, one will count toward the required courses and the other toward the elective courses.

For further information about the Management Sciences Option, contact the option co-ordinator in the Management Sciences Department.

6.18. Complementary Studies Electives

Rationale:

Remove Faculty-level rules for choice of Complementary Studies Courses and overhaul of the Complementary Studies Course Lists and associated “notes”.

The use of Complementary Studies Electives in Engineering programs has diverged sufficiently over the last two decades that the use of Faculty-level requirements is no longer reasonable. The four lists are retained, but all Faculty-level requirements have been removed. The distinction between List C and List D has also been made clearer. In addition, due to recent changes in Canadian Engineering Accreditation Board requirements, and to give students more opportunities and choice, the scope of courses that qualify for List C has been broadened. Finally, because the lists have not been systematically reviewed in over twenty years and because there is a desire to make lists in the Calendar as complete as possible, a comprehensive review was performed. As a result, many courses have been added to the lists. Units offering those courses were consulted.

Complementary Studies Requirements for Engineering Students Current Version

Printable Version

In addition to technical knowledge and skill, the professional engineer requires an understanding of society. An ability to make intelligent judgments that encompass human and social values, as well as technical values, is inherent in that role. Such areas form an essential complement to technical studies in the education of an engineer. The Complementary Studies component of the curricula in Engineering (Bachelor of Applied Science or Bachelor of Software Engineering) requires that all students in Engineering receive instruction in the humanities and social sciences, engineering economics, communication, and the impact of technology on society.

The aim of the Complementary Studies component is to provide an understanding of our heritage and social environment, and of the ways in which science and engineering interact with them. These studies should develop sufficient interest to encourage further individual study.

Further objectives are that the Engineering student develop a broader intellectual outlook, a broader understanding of moral, ethical and social values, and an improved ability to communicate.

Requirements

The Complementary Studies component of the students' plan must satisfy the following:

1. At least one course must be taken that deals with the impact of technology on society. Courses which satisfy this requirement appear in List A – Impact Courses.
2. At least one course must be taken in engineering economics. Courses which satisfy this requirement appear in List B – Engineering Economics Courses. Note that core components of a plan may contain a course from this list.
3. At least two courses must be taken that deal with the central issues, methodologies, and thought processes of the humanities and social sciences. Courses that satisfy this requirement appear in List C – Humanities and Social Sciences Courses.
4. A minimum number of courses must be taken as required by a plan. The exact requirements vary according to plans; for details, see individual plan regulations. Courses which appear in Lists A, B, C, and D may be used to meet these requirements.

5. Provision must be made to develop the students' ability to communicate adequately both orally and in writing. The exact manner in which this requirement is satisfied varies according to plan; for details, see individual plan regulations.

Complementary Studies Course Lists

There are a number of other constraints that limit a students' selection from the lists below. These constraints are listed as notes at the end of this page.

Some courses may not be offered in the current academic year. Refer to the course offering lists (Schedule of Classes or Course Selection Offerings) or verify with the department offering the course.

List A – Impact Courses

- BET 360 Design Frameworks for Social Ventures
- BET 420 Entrepreneurship for Social Impact
- BME 381 Biomedical Engineering Ethics
- ENVS 105 Environmental Sustainability and Ethics
- ENVS 205 Sustainability: The Future We Want
- ERS 215 Environmental and Sustainability Assessment 1
- ERS 315 Environmental and Sustainability Assessment 2
- GENE 22A Topics for List A Complementary Studies Courses Taken on Exchange by Engineering Students
- GEOG 203 Environment and Development in a Global Perspective
- GEOG 207 Climate Change Fundamentals
- GEOG 368 Conservation/Resource Management of the Built Environment
- GSJ 205 Technology, Gender, and Social Justice
- MSCI 422 Economic Impact of Technological Change and Entrepreneurship
- MSCI 442 Impact of Information Systems on Organizations and Society
- NE 109 Societal and Environmental Impacts of Nanotechnology
- PACS 315 Engineering and Peace
- PHIL 226 Biomedical Ethics
- SOC 232 Technology and Social Change
- STV 100 Society, Technology and Values: Introduction
- STV 202 Design and Society
- STV 205 Cybernetics and Society
- STV 208 Artificial Intelligence and Society: Impact, Ethics, and Equity
- STV 210 The Computing Society
- STV 302 Information Technology and Society
- STV 304 Technology in Canadian Society
- STV 305 Technology, Society and the Modern City
- STV 306 Biotechnology and Society
- SYDE 261 Design, Systems, and Society

Other courses may be acceptable for this requirement. Prior approval is required from the student's department associate chair.

List B – Engineering Economics Courses

- AE 392 Economics and Life Cycle Analysis
- BME 364 Engineering Biomedical Economics
- CIVE 392 Economics and Life Cycle Cost Analysis
- GENE 22B Topics for List B Complementary Studies Courses Taken on Exchange by Engineering Students
- MSCI 261 Engineering Economics: Financial Management for Engineers
- SYDE 262 Engineering Economics of Design

List C – Humanities and Social Sciences Courses

Course scheduling is an evolving process at the University of Waterloo and it is difficult to ensure access to all possible Complementary Studies courses. One of the steps taken to improve students' chances of having access to their Complementary Studies courses for those terms that have a Complementary Studies course requirement, is that course components (lectures, tutorials, or labs) of core engineering courses will not be scheduled during specified time slots. Currently, these slots are Monday, Wednesday, and Friday from 11:30 a.m. to 12:30 p.m., as well as evening time slots on Monday or Tuesday from 7 p.m. to 10 p.m.

The following humanities and social sciences courses are permissible. In general, all literature and civilization courses in language departments are approved as humanities and social sciences courses.

Anthropology: All ANTH
Architectural Engineering: AE 101
Arts: ARTS 490 (Topic title: Global Engagement Seminar)
Business Entrepreneurship and Technology: BET 100, BET 300, BET 320, BET 340, BET 350, BET 400, BET 430, BET 450, BET 460, BET 580
Classical Studies: All CLAS
East Asian Studies: EASIA 100R
Economics: All ECON, except ECON 211, ECON 221, ECON 311, ECON 371, ECON 412, ECON 421, ECON 422, ECON 471
English: All ENGL, except ENGL 109, ENGL 119, ENGL 129R, ENGL 140R, ENGL 210E, ENGL 210F
Environment: ENVS 195, ENVS 205
Fine Arts (FINE): see home department associate chair
French Studies: FR 296, FR 297
Gender and Social Justice: All GSJ, except GSJ 371 (may be acceptable at the discretion of the associate chair when a course outline is shown)
General Engineering: GENE 22C (Topics taken on exchange by Engineering students), GENE 412
Geography and Environmental Management: GEOG 101, GEOG 202, GEOG 203, GEOG 368
Gerontology: GERON 201
History: All HIST, except HIST 400-level courses
Human Resources Management: All HRM
Human Sciences: HUMSC 101, HUMSC 102
International Studies: INTST 101
Kinesiology: KIN 352, KIN 354
Knowledge Integration: INTEG 120, INTEG 210, INTEG 220, INTEG 221, INTEG 251
Legal Studies: LS 101, LS 202
Management Sciences: MSCI 211, MSCI 263, MSCI 311, MSCI 411
Music: MUSIC 140, MUSIC 253, MUSIC 256, MUSIC 334, MUSIC 355, MUSIC 363
Peace and Conflict Studies: All PACS
Philosophy: All PHIL, except PHIL 145, PHIL 200J, PHIL 216, PHIL 240, PHIL 256, PHIL 257, PHIL 441
Planning: PLAN 100
Political Science: All PSCI, except PSCI 314, PSCI 315
Psychology: All PSYCH, except PSYCH 207, PSYCH 256, PSYCH 261, PSYCH 291, PSYCH 292, PSYCH 306, PSYCH 307, PSYCH 312, PSYCH 317, PSYCH 391; PSYCH 400-level courses need approval of the Department of Psychology
Public Health Sciences: HLTH 320
Recreation and Leisure Studies: REC 230, REC 425
Religious Studies: All RS
Sexuality, Marriage, and Family Studies: All SMF
Social Development Studies: All SDS, except SDS 150R, SDS 250R, SDS 251R, SDS 350R, SDS 398R, SDS 399R
Social Work: All SOCWK, except SOCWK 390A, SOCWK 390B, SOCWK 398R, SOCWK 399R
Society, Technology and Values: All STV
Sociology: All SOC, except SOC 221, SOC 280, SOC 322, SOC 498, SOC 499A, SOC 499B
Studies in Islam: SI 121R, SI 132R, SI 221R, SI 230R, SI 231R, SI 315R
Theatre and Performance: THPERF 100, THPERF 200

List D – Other Permissible Complementary Studies Courses

While the following courses may not be used to satisfy Requirements 1, 2, or 3, they may be used to satisfy Requirement 4. For details, see departmental regulations.

Accounting and Financial Management: AFM 131
Applied Language Studies: APPLS 205R, APPLS 301, APPLS 304R, APPLS 306R
Architectural Engineering: AE 491
Civil Engineering: CIVE 491
English: ENGL 109, ENGL 129R, ENGL 191, ENGL 192, ENGL 210E, ENGL 210F
English for Multilingual Speakers: EMLS 101R, EMLS 102R, EMLS 110R, EMLS 129R
Environment: ENVS 201, ENVS 401
Environmental Engineering: ENVE 391
Fine Arts (FINE): see home department associate chair
General Engineering: GENE 22D (Topics taken on exchange by Engineering students), GENE 315, GENE 415
Health: HEALTH 100, HEALTH 105
Management Sciences: MSCI 454
Music: MUSIC 100, MUSIC 231, MUSIC 240, MUSIC 246, MUSIC 254, MUSIC 255, MUSIC 260, MUSIC 361
Philosophy: PHIL 145, PHIL 200J, PHIL 216, PHIL 256, PHIL 257
Psychology: PSYCH 256, PSYCH 307, PSYCH 312, PSYCH 317
Recreation and Leisure Studies: REC 100
Speech Communication: SPCOM 100, SPCOM 191, SPCOM 192, SPCOM 223

Notes

1. Some University of Waterloo online courses may be taken during a student's work terms. Also, courses taken at another university during a work term may be eligible for a transfer of credit if approved by the student's associate chair for undergraduate studies.
2. Students who register early are most likely to get their choice. Attempts to register later may be prevented if the class is already at capacity.
3. For descriptions of the content of courses, see the Course Description section of this Calendar. These courses are usually listed under the subject code of the academic unit, board, or faculty responsible for offering the course, e.g., CIVE – Civil Engineering, PHIL – Philosophy, etc.
4. Students who wish to take linguistic and grammar courses must have their choices approved by their home department associate chair for undergraduate studies and, if approved, students must also be assessed by the language department to determine their skill level with the language. Such courses may only be used to satisfy Requirement 4 above.
5. Students are responsible for ensuring they have the necessary prerequisites.
6. Departments and boards may impose additional constraints with respect to the C and D lists of the Complementary Studies Requirements. Review the various plan descriptions for further information.
7. In exceptional circumstances, associate chairs for undergraduate studies may accept other courses as satisfying a specific Complementary Studies Elective (CSE) requirement. Normally, such consideration will only be given when students are returning from exchange or being offered advanced admission.
8. Access to some courses is not controlled by Engineering and students may not qualify for some courses on these lists.

Complementary Studies Course Lists for Engineering CLEAN COPY (new)

Requirements for all Engineering plans (Bachelor of Applied Science or Bachelor of Software Engineering) include the development of non-technical knowledge and skills to complement technical knowledge and skills. Specific Engineering plans refer to one or more of the following lists of courses that contain substantial complementary studies content:

List A: Impact of Technology and/or Engineering on Society

List B: Engineering Economics

List C: Humanities and Social Sciences (excluding courses concentrated on development of language or other skills)

List D: Humanities and Social Sciences (courses concentrated on development of language or other skills)

Notes

1. In exceptional circumstances, academic advisors may deem a course that is not included in one of the lists below to be a reasonable fit for one or more of the lists. Normally such consideration will be given only for special topics or project courses where the advisor determines that the topic of the course or project is suitable, or in cases when students are returning from exchange, being offered advanced admission, transferring to Engineering from a non-Engineering plan, taking a secondary plan (e.g., a minor) that involves courses not normally available to Engineering students, or taking a course at another institution via a Letter of Permission.
2. Rarely, plan requirements may stipulate that students in that plan are not permitted to count a certain course in List A, B, C, or D even though the course is included in one or more of the lists below. See individual plan requirements for details.
3. Unless permitted otherwise in the individual plan requirements, a course that appears in more than one of the four lists below may be counted only once; for example, STV 100 may be counted as a List A course or a List C course, but not both.
4. Access to most courses in the lists below is not controlled by Engineering, and successful enrolment is not guaranteed. Some courses may not be offered in the current academic year, scheduling conflicts may be unavoidable, the demand for some courses may be higher than can be accommodated, and enrolment in some courses requires instructor consent.
5. Most upper-year courses have prerequisites or minimum expectations about student background. Students are responsible for ensuring that they meet the necessary prerequisites and background for all courses.
6. Some courses in List D are restricted to those who have a certain minimum or maximum background skill level (e.g., CHINA 101R is open only to students with little or no prior background in the Chinese language and MUSIC 111 is open only to students with minimal musical background). Students interested in one of these courses may be assessed by the department offering the course to determine if their background skill level is suitable, and on that basis the department has the right to refuse admission to, or grant credit for, courses.

Complementary Studies Course Lists

List A - Impact of Technology and/or Engineering on Society

- ANTH 106
- BET 360, BET 420
- BME 381
- CS 492
- ENVS 105, ENVS 205
- ERS 215, ERS 315
- GENE 22A
- GEOG 203, GEOG 207, GEOG 306, GEOG 368/PLAN 341
- GSJ 205
- MSCI 422, MSCI 442
- NE 109

- PACS 315
- PHIL 226
- SOC 232, SOC 324
- STV 100, STV 202, STV 205, STV 208, STV 210/HIST 212, STV 302, STV 304, STV 305, STV 306
- SYDE 261

List B - Engineering Economics

- AE 392/CIVE 392/ENVE 392/GEOE 392
- BME 364
- GENE 22B
- MSCI 261
- SYDE 262

List C - Humanities and Social Sciences (excluding courses concentrated on development of language or other skills)

- Accounting and Financial Management: AFM 131/ARBUS 101, AFM 333/ARBUS 301
- Anthropology: All ANTH, except ANTH 204, ANTH 251, ANTH 289, ANTH 305, ANTH 345, ANTH 355, ANTH 365, ANTH 371, ANTH 372, ANTH 377, ANTH 389, ANTH 391, ANTH 395, ANTH 455, ANTH 489, ANTH 498, ANTH 499A, ANTH 499B
- Applied Language Studies: All APPLS
- Architectural Engineering: AE 101, AE 491
- Arts: ARTS 122, ARTS 490 (Topic title: Global Engagement Seminar)
- Aviation: AVIA 100
- Biomedical Engineering: BME 381, BME 530
- Black Studies: BLKST 101, BLKST 102/VCULT 112/SPCOM 112/THPERF 112, BLKST 103, BLKST 201, BLKST 202, BLKST 203/ENGL 225, BLKST 210/ENGL 326, BLKST 224/SPCOM 224/THPERF 224, BLKST 230, BLKST 240/ENGL 327, BLKST 244/ENGL 328, BLKST 302, BLKST 304/PSCI 304, BLKST 309, BLKST 317/SPAN 317, BLKST 330, BLKST 410/ENGL 405, BLKST 421
- Business Entrepreneurship and Technology: BET 100, BET 300, BET 320, BET 340, BET 350, BET 400, BET 411, BET 420, BET 430, BET 450, BET 460, BET 470, BET 580
- Canadian Studies: All CDNST
- Church Music and Worship: CMW 363/MUSIC 363/RS 357, CMW 364/MUSIC 364/RS 358
- Civil Engineering: CIVE 491
- Classical Studies: All CLAS, except CLAS 390, CLAS 400-level courses
- Cognitive Science: COGSCI 300/PHIL 356
- Commerce: COMM 400
- Computer Science: CS 492
- Cultural Identities: CI 100, CI 200/GER 200, CI 250, CI 300/SPAN 300, CI 329/SPAN 329
- Dutch: DUTCH 271
- East Asian Studies: All EASIA, except EASIA 250R, EASIA 291R, EASIA 391R
- Economics: All ECON, except ECON 100/COMM 103, ECON 211, ECON 221, ECON 290, ECON 311, ECON 322, ECON 323, ECON 361, ECON 363, ECON 371, ECON 372, ECON 381, ECON 382, ECON 391, ECON 392, ECON 412, ECON 42x-level courses, ECON 452, ECON 456, ECON 47x-level courses, ECON 48x-level courses, ECON 49x-level courses
- English: All ENGL, except ENGL 109, ENGL 119, ENGL 129R/EMLS 129R, ENGL 140R, ENGL 191/SPCOM 191, ENGL 192/SPCOM 192, ENGL 193/SPCOM 193, ENGL 203/DAC 201, ENGL 204/DAC 202, ENGL 209, ENGL 210E, ENGL 210F, ENGL 210G, ENGL 210H, ENGL 210I/LS

291, ENGL 210J, ENGL 303/DAC 300/SPCOM 300, ENGL 304/DAC 203, ENGL 306A, ENGL 306B, ENGL 306G, ENGL 309E/SPCOM 323, ENGL 373/BLKST 308, ENGL 375/BLKST 310, ENGL 378/MTHEL 300, ENGL 403/DAC 400, ENGL 408B, ENGL 408C, ENGL 472, ENGL 48x-level courses, ENGL 49x-level courses

- Environment and Business: ENBUS 102, ENBUS 112, ENBUS 203, ENBUS 211, ENBUS 302, ENBUS 309, ENBUS 310, ENBUS 315, ENBUS 405, ENBUS 408, ENBUS 411
- Environment, Resources and Sustainability: ERS 100, ERS 215, ERS 222, ERS 225, ERS 253, ERS 288/ENGL 248, ERS 294/RS 285, ERS 315, ERS 320, ERS 328, ERS 361/GEOG 361, ERS 365, ERS 370, ERS 372, ERS 404/PSCI 432, ERS 406, ERS 454, ERS 460/GEOG 460, ERS 462/GEOG 462/PSCI 488
- Environment: ENVS 105, ENVS 195, ENVS 201, ENVS 205, ENVS 210, ENVS 220, ENVS 310, ENVS 350, ENVS 401
- Environmental Engineering: ENVE 391/GEOE 391
- Fine Arts: FINE 101/VCULT 101, FINE 102/VCULT 100, FINE 112, FINE 209, FINE 210, FINE 212, FINE 213, FINE 214, FINE 215, FINE 216/INDG 216, FINE 217, FINE 241/CLAS 241, FINE 242/CLAS 242, FINE 244, FINE 245, FINE 252/RS 270, FINE 256, FINE 257, FINE 258, FINE 259, FINE 262/GSJ 262, FINE 275/EASIA 231R/SI 231R, FINE 281, FINE 282, FINE 319, FINE 338/PHIL 331, FINE 341/CLAS 341, FINE 342/CLAS 342, FINE 362/GER 362, FINE 364/GER 364/REES 364, FINE 368, FINE 377/RS 377
- French Studies: FR 276, FR 291, FR 292, FR 296, FR 297, FR 332, FR 343, FR 354, FR 363, FR 365, FR 367, FR 373, FR 375, FR 410, FR 424, FR 471, FR 473, FR 484, FR 485, FR 487
- Gender and Social Justice: All GSJ, except GSJ 271, GSJ 371, GSJ 401/HLTH 401, GSJ 402/PHIL 402, GSJ 408/REC 408, GSJ 410/ENGL 410, GSJ 463/ENGL 463, GSJ 472, GSJ 473
- General Engineering: GENE 22C, GENE 315, GENE 415
- Geological Engineering: GEOE 391/ENVE 391
- Geography and Environmental Management: GEOG 101, GEOG 202, GEOG 203, GEOG 207, GEOG 215, GEOG 219, GEOG 222, GEOG 225, GEOG 233, GEOG 302, GEOG 306, GEOG 307, GEOG 314, GEOG 323/REC 383, GEOG 325, GEOG 336, GEOG 340, GEOG 349/PLAN 349, GEOG 361/ERS 361, GEOG 368/PLAN 341, GEOG 411, GEOG 423, GEOG 432/HLTH 420/PLAN 432, GEOG 460/ERS 460, GEOG 462/ERS 462/PSCI 488
- German: GER 100, GER 120/REES 220, GER 180/REES 180, GER 200/CI 200, GER 230, GER 261/REES 261, GER 262/REES 262, GER 271, GER 272, GER 283/JS 233/RS 272, GER 286/PHIL 286J, GER 301/APPLS 301, GER 330, GER 362/FINE 362, GER 363/FINE 363, GER 364/FINE 364/REES 364, GER 383, GER 385/REES 385
- Gerontology: GERON 201/HLTH 201, GERON 218/HLTH 218/PSYCH 218, GERON 352/KIN 352/HLTH 352/REC 362/SOC 352
- Greek: GRK 421
- History: All HIST, except HIST 391, HIST 397, HIST 398, HIST 400-level courses
- Human Resources Management: HRM 200
- Human Rights: All HRTS, except HRTS 390, HRTS 490
- Human Sciences: HUMSC 101, HUMSC 102, HUMSC 201, HUMSC 301, HUMSC 401, HUMSC 490
- Indigenous Entrepreneurship: INDENT 200, INDENT 210
- Indigenous Studies: All INDG, except INDG 101/MOHAWK 101R, INDG 102/MOHAWK 102R
- International Development: INDEV 100, INDEV 101, INDEV 200, INDEV 212, INDEV 262/PLAN 262, INDEV 300/PHIL 227, INDEV 302, INDEV 308, INDEV 387, INDEV 404, INDEV 475, INDEV 478
- International Studies: INTST 101
- Italian Studies: All ITALST, except ITALST 296, ITALST 394, ITALST 396
- Jewish Studies: All JS, except JS 350, JS 450
- Kinesiology: KIN 352/GERON 352/HLTH 352/REC 362/SOC 352, KIN 354

