FOR APPROVAL **PUBLIC** **OPEN SESSION**

TO: UTSC Academic Affairs Committee

SPONSOR: Prof. William Gough, Vice-Principal Academic and Dean
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PRESENTER: Prof. Mark Schmuckler, Vice-Dean Undergraduate
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DATE: February 3, 2020 for Monday, February 10, 2020

AGENDA ITEM: 5

ITEM IDENTIFICATION:

Minor Curricular Modifications, Undergraduate for (for approval)*

JURISDICTIONAL INFORMATION:

University of Toronto Scarborough Academic Affairs Committee (AAC) "is concerned with matters affecting the teaching, learning and research functions of the Campus" (*AAC Terms of Reference, Section 4*). Under section 5.6 of its terms of reference, the Committee is responsible for approval of "Major and minor modifications to existing degree programs." The AAC has responsibility for the approval of Major and Minor modifications to existing programs as defined by the University of Toronto Quality Assurance Process (*UTQAP, Section 3.1*).

GOVERNANCE PATH:

1. **UTSC Academic Affairs Committee [For Approval] (February 10, 2020)**

PREVIOUS ACTION TAKEN:

No previous action in governance has been taken on this item.

HIGHLIGHTS:

This package includes minor modifications to undergraduate curriculum, submitted by the Sciences academic units identified below, which require governance approval. Minor modifications to curriculum are understood as those that do not have a significant impact on program or course learning outcomes. They require governance approval when they modestly change the nature of a program or course.

- The Department of Computer and Mathematical Sciences (Report: Computer and Mathematical Sciences)
  - 2 new courses program changes
    - MATD67H3
    - STAD78H3
  - 27 course changes
    - CSCB07H3– prerequisite cGPA change
    - CSCB09H3– prerequisite cGPA change
    - CSCB36H3– prerequisite cGPA change
    - CSCB58H3– prerequisite cGPA change
    - CSCB63H3– prerequisite cGPA change
    - CSCC01H3– prerequisite cGPA change
    - CSCC09H3– prerequisite cGPA change
    - CSCC10H3– prerequisite cGPA change
    - CSCC11H3– prerequisite cGPA change
    - CSCC24H3– prerequisite cGPA change
    - CSCC37H3– prerequisite cGPA change
    - CSCC43H3– prerequisite cGPA change
    - CSCC46H3– prerequisite cGPA change
    - CSCC63H3– prerequisite cGPA change
    - CSCC69H3– prerequisite cGPA change
    - CSCC73H3– prerequisite cGPA change
    - CSCC85H3– prerequisite cGPA change
    - CSCD01H3– prerequisite cGPA change
    - CSCD18H3– prerequisite cGPA change
    - CSCD27H3– prerequisite cGPA change
    - CSCD37H3– prerequisite cGPA change
    - CSCD43H3– prerequisite cGPA change
    - CSCD58H3– prerequisite cGPA change
    - CSCD70H3– prerequisite cGPA change
    - CSCD71H3– prerequisite cGPA change
    - CSCD72H3– prerequisite cGPA change
    - CSCD84H3– prerequisite cGPA change

- The Department of Physical and Environmental Sciences (Report: Physical and Environmental Sciences)
  - 2 program changes
    - MAJOR PROGRAM IN BIOCHEMISTRY (SCIENCE)
    - SPECIALIST PROGRAM IN ENVIRONMENTAL PHYSICS (SCIENCE)
  - 7 new courses

        - CHMA12H3
        - CHMD47H3
        - EESB21H3
        - EESC26H3
        - EESD21H3
        - ESTB02H3
        - ESTB03H3
    - 1 course change
        - EESC24H3 – prerequisite cGPA change

FINANCIAL IMPLICATIONS:

There are no net implications to the campus operating budget.

RECOMMENDATION:

Be It Resolved,

THAT the minor modifications to undergraduate programs, submitted by UTSC undergraduate Sciences academic units, as described in Undergraduate Minor Curriculum Modifications for Approval, Report: Computer and Mathematical Sciences, and Report: Physical and Environmental Sciences, both dated February 10, 2020, and recommended by the Vice-Principal Academic and Dean, Professor William Gough, be approved to be effective as of Fall 2020 for the academic year 2020-21.

DOCUMENTATION PROVIDED:

1. 2020-21 Curriculum Cycle: Undergraduate Minor Curriculum Modifications for Approval Report: Computer and Mathematical Sciences, dated February 10, 2020
2. 2020-21 Curriculum Cycle: Undergraduate Minor Curriculum Modifications for Approval Report: Physical and Environmental Sciences, dated February 10, 2020

UNIVERSITY OF TORONTO SCARBOROUGH

2020-21 Curriculum Cycle
Undergraduate Minor Curriculum Modifications for Approval
Report: Computer and Mathematical Sciences

February 10, 2020

Computer & Mathematical Sciences (UTSC), Department of

2 New Courses:

MATD67H3: Differentiable Manifolds

Description:
Manifolds, vector fields, tangent spaces, vector bundles, differential forms, integration on manifolds.

Prerequisites: MATB43H3

Exclusions: MAT367H1

Learning Outcomes:
On completion of this course, students will be in a position to apply their knowledge in many areas such as topology, general relativity, dynamical systems and complex algebraic geometry. Note that UTSC already has undergraduate courses in the first three of these, and MATD67 would provide excellent backup for the above courses.
For those students who go on to graduate school in mathematics, this course gives them appropriate preparation for graduate courses in geometry.
This course provides useful background for several other UTSC undergraduate courses, for example, MATD34 (Complex Variables 2), MATC27 (Topology) and the D level courses on dynamical systems (MATD35) and partial differential equations (MATD46). The instructors of these courses have indicated that if the students in their courses had a background from the course on manifolds, this would enable them to teach further material that is currently unreachable for them because their students lack this background. A course on manifolds would thus open up areas of study for several other courses.

Topics Covered:
Inverse function theorem
Definition of differentiable manifolds
Regular value theorem (the preimage of a regular value of a differentiable map is a differentiable manifold)
Tangent spaces
Vector bundles
Differentiable forms
Integration on manifolds
As an example, we will be using the following texts:
-Michael Spivak, Calculus on Manifolds (1965) -- there is a Wikipedia article about this book.
-Loring Tu, An Introduction to Manifolds (Springer Universitext, 2011).
-These are both strictly aimed at undergraduates and require little background.

Methods of Assessment:

3 or 4 written assignments (total 30%)
Midterm exam 25%
Final exam 45%

Mode of Delivery: In Class

Breadth Requirements: Quantitative Reasoning

Rationale:
This course is designed to serve students enrolled in Specialist and Major program in Match and also Specialist and Major program in Physics. It provides useful background to the courses on dynamical systems and on partial differential equations. It is a useful complement to MATC27H3, as an alternative way to study topological objects such as spheres and projective spaces. It also complements MATC63H3, where the objects are assumed to be curves and surfaces in 3-dimensional space and the size and shape of the objects are important. The content covered in this course plays a central role in higher mathematics Without a course on manifolds, UTSC students risk falling behind their peers at other comparable universities and other campuses of University of Toronto, notably UTSG. For those students who go on to graduate school in mathematics, this course gives them appropriate preparation for graduate courses in geometry.

Consultation:
DCC Approval: October 7, 2019.
RO Approval: October 10, 2019.

Resources: To be taught by regular faculty, or by a sessional or a postdoc. No additional resources required.