- Knowledge Integration: INTEG 120, INTEG 220/PHIL 290, INTEG 221/PHIL 291, INTEG 240, INTEG 251
- Latin: LAT 202, LAT 331, LAT 332, LAT 381, LAT 421
- Legal Studies: All LS, except LS 203, LS 221/SOC 221, LS 229/SOC 229, LS 280/SOC 280, LS 283/AFM 231, LS 322/SOC 322, LS 330, LS 403, LS 404, LS 405, LS 413/SOC 413, LS 419/SOC 419, LS 422/SOC 422, LS 423/SOC 423, LS 425/SOC 425, LS 426/SOC 426, LS 428/SOC 428, LS 431, LS 433/SOC 433, LS 434/SOC 434, LS 435/SOC 435, LS 461/SOC 461, LS 496, LS 498
- Management: MGMT 220, MGMT 244/ARBUS 302, MGMT 345/ARBUS 303
- Management Sciences: MSCI 211, MSCI 263, MSCI 311, MSCI 411, MSCI 422, MSCI 442, MSCI 454
- Medieval Studies: All MEDVL, except MEDVL 291, MEDVL 391, MEDVL 491
- Mennonite Studies: MENN 125
- Music: MUSIC 100, MUSIC 110, MUSIC 140, MUSIC 231, MUSIC 232, MUSIC 240, MUSIC 246, MUSIC 253, MUSIC 254, MUSIC 255, MUSIC 256, MUSIC 260, MUSIC 261, MUSIC 262, MUSIC 332, MUSIC 333, MUSIC 334/GSJ 334, MUSIC 335/PACS 335, MUSIC 361, MUSIC 362, MUSIC 363/CMW 363/RS 357, MUSIC 364/CMW 364/RS 358
- Nanotechnology Engineering: NE 109
- Peace and Conflict Studies: All PACS, except PACS 290, PACS 301, PACS 302, all PACS 39x-level courses, all PACS 400-level courses
- Philosophy: All PHIL, except PHIL 216, PHIL 240, PHIL 252/SCI 252, PHIL 271, PHIL 340, PHIL 350, PHIL 355, PHIL 358, PHIL 371, PHIL 40x-level courses, PHIL 41x-level courses, PHIL 42x-level courses, PHIL 43x-level courses, PHIL 44x-level courses, PHIL 452, PHIL 455, PHIL 458, PHIL 459, PHIL 46x-level courses, PHIL 47x-level courses, PHIL 48x-level courses, PHIL 49x-level courses
- Planning: PLAN 100, PLAN 262/INDEV 262, PLAN 341/GEOG 368, PLAN 349/GEOG 349, PLAN 362, PLAN 414/REC 425, PLAN 415, PLAN 431, PLAN 432/GEOG 432/HLTH 420, PLAN 433, PLAN 471
- Political Science: All PSCI, except PSCI 299, PSCI 314, PSCI 315, PSCI 360, PSCI 390, PSCI 391, PSCI 400, PSCI 403, PSCI 426, PSCI 433, PSCI 437, PSCI 485, PSCI 49x-level courses
- Psychology: All PSYCH, except PSYCH 207, PSYCH 261, PSYCH 264, PSYCH 291, PSYCH 292, PSYCH 306, PSYCH 307, PSYCH 335, PSYCH 363, PSYCH 375R, PSYCH 389, PSYCH 39x-level courses, PSYCH 420, PSYCH 447/PHIL 447, PSYCH 45x-level courses, PSYCH 46x-level courses, PSYCH 47x-level courses, PSYCH 48x-level courses, PSYCH 49x-level courses
- Public Health Sciences: HLTH 101, HLTH 102, HLTH 201/GERON 201, HLTH 218/GERON 218/PSYCH 218, HLTH 245/GERON 245, HLTH 253/SOC 253, HLTH 260/GSJ 260, HLTH 301, HLTH 320/GERON 320, HLTH 352/GERON 352/KIN 352/REC 362/SOC 352, HLTH 380/GSJ 380, HLTH 412, HLTH 420/GEOG 432/PLAN 432
- Recreation and Leisure Studies: REC 100, REC 101, REC 200, REC 201, REC 202/HIST 205, REC 203/SOC 210, REC 206/PHIL 206, REC 219, REC 230, REC 280, REC 306/GSJ 306, REC 319, REC 356, REC 361, REC 362/GERON 352/HLTH 352/KIN 352/SOC 352, REC 383/GEOG 323, REC 408/GSJ 408, REC 422, REC 425/PLAN 414
- Religious Studies: All RS, except RS 101/GRK 101, RS 102/GRK 102, RS 223/GRK 201, RS 224/GRK 202, RS 271/FINE 253, RS 291, RS 391, RS 395, RS 398, RS 462/SOC 402, RS 491, RS 495, RS 498, RS 499
- Russian and East European Studies: All REES, except REES 260
- Science: SCI 266/PHIL 260/CLAS 260, SCI 267/PHIL 258
- Sexuality, Marriage, and Family Studies: All SMF, except SMF 200, SMF 220, SMF 230, SMF 310, SMF 365, SMF 366, SMF 400-level courses
- Social Development Studies: All SDS, except SDS 150R, SDS 250R/SWREN 250R, SDS 251R/SWREN 251R, SDS 370R, SDS 375R, SDS 398R, SDS 399R, SDS 450R, SDS 451R, SDS 49x-level courses

- Social Work: All SOCWK, except SOCWK 375R, SOCWK 390A, SOCWK 390B, SOCWK 398R, SOCWK 399R, SOCWK 450R, SOCWK 490R
- Society, Technology and Values: All STV, except STV 201, STV 400, STV 401
- Sociology: All SOC, except SOC 221/LS 221, SOC 229/LS 229, SOC 230, SOC 280/LS 280, SOC 322/LS 322, SOC 330, SOC 362, SOC 375R, SOC 398R, SOC 399R, SOC 40x-level courses, SOC 41x-level courses, SOC 42x-level courses, SOC 430, SOC 432, SOC 433/LS 433, SOC 434/LS 434, SOC 435/LS 435, SOC 436, SOC 44x-level courses, SOC 45x-level courses, SOC 46x-level courses, SOC 49x-level courses
- Spanish: SPAN 150, SPAN 217, SPAN 234, SPAN 300/CI 300, SPAN 317/BLKST 317, SPAN 326, SPAN 329/CI 329, SPAN 387, SPAN 400, SPAN 410, SPAN 430/GSJ 430
- Speech Communication: SPCOM 101, SPCOM 112/BLKST 102/VCULT 112/THPERF 112, SPCOM 201, SPCOM 210, SPCOM 224/BLKST 224/THPERF 224, SPCOM 226, SPCOM 228, SPCOM 335, SPCOM 339, SPCOM 399, SPCOM 401, SPCOM 402, SPCOM 420, SPCOM 430/LS 492, SPCOM 431, SPCOM 432, SPCOM 434/ENGL 309G/GSJ 309/HIST 309, SPCOM 435, SPCOM 471/LS 471, SPCOM 475, SPCOM 479
- Studies in Islam: All SI, except SI 375R
- Systems Design Engineering: SYDE 261
- Theatre and Performance: THPERF 112/BLKST 102/VCULT 112/SPCOM 112, THPERF 200, THPERF 224/BLKST 224/SPCOM 224, THPERF 246, THPERF 248, THPERF 278, THPERF 280, THPERF 282, THPERF 300, THPERF 371, THPERF 374, THPERF 376, THPERF 378, THPERF 386/ENGL 362, THPERF 387/ENGL 363

- Visual Culture: VCULT 100/FINE 102, VCULT 101/FINE 101, VCULT 112/BLKST 102/SPCOM 102/THPERF 112, VCULT 200, VCULT 300

List D - Humanities and Social Sciences (courses concentrated on development of language or other skills)

- American Sign Language: All ASL
- Anthropology: ANTH 251
- Arabic: All ARABIC
- Black Studies: BLKST 303, BLKST 308/ENGL 373, BLKST 310/ENGL 375, BLKST 380/THPERF 380, BLKST 499
- Chinese: All CHINA, except CHINA 391R
- Croatian: CROAT 101, CROAT 102
- Dutch: DUTCH 101, DUTCH 102
- English: ENGL 109, ENGL 119, ENGL 129R/EMLS 129R, ENGL 140R, ENGL 191/SPCOM 191, ENGL 192/SPCOM 192, ENGL 209, ENGL 210E, ENGL 210F, ENGL 210G, ENGL 210H, ENGL 210I/LS 291, ENGL 210J, ENGL 304/DAC 203, ENGL 306A, ENGL 306B, ENGL 306G, ENGL 309E/SPCOM 323, ENGL 373/BLKST 308, ENGL 375/BLKST 310, ENGL 408B, ENGL 408C
- English for Multilingual Speakers: All EMLS
- Environment: ENVS 131
- Environment, Resources and Sustainability: ERS 318
- Fine Arts: FINE 130, FINE 150
- French Studies: FR 101, FR 151, FR 152, FR 192A, FR 192B, FR 203, FR 250, FR 251, FR 252, FR 255, FR 303, FR 351, FR 353, FR 355, FR 400, FR 452
- General Engineering: GENE 22D, GENE 315, GENE 415
- Geography and Environmental Management: GEOG 417
- German: GER 101, GER 102, GER 201, GER 202, GER 211, GER 250, GER 261/REES 261, GER 303, GER 304, GER 307, GER 308, GER 331, GER 350

- Greek: GRK 101/RS 101, GRK 102/RS 102, GRK 105, GRK 201/RS 223, GRK 202/RS 224, GRK 331, GRK 332, GRK 351, GRK 451
- Health: HEALTH 100, HEALTH 105
- Indigenous Studies: INDG 101/MOHAWK 101R, INDG 102/MOHAWK 102R
- Italian: All ITAL, except ITAL 396
- Japanese: All JAPAN, except JAPAN 391R
- Knowledge Integration: INTEG 210, INTEG 410
- Korean: All KOREA, except KOREA 391R
- Latin: LAT 101, LAT 102, LAT 201, LAT 351, LAT 422, LAT 451
- Mohawk: MOHAWK 101R/INDG 101, MOHAWK 102R/INDG 102
- Music: MUSIC 111, MUSIC 222, MUSIC 226, MUSIC 227, MUSIC 233, MUSIC 270, MUSIC 271, MUSIC 275, MUSIC 322, MUSIC 370, MUSIC 371, MUSIC 376
- Portuguese: PORT 101, PORT 102
- Religious Studies: RS 101/GRK 101, RS 102/GRK 102, RS 223/GRK 201, RS 224/GRK 202
- Russian: RUSS 101, RUSS 102
- Spanish: SPAN 101, SPAN 102, SPAN 201A, SPAN 201B, SPAN 210, SPAN 290, SPAN 301A, SPAN 301B, SPAN 390, SPAN 395, SPAN 490
- Speech Communication: SPCOM 100, SPCOM 102/THPERF 102, SPCOM 149/THPERF 149, SPCOM 191/ENGL 191, SPCOM 192/ENGL 192, SPCOM 220/THPERF 220, SPCOM 223, SPCOM 225, SPCOM 227, SPCOM 323/ENGL 309E, SPCOM 324, SPCOM 325, SPCOM 326/THPERF 326, SPCOM 433, SPCOM 440/THPERF 440
- Theatre and Performance: THPERF 100, THPERF 102/SPCOM 102, THPERF 149/SPCOM 149, THPERF 220/SPCOM 220, THPERF 221, THPERF 222, THPERF 284, THPERF 301, THPERF 321, THPERF 322, THPERF 326/SPCOM 326, THPERF 343, THPERF 361, THPERF 366, THPERF 368, THPERF 379, THPERF 380/BLKST 380, THPERF 389, THPERF 440/SPCOM 440

7. Other

7.1. Electrical Engineering

Rationale:
Move all electrical engineering students into stream 4F. A significant fraction of the electrical engineering students have been transferring to computer engineering with the result that the enrolment in 2B and 3A EE core courses has been quite low recently. Putting all the EE students into one 4F stream will make students feel less isolated, will help with class spirit, will reduce transfers, and will make better use of teaching resources.

Study/Work Sequence

Legend for Study/Work Sequence Information Table

Key	Description
S/S	Engineering sequence/stream: 8=Stream 8, 4=Stream 4; 8D, 4D=two academic terms and two work terms back to back; 4F=both streams meet up in the 3B fall term; 8S and 4S=special sequencing of terms; 8X=one extended work term
F,W,S	Terms: F=September-December; W=January-April; S=May-August
1,2,3,4 plus A or B	Denotes academic year and term.
WT	Denotes scheduled work term.
1	The streaming for Computer Engineering varies depending on demand. With permission and co-ordination through the ECE Undergraduate Office, it is possible to create eight-month co-operative work terms by rearranging the term sequence.

Study/Work Sequence Information

Plan	S/S	F	W	S	F	W	S	F	W	S	F	W	S	F	W
Architectural	4S	1A	WT	1B	WT	2A	WT	2B	WT	3A	WT	3B	4A	WT	4B
Biomedical, Mechatronics	8X	1A	1B	WT	2A	WT	2B	WT	3A	WT	3B	WT	WT	4A	4B
Chemical	4D	1A	WT	1B	WT	2A	WT	2B	WT	3A	3B	WT	WT	4A	4B
Chemical	8D	1A	1B	WT	2A	WT	2B	WT	3A	WT	WT	3B	WT	4A	4B
Civil, Computer[1], ~~Electrical[1]~~, Management, Mechanical	8	1A	1B	WT	2A	WT	2B	WT	3A	WT	3B	WT	4A	WT	4B
Computer[1], Electrical	4F	1A	WT	1B	WT	2A	WT	2B	WT	3A	3B	WT	4A	WT	4B
Environmental, Geological, Mechanical, Mechatronics, Systems Design	4	1A	WT	1B	WT	2A	WT	2B	WT	3A	WT	3B	WT	4A	4B
Nanotechnology	8S	1A	1B	WT	2A	WT	2B	WT	WT	3A	3B	WT	WT	4A	4B
Software	8	1A	1B	WT	2A	WT	2B	WT	3A	WT	3B	WT	4A	WT	4B

7.2 Temporary Calendar Deviations due to the Pandemic

Background:

The following tables summarize all temporary Calendar deviations that programs made in W2022 to deal with conditions caused by the COVID-19 pandemic. The Faculty and University want an official record of the changes that are significant enough that they impact what is written in the calendar.

W2022 FINAL LIST OF CALENDAR DEVIATIONS AFFECTING PROGRAMS IN FACULTY OF ENGINEERING

Plan	W2022 Calendar Deviations
Architectural Engineering	No deviations
Architecture	ARCH126: no field trip due to covid restrictions ARCH392: no field trip due to covid restrictions
Biomedical Engineering	No deviations
Chemical Engineering	WKRPT200/300/400: Students may submit a reflective report in lieu of a technical report
Civil Engineering	No deviations
Electrical Engineering and Computer Engineering	WKRPT201/301/401: 3A, 3B, and 4B students were allowed to complete a work term reflection in place of the normal work-term reports
Environmental Engineering	No deviations
Geological Engineering	No deviations
Management Engineering	No deviations
Mechanical Engineering	No deviations
Mechatronics Engineering	No deviations
Nanotechnology Engineering	NE450: This course was moved from F2021. Students may submit a reflective report instead of a technical report. The course will be coded as DRNA. This cohort of students has already passed technical report requirements (in NE250 and NE350)
Software Engineering	No deviations
Systems Design Engineering	SYDE263: This course is being graded on a CR/NCR basis.

OCTOBER 2022
SENATE UNDERGRADUATE COUNCIL
Submission by the Faculty of Mathematics

1. New Courses
   1.1. ACTSC 362
   1.2. AMATH 333, AMATH 499
2. Course changes
   2.1. Offer Online: CO 331, CS 105, CS 106, CS 115, CS 116, CS 231, CS 234, MATH 207
   2.2. Requisites: CO 471, CS 240E, CS 383
   2.3. Add components: CS 251, MATH 127, MATH 128
   2.4. Clearer descriptions & reqs: CS 349, MATH 213
   2.5. Material reshuffle in P&C sequence: ACTSC 363, ACTSC 431, ACTSC 432
3. Course Inactivation
   3.1. WKRPT 200M, WKRPT 300M, WKRPT 400M
   3.2. ACTSC 463 (material now covered in ACTSC 362)
4. Academic Plan Changes – Minor Modifications
   4.1. Undergraduate Communication Requirement
   4.2. Upgrading from General Degree to Honours Degree
   4.3. The Repeat Rule
   4.4. Artificial Intelligence Specialization
   4.5. Amendment to previously approved modification to Math/CPA and Data Analytics specialization
   4.6. Co-op Work Term Report Requirements

NEW COURSES (for approval)

Applied Mathematics

Effective 01-SEP-2023

AMATH 333 (0.50) LEC Differential Geometry in Applied Mathematics and Physics

Manifolds and tensors, Lie derivatives and Lie groups, differential forms and applications to physics. This course covers the basic concepts of differential geometry from the perspective of its applications to physics. The course focuses on the concepts and the techniques that allow us to formulate physical problems in the powerful language of differential geometry including thermodynamics, classical mechanics, fluid dynamics, and relativity. [Offered: F]

Requisites : Prereq: PHYS 121; One of MATH 114, 136, 146; One of AMATH 231, MATH 227, PMATH 365

Rationale : While upper year mathematical physics courses need differential geometry and are currently self-contained, popular demand by AMATH and Physics students suggests creating a course that will help prepare students for various courses. PMATH 365 is another differential geometry course but doesn't cover topics needed for general relativity and quantum theory, in particular a coordinate focused notation. The courses chosen in the prerequisites are those in which students would have developed familiarity with Stokes/Green theorem. Short Title: Diff Geom in Appl Math & Phys

Effective 01-SEP-2023

AMATH 499 (0.50) PRJ, SEM Research Project

A research-based course that allows students with an interest in applied mathematics or mathematical physics to participate in a research project with a faculty member. The student is required to approach a faculty member of the applied mathematics department for supervision. The enrolled student is expected to hand in a written report of their research to the supervisor and present a summary of the project orally in front of a subset of the applied mathematics undergraduate committee as a final assessment. [Offered:S]

Requisites : Prereq: Level at least 4A students Applied Mathematics (all specializations), Mathematical Physics (Faculty of Mathematics), Joint Applied Mathematics, or Applied Mathematics with Scientific Computing.

Rationale : Offers students an opportunity to experience undergraduate research with applied mathematics faculty members as part of their undergraduate degree. Students will require department consent and an applied faculty member approval for supervision for course. Short Title: Research Project

Statistics & Actuarial Science

Effective 01-SEP-2023

ACTSC 362 (0.50) LEC, TUT Introduction to Property & Casualty Practice

Introduction to property & casualty coverages. Claim payment process, development triangles and diagnostic testing. Estimating ultimate claims using development, frequency-severity, expected and Bornhuetter Ferguson methods. Estimating unpaid claim and unallocated loss adjustment expense liabilities. Ratemaking process, including expense provisions, profit and contingencies, and adjustments for catastrophes and large losses. Pricing for deductibles and increased limits. Introduction to reinsurance pricing and reserving. Commercial lines pricing. [Offered: F,W]

Requisites : Prereq: ACTSC 231 with a grade of at least 60%; Actuarial Science or Mathematical Finance students only.
Coreq: STAT 231 or 241

Rationale : Create this new third-year ACTSC course to provide students with the introductory material on pricing and reserving in the field of property & casualty insurance at an early stage of their actuarial science major.
Short Title: Intro Prop & Casualty Practice

COURSE CHANGES (for approval)

Combinatorics & Optimization

Current Catalog Information

CO 331 (0.50) LEC Coding Theory

A first course in error-correcting codes. Linear block codes, Hamming-Golay codes, and multiple error-correcting BCH codes are studied. Various encoding and decoding schemes are considered. [Offered: W]

No Special Consent Required

Requisites : Prereq: MATH 225 or 235 or 245

Effective 01-SEP-2023

Course Attribute Change: Only Offered Online

Rationale : The CO 331 content hasn't changed since the mid-1980's, and can't really be updated since the modern codes are mostly out of scope for an undergraduate course. Hence an online offering will remain relevant far into the future without high maintenance requirements.

There is still strong demand for the course. The previous four offerings have had (total / enrolment cap) 53/60 (2019), 68/65 (2020), 89/95 (2021), and 74/75 (2022) students.

The course isn't difficult, so even the weaker students will be able to handle the material without in-person contact with an instructor.

The instructor (Prof. Menezes) made videos available in Winter 2022, even though the class was taught on campus in person, and it seems that even in an on-campus offering most students preferred watching videos to attending in-person lectures. Attendance at in-person lectures dipped to 15%-20% in the last couple of weeks of lectures. This attendance dip did not occur in pre-pandemic on-campus offerings.

Current Catalog Information

CO 471 (0.50) LEC Semidefinite Optimization

Optimization over convex sets described as the intersection of the set of symmetric, positive semidefinite matrices with affine spaces. Formulations of problems from combinatorial optimization, graph theory, number theory, probability and statistics, engineering design, and control theory. Theoretical and practical consequences of these formulations. Duality theory and algorithms.[Offered: S]

No Special Consent Required

Requisites : Prereq: MATH 239 or 249, AMATH/PMATH 331 or PMATH 351, CO 255; Cumulative overall average of at least 80%

Effective 01-SEP-2023

Requisite Change : Prereq: MATH 239 or 249; AMATH/PMATH 331 or PMATH 351; CO 255 or 367; Cumulative overall average of at least 80%

Rationale : CO 255 is an advanced-level version of CO 250. In general, it is undesirable to offer undergraduate courses where an advanced-level course is a required prerequisite, since such course offerings can pressure students into feeling like they have to take advanced sections. Here CO 250 is not enough, but the proposed change provides a pathway for students who did not take CO 255 to enrol in CO 471.

Computer Science - David R. Cheriton School of

Current Catalog Information

CS 105 (0.50) LAB, LEC, TST Introduction to Computer Programming 1

An introduction to the fundamentals of computer programming through media computation. Students will learn to write interactive graphical programs. Fundamental language concepts such as variables, conditionals, loops, functions, and arrays. Programming concepts such as coding style, modular design, testing, and debugging. Media concepts such as 2D graphics drawing, input, animation, and image processing.
[Offered: F]
No Special Consent Required

Requisites : Prereq: Not open to Mathematics students. Antireq: BME 121, CS 115, 135, 137, 145, CHE 121, CIVE 121, ECE 150, MTE 121/GENE 121, NE 111, MSCI 121, PHYS 236, SYDE 121

Effective 01-SEP-2023

Description Change: An introduction to the fundamentals of computer programming through media computation. Students will learn to write interactive graphical programs. Fundamental language concepts such as variables, conditionals, loops, functions, and arrays. Programming concepts such as coding style, modular design, testing, and debugging. Media concepts such as 2D graphics drawing, input, animation, and image processing.

Course Attribute Change: Also offered Online

Rationale : These courses were developed to help serve the GBDA program and GBDA has asked us if we can teach them online since it removes significant stresses that their students face like having to travel back and forth between Waterloo and Stratford.

Current Catalog Information

CS 106 (0.50) LAB, LEC, TST Introduction to Computer Programming 2

A continuation of the introduction to computer programming begun in CS 105. The use of programming, in conjunction with libraries, as a means of solving practical problems in art, design, and data processing. Basic text processing, manipulation of images and sound, handling and visualization of tabular and hierarchical data. Introductions to user interfaces, physical simulation, and object-oriented programming. [Offered: W]
No Special Consent Required

Requisites : Prereq: CS 105; Not open to Mathematics students. Antireq: BME 121, CS 115, 135, 137, 145, CHE 121, CIVE 121, ECE 150, MTE 121/GENE 121, NE 111, MSCI 121, SYDE 121

Effective 01-SEP-2023

Description Change: A continuation of the introduction to computer programming begun in CS 105. The use of programming, in conjunction with libraries, as a means of solving practical problems in art, design, and data processing. Basic text processing, manipulation of images and sound, handling and visualization of tabular and hierarchical data. Introductions to user interfaces, physical simulation, and object-oriented programming.

Course Attribute Change: Also offered Online

Rationale : These courses were developed to help serve the GBDA program. This program has asked us if we can teach them online since it removes significant stresses that their students face like having to travel back and forth between Waterloo and Stratford.

Current Catalog Information

CS 115 (0.50) LAB, LEC, TST, TUT Introduction to Computer Science 1

An introduction to the fundamentals of computer science through the application of elementary programming patterns in the functional style of programming. Function definition and application. Tracing via substitution. Design, testing, and documentation. Recursive data definitions. Lists and trees. Functional and data abstraction. [Note: See Note 2 above.] [Offered F, W, S]

No Special Consent Required

Requisites : Antireq: BME 121, CS 135, 137, 138, 145, CHE 121, CIVE 121, ECE 150, GENE 121/MTE 121, ME 101, NE 111, MSCI 121, PHYS 139, SYDE 121

Effective 01-SEP-2023

Description Change: An introduction to the fundamentals of computer science through the application of elementary programming patterns in the functional style of programming. Function definition and application. Tracing via substitution. Design, testing, and documentation. Recursive data definitions. Lists and trees. Functional and data abstraction. [Note: See Note 2 above.]

Course Attribute Change: Also offered Online

Rationale : Pre-pandemic, the Faculty of Mathematics had plans to offer FARM fully online and online offerings of CS 115 and CS 116 were created to facilitate this plan. While we do not currently admit to FARM online, having those courses already developed we can use them to help our students with their scheduling.

Current Catalog Information

CS 116 (0.50) LAB, LEC, TST, TUT Introduction to Computer Science 2

This course builds on the techniques and patterns learned in CS 115 while making the transition to use of an imperative language. Generative and structural recursion. Mutation (assignment) and its role is an imperative language. Primitive types and basic I/O. Sequencing, selection, looping. Function definition and use. File and consult I/O. Issues in commuter science [Offered F, W, S]

No Special Consent Required

Requisites : Antireq: BME 121, CS 135, 137, 138, 145, CHE 121, CIVE 121, ECE 150, GENE 121/MTE 121, ME 101, NE 111, MSCI 121, PHYS 139, SYDE 121

Effective 01-SEP-2023

Description Change: This course builds on the techniques and patterns learned in CS 115 while making the transition to use of an imperative language. Generative and structural recursion. Mutation (assignment) and its role in an imperative language. Primitive types and basic I/O. Sequencing, selection, looping. Function definition and use. File and console I/O. Issues in computer science.

Course Attribute Change: Also offered Online

Rationale : Pre-pandemic, the Faculty of Mathematics had plans to offer FARM fully online and online offerings of CS 115 and CS 116 were created to facilitate this plan. While we do not currently admit to FARM online, having those courses already developed we can use them to help our students with their scheduling.

Current Catalog Information

CS 231 (0.50) LAB, LEC, TST, TUT Algorithmic Problem Solving

The study of the steps required to solve real-world problems on a computer, including problem specification, choice of algorithmic paradigm, analysis, and implementation. Topics include exhaustive search, divide and conquer, greedy, and dynamic programming approaches. [Note: Lab is not scheduled and students are expected to find time in open hours to complete their work. Offered: S]

No Special Consent Required

Requisites : Prereq: One of CS 116, 136, 138, 146 or CS 114 with at least 60%; CS 115 or CS 135. Not open to Computer Science students. Antireq: BME 122, CS 341, ECE 250, MSCI 240, MTE 140, SYDE 223

Effective 02-SEP-2023

Description Change: The study of the steps required to solve real-world problems on a computer, including problem specification, choice of algorithmic paradigm, analysis, and implementation. Topics include exhaustive search, divide and conquer, greedy, and dynamic programming approaches. [Note: Lab is not scheduled and students are expected to find time in open hours to complete their work.]

Course Attribute Change: Also offered Online

Rationale : CS231 and CS234 are both CS Minor courses and there is increasing demand for these courses. We have had many discussions as to what our online strategy should be going forward and focusing on the CS Minor courses makes the most sense.

Current Catalog Information

CS 234 (0.50) LAB, LEC, TST Data Types and Structures

Top-down design of data structures. Using representation-independent data types. Introduction to commonly used data types, including lists, sets, mappings, and trees. Selection of data representation. [Note: Lab is not scheduled and students are expected to find time in open hours to complete their work. Offered: F,S]

No Special Consent Required

Requisites : Prereq: One of CS 116, 136, 138, 146 or CS 114 with at least 60%; CS 115 or CS 135. Not open to Computer Science students. Antireq: BME 122, CS 240, ECE 250, MSCI 240, MTE 140, SYDE 223

Effective 02-SEP-2023

Description Change: Top-down design of data structures. Using representation-independent data types. Introduction to commonly used data types, including lists, sets, mappings, and trees. Selection of data representation. [Note: Lab is not scheduled and students are expected to find time in open hours to complete their work.]

Course Attribute Change: Also offered Online

Rationale : CS231 and CS234 are both CS Minor courses and there is increasing demand for these courses. We have had many discussions as to what our online strategy should be going forward and focusing on the CS Minor courses makes the most sense.

Effective 02-SEP-2023

CS 240E (0.50) LAB, LEC, TST,TUT Data Structures and Data Management (Enriched)

Enriched version of CS 240. [Note: See notes 1 and 9 above. CS 240E may be substituted for CS 240 wherever the latter is a requirement. Enrolment is restricted. Lab is not scheduled and students are expected to find time in open hours to complete their work. Offered: As permitted by demand and available resources.]

Requisite Change : Prereq: A grade of 85% or higher in one of CS 136, 138 or 146; Computer Science and BMATH (Data Science) Students only. Coreq: One of STAT 206, 230, 240. Antireq: CS 234, ECE 250

Rationale : In 2019, the School of Computer Science revised prerequisites to allow more of the stronger students access to take E level courses. In transcription, the addition of Data Science students to CS 240E was lost at some point in the approval process. The School and the Faculty of Mathematics has now re-confirmed the desire to allow Data Science students in CS 240E.

Current Catalog Information

CS 251 (0.50) LAB, LEC, TST Computer Organization and Design

Overview of computer organization and performance. Basics of digital logic design. Combinational and sequential elements. Data representation and manipulation. Basics of processor design. Pipelining. Memory hierarchies. Multiprocessors. [Note: Students enrolled in Digital Hardware Specialization should enrol in ECE 222. Enrolment is restricted; see Note 1 above. Lab is not scheduled and students are expected to find time in open hours to complete their work. Offered: F,W,S]

No Special Consent Required

Requisites : Prereq: One of CS 136, 138, 146; Computer Science and BMath (Data Science) students only. Antireq: BME 292/393, ECE 222, ME 262, MTE 262, SYDE 192

Effective 01-SEP-2023

Component Change: LAB, LEC, TST, TUT

Rationale : Instructors would like the flexibility to offer tutorials, but for a TUT to be added to student schedules the TUT must be added to the calendar first.

Current Catalog Information

CS 349 (0.50) LAB, LEC, TST User Interfaces

An introduction to contemporary user interfaces, including the basics of human-computer interaction, the user interface design/evaluation process, the event abstraction, user interface components, specification of user interfaces, and the architectures within which user interfaces are developed. Implementation and evaluation of a typical user interface is considered. [Note: Lab is not scheduled and students are expected to find time in open hours to complete their work. Offered: F,W,S]

No Special Consent Required

Requisites : Prereq: CS 241 and (one of MATH 115, 136, 146); Computer Science students only

Effective 01-SEP-2023

Description Change: An introduction to contemporary user interface implementation concepts, including event abstraction, graphical components, layout, feedback, testing, accessibility, and architectures to develop user interfaces. One or more types of interface toolkit paradigms are considered. [Note: Lab is not scheduled and students are expected to find time in open hours to complete their work.]

Rationale : UI testing was missing and this change adds it. We are also removing user interface design/evaluation. These changes emphasizes that CS 349 is an implementation course, not a design course.

Current Catalog Information

CS 383 (0.50) STU Computational Digital Art Studio

An upper-level studio course to create computational projects that function as art works and aesthetic experiences. Students will work in an interdisciplinary environment to combine computer science principles with fine art technical and conceptual skills. [Offered: W]

No Special Consent Required

Requisites : Prereq: CS 240; FINE 228 or 229; FINE 257 or ENGL 293

Cross-listed as: FINE 383

Effective 01-SEP-2023

Description Change: An upper-level studio course to create computational projects that function as art works and aesthetic experiences. Students will work in an interdisciplinary environment to combine computer science principles with fine art technical and conceptual skills.

Requisite Change : Prereq: CS 240, FINE 228 or FINE 247

Rationale : FINE 229 was inactivated in September 2021, and the new course FINE 247 created to cover its content. Through a conversation between Fine Arts and CS, it was determined that only a studio course is needed aside from CS 240, and FINE 228 or FINE 247 are fine. There are no changes to the FINE 383 prerequisites. Students in the Computational Fine Art specialization will be taking FINE 257 or ENGL 293 as part of program, but no longer as prerequisites. This is solving a bottle-neck problem.

Dean of Mathematics

Current Catalog Information

MATH 127 (0.50) LEC, TUT Calculus 1 for the Sciences

Functions of a real variable: powers, rational functions, trigonometric, exponential and logarithmic functions, their properties and inverses. Intuitive discussion of limits and continuity. Definition and interpretation of the derivative, derivatives of elementary functions, derivative rules and applications. Riemann sums and other approximations to the definite integral. Fundamental theorems and antiderivatives; change of variable. Applications to area, rates, average value. [Offered: F,W,S; online: F,W,S]

No Special Consent Required

Requisites : Prereq: MATH 104 or 4U Calculus and Vectors. Antireq: MATH 109, 116, 117, 124, 137, 147

Effective 01-SEP-2023

Component Change: LEC, TST, TUT

Rationale : Effective Fall 2023, add a test component for academic integrity concerns, pedagogical reasons, and to conduct research on using optional test retakes to enhance learning by getting students to read and act upon feedback given on the midterm and to actually try to learn material they got wrong on the midterm. Science students form the bulk (75% to 90% depending on the term) of the students in MATH 127. Health students form the next larger contingent, mainly in spring terms, with additional students in winter. Science and Health are supportive of this change.

Current Catalog Information

MATH 128 (0.50) LEC, TUT Calculus 2 for the Sciences

Transforming and evaluating integrals; application to volumes and arc length; improper integrals. Separable and linear first order differential equations and applications. Introduction to sequences. Convergence of series; Taylor polynomials, Taylor's Remainder theorem, Taylor series and applications. Parametric/vector representation of curves; particle motion and arc length. Polar coordinates in the plane. [Offered: F,W,S; online: F,W,S]

No Special Consent Required

Requisites : Prereq: One of MATH 116, 117, 127, 137, 147. Antireq: MATH 118, 119, 138, 148

Effective 01-SEP-2023

Component Change: LEC, TST, TUT

Rationale : Effective Fall 2023, add a test component for academic integrity concerns, pedagogical reasons, and to conduct research on using optional test retakes to enhance learning by getting students to read and act upon feedback given on the midterm and to actually try to learn material they got wrong on the midterm. Science students form the bulk, and our own Faculty is the next biggest contingent. Science is supportive of this change.

Current Catalog Information

MATH 207 (0.50) LEC, TST, TUT Calculus 3 (Non-Specialist Level)

Multivariable functions and partial derivatives. Gradients. Optimization including Lagrange multipliers. Polar coordinates. Multiple integrals. Surface integrals on spheres and cylinders. Introduction to Fourier Series. [Offered: F,W,S]

No Special Consent Required

Requisites : Prereq: MATH 128 or 138 or 148. Antireq: AMATH 231, MATH 212, 212N/NE 217, MATH 217, 227, 237, 247

Effective 01-SEP-2023

Course Attribute Change: Also offered Online

Rationale : This course is attractive to students of multiple faculties. The addition of an online offering would be a good service to the institution, increasing the offerings for students on coop terms.

Current Catalog Information

MATH 213 (0.50) LEC, TUT Signals, Systems, and Differential Equations

Fourier series. Differential equations. Laplace transforms. Applications to circuit analysis. [Offered: W]

No Special Consent Required

Requisites : Prereq: MATH 119; Software Engineering students only. Antireq: AMATH 250, 251, MATH 211/ECE 205, 218, 228, MATH 212N/NE 217

Effective 01-SEP-2023

Description Change: Laplace transform methods for: solving linear ordinary differential equations, classical signals, and systems. Transfer functions, poles, and zeros; system stability. Frequency response of linear systems and its log-scale representation (Bode plot). Fourier series. Applications in areas of interest for software engineers and computer scientists. Brief introduction to Fourier transforms in the context of signals and systems.

Requisite Change : Prereq: One of MATH 118, MATH 119, MATH 128, MATH 138. Antireq: AMATH 250, 251, MATH 211/ECE 205, 218, 228

Rationale : The previous description did not list many important topics that were always taught. This caused confusion for students, advisors and the curriculum committee. The new description makes it more obvious how this course differs from AMATH 250 (Introduction to Differential Equations), removing confusion for people outside the ECE Controls group. The change of prerequisites will open the course to interested and qualified students outside of Software Engineering (SE), and in particular students in Artificial Intelligence option in Computer Science (BCS+AI) students, and other students interested in robotics (as controls are fundamental to robotics). Course reserves will be used to ensure SE students and BCS+AI students can take the course.

Statistics & Actuarial Science

Current Catalog Information

ACTSC 363 (0.50) LEC, TST, TUT Casualty and Health Insurance Mathematics 1

Models for loss frequency: Poisson, negative binomial, binomial, (a, b, 0) class; models for loss severity including exponential, gamma, lognormal, Pareto, and Weibull; impact of policy adjustments on loss frequency and severity; estimation; compound Poisson models; aggregate claims models: properties, recursion, simulation, and pricing; deterministic reserving methods: chain ladder and Bornhuetter Ferguson; introduction to reinsurance. [Offered: W,S]

No Special Consent Required

Requisites : Prereq: Actuarial Science or Mathematical Finance students only. Coreq: STAT 330. Antireq: ACTSC 431 (taken in or before spring 2020).

Effective 01-SEP-2023

Description Change: Introduction to the collective risk model; models for loss frequency: (a, b, 0) and (a, b, 1) classes of distributions, compound distributions and mixtures; models for loss severity: exponential, gamma, lognormal, Pareto, Weibull, and mixtures; measures of distribution tails; impact of policy adjustments on loss frequency and severity; estimation of frequency and severity models. [Offered: F,W]

Rationale : After a few offerings of the new redesigned Property and Casualty insurance sequence (which includes ACTSC 363, 431 and 432), it was noted by the most recent course instructors that the material was not optimally covered. Material has been reshuffle to improve efficiency.

Current Catalog Information

ACTSC 431 (0.50) LEC Casualty and Health Insurance Mathematics 2

Advanced models for loss frequency: (a, b, 1) class, mixed and compound Poisson models; concept of infinite divisibility; advanced models for loss severity: combination of exponentials, mixed Erlang, extreme value distributions; measure of distribution tails; impact of policy adjustments on loss frequency and severity; estimation; advanced aggregate claims models: properties, analytic results, (double) recursion, and pricing; risk measures. Other topics which may be covered include aggregate claim models with dependence, time-dependent claims, and ruin theory. [Offered: F,S]

No Special Consent Required

Requisites : Prereq: ACTSC 363 with a grade of at least 60%, STAT 330; Actuarial Science or Mathematical Finance students only

Effective 01-SEP-2023

Description Change: Aggregate loss and payment models: properties, analytic results, convolution-type methods, recursive methods, inversion-type methods, and simulation; advanced aggregate claims models; reinsurance; applications to insurance pricing; insurance pricing using generalized linear models. [Offered: F,S]

Requisite Change : Prereq: ACTSC 363 with a grade of at least 60%; STAT 330; One of STAT 331, 371, 373; Actuarial Science or Mathematical Finance students only

Rationale: After a few offerings of the new redesigned Property and Casualty insurance sequence sequence (which includes ACTSC 363, 431 and 432), it was noted by the most recent course instructors that the material was not optimally covered. Material has been reshuffled to improve efficiency.