STAD78H3: Machine Learning Theory

Description:
Presents theoretical foundations of machine learning. Risk, empirical risk minimization, PAC learnability and its generalizations, uniform convergence, VC dimension, structural risk minimization, regularization, linear models and their generalizations, ensemble methods, stochastic gradient descent, stability, online learning.

Prerequisites: STAB57H3 and STAC62H3

Recommended Preparation: STAC58H3 and STAC67H3

Learning Outcomes:
-Explain various ways that “learning” is formalized in machine learning and their differences, and be able to recognize which is most appropriate for a particular scenario.
-Explain the mechanisms at play in “overfitting” in machine learning, in particular, the role of data and the algorithm.
-Explain when empirical risk minimization should be expected to work and why.
-Be able to assess whether a particular learning problem is feasible and whether one will require some form of model selection or not.
-Explain the difference between regression viewed as a statistical model and as a machine learning technique.

Topics Covered:
Supervised learning, classification
Overfitting, generalization
Empirical risk minimization, PAC learnability
Uniform convergence, VC dimension
Nonuniform notions of learnability, structural risk minimization, Occam's razor
Model selection and cross-validation
Ensemble methods
Linear methods, kernel machines, Support vector machines, convex optimization
Stability and regularization
Online learning

Methods of Assessment:
Weekly take-home assignments
Midterm, final
In-class quizzes

Mode of Delivery: In Class

Breadth Requirements: Quantitative Reasoning
Rationale: At the moment, the Machine Learning (ML) track contains only courses that teach methodology. There is no course introducing the theoretical foundations of the methodology. Students interested in developing a new methodology or continuing to graduate school will benefit from learning the theoretical underpinnings of ML. STAD78H3 is designed to serve students interested in this area and enrolled in the Statistics Specialist program – Statistical Machine Learning and Data Science stream. The course will teach ML theory and is complementary to STAD68H3 Advanced Machine Learning and Data Mining, which is concerned with advanced ML methodology.
Consultation: DCC Approval: October 7, 2019. RO Approval: October 10, 2019.
Resources: Prof. Daniel Roy will be the usual instructor. The course requires a grader, covered by the department's existing budget. There are no additional resources required.

27 Course Modifications:

CSCB07H3: Software Design

Description: An introduction to software design and development concepts, methods, and tools, using a statically-typed object-oriented language such as Java. Topics from:version control, build management, unit testing, refactoring, object-oriented ~~object~~ ~~oriented~~ design and development, design patterns and advanced IDE usage.
Prerequisites: CSCA48H3 and[CGPA of at least 3.5 ~~3.0~~ , or enrolment in a CSC Subject POSt, or enrolment in a non-CSC Subject POSt for which this specific course is a program requirement]
Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.
Consultation: DCC Approval: October 7th, 2019.
Resources: None

CSCB09H3: Software Tools and Systems Programming

Prerequisites: CSCA48H3 and[CGPA of at least 3.5 ~~3.0~~ , or enrolment in a CSC Subject POSt, or enrolment in a non-CSC Subject POSt for which this specific course is a program requirement]
Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.
Consultation: DCC Approval: October 7, 2019.
Resources: None

CSCB36H3: Introduction to the Theory of Computation

Prerequisites: CSCA48H3 and[(CSCA65H3)or CSCA67H3]and [CGPA of at least 3.5 ~~3.0~~ , or enrolment in a CSC Subject POSt, or enrolment in a non-CSC Subject POSt for which this specific course is a program requirement]
Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.
Consultation: DCC Approval: October 7, 2019
Resources: None

CSCB58H3: Computer Organization

Prerequisites: [CSCA48H3 or PSCB57H3]and[CGPA of at least 3.5 ~~3.0~~ , or enrolment in a CSC Subject POSt, or enrolment in a non-CSC Subject POSt for which this specific course is a program requirement]
Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.
Consultation: DCC Approval: October 7, 2019.
Resources: None

CSCB63H3: Design and Analysis of Data Structures

Prerequisites: CSCB36H3 and[CGPA of at least 3.5 ~~3.0~~ , or enrolment in a CSC Subject POSt, or enrolment in a non-CSC Subject POSt for which this specific course is a program requirement]
Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.
Consultation: DCC Approval: October 7, 2019.
Resources: None

CSCC01H3: Introduction to Software Engineering

Prerequisites: CSCB07H3, CSCB09H3, and[CGPA of at least 3.5 ~~3.0~~ , or enrolment in a CSC Subject POSt, or enrolment in a non-CSC Subject POSt for which this specific course is a program requirement]
Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.
Consultation: DCC Approval: Oct 7, 2019
Resources: None

CSCC09H3: Programming on the Web

Prerequisites: CSCB09H3 and CSCC43H3 and[CGPA 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt]
Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.
Consultation: DCC Approval: October 7th, 2019.
Resources: None

CSCC10H3: Human-Computer Interaction

Prerequisites: CSCB07H3 and[CGPA 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt]
Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.
Consultation: DCC Approval: October 7th, 2019.

Resources: None

CSCC11H3: Introduction to Machine Learning and Data Mining

Prerequisites:
MATB24H3 and MATB41H3 and STAB52H3 and[CGPA of at least 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt or enrolment in a non-CSC Subject POSt for which this specific course is a program requirement].

Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.

Consultation: DCC Approval: October 7th, 2019.

Resources: None

CSCC24H3: Principles of Programming Languages

Prerequisites:
CSCB07H3 and CSCB09H3 and[CGPA 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt]

Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.

Consultation: DCC Approval: October 7th, 2019

Resources: None

CSCC37H3: Introduction to Numerical Algorithms for Computational Mathematics

Prerequisites:
MATA22H3 and[MATA36H3 or MATA37H3]and [CGPA of at least 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt or enrolment in a non-CSC Subject POst for which this specific course is a program requirement]

Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.

Consultation: DCC Approval: October 7th, 2019.

Resources: None

CSCC43H3: Introduction to Databases

Prerequisites:
CSCB09H3 and CSCB63H3[CGPA 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt]

Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.

Consultation: DCC Approval: October 7th, 2019.

Resources: None

CSCC46H3: Social and Information Networks

Prerequisites:
CSCB63H3 and STAB52H3 and[MATA22H3 or MATA23H3]and [a CGPA of 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt]

Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.

Consultation: DCC Approval: October 7th, 2019.

Resources: None

CSCC63H3: Computability and Computational Complexity

Prerequisites:
CSCB36H3 and CSCB63H3 and[CGPA of at least 3.5 ~~3.0~~ , or enrolment in a CSC Subject POSt, or enrolment in a non-CSC Subject POSt for which this specific course is a program requirement]]

Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.

Consultation: DCC approval: October 7th, 2019.

Resources: None

CSCC69H3: Operating Systems

Prerequisites:
CSCB07H3 and CSCB09H3 and CSCB58H3 and[CGPA 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt]

Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.

Consultation: DCC Approval: October 7th, 2019

Resources: None

CSCC73H3: Algorithm Design and Analysis

Prerequisites:
CSCB63H3 and STAB52H3 and[CGPA of at least 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt or enrolment in a non-CSC Subject POSt for which this specific course is a program requirement]

Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.