Current Catalog Information

ACTSC 432 (0.50) LEC, TUT Property and Casualty Insurance: Pricing

Introduction to ratemaking; rating factors; insurance pricing using generalized linear models; experience rating; credibility theory: Bayesian, Buhlmann, and Buhlmann-Straub; empirical Bayes parameter estimation. [Offered: F,S]

No Special Consent Required

Requisites : Prereq: ACTSC 363, STAT 330,(one of STAT 331,371,373);Actuarial Science or Mathematical Finance students only

Effective 01-SEP-2023

Title Change: Credibility and Risk Theory

Description Change: Credibility theory: American credibility, Bayesian, Bühlmann, Bühlmann-Straub,andempiricalBayesparameterestimation.Risktheory: claim arrival dynamics, surplus models, first-passage times, applications to solvency, and their analytical and numerical analyses. [Offered: F,S]

Requisite Change : Prereq: ACTSC363,STAT330, STAT333;Actuarial Science or Mathematical Finance students only

Rationale : After a few offerings of the new redesigned Property and Casualty insurance sequence (which includes ACTSC 363, 431 and 432), it was noted by the most recent course instructors that the material was not optimally covered. Material has been reshuffled to improve efficiency. The change to the ACTSC 432 course title is necessary to better reflect the updated content of this course. Pre-requisite changes have been made to ACTSC 432 to reflect the new course content. Short Title: Credibility and Risk Theory

COURSE INACTIVATIONS (for approval)

Dean of Mathematics

Effective 01-SEP-2023

WKRPT 200M (0.13) Work-term Report

Rationale : Reflective work reports are now embedded in all PD courses. The work report courses are no longer required and should be removed from the academic calendar and the Faculty of Math is removing them from its co-op degree requirements.

Effective 01-SEP-2023

WKRPT 300M (0.13) Work-term Report

Rationale : Reflective work reports are now embedded in all PD courses. The work report courses are no longer required and should be removed from the academic calendar and the Faculty of Math is removing them from its co-op degree requirements.

Effective 01-SEP-2023
WKRPT 400M (0.13) Work-term Report
Rationale : Reflective work reports are now embedded in all PD courses. The work report courses are no longer required and should be removed from the academic calendar and the Faculty of Math is removing them from its co-op degree requirements.

Effective 01-SEP-2023
ACTSC 463 (0.50) Introduction to Property and Casualty Loss Reserving
Rationale : Many of these topics are now covered in ACTSC 362. There may be interest to create an advanced reserving course, but this will be examined at a later time.

End of Report

4.1 Undergraduate Communication Requirement

Background and Rationale: Effective Fall 2023, amend Note 4 from the Undergraduate Communication Requirement in the Degree Requirements for Math Students section of the Undergraduate Calendar (https://ugradcalendar.uwaterloo.ca/page/MATH-Degree-Requirements-for-Math-students): remove the course load restriction (triggered when a student does not complete a List 1 communication course with a minimum grade of 60% prior to their 2A term) and introduce a student hold which will lead to student/advisor interaction for enrolment in a List 1 course. The course load restriction policy is viewed as punitive and does not assist students in meeting the requirement. It is also worth noting that the consequence of load restriction is more severe for students in structured plans such as Math/CPA and Double Degree. Placing a hold on a student's account if they have not fulfilled the List 1 requirement prior to 2A makes sense because it forces the student to obtain overrides from their advisors to enrol and the advisors can ensure a List 1 communication course is included in their enrolment. The load restriction unnecessarily slows a student's progression through their degree.

Currently, we use OAT queries to identify students who have not fulfilled the List 1 requirement, however, there are many issues surrounding the manual nature of this practice which result in the load restriction being applied inconsistently. The main issue is that the queries search for the milestones to identify students instead of the courses completed. We also have many students who spend several terms in 1A/1B due to not having enough units to advance to 2A which means we manually follow students' term after term to assess when they are in violation of the policy and require load restriction. As well, due to the severity of the consequence of load restriction we have adopted the practice of sending warning emails to students who are behind on the requirement to give them an opportunity to fulfill List 1 before we apply the load restriction so there are many students who are in 2A who have not yet been load restricted. All of this amounts to a large amount of manual work for staff with no real benefit for students.

The Chair of the UCRG (University Communication Requirement Group) was contacted regarding the following two questions:

1. Would the communication committee that he heads have any objection to this proposed change?
   a. Response: 'This has not been explicitly discussed but I would be surprised if there was any objection. The ADs would interpret that as the jurisdiction of each Faculty.'
2. Is Math the only faculty currently restricting enrolment limits for students who are behind on their communication requirements?
   a. Science = does not
   b. Engineering = example provided for SE - in practice, enrolment is only obstructed for students who are behind until they have a plan for satisfying the requirement (this is normally only 1% - 2% of students)
   c. Arts = no, calendar text does indicate holds will be placed on students who are behind but in practice the hold is not implemented because it creates too many difficulties for students trying to adjust their courses
   d. Health = no, there is no similar practice at this time. In the past when ELPE was required a hold would be placed on the accounts of students who had not met the requirement
   e. Environment = submission to the October SUC includes a UCR revision, which states: The rule regarding future registrations being cancelled if the UCR milestone has not been met by the completion of 2B has been removed, as this rule has never been implemented. Instead students are directed to their academic advisor to discuss the completion of this requirement if not met by 2B.

Calendar text
(https://ugradcalendar.uwaterloo.ca/page/MATH-Degree-Requirements-for-Math-students)

[…]

Undergraduate Communication Requirement

[…]

Notes

1. Students enrolled in SE must satisfy the Undergraduate Communication Requirement as set by the Faculty of Engineering.
2. SPCOM 111 will qualify as a List 1 course for students who are transferring from Accounting and Financial Management (AFM) and Mathematics/CPA.
3. Transfer credits may be used to satisfy the Undergraduate Communication Requirement.

4. Students who do not complete the first course prior to their 2A term (except Computing and Financial Management students) will ~~be restricted to enrolling in a course from the List 1 and two math courses until the first course requirement is met.~~ have a hold placed on their account and will be required to enrol in a List 1 course. Such students will need to seek assistance with enrolment from their academic advisor.

[…]

4.2 Upgrading from General Degree to Honours Degree

Background and Rationale: Effective Fall 2023, amend note one by adding "provided that at least three terms have passed since their last term of enrolment." Prior to 1 September 2021, Note 1 read "Students are not normally awarded an Honours BMath degree if they already hold a General BMath degree. Petitions for exceptions to this rule will normally be considered **only after an absence from the Faculty of several terms**." [emphasis added]. The rationale for the change to the current text was that it "remove[d] the need to declare their intent ahead of time, and clarifie[d] the process for readmission". That is, the removal of the reference to an absence does not appear to have been deliberate. The Faculty of Mathematics petition committee still has a guideline which requires an absence of several terms for these readmission requests to be granted, and has applied this guideline consistently. The specification of three terms as the minimum length of absence is arbitrary, but is chosen to match the period identified in the Absence from Studies section of the calendar (http://ugradcalendar.uwaterloo.ca/page/Acad-Regs-Absence-from-Studies).

Calendar text

(https://ugradcalendar.uwaterloo.ca/page/MATH-Degree-Requirements-for-Math-students)

[...]

Honours Fallback Provision

[…]

Notes

1. Graduates who were previously awarded a general degree may apply for readmission to upgrade to an honours degree, provided that at least three terms have passed since their last term of enrolment. These applications will be considered on a case-by-case basis. Courses and grades from the general degree would be used towards the upgraded degree if applicable, but students would otherwise need to meet current Calendar requirements.
2. Students choosing the Honours Fallback Provision may not combine this choice with any specialization, option, or minor.

4.3 The Repeat Rule

Background and Rationale: Effective Fall 2023, amend and add notes to the Repeat Rule. There has been confusion about enforcing the Repeat rule. This change reduces the confusion and explicitly states that the repeat rules applies to Faculty of Mathematics students, not to students of other faculties (over which we have no jurisdiction). The three additional notes further offer direction based on prototypical student situations.

Calendar text

(https://ugradcalendar.uwaterloo.ca/page/MATH-Math-Faculty-Policies)

Faculty Policies

[…]

Repeat Rule

Students registered in the Faculty of Mathematics are limited to a maximum of three attempts per course. A course attempt is defined in Table 1.

Notes:

1. For clarity, a cross-listed course is a single course listed under two academic units (and therefore having two different subject codes). The use of the two subject codes does not gain a student additional attempts.
2. Attempts at distinct courses listed as antirequisites may be considered to constitute attempts at the same course, at the discretion of the Faculty.
3. Some sets of courses offered by the Faculty of Mathematics are designed as antirequisites at different levels of mathematical sophistication (for example MATH 127 / MATH 137 / MATH 147). A student who has attempted the same course (or the course and its antirequisites) three times without success will be considered ineligible to enrol in a more advanced antirequisite course. However, they will normally be permitted to attempt a *less* advanced version.
4. In certain cases a third unsuccessful attempt may result in required withdrawal from the Faculty, for lack of progress.

[…]

List of courses related to Note 3 to be supplied to advisors as part of the Advising manual (but not in calendar text):

Algebra MATH 135, MATH 145 MATH 106, MATH 136, MATH 146 MATH 225, MATH 235, MATH 245	Calculus MATH 127, MATH 137, MATH 147 MATH 128, MATH 138, MATH 148 MATH 207, MATH 237, MATH 247	Combinatorics MATH 229, MATH 239, MATH 249 CO 250, CO 255
Computer Science CS 115, CS 135, CS 145 CS 116, CS 136, CS 146 CS 240, CS 240E CS 241, CS 241E CS 245, CS 245E CS 246, CS 246E CS 251, CS 251E CS 360, CS 365	Statistics STAT 220, STAT 230, STAT 240 STAT 221, STAT 231, STAT 241	Applied Mathematics AMATH 250, AMATH 251

4.4 Computer Science Artificial Intelligence Specialization

Background and Rationale: Effective Fall 2023, modify the AI Specialization course requirements as per modified calendar text below. The AI Specialization has been in place for several years so we better understand what is working and what is not. There have also been several new courses introduced which make sense to include in the specialization.

Calendar text

(additions in blue, removals in red)

(https://ugradcalendar.uwaterloo.ca/page/MATH-Computer-Sci-Artificial-Intelligence-Spec)

[…]

All of

- CS 486 Introduction to Artificial Intelligence
- CS 492 The Social Implications of Computing[2]
- CS 480 Introduction to Machine Learning or CS 485Statistical and Computational Foundations of Machine Learning

One of

- ECE 380 Analog Control Systems
- SE 380 Introduction to Feedback Control

Four additional courses, one of which must be from Mathematics and one from Engineering, from:

- BIOL 487/SYDE 552 Computational Neuroscience
- CO 367 Nonlinear Optimization
- CO 456 Introduction to Game Theory
- CO 463 Introduction to Convex Optimization and Analysis
- CO 466 Continuous Optimization
- CS 452 Real-time Programming
- CS 479 Neural Networks
- CS 480 Introduction to Machine Learning
- CS 484 Computational Vision
- CS 485 Statistical and Computational Foundations of Machine Learning
- STAT 341 Computational Statistics and Data Analysis
- STAT 440 Computational Inference
- STAT 441 Statistical Learning – Classification
- STAT 444 Statistical Learning – Advanced Regression
- ECE 380 Analog Control Systems or SE 380 Introduction to Feedback Control
- ECE 423 Embedded Computer Systems
- ECE 457C Reinforcement Learning
- ECE 481 Digital Control Systems
- ECE 486 Robot Dynamics and Control
- ECE 488 Multivariable Control Systems
- ECE 495 Autonomous Vehicles
- MSCI 446 Introduction to Machine Learning
- MTE 544 Autonomous Mobile Robots
- SYDE 522 Foundations of Artificial Intelligence
- SYDE 556 Simulating Neurobiological Systems
- SYDE 572 Introduction to Pattern Recognition

Notes:

1. Special topics courses (e.g., CS 489) may sometimes be appropriate for this Specialization; interested students should see the specialization co-ordinator for confirmation.
2. CS 497 may be substituted for CS 492, depending on the topic of the course.

4.5 Amendment to previously approved modification to Math/CPA and Data Analytics specialization

Background and Rationale: This motion modifies calendar text that has been approved at 28 June 2022 SUC. Note that this approved calendar text is not yet visible. Effective Fall 2023, add "or STAT 371 Applied Linear Models and Process Improvement for Business" to AFM 323/SAT 374 Quantitative Foundations for Finance in the "All of" list degree requirements for the MATH/CPA plan. A note in the Data Analytics specialization program requirement allowing this alternative for those students enrolled in the specialization is thus no longer needed and is thus also removed. It was highlighted that students who declare the specialization and take STAT 371 are no longer automatically eligible for the regular MATH/CPA credential. Indeed the substitution of STAT 371 for AFM 323/STAT 374 is not in the regular plan, and STAT 371 lists AFM 323/STAT 374 in its antirequisites. Math/Business revised their regular plan and specialization to allow students the possibility to back away from the specialization if they have trouble with 4th year STAT courses. The following is that revision. Consultation with STATS and ACTSCI occurred.

Calendar text

(additions in blue, removals in red)

MATH/CPA Degree Requirements
(https://ugradcalendar.uwaterloo.ca/page/MATH-Math-or-Chart-Prof-Accounting-co-Requirements)

[…]

- All of
  - AFM 111 Professional Pathways and Problem-solving
  - AFM 127/ACTSC 127 Introduction to Global Capital Markets and Financial Analytics
  - AFM 182 Foundations for Management Accounting
  - AFM 191 Foundations for Financial Reporting
  - AFM 206 Introduction to Tax (0.25 unit)
  - AFM 208 Introduction to Assurance (0.25 unit)
  - AFM 212 Financial Analysis and Planning
  - AFM 272/ACTSC 291 Global Capital Markets
  - AFM 274 Introduction to Corporate Finance
  - AFM 291 Intermediate Financial Accounting 1
  - AFM 311 Connections to Ethical Context
  - AFM 321 Personal Financial Planning
  - AFM 323/STAT 374 Quantitative Foundations for Finance or STAT 371 Applied Linear Models and Process Improvement for Business
  - AFM 341 Accounting Information Systems
  - AFM 362 Corporate Taxation
  - AFM 373 Cases and Application in Corporate Finance
  - AFM 382 Cost Management Systems
  - AFM 391 Intermediate Financial Accounting 2
  - AFM 423/ACTSC 423 Topics in Financial Econometrics
  - AFM 433 Business Strategy
  - AFM 451 Audit Strategy
  - AFM 462 Specialized Topics in Taxation
  - AFM 482 Performance Measurement and Organization Control
  - AFM 491 Advanced Financial Accounting
  - COMM 103/ECON 100 Principles of Economics or (ECON 101 Introduction to Microeconomics and ECON 102 Introduction to Macroeconomics)
  - SPCOM 111 Leadership, Communication, and Collaboration
- Six additional math courses (3.0 units)

[…]

MATH/CPA Data Specialization

This academic plan has the same requirements as Honours Mathematics/Chartered Professional Accountancy, with the following additional requirements:

- All of
  - CS 234 Data Types and Structures
  - CS 338 Computer Applications in Business: Databases
  - STAT 341 Computational Statistics and Data Analysis
  - STAT 371 Applied Linear Models and Process Improvement for Business
- Three of
  - STAT 441 Statistical Learning – Classification
  - STAT 442 Data Visualization
  - STAT 443 Forecasting
  - STAT 444 Statistical Learning – Advance Regression
- ~~Note~~
  - ~~Students enrolled in the Mathematics/Chartered Professional Accountancy Data Analytics specialization may substitute~~
  - ~~STAT 371 for AFM 323/STAT 374~~

4.6 Co-op Work Term Report Requirements

Motion: Effective 1 September 2023, eliminate WKRPT 200M, 300M, 400M from co-op degree requirements, and have these changes applied retroactively to benefit current students. The changes indicated below will be made to the published 2023-2024 Undergraduate Studies Academic Calendar. However, they are also being made retro-actively to the programs listed to impact the fall 2018, 2019, 2020, 2021, and 2022 cohorts (students graduating in 2023 or later). Although the changes will not be made to the 2018-2019, 2019- 2020, 2020-2021, 2021-2022, and 2022-2023 academic calendars, the changes will be made to the advisement templates in Quest. These changes are as follows:

- Table 1 – Degree Requirements
  1. Remove ** (second point) in Legend
  2. Remove Row with "Minimum WKRPT course units"
- Table describing terms used in Table 1
  1. Remove reference to WKRPT in row of “Non-Math Courses”
  2. Remove reference to WKRPT in row of “Unusable Course Attempt”
- Co-op regulations Page:
  1. Remove the section on Work Reports
- Co-op standing Rules
  1. Remove "Two missing or failed work reports" in the first row. Change "Two missing or failed PD courses and one missing or failed work report" to "Two missing or failed PD courses."
- Co-op Standing Rules Implications:
  1. Under Co-op Probation, remove “or work reports” on the fourth line
- Multiple Co-op majors:
  1. Change "Can count completed work terms, PD courses, and work term reports" to "Can count completed work terms and PD courses".

Rationale: As of Spring 2022, in all courses that may be taken as PD electives by Math students on their work terms, students must pass a major reflective report in order to receive credit for the course. The major reflective report will meet work report requirements for accreditation purposes by CEWIL Canada, and will better meet many of the goals of work reports compared to our current technical report system. Traditionally, work reports have allowed students an opportunity to reflect on some aspects of their work experience, and to share that experience with their employer and the faculty, and have provided students with writing experience. The MRR will provide students with many of the same benefits, with the bonus that this work may help them reflect on their actual experiences working and how it might relate to future plans. Students will still be required to complete PD11, which teaches them how to prepare a technical report, and will help prepare them for any formal writing required as part of a work term.

The removal of the WKRPT courses addresses concerns about student wellness during work terms by reducing the amount of academic work that must be completed during an official work term.

Environment, Health and Science had a joint motion at the 10 May 2022 SUC to bring changes to their co- op degree requirements for the 2022-2023 calendar. All changes are similarly motivated by the PD course changes. Arts had done so earlier in the May 2020 SUC meeting. Current requirements for Arts, ENV, and Health involve reflective reports, and Science involves technical reports, like Math. Several (but not all) units in ENG are currently looking at removing their technical work report requirements, including ECE. A separate motion is coming from Software Engineering at this SUC.

The changes to the PD courses have already started, and students are completing the reflective reports now. If we feel these reports are meeting the primary purpose of work reports, then there is no reason to continue to require current students to complete both PD and WKRPT courses during a work term. For current students, the overhead associated with recording how a work report credit was attained (w*as it earned by passing a PD course or a WKRPT course directly?*) would be complicated, and not to any great added benefit. With this in mind, these retroactivities have been agreed upon with the Registrar's Office.

Calendar text
(additions in blue, removals in red)
(https://ugradcalendar.uwaterloo.ca/page/MATH-Degree-Requirements-for-Math-students)

The Faculty of Mathematics section of this Calendar contains regulations and requirements that must be satisfied to obtain a credential offered by the Faculty. All undergraduate students are also responsible for following the University Policies, Guidelines, and Academic Regulations section of this Calendar. Table 1 - Degree Requirements Legend * The minimum co-op work-term course units for the Mathematics/Chartered Accountancy and Mathematics/Teaching academic plans is 2.0. ~~** WKRPT courses have a credit weight of 0.13 units. A student needs PD 11 and three WKRPT courses to satisfy the 'four work report' requirement.~~ *** Students in Mathematical Studies are permitted up to 4.0 units of failed or excluded courses.

Requirements	Four-Year Honours Plans		Double Degree Plans	
	Co-op	Regular	Co-op	Regular
Minimum course units (excluding courses with the subject code COOP, PD, and WKRPT)	20.0	20.0	26.0	26.0
Minimum COOP course units	2.5*	0	2.0	0
Minimum PD course units	2.5	0	2.5	0
Minimum WKRPT course units	0.39**	0	0.39**	0
Minimum non-math units	5.0	5.0	12.0	12.0
Minimum cumulative average (CAV)	60%	60%	60%	60%
Minimum major average (MAV) In addition, a minimum special major average (SMAV) may apply. See the more comprehensive table of major averages.	All Applied Mathematics, including Mathematical Physics, Combinatorics and Optimization, including Mathematical Optimization, Pure Mathematics, and Statistics academic plans: 65% Mathematical Finance: 70% All other academic plans: 60%	All Applied Mathematics, including Mathematical Physics, Combinatorics and Optimization, including Mathematical Optimization, Pure Mathematics, and Statistics academic plans: 65% Mathematical Finance: 70% All other academic plans: 60%	60%	60%
Maximum failed or excluded course units (excluding courses with the subject code COOP, PD, and WKRPT)	2.0***	2.0***	2.0***	2.0***

[…]

The terms used in Table 1 are explained below.

Term	Term Description

Course attempt	Any course enrolment for which a student is assigned a final grade, including a grade of WD (Withdrew). Transfer credits from other institutions are also considered to be course attempts.
Cumulative average (CAV)	See Averages for Math Students in Faculty Policies.
Excluded course	A course taken between fall 2004 and spring 2013 either with a grade below 50, or that a student has voluntarily excluded.
Full-time term	A term in which a student is enrolled in at least 1.5 course-attempt units.
Major average (MAV)	See Major Averages for Math Students in Faculty Policies.
Math courses	Courses with one of these subject codes: ACTSC, AMATH, CO, CS, MATBUS, MATH, PMATH, and STAT. Any course that is cross-listed with a course having one of these subject codes is also considered a math course, regardless of the subject code under which it is taken.
Non-math courses	Courses with the subject code COMM and MTHEL, and those courses offered by other faculties (excluding courses cross-listed with math courses and courses listed above as math courses). COOP and PD, and WKRPT courses do not count as math or non-math courses.
Unit	The credit value associated with any course.
Unusable course attempt	A course attempt is counted as unusable if the course is not a COOP or PD, or WKRPT course and one of the following conditions holds: • a failing grade is assigned (grade <50, DNW, FTC, NCR, NMR, or WF) (see Grades for descriptions), or • a CLC is assigned to the course attempt.

[…]

(https://ugradcalendar.uwaterloo.ca/page/MATH-Math-Co-op-Regulations)

General Regulations

- Co-operative mathematics students are expected to follow the normal study/work-term sequence appropriate to their plan from admission through to graduation.
- Students admitted at the 1A level (except for those in Mathematics/Chartered Professional Accountancy, the Bachelor of Business Administration (BBA)/Bachelor of Mathematics (BMath) double degree, and the Bachelor of Business Administration (BBA)/Bachelor of Computer Science (BCS) double degree) will normally have eight academic terms and six work terms.
- Students may not end their sequence with a work term.

- Students' requests to re-arrange their sequence will normally be approved if all the criteria listed on the Faculty of Mathematics Sequence Change Form are met. Students who alter their sequence without obtaining prior approval may be required to withdraw from the co-op system. It is the student's responsibility to deal with any timetabling difficulties that may arise and to select courses for subsequent terms.

Professional Development (PD) Courses

- As specified in Table 1, co-op students are required to complete a minimum of five different Professional Development (PD) courses.
- PD 1 is required in the academic term prior to the first work term and PD 11 is required during the first work term.
- Students in the Bachelor of Mathematics in Computer Science and Bachelor of Computer Science plans must include PD 10, Professional Responsibility in Computing, as one of their PD courses.
- With the exception of PD 1, PD courses are normally taken during co-op work terms.
- Students are required to take a PD course each work term until the requirement is completed.

Work Reports

Co-op students must submit a work report following every work term until they have completed four acceptable work reports. Successful completion of PD 11 meets the requirement for a first work report.

Co-op Standing Rules

Conditions	Co-op Standing
Any of the following: • The student is required to withdraw from the Faculty, or • The student is on academic probation after a full-time academic term for the second time, or • Two unemployed or failed work-term opportunities, or • Three missing or failed PD courses, or • Two missing or failed work reports, or • The Standings & Promotions (S&P) Committee deems that the student is unlikely to profit from further participation in co-op or is not making satisfactory progress toward fulfilling co-op degree requirements. Presentation of such requests to S&P result in a notification to the student and an opportunity to reply prior to S&P's decision.	Withdraw from Co-op
No co-op standing above applies, and any of the following: • The student is on academic probation after a full-time term for the first time. • Two missing or failed PD courses. and one missing or failed work report.	Co-op Probation
No co-op standing above applies, and in the most recent work term, the employer evaluation was Excellent or Outstanding.	Excellent co-op standing
No co-op standing above applies.	Good co-op standing

Co-op Standing Rules Implications

The following table describes the implications of the co-op standings listed above.

Co-op Standing	Implications
Withdraw from Co-op	The student must withdraw from co-op and will be transferred to the most closely matching regular academic plan for which the student is admissible.
Co-op Probation	The student must meet with a co-op advisor to determine conditions necessary to remediate their co-op standing. A student who is on probation in co-op solely because of their academic standing will be placed in Good co-op standing if they return to Good or Excellent academic standing after one full-time academic term without missing or failing any PD courses. or work reports. The student's access to the co-op employment process will be blocked pending completion of remedial requirements.
Good co-op standing	Eligible to continue in co-op.

Excellent co-op standing	Eligible to continue in co-op.

[…]

Multiple Co-op Majors

- Students pursuing more than one stand-alone honours co-op plan in the Faculty of Mathematics:
    - Must meet the co-op requirements associated with each academic plan.
    - Can count completed work terms and PD courses and work term reports toward each stand-alone honours co-op academic plans.
- Students cannot graduate with a combination of co-op and non-co-op honours academic plans (see Bachelor of Computer Science and Bachelor of Mathematics Academic Plan Combinations).

[…]

October 2022

SENATE UNDERGRADUATE COUNCIL

Submission for Computing and Financial Management

1. Course Change
   1.1 CFM 101
2. Academic Plan Changes - Minor Modifications
   2.1. Computing and Financial Management

Computer and Financial Management

Current Catalog Information

CFM 101 (0.50) LEC, TST, TUT Introduction to Financial Markets and Data Analytics This course introduces financial markets and institutions, commonly used financial data, and data schema and visualization therein. It covers fundamental functions of financial institutions and their usage of data, and basic financial data management techniques. The course will focus on buy side institutions and stock market data.

Requisites:	Prereq: Computing and Financial Management students. Antireq: AFM 121

Effective 01-SEP-2023

Requisite Change:	Prereq: Computing and Financial Management students. Antireq: AFM 121, AFM 127/ACTSC 127, COMM 101.
Rationale :	To change antirequisities. Adding AFM 127/ACTSC 127 and COMM 101 as antirequisites due to content similarity with CFM 101.

2.1 Computing and Financial Management

Background and Rationale: Effective Fall 2023, remove AFM 275/ACTSC 391 (Corporate Finance) and replace with AFM 274 (Introduction to Corporate Finance) in CFM plan requirements. It has been determined that CFM students do not require the additional quantitative/mathematical focus of AFM 275 and AFM 274 meets the needs students have for an introduction to corporate finance.

Calendar text
(additions in blue, removals in red)

(https://ugradcalendar.uwaterloo.ca/page/MATH-Computing-Financial-Mngt-Overview-Degree-Req)

[…]

All of

- AFM 132 Introduction to Business Stages
- AFM 191 Foundations for Financial Reporting
- AFM 272/ACTSC 291 Global Capital Markets
- AFM 275/ACTSC 391 Corporate Finance
- AFM 274 Introduction to Corporate Finance
- AFM 322 Derivative Securities
- AFM 424 Equity Investments

[…]

[…]

WATERLOO | ENGINEERING

Engineering Undergraduate Office

MEMORANDUM

September 20, 2022

TO: **Tim Weber-Kraljevski, Associate University Secretary, Secretariat**

FROM: **Dan Davison, Associate Dean, Undergraduate Studies, Faculty of Engineering**
Benoit Charbonneau, Associate Dean, Undergraduate Studies, Faculty of Mathematics

SUBJECT: **Items for Approval at October 4, 2022 Senate Undergraduate Council**

ALL CURRICULUM CHANGES ARE EFFECTIVE SEPTEMBER 2023 UNLESS OTHERWISE NOTED.

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1. **Academic Plans** *[For Approval]*
   1.1 Software Engineering

2.1. Software Engineering [for approval]

Summary:

Add courses to the Science Elective list
Remove CS 492 from the Linkage Elective course list
Remove and inactive work-term report courses
Add PD 11 as a required PD course

Rationale

Adding the following courses to the Science Course Electives list: PHYS233, PSYCH 207, PSYCH 261, PSYCH 306, PSYCH 307, SCI 201.

i. PHYS233 Introduction to Quantum Mechanics. A variant of PHYS234 (already approved) intended for engineers.
ii. Cognitive science courses PSYCH207, PSYCH261, PSYCH306, PSYCH307. Cognitive science is funded by NSERC, and corresponds to HCI, which is a core part of the SE technical curriculum. ECE is also adding these to their science elective list.
iii. SCI201 Global Warming and Climate Change. An important topic. The course includes many scientific laws with mathematical formulation, and students must apply quantitative techniques on every assessment.

The units offering these courses have been consulted.

Removing CS 492 from the Linkage Elective course list because the course is now on the Complementary Studies Electives List A and there is no reason to mention it separately.

PD courses now have embedded reflective reports, so separate work-term reports are being removed from the Software Engineering curriculum. This change will appear in the 2023 calendar, but will be applied retroactively to students who are following the 2018 – 2022 calendars.

Math has a rule requiring that students take PD11. SE, which is jointly governed by Engineering and Math, should be in compliance with this rule.

Software Engineering MARK UP

The Honours Software Engineering plan leads to a Bachelor of Software Engineering (BSE) degree.

Admissions

The Software Engineering Board, in consultation with the faculties of Engineering and Mathematics and their admissions committees, determines the admission requirements for Software Engineering.

For details on admission information, see the Admissions section of this Calendar.

Options, Specializations, Minors, and Joint Honours

Software Engineering students are considered as both Mathematics and Engineering students, and can thus take advantage of degree enhancements available to students from either faculty. These enhancements take the form of additional plans such as options, specializations, minors, and joint honours.

Software Engineering students are eligible for either the Artificial Intelligence Option (Engineering) or the Artificial Intelligence Specialization (Computer Science), but cannot graduate with both degree enhancements. See the full list of Computer Science specializations or the full list of Options, Specializations and Electives for Engineering Students.

The following Mathematics Joint Honours plans are also approved as additional plans for BSE students:

- Joint Applied Mathematics
- Joint Combinatorics and Optimization
- Joint Pure Mathematics, and
- Joint Statistics

BSE students are not eligible to add Joint Computer Science (Bachelor of Mathematics), Joint Bachelor of Computer Science plans, or stand-alone BMath Honours plans from the Faculty of Mathematics. BSE students pursuing a Joint Honours plan are not required to satisfy the Table 2 Faculty Core Courses requirements in the degree requirements for all Mathematics students. These students are still required to fulfil all requirements for the BSE.

BSE students may be eligible to add other options, specializations, or minors in Mathematics, Engineering, or other faculties, subject to the approval of the Software Engineering associate director. Students should be aware that adding plans will constrain their choice of electives, and may require additional courses. Thus, it is advisable to start preparing for additional plans in the first and second years. Students should also consider the benefits of not adding plans, in that they are better able to personalize their curriculum if they have more flexibility in choosing their electives. Students interested in pursuing additional academic plans, see invalid credential combinations.

Software Engineering Awards

Students in the Bachelor of Software Engineering plan are eligible for Awards of Excellence in the Faculty of Mathematics. Students in the Bachelor of Software Engineering plan are eligible for Awards of Excellence in the Faculty of Engineering.

Honours Software Engineering

The Software Engineering plan is offered jointly by the David R. Cheriton School of Computer Science and the Department of Electrical and Computer Engineering; it is only offered in the co-operative 8-stream.

Students will be considered members of both the Faculty of Engineering and the Faculty of Mathematics, although for administrative purposes they will be registered officially in a separate unit. Students will be promoted based on the Examinations and Promotions rules used in the Faculty of Engineering. A non-voting representative from the Faculty of Mathematics will sit on the Engineering Examinations and Promotion Committee, to provide insight into the policies, philosophies, culture, and requirements that pertain to Mathematics students. The Software Engineering plan is also considered an Honours Mathematics plan for purposes of student access to Mathematics courses. The Software Engineering advisor will advise students on how to achieve their academic goals.

Legend for Study/Work Sequence Table

Key	Description
F,W,S	F=fall term, W=winter term, S=spring term
1,2,3,4 plus A or B	Denotes academic year and term.
WT	Denotes scheduled work terms.

Study/Work Sequence

Sequence	F	W	S	F	W	S	F	W	S	F	W	S	F	W
Stream 8	1A	1B	WT	2A	WT	2B	WT	3A	WT	3B	WT	4A	WT	4B

Academic Curriculum

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- CS 137 Programming Principles ~~(3 LEC,1 TUT,2 LAB)~~
- ECE 105 Classical Mechanics ~~(3 LEC,1 TUT, 1.25 LAB)~~
- MATH 115 Linear Algebra for Engineering ~~(3 LEC,2 TUT)~~
- MATH 117 Calculus 1 for Engineering ~~(3 LEC,2 TUT)~~
- MATH 135 Algebra for Honours Mathematics ~~(3 LEC,1 TUT)~~
- SE 101 Introduction to Methods of Software Engineering ~~(1 SEM,2 LAB)~~

Term 1B (Winter)

- CS 138 Introduction to Data Abstraction and Implementation ~~(3 LEC,1 TUT,2 LAB)~~
- ECE 106 Electricity and Magnetism ~~(3 LEC,1 TUT,1.25 LAB)~~
- ECE 124 Digital Circuits and Systems ~~(3 LEC,1 TUT,1.25 LAB)~~
- ECE 140 Linear Circuits ~~(3 LEC,2 TUT,1.25 LAB)~~
- MATH 119 Calculus 2 for Engineering ~~(3 LEC,2 TUT)~~
- SE 102 Seminar ~~(1 SEM)~~

Term 2A (Fall)

- CHE 102 Chemistry for Engineers (see Note 7) ~~(3 LEC,2 TUT)~~
- CS 241 Foundations of Sequential Programs ~~(3 LEC,1 TUT,2 LAB)~~
- ECE 222 Digital Computers ~~(3 LEC,1 TUT,1.25 LAB)~~
- SE 201 Seminar ~~(1 SEM)~~
- SE 212 Logic and Computation ~~(3 LEC,1 TUT)~~
- STAT 206 Statistics for Software Engineering (see Note 5) ~~(3 LEC,1 TUT)~~
- Undergraduate Communication Requirement (see Note 6)

Term 2B (Spring)

- CS 240 Data Structures and Data Management ~~(3 LEC,3 LAB)~~
- CS 247 Software Engineering Principles ~~(3 LEC,1 TUT, 3 LAB unscheduled)~~
- CS 348 Introduction to Database Management ~~(3 LEC,1 LAB)~~
- ECE 192 Engineering Economics and Impact on Society ~~(2 LEC,1 TUT)~~

- MATH 239 Introduction to Combinatorics ~~(3 LEC,1 TUT)~~
- SE 202 Seminar ~~(1 SEM)~~
- Elective (see Note 1)
- ~~WKRPT 200 Work-term Report~~

Term 3A (Winter)

- CS 341 Algorithms ~~(3 LEC,3 LAB)~~
- CS 349 User Interfaces ~~(3 LEC,1 LAB-unscheduled)~~
- MATH 213 Signals, Systems, and Differential Equations ~~(3 LEC,1 TUT)~~
- SE 301 Seminar ~~(1 SEM)~~
- SE 350 Operating Systems ~~(3 LEC,1 TUT,1.25 LAB)~~
- SE 465 Software Testing and Quality Assurance ~~(3 LEC,1 TUT,3 LAB-unscheduled)~~
- Elective (see Notes 1 and 2)

Term 3B (Fall)

- CS 343 Concurrent and Parallel Programming ~~(3 LEC,3 LAB)~~
- ECE 358 Computer Networks ~~(3 LEC,1 TUT,1.25 LAB)~~
- SE 302 Seminar ~~(1 SEM)~~
- SE 380 Introduction to Feedback Control ~~(3 LEC,1 TUT,1.25 LAB)~~
- SE 390 Design Project Planning ~~(2 LEC,2 PRJ,LAB-unscheduled)~~
- SE 464 Software Design and Architectures ~~(3 LEC,1 TUT,3 LAB-unscheduled)~~
- Elective (see Notes 1 and 2)
- ~~WKRPT 300 Work-term Report~~

Term 4A (Spring)

- SE 401 Seminar ~~(1 SEM)~~
- SE 463 Software Requirements Specification and Analysis ~~(3 LEC,1 TUT,3 LAB-unscheduled)~~
- SE 490 Design Project 1 ~~(2 LEC,9 PRJ,LAB-unscheduled)~~
- Three Electives (see Notes 1 and 3)
- ~~WKRPT 400 Work-term Report~~

Term 4B (Winter)

- SE 402 Seminar ~~(1 SEM)~~
- SE 491 Design Project 2 ~~(2 LEC,2 PRJ,LAB-unscheduled)~~
- Four Electives (see Notes 1 and 3)

Advanced Technical Electives

The three advanced technical electives (ATEs) comprise fourth-year CS or ECE course offerings. Students are advised to plan ahead when selecting ATEs. Most ATEs are not offered every term, and some ATEs have other ATEs as prerequisites. The academic advisors may approve other courses.

CS List

One of the following CS courses:

- CS 360 Introduction to the Theory of Computing
- CS 365 Models of Computation
- CS 370 Numerical Computation
- CS 371 Introduction to Computational Mathematics
- CS 442 Principles of Programming Languages
- CS 444 Compiler Construction
- CS 448 Database Systems Implementation
- CS 449 Human-Computer Interaction
- CS 450 Computer Architecture
- CS 451 Data-Intensive Distributed Computing
- CS 452 Real-time Programming
- CS 454 Distributed Systems
- CS 457 System Performance Evaluation
- CS 458 Computer Security and Privacy
- CS 462 Formal Languages and Parsing
- CS 466 Algorithm Design and Analysis
- CS 479 Neural Networks
- CS 480 Introduction to Machine Learning
- CS 484 Computational Vision
- CS 485 Statistical and Computational Foundations of Machine Learning
- CS 486 Introduction to Artificial Intelligence
- CS 487 Introduction to Symbolic Computation
- CS 488 Introduction to Computer Graphics
- CS 489 Advanced Topics in Computer Science

ECE List

One of the following ECE courses:

- ECE 313 Digital Signal Processing
- ECE 320 Computer Architecture
- ECE 327 Digital Hardware Systems
- ECE 340 Electronic Circuits 2
- ECE 409 Cryptography and System Security
- ECE 416 Advanced Topics in Networking
- ECE 417 Image Processing
- ECE 423 Embedded Computer Systems
- ECE 454 Distributed Computing
- ECE 455 Embedded Software
- ECE 457A Co-operative and Adaptive Algorithms

- ECE 457B Fundamentals of Computational Intelligence
- ECE 457C Reinforcement Learning
- ECE 458 Computer Security
- ECE 459 Programming for Performance
- ECE 481 Digital Control Systems
- ECE 486 Robot Dynamics and Control
- ECE 488 Multivariable Control Systems
- ECE 493 Special Topics in Electrical and Computer Engineering
- ECE 495 Autonomous Vehicles

One additional course from the CS and ECE Lists above, or from the Extended List below.

Extended List

- CO 331 Coding Theory
- CO 342 Introduction to Graph Theory
- CO 351 Network Flow Theory
- CO 353 Computational Discrete Optimization
- CO 367 Nonlinear Optimization
- CO 456 Introduction to Game Theory
- CO 481 Introduction to Quantum Information Processing
- CO 485 The Mathematics of Public-Key Cryptography
- CO 487 Applied Cryptography
- MSCI 343 Human-Computer Interaction
- MSCI 446 Introduction to Machine Learning
- MSCI 543 Analytics and User Experience
- MTE 544 Autonomous Mobile Robots
- MTE 546 Multi-~~S~~sensor Data Fusion
- SE 498 Advanced Topics in Software Engineering
- STAT 440 Computational Inference
- STAT 441 Statistical Learning - Classification
- STAT 442 Data Visualization
- STAT 444 Statistical Learning - Advanced Regression
- SYDE 533 Conflict Resolution
- SYDE 543 Cognitive Ergonomics
- SYDE 548 User-Centered Design Methods
- SYDE 552 Computational Neuroscience
- SYDE 556 Simulating Neurobiological Systems
- SYDE 575 Image Processing

Science Course Electives

Normally, the science course electives (SCEs) are in the natural sciences, chosen from the list below. Alternate courses may be chosen in consultation with the SE academic advisors.

Two of

- BIOL 110, BIOL 120, (BIOL 130 and BIOL 130L), BIOL 150, BIOL 165, BIOL 211, BIOL 239, (BIOL 240 and BIOL 240L), BIOL 241, BIOL 273, (BIOL 373 and BIOL 373L)
- CHE 161

- (CHEM 123 and CHEM 123L), CHEM 209, (CHEM 237 and CHEM 237L), CHEM 254, (CHEM 262 and CHEM 262L), CHEM 266, CHEM 356, CHEM 404
- EARTH 121, EARTH 122, EARTH 123, EARTH 221, EARTH 270, EARTH 281
- ECE 231, ECE 403, ECE 404, ECE 405
- ENVE 275
- ENVS 200
- NE 222
- PHYS 124, PHYS 175, **PHYS 233**, PHYS 234, PHYS 263, PHYS 275, PHYS 280, PHYS 334, PHYS 335, PHYS 375, PHYS 380
- **PSYCH 207, PSYCH 261, PSYCH 306, PSYCH 307**
- **SCI 201,** SCI 238, SCI 250

Linkage Electives

Three linkage electives (LEs) courses as specified below. Students should be aware that these courses may have enrolment limits, or may not fit their schedules.

One course on ~~Societal Issues~~ **Impact of Technology and/or Engineering on Society**:

- ~~CS 492,~~ Complementary Studies Elective List A

One additional course on Humanities and Social Sciences **(excluding courses concentrated on development of language or other skills)**:

- Complementary Studies Elective List C

One course on Communications (see Note 6)

- ENGL 109
- ENGL 119
- ENGL 129R/EMLS 129R
- ENGL 209
- ENGL 210E
- EMLS 101R
- EMLS 102R
- SPCOM 100
- SPCOM 223

Notes

1. There are 10 electives. These electives must include three Advanced Technical Electives, two Science Course Electives, and three Linkage Electives. For their remaining two electives, students may choose to take additional courses from the elective lists above or any other 0.5 credit course(s) for which they meet the requisites. Advanced Technical Electives may not be taken before the 3A term.
2. Students must take one elective in third year, but can choose to take it in either 3A or 3B. Students may take electives in both terms if they choose.
3. Students may choose to take three electives in 4A and four electives in 4B, instead of two in 4A and five in 4B.