Consultation: DCC Approval: October 7th, 2019

Resources: None

CSCC85H3: Introduction to Embedded Systems

Description:
The course introduces ~~covers~~ the ~~components~~ ~~and~~ fundamental principles , problems , and techniques involved in the ~~of~~ operation of mobile robots and other automated systems . Course topics include ~~built~~ ~~around~~ ~~micro-processing~~ ~~elements~~ : components ~~the~~ ~~architecture~~ ~~,~~ ~~operation~~ ~~,~~ ~~and~~ ~~types~~ of automated systems ~~micro-processing~~ ~~components;~~ ~~sensors~~ , sensors and sensor management ~~actuators~~ , signal acquisition and noise reduction ~~processing~~ , ~~and~~ ~~basic~~ principles of robot localization , FSM-based A.I ~~control~~ ~~theory~~ . for planning , fault-tolerance and building fault-tolerant systems , real-time operation and real-time operating systems; and computational considerations such as hardware limitations and code optimization . Ethical considerations in ~~Laboratory~~ ~~sessions~~ ~~involving~~ the implementation and deployment ~~use~~ of automated s ystems are discussed . The concepts covered in the course are put in practice via projects developed on a Lego ~~mobile~~ robotic platform ~~provide~~ ~~hands-on~~ ~~experience~~ .

Prerequisites:
CSCB58H3 and CSCB09H3 and[CGPA 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt]

Learning Outcomes:

At the end of the course, students will be able to: Implement and manage a sensor suite that accounts for noise, possible sensor failures, and the need to integrate data from multiple sensors. Implement robot localization techniques, whether on a robotics platform, or a mobile application. Design an FSM (Finite State Machine) A.I. planning module, and explain how it works to carry out a specified task. Design and model a system to achieve fault-tolerance. Optimize code for speed/memory utilization based on knowledge of the underlying CPU architecture. Explain and apply basic signal processing techniques needed to process sensor input. Apply the techniques covered in the course to solving problems in a variety of platforms including transportation systems such as planes or self-driving cars (fault-tolerance, localization, planning), medical diagnosis devices (signal processing, sensors, denoising), and mobile devices like smartphones or tablets (optimization, localization, sensor management). Discuss the ethical considerations involved in the design, implementation, testing, and deployment of automated systems, in particular those designed to aid or replace human operators. Integrate knowledge acquired through the entire course toward solving complex robotics-based tasks (robo-soccer).

Topics Covered:
Robot localization and mapping Planning and A.I. Fault-tolerance and building fault-tolerant systems Real-time operation and real-time operating systems Ethical considerations involved in the design, implementation, and deployment of automated systems

Rationale:
1. The course description has been revised to better reflect the content and topics covered in the course.
2. The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.
3. The learning outcomes and topics covered for this course are being revised. The proposed change is simply as a result of the natural evolution of the course over the past few years. Initially, the course was developed to update/upgrade the previous CSCC85H3 which was heavily geared toward assembly-language programming and covered little beyond that. CSCC85 scope has broadened to cover any type of special-purpose system based on a computer. Embedded systems at its origin were meant to provide a more thorough exploration of micro-processor-based systems and their applications. Over time, the course has evolved to follow the industry trends in embedded systems. Consequently, the course took more upon tasks such as localization, sensor management, signal processing, and real-time constraints – plus a necessary and ever more relevant ethical aspect. The course still fulfills the goal of providing students with an in-depth tour of systems based on micro-processors, the problems and techniques involved, and their current applications, but the focus is now on the systems themselves and their fundamental principles, rather than on the low-level programming aspects.
As such, we propose to update the calendar description to bring it back into agreement with the current contents and focus of the course and to enable students to make a correctly informed choice when selecting whether or not to take this course during their program.

Consultation: DCC Approval: October 7th, 2019.

Resources: None

CSCD01H3: Engineering Large Software Systems

Prerequisites:
CSCC01H3 and[CGPA 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt]

Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.

Consultation: DCC Approval: October 7th, 2019.

Resources: None

CSCD18H3: Computer Graphics

Prerequisites:
MATB24H3 and MATB41H3 and[CSCB09H3 or proficiency in C]and CSCC37H3 and [a CGPA of at least 3.5 ~~3.0~~ or enrolment in a Computer Science Subject POSt]

Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.

Consultation: DCC Approval: October 7th, 2019.

Resources: None

CSCD27H3: Computer and Network Security

Prerequisites:
CSCB09H3 and CSCB36H3 and CSCB58H3 and[CGPA of at least 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt]

Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.

Consultation: DCC Approval: October 7th, 2019.

Resources: None

CSCD37H3: Analysis of Numerical Algorithms for Computational Mathematics

Prerequisites:
CSCC37H3 and MATB24H3 and MATB41H3 and[CGPA of at least 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt or enrolment in a non-CSC Subject POSt for which this specific course is a program requirement]

Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.

Consultation: DCC Approval: October 7th, 2019

Resources: None

CSCD43H3: Database System Technology

Prerequisites:
CSCC43H3 and CSCC69H3 and CSCC73H3 and[CGPA 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt]

Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.

Consultation: DCC approval: October 7th, 2019.

Resources: None

CSCD58H3: Computer Networks

Prerequisites:
CSCB58H3 and CSCB63H3 and STAB52H3 and[CGPA 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt]

Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.

Consultation: DCC approval: October 7th, 2019.

Resources: None

CSCD70H3: Compiler Optimization

Prerequisites:
CSCB63H3 and CSCC69H3 and[CGPA 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt]

Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.

Consultation: DCC Approval: October 7th, 2019.

Resources: None

CSCD71H3: Topics in Computer Science

Prerequisites: Permission of the instructor and[CGPA 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt]. Normally intended for students who have completed at least 8 credits.
Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.
Consultation: DCC Approval: October 7th, 2019.
Resources: None

CSCD72H3: Topics in the Theory of Computing

Prerequisites: Permission of the instructor and[CGPA 3.5 ~~3.0~~ or enrolment in a CSC Subject POSt]. Normally intended for students who have completed at least 8 credits.
Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students.
Consultation: DCC Approval: October 7th, 2019.
Resources: None

CSCD84H3: Artificial Intelligence

Prerequisites: ~~CSCC24H3~~ ~~and~~ STAB52H3 and[CGPA 3.5 ~~3.0~~ or enrolment in a CSC subject POSt]
Rationale: The course prerequisite has been revised to increase the CGPA from 3.0 to 3.5 only for non CMS program students, the change is necessary to stabilize the number of non program students. CSCC24H3 has been removed as it is no longer a relevant prerequisite to CSCD84H3.
Consultation: DCC Approval: October 7th, 2019
Resources: None

UNIVERSITY OF TORONTO SCARBOROUGH

2020-21 Curriculum Cycle
Undergraduate Minor Curriculum Modifications for Approval
Report: Physical and Environmental Sciences

February 10, 2020

Physical & Environmental Sciences (UTSC), Department of

2 Minor Program Modifications:

MAJOR PROGRAM IN BIOCHEMISTRY (SCIENCE)

Description:

Supervisor Email: biochemistry-major@utsc.utoronto.ca

The Major program in Biochemistry provides students with ~~This~~ ~~Program~~ ~~places~~ ~~a~~ ~~greater~~ ~~emphasis~~ ~~on~~ the opportunity to explore the chemistry of living systems. In the first two years, students take a suite ~~biological~~ ~~a~~ ~~spects~~ of core courses in both biology and chemistry. In later years, students merge these disciplines through co urses that explore ~~than~~ ~~does~~ the chemistry of proteins, enzymes and metabolism ~~general~~ ~~Chemistry~~ ~~Major~~ ~~Prog ram~~. This program ~~It~~ is intended ~~offered~~ for students who are ~~primarily~~ interested in biochemistry, ~~chemistry~~ but who do not wish ~~also~~ ~~want~~ to complete ~~study~~ the more focused specialist in biol ogical chemistry. The program is also excellent preparation for students wishing to pursue professional schools su ch as medicine, pharmacy or law ~~of~~ ~~living~~ ~~systems~~.