4. Students enrolled in Software Engineering will only be permitted to use the WD and WF (see Grades for descriptions) provisions used in the Faculty of Mathematics to withdraw from extra courses taken above the degree requirements.
5. Students may replace STAT 206 and one of their unrestricted electives with the combination of STAT 230 and STAT 231.
6. The linkage elective on communication (Undergraduate Communication Requirement) is normally taken in the 2A term. It must be completed with a grade of at least 60% prior to enrolling in the 3A term.
7. CHE 102 is treated as an elective for the purpose of reduced load; that is, students may take CHE 102 either before or after their 2A term. Students may take CHEM 120 instead of CHE 102.

Undergraduate Communication Requirement

Strong communication skills are essential to academic, professional, and personal success. As such, Software Engineering students must take a course from the Linkage Elective Undergraduate Communication Requirement List in the 2A term. This elective list is intended to include all of Mathematics Undergraduate Communication Requirement List 1, and selections from Mathematics Undergraduate Communication Requirement List 2. Communication skills are further developed and evaluated ~~in three work-term reports (described below) and~~ in **PD 11,** SE 101, SE 390, SE 490, and SE 491.

~~**Three Work-term Reports**~~

~~Work-term reports (WKRPTs) are listed as part of the Software Engineering curriculum; they are treated as courses that a BSE student must successfully complete to satisfy the plan requirements. They appear on all grade reports and transcripts, but they are not used in calculating term averages.~~

~~Each work-term report requirement is satisfied by earning a grade of satisfactory or better on a work-term report related to the previous term's co-op employment. Each work-term report must be submitted at the beginning of the academic term in which it is listed as a course; it is due seven days after the first official day of lectures. Reports submitted after the due date will receive a failing grade and will be evaluated the following academic term.~~

~~Failed work-term reports contribute to a student's accumulated failed-course count. They also appear on a student's transcript. Once a failure has cleared, the original grade will still be listed on the transcript but will be annotated with a credit (CR) in the "sup" field.~~

Professional Development Courses

Five professional development (PD) courses are required as described in the BASc and BSE specific degree requirements section on Work Terms. Two core PD courses are specified for all engineering students: PD 19 and PD 20. **One core PD course is specified for all mathematics students, PD 11.** Due to the importance of understanding the legal and ethical ramifications of software development, Software Engineering students are also required to take PD 10. This course replaces one of the PD electives, such that Software Engineering students have ~~three~~ **four** core PD courses (PD 10, **PD 11,** PD 19, and PD 20) and ~~two~~ **one** PD elective course~~s~~. Software Engineering students are automatically enrolled in ~~PD 10,~~ PD 19~~,~~ and PD 20 but must enrol in **PD 10, PD 11, and** the elective PD course~~s~~ using the normal Quest enrolment process.

The Honours Software Engineering plan leads to a Bachelor of Software Engineering (BSE) degree.

Admissions

The Software Engineering Board, in consultation with the faculties of Engineering and Mathematics and their admissions committees, determines the admission requirements for Software Engineering.

For details on admission information, see the Admissions section of this Calendar.

Options, Specializations, Minors, and Joint Honours

Software Engineering students are considered as both Mathematics and Engineering students, and can thus take advantage of degree enhancements available to students from either faculty. These enhancements take the form of additional plans such as options, specializations, minors, and joint honours.

Software Engineering students are eligible for either the Artificial Intelligence Option (Engineering) or the Artificial Intelligence Specialization (Computer Science), but cannot graduate with both degree enhancements. See the full list of Computer Science specializations or the full list of Options, Specializations and Electives for Engineering Students.

The following Mathematics Joint Honours plans are also approved as additional plans for BSE students:

- Joint Applied Mathematics
- Joint Combinatorics and Optimization
- Joint Pure Mathematics, and
- Joint Statistics

BSE students are not eligible to add Joint Computer Science (Bachelor of Mathematics), Joint Bachelor of Computer Science plans, or stand-alone BMath Honours plans from the Faculty of Mathematics. BSE students pursuing a Joint Honours plan are not required to satisfy the Table 2 Faculty Core Courses requirements in the degree requirements for all Mathematics students. These students are still required to fulfil all requirements for the BSE.

BSE students may be eligible to add other options, specializations, or minors in Mathematics, Engineering, or other faculties, subject to the approval of the Software Engineering associate director. Students should be aware that adding plans will constrain their choice of electives, and may require additional courses. Thus, it is advisable to start preparing for additional plans in the first and second years. Students should also consider the benefits of not adding plans, in that they are better able to personalize their curriculum if they have more flexibility in choosing their electives. Students interested in pursuing additional academic plans, see invalid credential combinations.

Software Engineering Awards

Students in the Bachelor of Software Engineering plan are eligible for Awards of Excellence in the Faculty of Mathematics. Students in the Bachelor of Software Engineering plan are eligible for Awards of Excellence in the Faculty of Engineering.

Honours Software Engineering

The Software Engineering plan is offered jointly by the David R. Cheriton School of Computer Science and the Department of Electrical and Computer Engineering; it is only offered in the co-operative 8-

stream.

Students will be considered members of both the Faculty of Engineering and the Faculty of Mathematics, although for administrative purposes they will be registered officially in a separate unit. Students will be promoted based on the Examinations and Promotions rules used in the Faculty of Engineering. A non-voting representative from the Faculty of Mathematics will sit on the Engineering Examinations and Promotion Committee, to provide insight into the policies, philosophies, culture, and requirements that pertain to Mathematics students. The Software Engineering plan is also considered an Honours Mathematics plan for purposes of student access to Mathematics courses. The Software Engineering advisor will advise students on how to achieve their academic goals.

Legend for Study/Work Sequence Table

Key	Description
F,W,S	F=fall term, W=winter term, S=spring term
1,2,3,4 plus A or B	Denotes academic year and term.
WT	Denotes scheduled work terms.

Study/Work Sequence

Sequence	F	W	S	F	W	S	F	W	S	F	W	S	F	W
Stream 8	1A	1B	WT	2A	WT	2B	WT	3A	WT	3B	WT	4A	WT	4B

Academic Curriculum

The term-by-term academic component of the curriculum is as follows:

Term 1A (Fall)

- CS 137 Programming Principles
- ECE 105 Classical Mechanics
- MATH 115 Linear Algebra for Engineering
- MATH 117 Calculus 1 for Engineering
- MATH 135 Algebra for Honours Mathematics
- SE 101 Introduction to Methods of Software Engineering

Term 1B (Winter)

- CS 138 Introduction to Data Abstraction and Implementation
- ECE 106 Electricity and Magnetism
- ECE 124 Digital Circuits and Systems
- ECE 140 Linear Circuits
- MATH 119 Calculus 2 for Engineering
- SE 102 Seminar

Term 2A (Fall)

- CHE 102 Chemistry for Engineers (see Note 7)
- CS 241 Foundations of Sequential Programs
- ECE 222 Digital Computers
- SE 201 Seminar
- SE 212 Logic and Computation
- STAT 206 Statistics for Software Engineering (see Note 5)
- Undergraduate Communication Requirement (see Note 6)

Term 2B (Spring)

- CS 240 Data Structures and Data Management
- CS 247 Software Engineering Principles
- CS 348 Introduction to Database Management
- ECE 192 Engineering Economics and Impact on Society
- MATH 239 Introduction to Combinatorics
- SE 202 Seminar
- Elective (see Note 1)

Term 3A (Winter)

- CS 341 Algorithms
- CS 349 User Interfaces
- MATH 213 Signals, Systems, and Differential Equations
- SE 301 Seminar
- SE 350 Operating Systems
- SE 465 Software Testing and Quality Assurance
- Elective (see Notes 1 and 2)

Term 3B (Fall)

- CS 343 Concurrent and Parallel Programming
- ECE 358 Computer Networks
- SE 302 Seminar
- SE 380 Introduction to Feedback Control
- SE 390 Design Project Planning
- SE 464 Software Design and Architectures
- Elective (see Notes 1 and 2)

Term 4A (Spring)

- SE 401 Seminar
- SE 463 Software Requirements Specification and Analysis
- SE 490 Design Project 1
- Three Electives (see Notes 1 and 3)

Term 4B (Winter)

- SE 402 Seminar
- SE 491 Design Project 2
- Four Electives (see Notes 1 and 3)

Advanced Technical Electives

The three advanced technical electives (ATEs) comprise fourth-year CS or ECE course offerings. Students are advised to plan ahead when selecting ATEs. Most ATEs are not offered every term, and some ATEs have other ATEs as prerequisites. The academic advisors may approve other courses.

CS List

One of the following CS courses:

- CS 360 Introduction to the Theory of Computing
- CS 365 Models of Computation
- CS 370 Numerical Computation
- CS 371 Introduction to Computational Mathematics
- CS 442 Principles of Programming Languages
- CS 444 Compiler Construction
- CS 448 Database Systems Implementation
- CS 449 Human-Computer Interaction
- CS 450 Computer Architecture
- CS 451 Data-Intensive Distributed Computing
- CS 452 Real-time Programming
- CS 454 Distributed Systems
- CS 457 System Performance Evaluation
- CS 458 Computer Security and Privacy
- CS 462 Formal Languages and Parsing
- CS 466 Algorithm Design and Analysis
- CS 479 Neural Networks
- CS 480 Introduction to Machine Learning
- CS 484 Computational Vision
- CS 485 Statistical and Computational Foundations of Machine Learning
- CS 486 Introduction to Artificial Intelligence
- CS 487 Introduction to Symbolic Computation
- CS 488 Introduction to Computer Graphics
- CS 489 Advanced Topics in Computer Science

ECE List

One of the following ECE courses:

- ECE 313 Digital Signal Processing
- ECE 320 Computer Architecture
- ECE 327 Digital Hardware Systems
- ECE 340 Electronic Circuits 2
- ECE 409 Cryptography and System Security
- ECE 416 Advanced Topics in Networking
- ECE 417 Image Processing
- ECE 423 Embedded Computer Systems
- ECE 454 Distributed Computing
- ECE 455 Embedded Software
- ECE 457A Co-operative and Adaptive Algorithms
- ECE 457B Fundamentals of Computational Intelligence
- ECE 457C Reinforcement Learning
- ECE 458 Computer Security
- ECE 459 Programming for Performance
- ECE 481 Digital Control Systems
- ECE 486 Robot Dynamics and Control
- ECE 488 Multivariable Control Systems
- ECE 493 Special Topics in Electrical and Computer Engineering
- ECE 495 Autonomous Vehicles

One additional course from the CS and ECE Lists above, or from the Extended List below.

Extended List

- CO 331 Coding Theory
- CO 342 Introduction to Graph Theory
- CO 351 Network Flow Theory
- CO 353 Computational Discrete Optimization
- CO 367 Nonlinear Optimization
- CO 456 Introduction to Game Theory
- CO 481 Introduction to Quantum Information Processing
- CO 485 The Mathematics of Public-Key Cryptography
- CO 487 Applied Cryptography
- MSCI 343 Human-Computer Interaction
- MSCI 446 Introduction to Machine Learning
- MSCI 543 Analytics and User Experience
- MTE 544 Autonomous Mobile Robots
- MTE 546 Multi-sensor Data Fusion
- SE 498 Advanced Topics in Software Engineering
- STAT 440 Computational Inference
- STAT 441 Statistical Learning - Classification
- STAT 442 Data Visualization
- STAT 444 Statistical Learning - Advanced Regression
- SYDE 533 Conflict Resolution
- SYDE 543 Cognitive Ergonomics
- SYDE 548 User Centred Design Methods

- SYDE 552 Computational Neuroscience
- SYDE 556 Simulating Neurobiological Systems
- SYDE 575 Image Processing

Science Course Electives

Normally, the science course electives (SCEs) are in the natural sciences, chosen from the list below. Alternate courses may be chosen in consultation with the SE academic advisors.

Two of

- BIOL 110, BIOL 120, (BIOL 130 and BIOL 130L), BIOL 150, BIOL 165, BIOL 211, BIOL 239, (BIOL 240 and BIOL 240L), BIOL 241, BIOL 273, (BIOL 373 and BIOL 373L)
- CHE 161
- (CHEM 123 and CHEM 123L), CHEM 209, (CHEM 237 and CHEM 237L), CHEM 254, (CHEM 262 and CHEM 262L), CHEM 266, CHEM 356, CHEM 404
- EARTH 121, EARTH 122, EARTH 123, EARTH 221, EARTH 270, EARTH 281
- ECE 231, ECE 403, ECE 404, ECE 405
- ENVE 275
- ENVS 200
- NE 222
- PHYS 124, PHYS 175, PHYS 233, PHYS 234, PHYS 263, PHYS 275, PHYS 280, PHYS 334, PHYS 335, PHYS 375, PHYS 380
- PSYCH 207, PSYCH 261, PSYCH 306, PSYCH 307
- SCI 201, SCI 238, SCI 250

Linkage Electives

Three linkage electives (LEs) courses as specified below. Students should be aware that these courses may have enrolment limits, or may not fit their schedules.

One course on Impact of Technology and/or Engineering on Society:

- Complementary Studies Elective List A

One additional course on Humanities and Social Sciences (excluding courses concentrated on development of language or other skills):

- Complementary Studies Elective List C

One course on Communications (see Note 6)

- ENGL 109
- ENGL 119
- ENGL 129R/EMLS 129R
- ENGL 209
- ENGL 210E
- EMLS 101R
- EMLS 102R
- SPCOM 100

- SPCOM 223

Notes

1. There are 10 electives. These electives must include three Advanced Technical Electives, two Science Course Electives, and three Linkage Electives. For their remaining two electives, students may choose to take additional courses from the elective lists above or any other 0.5 credit course(s) for which they meet the requisites. Advanced Technical Electives may not be taken before the 3A term.
2. Students must take one elective in third year, but can choose to take it in either 3A or 3B. Students may take electives in both terms if they choose.
3. Students may choose to take three electives in 4A and four electives in 4B, instead of two in 4A and five in 4B.
4. Students enrolled in Software Engineering will only be permitted to use the WD and WF (see Grades for descriptions) provisions used in the Faculty of Mathematics to withdraw from extra courses taken above the degree requirements.
5. Students may replace STAT 206 and one of their unrestricted electives with the combination of STAT 230 and STAT 231.
6. The linkage elective on communication (Undergraduate Communication Requirement) is normally taken in the 2A term. It must be completed with a grade of at least 60% prior to enrolling in the 3A term.
7. CHE 102 is treated as an elective for the purpose of reduced load; that is, students may take CHE 102 either before or after their 2A term. Students may take CHEM 120 instead of CHE 102.

Undergraduate Communication Requirement

Strong communication skills are essential to academic, professional, and personal success. As such, Software Engineering students must take a course from the Linkage Elective Undergraduate Communication Requirement List in the 2A term. This elective list is intended to include all of Mathematics Undergraduate Communication Requirement List 1, and selections from Mathematics Undergraduate Communication Requirement List 2. Communication skills are further developed and evaluated in PD 11, SE 101, SE 390, SE 490, and SE 491.

Professional Development Courses

Five professional development (PD) courses are required as described in the BASc and BSE specific degree requirements section on Work Terms. Two core PD courses are specified for all engineering students: PD 19 and PD 20. One core PD course is specified for all mathematics students, PD 11. Due to the importance of understanding the legal and ethical ramifications of software development, Software Engineering students are also required to take PD 10. This course replaces one of the PD electives, such that Software Engineering students have four core PD courses (PD 10, PD 11, PD 19, and PD 20) and one PD elective course. Software Engineering students are automatically enrolled in PD 19 and PD 20 but must enrol in PD 10, PD 11, and the elective PD course using the normal Quest enrolment process.

Faculty of Arts/Faculty of Environment

Report to Senate Undergraduate Council
04 October 2022

The Bachelor of Sustainability and Financial Management is a joint program between the Faculty of Arts and the Faculty of Environment.

1. **NEW COURSES [for approval]**

   Sustainability and Financial Management: SFM

2. **ACADEMIC PLAN CHANGES – MAJOR MODIFICATIONS [for approval]**

   Bachelor of Sustainability and Financial Management

1.

NEW COURSES (for approval)

Interdisciplinary Studies

Effective 01-SEP-2023

SFM 328 (0.25) PRJ Sustainability Integration Consulting Group - Junior Strategist

This course provides students hands-on training in strategic integration of sustainability objectives and measurement within the firm with guidance from industry experts and supervision by faculty. This will generally be the first course that students take when they join the Sustainability Integration team. Junior strategists will attend consulting group meetings, assist in firm research and materiality assessments, and assist in the preparation of consulting reports/recommendations. [Note: This is a repeatable course, subject to different content; it may be completed a total of two times. Course will be graded on a CR/NCR basis.]

Requisites : Prereq: Level at least 3A; Accounting and Financial Management, Environment and Business, or Sustainability and Financial Management students; Accounting and Financial Management students require three of: AFM 485, ENBUS 102, ENBUS 202, ENBUS 310, ENBUS 407, ENBUS 408, ENBUS 410, ENVS 195, ENVS 200, ENVS 205, ENVS 220, INDEV 100, INDEV 200

Rationale : The course is designed to allow students focused on sustainability and management studies to have an experiential learning opportunity similar to that of those providing sustainability expertise and services to other businesses. The course will be graded on a credit/no credit basis and requires department consent to enrol. Short title: Sust Int Consulting: Jr.

Effective 01-SEP-2023

SFM 329 (0.25) PRJ Sustainability Integration Consulting Group - Senior Strategist

This course provides students hands-on training in strategic integration of sustainability objectives and measurement within the firm with guidance from industry experts and supervision by faculty. This course is normally taken after a student has completed one term as a junior strategist with the consulting group. Senior strategists interface with firm representatives, lead the consulting student team, and oversee consulting reports/recommendations. [Note: This is a repeatable course, subject to different content; it may be completed a total of two times. Course will be graded on a CR/NCR basis.]

Requisites : Prereq: Level at least 3A; Accounting and Financial Management, Environment and Business, or Sustainability and Financial Management students; Accounting and Financial Management students require three of: AFM 485, ENBUS 102, ENBUS 202, ENBUS 310, ENBUS 407, ENBUS 408, ENBUS 410, ENVS 195, ENVS 200, ENVS 205, ENVS 220, INDEV 100, INDEV 200

Rationale : The course is designed to allow students focused on sustainability and management studies to develop a breadth and depth of experience engaging in sustainability consulting similar to SFM 328. The course can be repeated provided it adds to the breadth of their experience (i.e., not simply doing the same thing). The course is graded on a credit/no credit basis and requires department consent to enrol. Short title: Sust Int Consulting: Sr.

End of Report

2. Major Modifications

Plan Title(s): Bachelor of Sustainability and Financial Management

Effective Date: 01 September 2023

Rationale: *The Indigenous Entrepreneurship Diploma and Minor already offered by the Faculty of Arts is being integrated into the BSFM to provide an alternative pathway of study to meet the specialization requirement of the program. This change expands the instructional focus of the program more fully on Indigenous opportunities in business and increases the accessibility of the BSFM for students with non-traditional education pathways who commence studies at Waterloo in the Indigenous Entrepreneurship Diploma. Adding this specialization builds on the Indigenous Entrepreneurship Minor and complements the other two specializations in the program. Students cannot combine the Indigenous Entrepreneurship Specialization with the Indigenous Entrepreneurship Diploma or the Indigenous Entrepreneurship Minor.*
The specialization will draw on existing courses, primarily INDENT, and provides students with flexibility by way of three electives. ERS 275 addresses Indigenous sustainable entrepreneurship directly and provides an opportunity for understanding business and economic development concepts through Indigenous knowledge systems, including exposure to Indigenous business leaders and business models. This course replaces ERS 372, which focuses on Indigenous environmental knowledge, but with limited business and entrepreneurship content. ENVS 401, Indigenous Peoples, Canadian Law and Natural Resource Development, provides the constitutional foundations of Aboriginal and treaty rights under s.35 of the Constitution Act, and addresses the obligations the Crown and resource developers owe Indigenous groups in relation to land and resource development. Understanding the unique legal position of Canada's Indigenous groups is central to the business and development practices that are at the core of the specialization. St. Paul's University College has been consulted and approves the inclusion of these courses.

Calendar text, including <u>additions</u> and ~~deletions~~:

Eligibility for the degree of Bachelor of Sustainability and Financial Management (Co-op) requires:

1. Successful completion of 20 academic course units with a minimum cumulative overall average of 60%. A minimum cumulative average of 70% is required in all of the courses identified in sections (2) and (3), and all Accounting and Financial Management (AFM), Sustainability and Financial Management (SFM), Environment and Business (ENBUS), and Environment (ENVS) electives.
2. Successful completion of the following 12.5 academic course units:
    - AFM 112, AFM 113, AFM 121, AFM 182, AFM 191, AFM 205 (0.25 unit), AFM 208 (0.25 unit), AFM 244, AFM 273, AFM 274, AFM 291, AFM 373, AFM 391
    - SFM 101, SFM 102, SFM 201, SFM 301, SFM 309
    - ENBUS 202
    - ENVS 200, ENVS 201, ENVS 205
    - GEOG 207
    - AFM 433 or ENBUS 302
    - AFM 111, ENVS 131 (see Note 1)
3. Successful completion of one of the ~~two~~ **<u>three</u>** 6.0 academic unit specializations.
4. Successful completion of co-op requirements.

Notes

1. Communication skills are essential to academic, professional, and personal success. The Undergraduate Communication Requirement is fulfilled for Bachelor of Sustainability and Financial Management (BSFM) students by the successful completion of both AFM 111 and ENVS 131.
2. Students are required to complete courses in first and second year in the following sequence:
   1A Term: AFM 111, AFM 112, AFM 191, ENVS 205, SFM 101
   1B Term: AFM 113, AFM 121, AFM 182, ENVS 131, SFM 102
   2A Term: AFM 205, AFM 208, AFM 273, ENBUS 202, ENVS 200, GEOG 207
   2B Term: AFM 244, AFM 274, AFM 291, ENVS 201, SFM 201
   Students who are required to repeat a course or who can't follow this sequence due to transfer credits are required to follow a course sequence approved by the academic advisor.

…

Indigenous Entrepreneurship Specialization

- **ENVS 401, ERS 275 (Topic: Indigenous Sustainability Entrepreneurship), INDENT 200, INDENT 210, INDENT 225, INDENT 310, INDENT 325**
- **Two of HIST 269, HIST 271, INDG 201/CDNST 201, INDG 272/ ANTH 272, INDG 301, INDG 318/RS 318**
- **1.5 academic units AFM, ENBUS, ENVS, INDENT, SFM courses at the 300-level or above**

Course List
ENVS 401 – Canadian Law, Indigenous Peoples, and Natural Resource Development
ERS 275 – Special Readings/Seminar on Select Topics (Topic: Indigenous Sustainability Entrepreneurship)
HIST 269 – Indigenous Histories in Canada
HIST 271 – Global Indigenous Issues
INDENT 200 – The Past, Present, and Future of Indigenous Entrepreneurship
INDENT 210 – Fundamentals of Indigenous Entrepreneurship
INDENT 225 – Practicum in Indigenous Entrepreneurship 1
INDENT 310 – Case Studies in Indigenous Venture Creation
INDENT 325 – Practicum in Indigenous Entrepreneurship 2
INDG 201/CDNST 201 – The Indigenous Experience in Canada
INDG 272/ANTH 272 – Issues in Contemporary Indigenous Communities in Canada
INDG 301 – Critical Theories of Indigeneity in a Global Perspective
INDG 318/RS 318 – Indigenous Worldviews and Spirituality

UNIVERSITY OF WATERLOO

CO-OPERATIVE EDUCATION COUNCIL

Report to Senate Undergraduate Council

October 4, 2022

The following calendar revisions have been approved by the Co-operative Education Council and are being submitted for consideration and approval by Senate Undergraduate Council at its meeting on October 4, 2022.

1. Course change – PD20
2. Certificate in Experiential Education (EDGE) calendar text change

COURSE CHANGES (for approval)

Interdisciplinary Studies

Current Catalog Information

PD 20 (0.50) LEC Engineering Workplace Skills 1: Developing Reasoned Conclusions

An introduction to critical thinking and communication in the workplace for co-op engineering students. Students will practise general critical thinking and communication skills to assess evidence, interpret textual and visual information, and work through ethical and professional situations. Topics include the role of self-reflection in successful professional development, admitting ignorance to develop improved knowledge, understanding arguments, evaluating evidence, communicating conclusion and findings, recognizing and avoiding bias, and application to professional conduct. [Note: Course will be graded on a CR/NCR basis.]

No Special Consent Required

Requisites : Prereq: Engineering students only

Effective 01-SEP-2023

Title Change: Strategies for Career Success

Rationale : PD 20 was formerly completed by Engineering students on their first work term. After the creation of PD 19: Tactics for Workplace Success, PD 20 is now completed by Engineering students during their second work term and the course content was updated accordingly. To align with the new content, the Engineering Curriculum Committee has recommended a course title change. This change has been approved by the Co-operative Education Council. Note: the short title is the same as the long title.

End of Report

Certificate in Experiential Education (EDGE) calendar text change

Motion: to remove the double counting clause from the Certificate in Experiential Education (EDGE) calendar text.

Background and rationale: Students participating in the EDGE certificate are permitted to double count any approved work- or community-based experiential education courses toward the EDGE certificate and one other credential. This policy is aligned with the Counting of Courses guideline in the undergraduate calendar and therefore not required to be listed in the calendar text for the EDGE certificate. The proposed change is to remove redundancy from the calendar text and not a change to the double counting rule associated with the EDGE certificate.

Calendar text:

2. **Experiential education (EE) courses** – Students fulfil this component by successfully completing work- or community-based experiential education courses. Alternatively, students may pair a Professional Development (PD) course with an approved extra-curricular or co-curricular experiential education opportunity. For each of the experiences associated with the EE courses, students must submit a performance appraisal completed by their work- or community-based supervisor (or approved delegate). Upon completion of each experiential education opportunity, students produce a reflection assignment. Specific requirements follow:

    - Students can complete any combination of three work- or community-based experiential education courses or PD courses paired with an approved experience.
    - Students must indicate their interest in counting work- or community-based experiential education courses towards the Certificate in Experiential Education by the end of the course add period.
    - Students pursuing co-curricular or extra-curricular opportunities must have their opportunities approved and must be registered in a PD course by the end of the course add period.
    - To qualify for the Certificate in Experiential Education, co-curricular and extra-curricular activities must involve a minimum of 36 hours in any given term.
    - With the exception of PD 1, PD courses can be taken only when paired with an approved co-curricular or extra-curricular opportunity.
    - Students wishing to take a work- or community-based experiential education course or PD course which would exceed their approved course load may do so with permission of their undergraduate academic advisor.
    - ~~Work- or community-based experiential education courses may be double counted towards the Certificate in Experiential Education and one other credential.~~
    - Although PD courses carry credit weight, they cannot be counted towards a student's primary degree.
    - There are many courses that provide optional opportunities for work- and community-based EE. With the approval of the WIL Programs Director or delegate, courses other than those on the approved work or community-based experiential education list may be used towards the course component of the certificate. Students are responsible for demonstrating the experiential nature of their course work.

OFFICE OF THE REGISTRAR REPORT TO
SENATE UNDERGRADUATE COUNCIL and
SENATE GRADUATE & RESEARCH COUNCIL
October 2022

1. **REGULATIONS**

1.1. **Academic Calendar Dates for 2023-2024**

Symbols and abbreviations:
(M) Monday, (T) Tuesday, (W) Wednesday, (R) Thursday, (F) Friday, (S) Saturday, (U) Sunday, N/A – Not Applicable

	Fall 2023	**Winter 2024**	**Spring 2024**
Co-operative Work Term Begins	Sept. 5 (T)	Jan. 8 (M)	May 6 (M)
Classes Begin	Sept. 6 (W)	Jan. 8 (M)	May 6 (M)
Holidays	Oct. 9 (M)	Feb. 19 (M) Mar. 29 (F)	May 20 (M) July 1 (M) Aug. 5 (M)
Reading Week	Oct. 7-15 (S-U)	Feb. 17-25 (S-U)	N/A
Convocation	Oct. 20, 21 (F,S)	N/A	June 11-15 (T-S)
Classes End	Dec. 5 (T)	Apr. 8 (M)	July 30 (T)
Make-up Day(s) for in-term holidays	N/A	Apr. 8 (M) for Mar. 29 (F schedule)	May 21 (T) for May 20 (M schedule) July 29 (M) for July 1 (M schedule) July 30 (T) for May 21 (T schedule)
Pre-Examination Study Day(s)	Dec. 6, 7 (W,R)	Apr. 9, 10 (T,W)	July 31, Aug. 1 (W,R)
Examinations Begin	Dec. 8 (F)	Apr. 11 (R)	Aug. 2 (F)
In-Person Exam Days for Online Courses	Dec. 8, 9 (F,S) Dec. 13, 16 (W,S)	Apr. 12, 13 (F,S) Apr. 17, 20 (W,S)	Aug. 9, 10 (F,S) Aug. 14, 17 (W,S)
Examinations on Sunday	Dec. 10 (U)	N/A	N/A
No Exams on the Following Days	Dec. 17 (U)	Apr. 14 (U) Apr. 21 (U)	Aug. 3 (S) Aug. 4 (U) Aug. 5 (M) Aug. 11 (U)
Examinations End (including Emergency Day)	Dec. 22 (F)	Apr. 26 (F)	Aug. 17 (S)
Co-operative Work Term Ends	Dec. 22 (F)	Apr. 26 (F)	Aug. 23 (F)
Teaching days	60	60	60
Pre-examination Study Day(s)	2	2	2
Examination days	13 (+1 Emergency Day)	13 (+1 Emergency Day)	11 (+1 Emergency Day)

Guidelines for Determining Academic Calendar of Dates

The following are principles and guidelines either formally agreed upon by Senate or adopted as common practice in determining the dates for the academic year.

1. That the practice of setting dates for each academic year continues to be an annual exercise.
2. That there be no fewer than **60 teaching days** (12 weeks) in a term. A clear rationale for fewer than 60 teaching days must be communicated to Senate at the time calendar dates are approved. In calculating teaching days in a term, Saturdays, Sundays, and public or University holidays are excluded.
3. That attention be given to **balancing the number of meets** in courses. Where an imbalance may occur because of public holidays, the class schedule for a day different than the calendar day can be used to balance the number of course meets.
4. That **fall convocation** be the Friday and Saturday that fall in the third full week (beginning Sunday) of October.
5. That **spring convocation** be the Tuesday to Saturday in the second full week (beginning Sunday) in June.
6. That the **reading weeks** occur in all faculties in the fall and winter terms. They must begin on the Saturday before the public holidays of Thanksgiving Day and Family Day and will end on the following Sunday.
7. That **fall term** classes begin on the Wednesday following the public holiday of Labour Day. **Exception:** The fall term begins on Tuesday, September 8 when Labour Day is September 7.
8. That the start date for **winter term** be set as follows:
    - If January 1 is a Sunday, then start of classes is Wednesday, January 4.
    - If January 1 is a Monday, then start of classes is Wednesday, January 3.
    - If January 1 is a Tuesday, then start of classes is Monday, January 7.
    - If January 1 is a Wednesday, then start of classes is Monday, January 6.
    - If January 1 is a Thursday, then start of classes is Monday, January 5.
    - If January 1 is a Friday, then start of classes is Tuesday, January 5.
    - If January 1 is a Saturday, then start of classes is Wednesday, January 5.

9. The start date for **spring term** be set as follows:
    - If May 1 is a Sunday, then start of classes is Monday, May 2.
    - If May 1 is a Monday, then start of classes is Monday, May 1.
    - If May 1 is a Tuesday, then start of classes is Tuesday, May 1.
    - If May 1 is a Wednesday, then start of classes is Wednesday, May 1.
    - If May 1 is a Thursday, then start of classes is Monday, May 5.
    - If May 1 is a Friday, then start of classes is Monday, May 4.
    - If May 1 is a Saturday, then start of classes is Monday, May 3.

10. That there be no fewer than one **pre-examination study day** and when possible, two pre-examination study days (excluding Saturday, Sunday, and public holidays) between the end of classes and the beginning of examinations. A clear rationale for using fewer than two days or

Saturday, Sunday, and holidays as pre-examination study days, must be communicated to Senate at the time calendar dates are approved.

11. That there be no fewer than 13 **examination days** in the fall and winter terms, and 11 examination days in the spring term. In addition, one Emergency Day with no scheduled examinations is added to the end of the examination period.
12. In calculating **examination days**, Saturdays which fall within the period are included, whereas Sundays and public or University holidays are excluded.

    Exceptions:

    - Examinations will not be scheduled on the Saturday following Good Friday when that day falls within the examination schedule or the Saturday of the Civic Day weekend.
    - The first Sunday within the examination period may be used when required to accommodate the prescribed number of examination days in the fall term.
13. That for the **fall term's examination period**, no examinations be scheduled beyond December 22. The Emergency Day cannot be scheduled beyond December 23.
14. That **online course examination days** in each term be the first consecutive Friday and Saturday in the examination period.
15. **Grades due dates** for on campus courses are normally scheduled seven days from the date of the final examination. Grades for online (Centre for Extended Learning) courses that have a scheduled final examination are due on the last day of the grades submission period. Grades for all courses without a scheduled final examination are normally due 14 days after the start of examinations.
16. **Co-op work terms** are expected to be 16 week in duration. Actual start and end dates may vary depending on employer or student requirements in consultation with Co-operative Education.

Prepared by:
C. Newell Kelly, Registrar
August 2022

Rules that Require Exceptions with Rationale:

Rule 8

*That the start date for **winter term** be set as follows:*

- *If January 1st is a Monday, then start of classes is Wednesday, January 3rd.*

To allow for adequate transition time between the fall and the winter terms, classes will begin on Monday, January 8, 2024 rather than Wednesday, January 3, 2024.

Rule 9

*The start date for **spring term** be set as follows:*

- *If May 1st is a Wednesday, then start of classes is Wednesday, May 1st.*

To allow for adequate transition time between the winter and the spring terms, classes will begin on Monday, May 6, 2024 rather than Wednesday, May 1, 2024.

Rule 12

… The first Sunday within the examination period may be used when required to accommodate the prescribed number of examination days in the fall term.

With fall term classes beginning September 6, 2023, and the scheduling of two study days prior to the fall final exam period, the first Sunday within the exam period was required for scheduling exams to accommodate the prescribed number of examination days.

… Examinations will not be scheduled on the Saturday following Good Friday when that day falls within the examination schedule or the Saturday of the Civic Day weekend.

Saturday, August 3, 2024 will not be used for schedule of examinations during the 2024 spring term final exam period, as it is the Saturday of the Civic Day weekend.

Rule 14

*That **online course examination days** in each term be the first consecutive Friday and Saturday in the examination period.*

It has been determined that with the expected volume of online courses with in-person exams, additional days will be required, and therefore dates have been selected for the first a consecutive Friday and Saturday and second consecutive Wednesday and Saturday of each exam period.

For Presentation to Senate Undergrad Committee

Proposed University of Waterloo Digital Learning Framework

David Davidi, AVPA
Aldo Caputo, Director, Centre for Extended Learning

We are bringing a Digital Learning Framework to SUC for to address some needs that have become evident since the start of the pandemic. The Framework is in two parts.

1. A set of principles and definitions are articulated that are intended to serve as both baseline and guidelines for digital teaching and learning at Waterloo with the goal of ensuring that digital teaching and learning is done in a manner that complies with university policies and Canadian law, meets Waterloo's standards for quality, and clearly communicates to students the expectations around mode of delivery. We will seek SUC endorsement of this part of the Framework, and that SUC recommend that Senate do the same.
2. The Framework also proposes a review and approval process, but these are procedural matters that do not require Senate endorsement in the same way. We bring this part of the Framework for feedback and discussion.

Motion: That Senate Undergraduate Council endorses the Principles for Digital Learning and Definitions as specified in the attachment, and that SUC recommends that Senate likewise endorse them.

Rationale

The need for something like these guidelines has become clear because of the greater prevalence of the digital learning since the pandemic. To a great extent, the University has been relying on the fact that most of the digital learning on campus has taken place in online courses developed in partnership with the Centre for Extended Learning. Partnership with CEL ensured compliance with these guidelines as a matter of course. Since digital learning materials are increasingly being developed without CEL partnership, it is important that the guidelines be made explicit. The guidelines should apply to all internally developed digital learning materials. Being explicit about them opens up greater opportunities for the continued expansion of digital learning on campus, including:

- the expanded use of digital resources in all courses
- potential for a greater variety of course delivery modes than before the pandemic, including current initiatives to expand the use of blended learning
- the potential for more independently (instructor) created online and blended courses to being created with ad hoc or no Centre for Extended Learning support, while still assuring adherence to the articulated principles

Universal Principles for Digital Learning (including on-campus, blended, and online)

1. The learning materials and delivery platforms must conform to all relevant University policies, including meeting security, privacy, ancillary fee, and course outline requirements.
2. The platforms and materials must meet or exceed AODA accessibility requirements.
3. The learning materials must conform to Canadian Copyright law and UW Copyright guidelines.
4. Learning materials are subject to Policy 73 (see brief https://uwaterloo.ca/associate-vice-president-academic/remote-teaching-and-learning-intellectual-property) unless covered by separate development agreement or licensing (e.g., Creative Commons or Ontario Open License).
5. Waterloo encourages the open licensing of materials within and outside Waterloo as open educational content, as well as the reuse of existing open educational materials (OERs) developed elsewhere. Materials should be made available to students at low or no cost whenever possible.
6. Instruction should make use of university-supported platforms that provide adequate instructor and student support and ensure a more consistent teaching and learning experience.

An ONLINE class: [1]

1. is indicated in the schedule as "ONLN" and uses the appropriate components and scheduling.
2. can be completed remotely via digital delivery and does not require in-person activity or on-campus presence, except for in-person exams (which may be supported in the student's geographic location), although some online programs may have a short on-campus requirement (e.g., orientation session or capstone).
3. has the approval of the Dean or delegate (as determined in each Faculty) and undergoes appropriate quality assurance process before offer, as well as periodic review.
4. is recognized as equivalent to all other offers of the same course in terms of course credit, learning outcomes, and academic rigor.[2]
5. involves instructor effort equivalent to all other modalities.[3]
6. provides regular and timely access to instructors, as well as opportunities for meaningful interaction with instructors, other students, and content.
7. has a schedule that conforms to the academic calendar for the term including start and finish dates and any study breaks, and provides milestones and due dates for activities, assignments, and assessments.
8. uses the appropriate modality (asynchronous or synchronous) for the course content and learning outcomes, with consideration of the needs of the prospective/intended students. Waterloo encourages asynchronous delivery as it offers the greatest flexibility and access, among other benefits.

[1] "class" is intentionally used here as it denotes a specific offer and section of a course (i.e., there may be other sections or classes of the same course offered in different modes)
[2] principles 4 and 5 were established by the UW Online Learning Task Force, 2008.
[3] this principle supposes that modalities should be considered equivalent in terms of instructor workload

An asynchronous ONLN class:

1. has no scheduled meets.
2. may include *limited* synchronous elements, for which equivalent alternatives or flexible options exist.
3. has materials prepared and available in advance of schedule, with all content prepared before start of term.
4. is developed either with the full assistance of CEL through the regular intake process *OR* undergoes an alternate quality assurance process before offer and receives final approval by Dean/VPAD (or delegate) before being scheduled.
5. features regular and substantive instructor availability, and regular, meaningful interaction among students and instructors.[4]

A synchronous[5] ONLN class:

1. has regular (usually weekly) scheduled online meets throughout term posted in Quest.
2. provides an alternative or backup for students who cannot attend individual classes (e.g., recording of lectures).
3. has a course design and delivery plan that is reviewed by CEL.
4. is approved by Dean/VPAD (or delegate) before scheduling.

[4] The phrase “regular and substantive interaction” is used in the U.S. to delineate between “distance education” and “correspondence education” for the purposes of establishing eligibility for federal aid.

[5] i.e., a live class facilitated in real time using a tool like Zoom or Teams. This pre-supposes that synchronous online delivery will be common ongoing strategy; the Digital Learning Strategy findings and recommendations may have a bearing on that.

Approvals for ONLN Courses developed outside of CEL process

Online courses developed outside the full CEL intake and development process (either with Agile Development Team assistance or fully instructor developed)[6] would follow the following approval steps:

1. Dean/VPAD (or delegate) approves request for new ONLN course.
2. Author requests review by CEL. Timing should allow for review to be completed and approved by Dean *before* course is scheduled for offer.
3. CEL reviews final course design using a checklist based on above principles, with the following possible outcomes:
    a. Recommend
    b. Recommend, with minor issues that can be quickly/easily rectified without additional review, or
    c. Course has serious issues which must be addressed before offer and may require support and review (return to step 2).

4. In addition to CEL review, the Faculty/AFIW may elect to conduct a peer review of content and course design.

5. Dean/VPAD (or delegate) issues final approval based on review(s).

Questions and Implications

- Approval process really pushes the timeline forward for course creation
- Diverging from historical practices (that most online courses were created and maintained with CEL assistance) removes the quality and subsequent oversight of above standards.
- should there be periodic review of these courses to ensure they meet standards in subsequent offers??
- Should Faculty, Dept, or program engage with CEL to review courses at regular intervals (e.g., like program reviews)?
- Should peer review be employed?
- CEL will have to create a Quality Checklist/resource package and also support reviews in a timely fashion

[6] currently there is no policy requiring CEL support or approval for any modality

Review of Class Delivery Modes and Components – September 26, 2022

Updated from Sept 20, 2022, UOps meeting feedback

Submitted by: Jen Coghlin, RO; Aldo Caputo, Donna Ellis, and Mary Power, Keep Learning Team

Overview

This document provides recommendations and proposed definitions for both class delivery modes and components that were developed by the Associate Registrar and members of the Keep Learning Team in order to improve clarity for instructors and students when scheduling and selecting courses each term. The increased interest in and adoption of blended learning courses has amplified the importance of this project at this time.