Completion Requirements:

Program Requirements

Students should complete the following 9.0 ~~8.5~~ credits:

First Year:

1. 3.0 credits from the following

BIOA01H3 Life on Earth: Unifying Principles
BIOA02H3 Life on Earth: Form, Function and Interactions
CHMA10H3 Introductory Chemistry I: Structure and Bonding
[CHMA11H3 Introductory Chemistry II: Reactions and Mechanisms *or* CHMA12H3 Advanced General Chemistry]
[MATA29H3 Calculus I for the Life Sciences *or* MATA30H3 Calculus I for Physical Sciences]
[MATA35H3 Calculus II for Biological Sciences *or* MATA36H3 Calculus II for Physical Sciences]

Second and Later Years **:**

2. 6.0 ~~5.5~~ credits from the following

BIOB10H3 Cell Biology
BIOB11H3 Molecular Aspect of Cellular and Genetic Processes
BIOB12H3 Cell & Molecular Biology Laboratory

BIOC12H3 Biochemistry I: Proteins & Enzymes
BIOC13H3 Biochemistry II: Bioenergetics & Metabolism
BIOC23H3 Practical Approaches to Biochemistry
CHMB16H3 Techniques in Analytical Chemistry
CHMB41H3 Organic Chemistry I
CHMB42H3 Organic Chemistry II
CHMC47H3 Bio-Organic Chemistry
and
0.5 credit from the following:
CHMB20H3 *Chemical Thermodynamics and Elementary Kinetics
CHMB23H3 *Introduction to Chemical Thermodynamics and Kinetics: Theory and Practice
CHMB31H3 Introduction to Inorganic ~~Chemistry~~
~~CHMB55H3~~ ~~Environmental~~ Chemistry
CHMC11H3 Principles of Analytical Instrumentation
CHMC41H3 Organic Reaction Mechanisms
CHMC42H3 Organic Synthesis
*If CHMB20H3 or CHMB23H3 is selected, PHYA10H3 is required.
and
0.5 credit from the following :
CHMD47H3 Advanced Bio-Organic Chemistry
CHMD69H3 Chemical Elements in Living Systems
CHMD71H3 Pharmaceutical Chemistry
CHMD79H3 Topics in Biological Chemistry

Note : This program cannot be combined with the Major Program in Chemistry. However, when students are selecting their course of studies, they should refer to the University of Toronto guidelines for program breadth and depth requirements (see Degree Requirements).

Description of Proposed Changes:
1. Program Description updated.
2. Program total credit requirement: increase by 0.5 credit
3. Requirement 1: CHMA12H3 is being added as an optional course to CHMA11H3 or CHMA12H3
4. Requirement 2: Increase credit from 5.5. to 6.0 credit. Added additional 0.5 optional courses: CHMD47H3, CHMD69H3, CHMD71H3, CHMD79H3 Removed CHMB55H3 from optional courses.

Rationale:
1. The program description was updated to provide a more in-depth overview of the program.
2. The total program requirement has increased by 0.5 credit to accommodate the credit increase in requirement 2
2. CHMA12H3 is a new course, this course will provide students with more flexibility to complete this program requirement.
3. Increased requirement 2 to 6.0 credits from 5.5 credits to ensure students complete an additional optional D-level course. This is necessary to help students meet the program-level related learning outcomes. In particular, the listed D-level courses have been selected for their relevance to the program, allowing students to increase their depth of knowledge in the field while exploring current applications of their knowledge. This also results in the program's total credit requirement increase from 8.5 to 9.0 credits. CHMB55H3 is being removed because it does not function as a prerequisite to any of the D-level courses now listed in the program.

Impact: None

Consultation: DCC Approval: Oct 1, 2019

Resource Implications: None.

SPECIALIST PROGRAM IN ENVIRONMENTAL PHYSICS (SCIENCE)

Completion Requirements:

Program Requirements
Total Requirements: 16.0 ~~15.5~~ credits

First Year (4.0 credits):
~~PHYA10H3 Physics I for the Physical Sciences~~
~~PHYA21H3 Physics II for the Physical Sciences~~
~~MATA30H3 Calculus I for Physical Sciences~~
~~MATA36H3 Calculus II for Physical Sciences~~
CHMA10H3 Introductory Chemistry I: Structure and Bonding
CHMA11H3 Introductory Chemistry II: Reactions and Mechanisms
EESA06H3 Introduction to Planet Earth
MATA23H3 Linear Algebra I
MATA30H3 Calculus I for Physical Sciences
MATA36H3 Calculus II for Physical Sciences
PHYA10H3 Physics I for the Physical Sciences
PHYA21H3 Physics II for the Physical Sciences

Second Year (4.5 credits):
~~PHYB10H3 Intermediate Physics Laboratory I~~
~~PHYB21H3 Electricity and Magnetism~~
EESB19H3 Mineralogy ~~PHYB52H3 Thermal Physics~~
~~PHYB54H3 Mechanics : From Oscillations to Chaos~~
MATB41H3 Techniques of Calculus of Several Variables I
MATB42H3 Techniques of Calculus of Several Variables II
MATB44H3 Differential Equations I
PHYB10H3 Intermediate Physics Laboratory I
PHYB21H3 Electricity and Magnetism
PHYB54H3 Mechanics : From Oscillations to Chaos
and
1.0 credit from the following:
EESB02H3 Principles of Geomorphology
EESB03H3 Principles of Climatology
EESB04H3 Principles of Hydrology
EESB05H3 Principles of Soil Science
EESB15H3 Earth History

Third Year (4.0 credits):
~~PHYB56H3 Introduction to Quantum Physics~~
EESB20H3 Sedimentology and Stratigraphy
MATC46H3 Differential Equations ~~PHYC11H3 Intermediate Physics Laboratory~~ II
PSCB57H3 Introduction to Scientific Computing
~~MATC46H3 Differential Equations II~~
STAB22H3 Statistics I
and
1.5 credits ~~0.5 credit~~ from the following:
EESB21H3 Exploration Geophysics
EESB26H3 Introduction to Global Geophysics
EESC26H3 Seismology and Seismic Methods
PHYB52H3 Thermal Physics
PHYC11H3 Intermediate Physics Laboratory II
PHYC50H3 Electromagnetic Theory
PHYC54H3 Classical Mechanics
and
0.5 ~~1.0~~ credit from the following:
CHMB55H3 Environmental Chemistry
~~EESB26H3 Introduction to Global Geophysics~~
EESC07H3 Groundwater
EESC18H3 Limnology
EESC19H3 Oceanography
EESC20H3 Geochemistry
EESC31H3 Glacial Geology

Fourth Year (3.5 ~~3.0~~ credits):

EESC36H3 Petrology
EESC37H3 Structural Geology
EESD21H3 Geophysical and Climate Data Analysis
PHYD37H3 Introduction to Fluid Mechanics
~~PHYD38H3 Nonlinear Systems and Chaos~~
and
1.5 ~~2.0~~ credits from the following:
ASTC25H3 Astrophysics of Planetary Systems
EESC03H3 Geographic Information Systems and Remote Sensing
EESD02H3 Contaminant Hydrogeology
~~EESD06H3 Climate Change Impact Assessment~~
EESD09H3 Research Project in Environmental Science*
EESD10Y3 Research Project in Environmental Science*
EESD13H3 Environmental Law, Policy and Ethics
EESD33H3 Field Techniques
PHYC50H3 Electromagnetic Theory
PHYC54H3 Classical Mechanics
PHYD01H3 Research Project in Physics and Astrophysics*
PHYD26H3 Planetary Geophysics
PHYD38H3 Nonlinear Systems and Chaos
PHYD72H3 Supervised Reading in Physics and Astrophysics*
*no more than two of EESD09H3, EESD10Y3, PHYD01H3, and PHYD72H3 may be counted as fulfilling the program requirements.