Summary of Recommendations

- **Adoption of new and revised definitions for the undergraduate calendar.**
  - The University should adopt the delivery mode definitions for In-Person, Blended, and Online in this document.
  - The University should adopt the revisions to the descriptions of the components in this document.
    - All components should be retained except for the “Test-slot – lecture (TLC)” one because it is not currently used. The “Online” component should have a definition that can be used for fully online and blended courses. The “Workshop” and “Tutorial” component descriptions should be revised to enable use for the in-person component of blended courses.
    - University-wide component descriptions in the calendar should only include a description of the activity and its format. Some special considerations may also be included where relevant (e.g., location). Existing information about instructor/student ratio, room type, meet type, and duration should be removed.
- **Addition of Faculty-specific guidelines regarding course delivery modes and components.**
  - Via consultation, Faculties should develop guidelines that address their expectations for: the time estimates for components; which courses must use specific component types (e.g., lab, clinic) in order to meet program requirements; course modes to be used (in-person, online, blended).

- Via consultation, Faculties should also develop guidelines for blended courses regarding the reduction of in-person class time and the inclusion of components that will replace that time to assist department chairs and scheduling reps when advising faculty on scheduling options.

NOTE: The team submitting these recommendations is continuing to investigate whether or not to submit a change to the process for approval of course components. Components for each individual course currently get approved at Senate Undergraduate Council and Senate. This current practice dictates that it can take up to a year for an instructor to be able to select a component not already approved for their course. Our instructors would benefit from more flexibility when selecting components and our students would benefit from having more accurate information about a course experience when registering. However, until the capabilities of the new calendar/curriculum software can be determined by the Registrar's Office, we are reluctant to bring forward a process change.

DRAFT Waterloo Class Delivery Mode Definitions

The following definitions and guide were developed to help instructors understand the delivery modes available at Waterloo and decide which scheduling option(s) to select based on their goals. The definitions also provide students with information that can assist them when making course selections.

Definitions for Modes

IN-PERSON: a class scheduled with primarily in-person activity.

BLENDED: a class that includes both scheduled in-person and online activity (generally asynchronous) in which some in-person activity is substituted with online activity (i.e., class time is reduced).

ONLINE: a class scheduled to be fully online that requires no in-person activity (may require an in-person exam(s); may be exclusively asynchronous (no scheduled meets), synchronous (scheduled meets), or a combination of the two.

NOTE (not for inclusion in the calendar): Hyflex classes have recently been delivered in a held-with format, where 2 delivery modes are held simultaneously. Hyflex is an emerging combined mode that will need definition and system development in order to evolve further. Hyflex = a class that is scheduled both in-person and is simultaneously delivered remotely. Students have the choice to attend in-person or remotely on a class-by-class basis. Future considerations of hyflex should also address the possibility of an asynchronous option for those engaging in the course online.

CLASS DELIVERY MODES	DEFINITION	NOTES/EXAMPLES	SCHEDULING TERMS ASSOCIATED WITH EACH DELIVERY MODE		
			THE "CAMPUS" CODES INDICATE WHICH INSTITUTION OFFERS THE COURSE	THE "LOCATION" OF WHERE A COURSE IS TAUGHT IS ALSO IDENTIFIED	EXAMPLES
IN-PERSON	A class scheduled with primarily in-person activity	Scheduled meet only on campus/in-person	**UW:** University of Waterloo (Main) **CGC:** Conrad Grebel University College **REN:** Renison University College **STJ:** St. Jerome's University **STP:** St. Paul's University College **WLU:** Wilfrid Laurier University	**U:** Main campus **G:** Conrad Grebel University College **J:** St. Jerome's University **P:** St. Paul's University College **R:** Renison University College **L:** Wilfrid Laurier University **STRATFORD:** Stratford campus	**UW U** = Taught by the University of Waterloo at the University of Waterloo's Main Campus **UW STRATFORD =** Taught by the University of Waterloo at the University of Waterloo's Stratford Campus
BLENDED	A class that includes both scheduled in-person and online activity in which some in-person activity is substituted with online activity (i.e., class time is reduced)	• Scheduled on-campus meet + asynchronous online meet/activity (e.g., flipped classroom) • Scheduled on-campus meet + synchronous online meet/activity	**BLND:** Blended course (Main) **BLNDG:** Blended course (Conrad Grebel University College)	**U:** Main campus **G:** Conrad Grebel University College **J:** St. Jerome's University **P:** St. Paul's University College	**BLND U =** Taught by the University of Waterloo; on-campus meet is at the University of Waterloo's Main

		Both types of meets must appear in the schedule of classes, including the online piece whether asynchronous or synchronous To reduce class time, seek approval from department chair	**BLNDJ:** Blended course (St. Jerome's University) **BLNDP:** Blended course (St. Paul's University College) **BLNDR:** Blended course (Renison University College)	**R:** Renison University College **L:** Wilfrid Laurier University **STRATFORD:** Stratford campus **+** **ONLINE:** Online course	Campus and includes online element **BLND P =** Taught by the University of Waterloo; the on-campus meet is at St. Paul's University College and includes online element
Online	A class scheduled to be fully online that requires no in-person activity (may require in-person exam); may be exclusively asynchronous, synchronous, or a combination of the two.	• Fully online CEL course • Instructor-developed online course • Fully synchronous course with regularly scheduled meets via web conferencing • Asynchronous course with some scheduled meets (seminars, tutorials, office hours) • Synchronous course with online asynchronous discussion or other activities	**ONLN:** Online course (Main) **ONLNG:** Online course (Conrad Grebel University College) **ONLNJ:** Online course (St. Jerome's University) **ONLNP:** Online course (St. Paul's University College) **ONLNR:** Online course (Renison University College)	**ONLINE:** Online course	**ONLN ONLINE =** Taught by the University of Waterloo and occurs online **ONLNR ONLINE =** Taught by Renison University College and occurs online

DRAFT Waterloo Class Components Definitions

The two main purposes of course components are: 1) to enable instructors to identify which scheduling option(s) to pick based on what they are planning to do in their courses, and 2) to help students understand what each course entails when registering for their courses.

COMPONENT	PROPOSED DEFINITION
Clinic (CLN)	Teaching is devoted to the analysis, treatment and management of direct care for clinical cases. Students operate in various specialty fields typically in a clinical setting.
Discussion (DIS)	Teaching is based primarily on engaging the students in instructor-guided group discussions.
Ensemble (ENS)	Teaching is conducted by means of evaluating musical performance amongst a group of supporting players.
Essay (ESS)	Evaluation is normally based on a formal written piece of work that contains a thesis, substantiated by an argument that is properly referenced. Students work independently in consultation with an instructor.
Field studies (FLD)	Teaching is conducted outside the classroom. Work is with the primary materials in their original setting.
Flight (FLT)	The flight component is held off campus at the Region of Waterloo International Airport, and is the practical application of flight material learned in the course.
Lab (LAB)	Teaching takes place in a room containing special purpose equipment required for student observation, participation, experimentation, or practice.
Lecture (LEC)	Teaching is usually in the form of a series of lectures. The total class size should be normally more than three students; therefore, when a lecture section is combined with another lecture section (undergraduate or graduate), enrolment may be limited to less than three students in either one of the class sections.
Online Activities (OLN)	Teaching and learning occur online for a fully online course or as part of a blended course. This component indicates that a range of instructional approaches are used online such as lectures, readings, discussions, and assessments. For blended courses, usually there are weekly online activities that help students prepare for or otherwise complement the in-person learning component of the course.
Oral conversation (ORL)	Teaching is based primarily on engaging the students in instructor-guided group discussions and verbal interaction, usually in a language other than English.
Practicum (PRA)	Teaching involves supervised placement time in a work setting exercising practical routines and techniques related to a particular academic plan. Research and analytical skills are demonstrated based on the practical application of material learned in the primary meet. Usually, a formal report summarizing the skills learned is required. Facility requirements will vary by discipline. In some disciplines the course may need a specially equipped room and may meet off campus.

Project (PRJ)	Similar to the reading component, learning usually takes place as a result of independent study/research. However, in this case it makes use of special purpose equipment for student observation, participation, experimentation, or practice. This component is used at the undergraduate level only.
Reading (RDG)	Learning takes place as a result of student independent study under the supervision of an instructor.
Seminar (SEM)	Teaching involves students collectively exploring a topic or field of study. May be led all or in part by the students.
Studio (STU)	Teaching consists of instructor coaching focused on practical skills execution, normally in a room with special purpose equipment, such as audio-visual recording equipment, theatre technical equipment, etc.
Test slot (TST)	Used only to designate a time slot for holding mid-term exams. A specific calendar date for each test slot must be included with each TST component section.
Tutorial (TUT)	Teaching provides students with additional information, assistance, and practice applying the course material. The format is typically in the form of an open discussion or problem-solving session.
Work term (WRK)	This component is only used on a co-operative education course to represent an official work-term placement.
Workshop (WSP)	Teaching includes intensive instructor/student contact as well as independent project work. It may be held in a theatre, studio, or a specially equipped room like a flexible or active learning classroom to support groupwork.

The table below shows the original current description for each component and the proposed new text.

Existing Text (currently in Glossary of Terms in Calendar)	**Proposed Text (new text appears in red)**
Clinic (CLN): This is a primary meet where teaching is devoted to the analysis and treatment of cases in various special fields normally in a specially equipped clinic setting. There may be a high student/instructor ratio. The frequency of meetings can be as many as five per week for a total contact time of 45 hours.	**Clinic (CLN):** ~~This is a primary meet where~~ Teaching is devoted to the analysis, ~~and~~ treatment and management of direct care for clinical cases. Students operate in various specialty fields typically in a clinical setting. ~~and management of direct care for clinical cases. Students operate in various specialty fields typically in a clinical setting. of cases in various special fields normally in a specially equipped clinic setting. There may be a high student/instructor ratio. The frequency of meetings can be as many as five per week for a total contact time of 45 hours.~~
Discussion (DIS): Teaching is based primarily on engaging the students in instructor-guided group discussions. The student/instructor ratio is similar to a seminar. The course is usually held in a smaller teaching or seminar room to facilitate more group involvement. Usually there is one meeting per week for a total contact time of one to three hours.	**Discussion (DIS):** Teaching is based primarily on engaging the students in instructor-guided group discussions. ~~The student/instructor ratio is similar to a seminar. The course is usually held in a smaller teaching or seminar room to facilitate more group involvement. Usually there is one meeting per week for a total contact time of one to three hours.~~
Ensemble (ENS): A primary meet where instruction is conducted by means of evaluating musical performance amongst a group of supporting players. Usually, these meets are held in a specially equipped room with one to two meetings per week for a total contact time of three to four hours.	**Ensemble (ENS):** ~~A primary meet where instruction~~ Teaching is conducted by means of evaluating musical performance amongst a group of supporting players. ~~Usually, these meets are held in a specially equipped room with one to two meetings per week for a total contact time of three to four hours.~~
Essay (ESS): A primary meet where evaluation is normally based on a formal written piece of work that contains a thesis, substantiated by an argument that is properly referenced. Students work independently in consultation with an instructor. Contact is usually three hours per week.	**Essay (ESS):** ~~A primary meet where~~ Evaluation is normally based on a formal written piece of work that contains a thesis, substantiated by an argument that is properly referenced. Students work independently in consultation with an instructor. ~~Contact is usually three hours per week.~~
Field studies (FLD): A primary meet where teaching is conducted outside the classroom. Work is with the primary materials in their original setting. Meetings are usually one to three per week for a total contact time of one to three hours.	**Field studies (FLD):** ~~A primary meet where~~ Teaching is conducted outside the classroom. Work is with the primary materials in their original setting. ~~Meetings are usually one to three per week for a total contact time of one to three hours.~~
Flight (FLT): The flight component is held off campus at the Region of Waterloo International Airport. The practical application of flight material learned in the primary meet section.	**Flight (FLT):** The flight component is held off campus at the Region of Waterloo International Airport, and is~~. T~~the practical application of flight material learned in the course. ~~primary meet section. Student to instructor ratio is very low. Flights are~~

Student to instructor ratio is very low. Flights are usually two to four times per week for a total contact time of three to six hours.	~~usually two to four times per week for a total contact time of three to six hours.~~
Lab (LAB): Teaching takes place in a room containing special purpose equipment required for student observation, participation, experimentation, or practice. Usually, but not always, a LAB is attached to a regular Lecture (LEC), and frequently the instructors for both lecture and lab are the same. There may be a high student/instructor ratio. Normally there are one to three meetings per week for a total contact time of one to three hours.	**Lab (LAB):** Teaching takes place in a room containing special purpose equipment required for student observation, participation, experimentation, or practice. ~~Usually, but not always, a LAB is attached to a regular Lecture (LEC), and frequently the instructors for both lecture and lab are the same. There may be a high student/instructor ratio. Normally there are one to three meetings per week for a total contact time of one to three hours.~~
Lecture (LEC): Teaching normally takes place in a classroom setting. Instruction is usually in the form of a series of lectures that meet one to four times per week for a total contact time of two to four hours. Typically, there is a large student/instructor ratio. The total class size should be normally more than three students; therefore, when a lecture section is combined with another lecture section (undergraduate or graduate), enrolment may be limited to less than three students in either one of the class sections.	**Lecture (LEC):** ~~Teaching normally takes place in a classroom setting. Instruction~~ Teaching is usually in the form of a series of lectures. ~~that meet one to four times per week for a total contact time of two to four hours. Typically, there is a large student/instructor ratio.~~ The total class size should be normally more than three students; therefore, when a lecture section is combined with another lecture section (undergraduate or graduate), enrolment may be limited to less than three students in either one of the class sections.
Online (OLN) [no definition provided]	**Online Activities (OLN):** Teaching and learning occur online for a fully online course or as part of a blended course. This component indicates that a range of instructional approaches are used online such as lectures, readings, discussions, and assessments. For blended courses, usually there are weekly online activities that help students prepare for or otherwise complement the in-person learning component of the course.
Oral conversation (ORL): Teaching is based primarily on engaging the students in instructor-guided group discussions and verbal interaction, usually in a language other than English. The student/instructor ratio is similar to a seminar. The course is usually held in a smaller teaching or seminar room to facilitate more group involvement. Usually there is one meeting per week for a total contact time of one hour.	**Oral conversation (ORL):** Teaching is based primarily on engaging the students in instructor-guided group discussions and verbal interaction, usually in a language other than English. ~~The student/instructor ratio is similar to a seminar. The course is usually held in a smaller teaching or seminar room to facilitate more group involvement. Usually there is one meeting per week for a total contact time of one hour.~~
Practicum (PRA): Supervised placement time in a work setting exercising practical routines and techniques related to a particular academic plan. This is a secondary or tertiary meet where research and analytical skills are demonstrated based on	**Practicum (PRA):** Teaching involves supervised placement time in a work setting exercising practical routines and techniques related to a particular academic plan. ~~This is a secondary or tertiary meet where r~~Research and analytical skills are

the practical application of material learned in the primary meet. Usually, a formal report summarizing the skills learned is required. Facility requirements will vary by discipline. In some disciplines the course may need a specially equipped room and may meet off campus. Meetings are usually one to three per week for a total contact time of three to 10 hours.	demonstrated based on the practical application of material learned in the primary meet. Usually, a formal report summarizing the skills learned is required. Facility requirements will vary by discipline. In some disciplines the course may need a specially equipped room and may meet off campus. ~~Meetings are usually one to three per week for a total contact time of three to 10 hours.~~
Project (PRJ): Similar to the reading component, learning usually takes place as a result of independent study/research. However, in this case it makes use of special purpose equipment for student observation, participation, experimentation, or practice. This component is used at the undergraduate level only. There is usually a smaller student/instructor ratio.	**Project (PRJ):** Similar to the reading component, learning usually takes place as a result of independent study/research. However, in this case it makes use of special purpose equipment for student observation, participation, experimentation, or practice. This component is used at the undergraduate level only. ~~There is usually a smaller student/instructor ratio.~~
Reading (RDG): Learning takes place as a result of student independent study under the supervision of an instructor. Normally there is a one-to-one student/instructor ratio, although, there may be several students studying the same topic with the same instructor. Typically, there is no defined time/room booking and usually the student(s) meet with the instructor on an informal basis.	**Reading (RDG):** Learning takes place as a result of student independent study under the supervision of an instructor. ~~Normally there is a one-to-one student/instructor ratio, although there may be several students studying the same topic with the same instructor. Typically, there is no defined time/room booking and usually the student(s) meet with the instructor on an informal basis.~~
Seminar (SEM): Teaching normally takes place in a less formal teaching atmosphere than a lecture. There is typically a smaller student/instructor ratio than with a lecture. The course is usually held in a smaller teaching or seminar room to facilitate more group interaction than occurs in a lecture course. Usually there is one meeting per week for a total contact time of one to three hours.	**Seminar (SEM):** Teaching involves students collectively exploring a topic or field of study. May be led all or in part by the students. ~~normally takes place in a less formal teaching atmosphere than a lecture. There is typically a smaller student/instructor ratio than with a lecture. The course is usually held in a smaller teaching or seminar room to facilitate more group interaction than occurs in a lecture course. Usually there is one meeting per week for a total contact time of one to three hours.~~
Studio (STU): This is a primary meet where teaching consists of instructor coaching focused on practical skills execution, normally in a room with special purpose equipment, such as, audio visual recording equipment, theatre technical equipment, etc. There are strict limit capacities on enrolment. Meetings are at least two times per week for a total contact time of four or more hours.	**Studio (STU):** ~~This is a primary meet where~~ Teaching consists of instructor coaching focused on practical skills execution, normally in a room with special purpose equipment, such as audio visual recording equipment, theatre technical equipment, etc. ~~There are strict limit capacities on enrolment. Meetings are at least two times per week for a total contact time of four or more hours.~~

Test slot – lecture (TLC): This component is used in situations where the course has multiple lecture sections and reserve caps and the department does not care how many reserved students go into each section, but they want an overall number of reserved students in the entire course. This means that the course is setup with one TLC primary component and LEC (lecture) is the secondary component	~~**Test slot – lecture (TLC):** This component is used in situations where the course has multiple lecture sections and reserve caps and the department does not care how many reserved students go into each section, but they want an overall number of reserved students in the entire course. This means that the course is setup with one TLC primary component and LEC (lecture) is the secondary component~~
Test slot (TST): Used only to designate a time slot for holding mid-term exams. Tests are conducted in lecture-type seating equipped with tables and chairs. Tests for a course are usually held once or twice per term for a period of two to three hours each time. A specific calendar date for each test slot must be included with each TST component section.	**Test slot (TST):** Used only to designate a time slot for holding mid-term exams. ~~Tests are conducted in lecture-type seating equipped with tables and chairs. Tests for a course are usually held once or twice per term for a period of two to three hours each time.~~ A specific calendar date for each test slot must be included with each TST component section.
Tutorial (TUT): Often optional, a tutorial is a meeting designed to provide the student with additional information and assistance with the course material that is presented in the primary meet. The format is typically in the form of an open discussion or problem-solving session. There may be a high student/instructor ratio. Lecture or seminar type seating may be utilized. Usually there is one meeting per week for a total contact time of one to three hours.	**Tutorial (TUT):** ~~Often optional,A tutorial is a meeting designed to~~ Teaching provides ~~the~~ students with additional information, assistance, and practice ~~with~~ applying the course material ~~that is presented in the primary meet~~. The format is typically in the form of an open discussion or problem-solving session. ~~There may be a high student/instructor ratio. Lecture or seminar type seating may be utilized. Usually there is one meeting per week for a total contact time of one to three hours.~~
Work term (WRK): This is a primary meet component that is only used on a co-operative education course to represent an official work-term placement.	**Work term (WRK):** This ~~is a primary meet~~ component ~~that~~ is only used on a co-operative education course to represent an official work-term placement.
Workshop (WSP): This is a primary meet where teaching includes intensive instructor/student contact as well as independent project work. It may be held in a theatre, studio, or a specially equipped room. Projects may include such topics as audio-visual recording, theatrical scenic painting, puppet construction, costume construction. There are strict limit capacities on enrolment. The duration of a workshop is four hours or more at least twice per week.	**Workshop (WSP):** ~~This is a primary meet where~~ Teaching includes intensive instructor/student contact as well as independent project work. It may be held in a theatre, studio, or a specially equipped room like a flexible or active learning classroom to support groupwork. ~~Projects may include such topics as audio-visual recording, theatrical scenic painting, puppet construction, costume construction. There are strict limit capacities on enrolment. The duration of a workshop is four hours or more at least twice per week.~~