Note: Where any course appears on more than one option list, it may only be counted as fulfilling the requirements for one of those lists of options .
Strongly recommended : EESC16H3 Field Camp I or EESD07H3 Field Camp II or EESD33H3 Field Techniques.

Description of Proposed Changes:
1. Total program credit requirement: increased from 15.5 to 16.0 credits
2. First Year: rearranged courses
3. Second Year: replaced mandatory course PHYB52H3 with EESB19H3. Rearranged courses
4. Third Year: added EESB20H3 as a mandatory course and removed PHYB56H3 and PHYC11H3 as mandatory courses.
    (a). 0.5 additional credit bin: Increased bin from 0.5 additional credit to 1.5 additional credits and added EESB26H3, EESC26H3, PHYB52H3 and PHYC11H3 as optional courses in this bin.
    (b) 1.0 additional credit bin: Decreased bin to 0.5 credit and removed EESB26H3 as an optional course for this bin
5. Fourth Year: Increased credit from 3.0 to 3.5 credits. Removed PHYD38H3 as a mandatory course and added EESC36H3, EESC37H3, and EESD21H3 as mandatory courses.
    (a). 2.0 credits bin: reduced to 1.5 credits. Added PHYD28H3 as an optional course
6. Added strongly recommended courses note.

Rationale:
1. The total program credit requirement has increased by 0.5 credit in order to fit the program with the knowledge requirements of the Association of Professional Geoscientist of Ontario (APGO) and thus, make the program eligible for P.Geo (Professional Geoscientist) certification.
2. Rearranged courses to ensure they are in alphabetical order.
3. EESB19H3 has been changed to a mandatory course because it is a requirement for the P.Geo certification, whereas PHYB52H3 is only recommended for this certification. Rearranged courses to ensure they are in alphabetical order.
4. EESB20H3 as been changed to a mandatory course because it is a requirement for the P.Geo certification, whereas PHYB56H3 and PHYC11H3 are not required for this certification.
    (a). The increase from 0.5-1.5 credits is to ensure students take at least three of the courses listed in this bin as they are required for the P.Geo Certification.
    (b) decrease from 1.0 to 0.5 to adjust for the added credits in the previous bin. Added EESB26H3 to provide students with an additional option to complete this program requirement bin.
5. Increase the credit from 3.0 to 3.5 to ensure students take all required courses mandatory for the APGO accreditation.

(a). Reduced bin from 2.0 to 1.5 to accommodate the credit increase in previous fourth-year credit requirements. Added PHYD28H3 to provide students with an additional option to complete this program requirement bin.
6. Added note because APGO accreditation docs note the importance of Field Experience in obtaining recognition, this information is also beneficial for students enrolled in this program

Impact:
There will be no impact on students already enrolled in the program. Students enrolling in the revised program will have the option to gain their P.Geo (Professional Geoscientist Certification) from APGO (Association of Professional Geoscientists of Ontario). There will be no impact on other academic units/divisions.

Consultation: DCC Approval: October 01, 2019

Resource Implications: None.

7 New Courses:

CHMA12H3: Advanced General Chemistry

Description:
This course will build on the topics from CHMA10H3 and CHMA11H3 including a close examination of solutions, dynamic chemical equilibrium, acid/base and solubility equilibria and thermochemistry, including calorimetry and thermodynamics, kinetics and electrochemistry as they relate to Gibbs Free Energy. In this course, students will explore these ideas in more detail both from a theoretical and practical point of view. The lecture portion will focus on how chemical concepts are applied in cutting edge research. The weekly laboratory period will provide students with access to the most current equipment used in both industrial and research settings as well as workshops that will explore how to analyze and extract data from published, peer-reviewed journal articles.

Prerequisites: CHMA10H3 with a grade of 70% or higher and [MATA29H3 or MATA30H3]

Exclusions:
CHMA11H3, CHM151Y1, CHM135H1, CHM110H5

Enrolment Limits: 100

Learning Outcomes:
Course-Specific Learning Outcomes:
Describe the importance of chemistry in everyday life and the interdisciplinary nature of chemistry.
Use critical thinking skills to explain, make connections between and apply chemical principles, laws, and theories pertaining to ideal gases, thermodynamics, chemical equilibria, electrochemistry, chemical Kinetics, biochemistry and green chemistry.
Evaluate and assess chemical data and explain how they relate to chemical theories/laws.
Apply chemical theories or laws to solve a variety of new qualitative and quantitative chemical problems.
Safely use a variety of laboratory equipment and instrumentation to perform experimental procedures and explain the underlying theory behind all of them.
Conduct laboratory experiments and draw conclusions from collected experimental data and results.
Communicate thoughts, ideas, and observations verbally and in writing.

Topics Covered:
Lecture Topics:
- Solution chemistry and dynamic chemical equilibrium
- acid/base and solubility equilibria and thermochemistry
- calorimetry
- thermodynamics
- kinetics including the steady-state approximation and Michaelis-Menten mechanism
- electrochemistry
- Gibbs Free Energy.

Potential Workshop Topics (in addition to how to analyze and extract data from a peer-reviewed journal article
- Quantum model of the atom, molecular orbital theory and symmetry as well as hybridization
- organic functional groups and aromaticity

- Transition metal and coordination compounds
- Principle of green chemistry

Methods of Assessment:
Methods of Assessment
Describe the methods of assessment and indicate how they will support the course learning outcomes.
1.Term test with a combination of short answer, calculation and multiple choice (20%): Short answer questions will be used to ask students about theoretical concepts and provide them with an opportunity to practice their write communication skills. A portion of the course content involves theories and models that require students to perform detailed calculations and hence students will be asked to perform calculations for the test and show their work.
2.Lab Reports (25%):
-In lab performance: (5/25). How a student performs each lab will reflect their development of scientific laboratory skills, whether they recognize when to seek assistance and also if they have developed respect for, and comply with, regulations and policies.
- Datasheets (10/25): will be used that are designed to provide a guide of how to a formal lab report is constructed; students are asked questions about both practical and theoretical aspects of the lab; students are also required to do a some of their own research either from their lab manual, textbook or appropriate online sources to draw conclusions about the results they collected.
-Students will submit one formal lab reports with peer feedback model (10/25): students will be assigned a lab early in the semester and will work through scaffolded exercises and workshops to write a formal report that will be handed in at the end of the term.
3. Online lab/tutorial quizzes (10%): Quizzes will be offered through Quercus and will be made available 3 days before the start of a new lab. The quizzes will test student preparedness for the lab by focusing on theory, safety and equipment that will be used for the particular lab. The results of the quiz show how well students can comply with regulations and policies and allows students to demonstrate working knowledge in both theoretical and practical forms of chemistry.
4. Oral Presentation (in pairs, for one lab) (10%): Students will be assigned one lab from the course to prepare and present on (15 minutes + 5 minutes of questions). Students will engage in the interpretation of communicated scientific data and practice and develop their oral communication skills. Oral presentations are utilized in C and D level courses in chemistry and hence this method of assessment provides students with an introduction to orally presenting their work.
5. Final Exam with a combination of short answer, calculation and multiple choice (35%): Short answer questions will be used to ask students about theoretical concepts and provide them with an opportunity to practice their written communication skills. A portion of the course content involves theories and models that require students to perform detailed calculations and hence students will be asked to perform calculations for the test and show their work.

Mode of Delivery: In Class

Breadth Requirements:

Rationale:
The explicit role of this new course, CHMA12H3, is to engage students who want to pursue either a Major or Specialist in Chemistry, Environmental Science, Biological Chemistry or Biochemistry. This course will also help boost student enrolment in the Specialist program in Chemistry and Biological Chemistry since it is specifically designed to prepare students for graduate studies or to go onto other professional programs such as medical school or dental school. Furthermore, both UTSGs and the UTM have courses designed to prepare students for Specialist programs and CHMA12H3 would hence bring UTSC in-line with the other two campuses. CHMA12H3 will allow students to experience more advanced lab techniques as well as utilize more advanced equipment in the department of Chemistry. It will also provide students with the opportunity to write a formal lab report and give an oral presentation which will better prepare them for their future chemistry courses.

Consultation:
DCC Approval: October 1, 2019
RO Course Code Approval: October 2, 2019

Resources:
CHMA12H3 will be taught by regular faculty. Future iterations of CHMA11H3 will no longer offer LEC02 and the extra overflow of students will be absorbed by an expanded enrolment CHMA12H3. The lab teaching and supervision will require an additional TA support that will be covered by the departments existing budget. This course will have an ancillary fee. No additional resources or equipment is required for this course.

CHMD47H3: Advanced Bio-Organic Chemistry

Description:

This course will teach biochemical reactions in the context of Organic Chemistry. This course will build on topics from CHMC47H3. Application of enzymes in organic synthesis, chemical synthesis of complex carbohydrates and proteins, enzyme catalyzed proton transfer reactions and co-enzymes will be discussed in depth with recent literature examples. Experiential learning is an integral part of this course. Students will explore the applications of Bio-Organic Chemistry in healthcare and industrial settings as part of an experiential learning project.

Prerequisites: BIOC12H3 and BIOC13H3 and CHMC47H3

Exclusions: CHM447H

Recommended Preparation: CHMB20H3

Enrolment Limits: 30-40

Learning Outcomes:

Course Specific Learning Outcomes:

- Use critical thinking skills to make conceptual connection between chemical principles, laws, and theories pertaining to fundamental reactions in biochemical systems.
- Understand the interdisciplinary aspects of chemistry in real-life applications through experiential learning projects that expose students to health care and industrial settings.
- Explain the role of chemistry in addressing social and economic issues.
- Explore new area of research in Bio-Organic chemistry and communicate the knowledge gained in oral and written format to both scientists and lay audience.

Topics Covered:

- Small Biological Probes for Studying Biological Processes
- Solid-phase Organic Synthesis and Combinatorial Chemistry
- Use of Enzymes in Organic Synthesis
- Advanced Topics on Enzymatic Catalysis and Kinetics
- Chemical Synthesis of Complex Carbohydrates, Structure, Conformation and Reactivity
- Chemical Mapping of Nucleic Acid Conformation
- The Chemistry of Protein-DNA Interactions

Methods of Assessment:

1. Term Tests (2, Short answer and multiple choice) (20%)
   - Multiple choice questions will test students on their comprehensive understanding on biochemical principles.
   - Short answer question will test students on reaction mechanisms and synthetic routes for biochemical reactions.

These formative assessments allow students to demonstrate their critical thinking and problem-solving skills to make conceptual connections between chemical principles and theories and practice their written communication skills.

2. Experiential Learning Project (40%)
   - Students will be assigned research topics in the field of healthcare or industrial research for a mini literature review (10%).
   - Students will get to experience the work setting of health care practitioner or researcher (with help from Integrated Learning Experience Coordinator) and conduct an interview.
   - Student will do a presentation for lay audience in a high school classroom setting about their learning from the literature review and placement interview (10%).
   - Students will write a reflection paper on their experiential learning experience (10%).
   - Students will do an oral presentation for faculty audience (10%).
3. Final Exam (Short answer) (40%)

Short answer questions will be used to test students' understanding on theoretical concepts and their application in proposing synthesis and mechanisms of important biochemical reactions. This assessment will test students on their critical thinking, problem solving and written communication skills.

Mode of Delivery: In Class

Rationale:

The explicit role of this new course is to engage students enrolled in the Specialist program in Biological Chemistry and Major program in Biochemistry. This course will help students to specialize in Bio-Organic Chemistry topics and to explore career options through experiential learning projects. Experiential learning projects will expose students to interact with researchers and practitioners from healthcare and industrial settings. Students enrolled in the Major program in

Biochemistry are required to take two D-level courses to satisfy the degree level requirement and this course will be one of the options for students.

Consultation:
DCC Approval: October 1, 2019
RO Approval: October 3, 2019

Resources: CHMD47H3 will be taught by regular faculty members. This course will require additional TA support that will be covered by the department's existing budget.

EESB21H3: Exploration Geophysics

Description:
The course will provide a general introduction to the most important methods of geophysical exploration. Topics covered will include physical principles, methodology, interpretational procedures and field application of various geophysical survey methods. Concepts/methods used to determine the distribution of physical properties at depths that reflect the local surface geology will be discussed.

Prerequisites: EESA06H3 and PHYA21H3

Corequisites: None

Exclusions: JGA305

Recommended Preparation: EESB15H3, EESB20H3

Enrolment Limits: 30

Learning Outcomes:
- Understanding geophysical methods, including seismic, gravity, magnetic, electrical resistivity and electromagnetic radar.
- Detection and delineation of local features/subsurface resources using geophysical methods
- Application of appropriate geophysical surveying methods for the exploration of fossil fuels (oil, gas, coal); metalliferous mineral deposits; bulk mineral deposits (sand and gravel); groundwater supplies; archaeological investigations

Topics Covered:
- Geophysical methods including seismic, gravity, magnetic, electrical resistivity, and electromagnetic radar
- Travel times of seismic waves, spatial variations in the Earth’s gravitational and geomagnetic fields, Earth resistance/response to induced polarization and electromagnetic radiation
- Airborne/remote Sensing, Archeological, Borehole, Geotechnical and Marine Geophysics

Methods of Assessment:
Lab assignments (4 x 5%) 20%
GPR report 25%
GPR group presentation 10%
Participation (graded as field notebook) 15%
Final Exam 30%

Mode of Delivery: In Class

Breadth Requirements: Natural Sciences

Rationale:
The course fits into DPES's Geosciences and Environmental Physics offerings. The Department offers no similar course and features current glaring weaknesses in its preparation of students wishing to pursue a career in geophysics. The Departmental external review identified geophysics as an area well suited for growth at UTSC.The proposed course's content will satisfy a further requirement of the Association of Professional Geoscientists of Ontario (Geophysics Specialty) for students following the specified electives in the Environmental Physics program.

Consultation:
EES Faculty: September 03, 2019
DCC: October 01, 2019
RO Approval: September 26, 2019

Resources:
Mr. Tom Meulendyk (DPES Environmental Technician) will teach this course. The course will require additional TA support, this will be covered by the department's existing budget. No other additional resources are required.

EESC26H3: Seismology and Seismic Methods

Description:
A course describing how seismology is used to probe both shallow layers near the surface as well as Earth's deep interior. Topics covered will include refraction and reflection methods, surface waves, tomography, magnitude and the Richter scale. Concepts including travel times and anisotropy will be discussed.

Prerequisites: EESB26H3

Exclusions: JPE493

Learning Outcomes:
- Understanding the terms used by seismologists, e.g., Richter scale, magnitude, travel time
- Understanding the advantages and disadvantages of reflection and refraction methods
- Mathematical methods applied to determine epicenter locations and interpretation of data stacking and seismographs
- Identification of diffraction and interference and damping, seismic signatures of resources

Topics Covered:
- Wave types in elastic media, pressure and transverse waves, surface waves
- Detection of seismic waves, magnitude, the Richter scale, tomography, free oscillations
- Reflection and refraction seismology, exploration methods, arrays
- Travel times, sources and attenuation, anisotropy and dispersion

Methods of Assessment:
- Four Assignments – mathematically based to reinforce understanding of the physics governing wave propagation in the Earth and emphasize mathematics as a tool to understand how waves travel in the Earth's interior.
- A midterm – to ensure students are absorbing the main concepts delivered early in the course.
- A final exam – both mathematically based and concept question based

Mode of Delivery: In Class

Breadth Requirements: Natural Sciences

Rationale:
The course naturally fits into the department's Geosciences offerings. The Department offers no similar course at the C-level and features current glaring weaknesses in its preparation of students wishing to pursue a career in geophysics. The Departmental external review identified geophysics as an area well suited for growth at UTSC. Also, this new course includes a greater degree of physics and mathematics and present much greater detail and mathematical extension of the concepts introduced in EESB26H3 and PHYB26H3. Accordingly, the course's content will satisfy a further requirement of the Association of Professional Geoscientists of Ontario (Geophysics Specialty) for students following the specified electives in the Environmental Physics program.

Consultation:
EES Group: September 03, 2019
DCC Approval: October 01, 2019
RO Course Code Approval: September 26, 2019

Resources:
A Professor yet to be identified will teach the course. The course will require TA support, this will be covered by the department's existing budget. No other additional resources required.

EESD21H3: Geophysical and Climate Data Analysis

Description:
This course offers an advanced introduction to geophysical data analysis. It is intended for upper-level undergraduate students and graduate students interested in data analysis and statistics in the geophysical sciences and is mainly laboratory (computer) based. The goal is to provide an understanding of the theory underlying the statistical analysis of geophysical data, in space, time and spectral domains and to provide the tools to undertake this statistical analysis.

Important statistical techniques such as regression, correlation and spectral analysis of time series will be explored with a focus on hypothesis formulation and interpretation of the analysis. Multivariate approaches will also be introduced. Although some previous knowledge of probability and statistics will be helpful, a review will be provided at the beginning of the course. Concepts and notation will be introduced, as needed.

Jointly offered with EES1132H.

Prerequisites: [MATA21H3 or MATA35H3 or MATA36H3] and PSCB57H3 and STAB22H3

Exclusions: EES1132H

Enrolment Limits: 38

Note: Graduate students enrolled in the Master of Environmental Science or in a Ph.D. program in DPES have enrollment priority as EESD21H3 it is a partner course for an existing graduate course EES1132H.

Learning Outcomes:
By the end of the course students will be able to:
- perform preliminary data discovery using descriptive statistics and visualization,
- assess probabilities associated with the standard normal distribution,
- diagnose and formulate real science problems into testable hypotheses,
- apply analysis techniques to time series data, such as regression, correlation and spectral analysis.
- evaluate the statistical significance, i.e., the robustness, of your analysis,
- manage multi-dimensional data and conceptualize the key elements of principal component analysis
- employ programming software (Python) to perform statistical analysis
- review and critically assess the analysis techniques presented in the literature,
- develop and generate independent scientific data analysis
- present scientific data analysis, both orally and in written form, in a professional manner.

Topics Covered:
There are four main topics covered with multiple sub-topics:
1) Signal-to-Noise:
- Summary statistics
- Basic Probability
- The Standard Normal Distribution
- Hypothesis Testing and the Central Limit Theorem
- Resampling Techniques
2) Regression and Correlation
- Least-Squares Linear Regression
- Correlation and the Fisher Z-Transformation
- Autocorrelation and Autoregressive models
- Multiple Linear Regression
3) Time Series Analysis
- Filtering in the Time Domain
- Harmonic analysis
- Fourier Transforms and Power Spectra
- Convolution and Filtering in the Frequency Domain
4) Introduction to Multivariate Approaches
- Eigen-analysis
- Principal Component Analysis (PCA)/Empirical Orthogonal Functions (EOFs)
- Applications of PCA/EOFs

Methods of Assessment:
The course grade will be made up of class participation (4%), pre-class assessments (10%), assignments (56%) and a final project (30%).
1) Class Participation (4%): The best way to learn statistics is to do statistics. The course will be held in a computer lab and students are expected to attend regularly and participate in in-class exercises, activities and discussions. Data sets and Python files will be provided for each class.
2) Class Assessments (10%): The pre-class assessments will require students to read posted content and/or watch online videos before each class and answer questions about these materials and apply the concepts discussed in the materials to a specific problem. This course has a lot of material, so the pre-class assessments are designed to help students keep on top of

the material presented in the last class and to prepare them for the next class. Pre-class assessments are expected to be completed independently.
3) Assignments (56%)
There will be four assignments corresponding to the four main topics in the course, each of varying length. Assignment instructions and Python file templates will be provided on the course website. The assignments will take students through the analysis of provided data sets using techniques from specific sections of the course material.
4) Final Project (30%)
The final project will address a research question of the student's choice and will require students to integrate many of the tools and concepts used throughout the semester. Students will be required to formulate their own research question, find the data to address the question, analyze the data using techniques covered in the course, and write- up your results in the style of a short scientific journal article. The evaluation of the final project includes a poster presentation on the final day of class.

Mode of Delivery: In Class

Breadth Requirements: Quantitative Reasoning

Rationale:
The Environmental Science section of DPES does not currently offer an advanced data analysis class for students who are interested in learning more about how data analysis is performed in the environmental and geophysical sciences. This new course will allow students to enhance their skills in this area. EES1132H is currently offered in DPES as a graduate course and students have found that it provides them will very practical quantitative skills that assist them in their research endeavours and their future careers. Therefore, this new course will allow undergraduate students the same development. The focus of the proposed course is on the application of statistical techniques. The combination is designed to reflect the statistical techniques that are commonly used in the environmental and geophysical sciences. This course is primarily intended for Specialist students in Environmental Physics, but the topics covered may also interest students in other Environmental Science programs who satisfy the pre-requisites. For Specialists in Environmental Geophysics, the proposed course satisfies the Geoscientists Canada and Association for Professional Geoscientists of Ontario (APGO) recommendation for undergraduate students in geophysics to take a course in "Digital Signal Processing".

Consultation:
DPES Chair Meeting: July 22, 2019
DCC Approval: October 1, 2019
RO Approval: October 03, 2019

Resources:
This course exists as a graduate course, the resources required are already in place. Based on past enrolments in the Specialist program in Environmental Physics, enrolment in this course by undergraduate students is anticipated to be about 10 students per year on average. If undergraduate enrolment increases, then additional TA hours will be required and this will be covered by the department's existing budget.

ESTB02H3: Whose Land Is It Anyway? Canada, Indigenous Peoples, and the Land

Description:

Introduces students to the geography of Indigenous-Crown-Land relations in Canada. Beginning with pre-European contact and the historic Nation-to-Nation relationship, the course will survey major research inquiries from the Royal Commission on Aboriginal Peoples to Missing and Murdered Indigenous Women and Girls. Students will learn how ongoing land and treaty violations impact Indigenous peoples, settler society, and the land in Canada.

Same as GGRB18H3

Prerequisites: 4.0 credits, including at least 0.5 credit in ANT, CIT, GGR, HLT, IDS, POL or SOC

Exclusions: GGRB18H3

Enrolment Limits: 80

Learning Outcomes:
1. Understand the significance of the historic Nation-to-Nation relationship to the formation of Canada, and know-how and why this relationship has shifted over time;
2. Comprehend the link between violence to Indigenous lands, communities, and bodies;

3. Think critically about the institutions that mediate the relationship between Indigenous peoples and lands;
4. Reflect and comment on your relationship to Indigenous lands, peoples, histories, and geographies;
5. Assess current policy frameworks as they relate to Indigenous self-determination; and
6. Develop effective notetaking, organization, and study skills and habits.

Support for program learning outcomes: these learning outcomes equip students to engage directly with a diversity of Indigenous perspectives, i.e. Indigenous voices (including scholarly and non-scholarly literature, policy frameworks, actions) regarding contemporary social science thought and the ways in which location, landscape, and spatial context shape (and are shaped by) social structures, functioning, and behavior (Human Geography), and regarding the environment, environmental issues, and solutions (Environmental Studies, DPES).

Topics Covered:
- Separate worlds (pre-European contact)
- History of the Nation-to-Nation relationship
- Policies of domination and assimilation
- Land-based conflict
- Grassroots movements
- Aboriginal and treaty rights in Canada
- Land claims
- Self-determination
- Truth and reconciliation

Methods of Assessment:
Student personal reflections will facilitate and track student learning of sometimes difficult historical truths about settler-colonialism and its impact on Indigenous peoples, settler society, and the land.
Short essays will support student syntheses of historical facts, processes, and concepts at work in the shifting nation-to-nation relationship. Students will be asked to articulate and evaluate key processes and frameworks.
Take home quizzes, mid-term exams and a final exam will support study habits and organizational skills needed to understand the broad contours and key moments spanning more than 500 years of history in Canada. Students will be encouraged to articulate and evaluate key processes and frameworks.

Mode of Delivery: In Class

Rationale:
This course is being proposed to fill a gap in the current curriculum in both Human Geography and Environmental Studies. It will complement courses in social, political and environmental Geography and courses about environmental conflict, decision-making, and diverse knowledge systems in Environmental Studies. However, this course is also unique in that it centers/prioritizes. No course in geography explicitly prioritizes Indigenous scholarship and perspectives on a breadth of issues on their own terms. Also, no course in environmental studies centers Indigenous relations to the land in a holistic manner, according to Indigenous voices themselves. This B-level course will provide foundational knowledge to equip students to grapple with advanced course content in other courses and units, and subsequent D-level courses in geography and environmental studies. Beyond the classroom, it will also equip students to engage and participate in the work towards truth, reconciliation, and justice in Canada.

Consultation:
Consultation with DPES/Human Geo: Sept 30, 2019
DCC Approval: October 3, 2019
RO Approval: October 1, 2019

Resources:
This course will be taught by a regular full-time faculty member, Assistant Professor Nicole Latulippe. Additional TA support will be covered by the department's existing budget. No additional resources are required.

ESTB03H3: Land

Description:
In this course students will learn about sustainability thinking, its key concepts, historical development and applications to current environmental challenges. More specifically, students will gain a better understanding of the complexity of values, knowledge, and problem framings that sustainability practice engages with through a focused interdisciplinary study of land.

Enrolment Limits: 50

Learning Outcomes:
1. Develop the capacity to integrate knowledge and to analyze and evaluate a broad range of sustainability aspects from multiple disciplinary perspectives and in an interdisciplinary way. This learning outcome will support the Sustainability Certificate's expectation of breadth of knowledge of sustainability issues and perspectives.
2. Have an in-depth understanding of some issues of sustainability from some disciplinary perspective. This learning outcome will support the Sustainability Certificate's expectation of depth of knowledge in at least some sustainability issues of interest to the student and from a disciplinary perspective.
3. Students will be able to communicate and work with scholars from other disciplines. This learning outcome will support the Sustainability Certificate's expectation of interdisciplinary interest and ability to communicate across disciplines.
4. Gain an understanding of sustainability issues involving Indigenous-Canada relations and the land.

Topics Covered:
Some of the topics will be focused on Ontario such as landforms, land uses and conflicts, Ontario Treaties and Indigenous land claims, invasive species, environmental planning. Other topics will be more general such as landscape art, landscape in environmental literature, environmental perception. Some topics will refer to current environmental challenges such as climate change. Students will also be introduced to key topics covered in Sustainable Development Goals.

Methods of Assessment:
1. Reflective responses to class discussions (20 %)
Each student will write 5 reflective responses to modules/outings (4% each). Students should write about how complexity is dealt with in the sustainability challenge discussed in the module/outing and different perspectives from which to frame the sustainability challenge and its potential solutions. This reflective response is also an opportunity for students to write about a perspective that is new to them and which made them think differently about the policy problem discussed. This component will address the first and third learning outcomes.
2. Online test about Indigenous land rights and treaties (10%).
This component will address the fourth learning outcome.
3. Project (proposal 10%, final output 20%)
Students will have a course project to complete. Student may choose any land-focused sustainability challenge for their project, in consultation with the lead instructor and at least one of the other faculty co-teaching the course. Students will be asked to use an interdisciplinary approach that spans the social and natural sciences and arts and make clear links to key topics related to the Sustainable Development Goals. This component will address the first and third learning outcomes.
4. Walk assignment (15%)
Students (in groups) are asked to design a walk during class time (40min) that is related to key concepts of sustainability and how they are interpreted through the lens of "land."
5. Final Exam (25%)
The final exam will consist of short answer and essay questions on key concepts, disciplinary perspectives and sustainability topics covered in class. This component will address the second learning outcome.

Mode of Delivery: In Class

Breadth Requirements: Social & Behavioural Sciences

Rationale:
This course will be the core course in a new Category 2 Certificate in Sustainability that is currently in development. In it, students will learn about sustainability thinking, its key concepts, its historical development and its applications to current environmental challenges. More specifically, students will gain a better understanding of the complexity of values, knowledge, and problem framing that sustainability practice engages with through a focused interdisciplinary study of land. The course will be open, and of interest, to students in Environmental Science and Environmental Studies programs.

Consultation:
DCC Approval: Oct 1, 2019
RO Approval: October 1st, 2019

Resources:
1. The course will be taught by Nicole Klenk as part of her regular teaching load.
2. The course will require 80 hours of TA support. If additional funding is needed, this has been approved by the Dean's Office on Dec 16, 2019.
3. Ontario lands field trip: initial costs will be covered by the Department's existing budgets, but if needed they will submit

a request to the Dean's Office for additional funds.
4. OTO honorarium for guest speakers: costs will be covered by the Dept's existing budgets.

1 Course Modification:

EESC24H3: Advanced Readings in Environmental Science

Prerequisites: A minimum CGPA ~~GPA~~ of 2.5, and 3.0 ~~3~~ ~~full~~ credits in EES and / or EST courses. Permission of the Supervisor of Studies.
Rationale: The course prerequisites have been revised to correct GPA to CGPA since the cumulative GPA (CGPA) is the one that is used to determine enrollment. In addition, the course prerequisites have been revised to provide students with more flexibility.
Consultation: DCC Approval: Oct 1, 2019
Resources: None