UNIVERSITY OF TORONTO
FACULTY OF ARTS & SCIENCE

Science Curriculum Committee
Proposals for Information (Abbreviated Review)

November 15, 2018
1 Minor Program Modification:

**Bioinformatics and Computational Biology Specialist**

**Description:**

The genomic and post-genomic era brings opportunities for new insight into all aspects of biology and medicine, based on the computational analysis of very large datasets in a biological context. The Bioinformatics and Computational Biology Program is an interdepartmental, interdisciplinary Program of Study that balances computer-science and life-science courses towards that goal. As a Specialist Program it is designed to prepare students for graduate studies in the field.

The Program is formally administered by the Department of Cell and Systems Biology Biochemistry and co-sponsored by the Departments of Biochemistry Cell and Systems Biology, Computer Science, Ecology and Evolutionary Biology, and Molecular Genetics; all sponsoring Departments have clear trajectories to extend the Program into graduate studies in the respective Department.

This program has unlimited enrolment and no specific admission requirements. All students who have completed at least 4.0 courses are eligible to enrol.

However, students are advised that the very rigorous courses that are part of the Program, the very limited overlap in course material between the theory-centric and the biology-centric courses, and the different academic cultures in the life- and computer sciences, make this Program suitable only for the academically strongest and most highly motivated students on campus. As a rule of thumb, students who expect to do well should be able to regularly perform at the top 20% level in their classes.

You should seek advice from both the Program Director and the Department of Computer Science on how to distribute your courses.

**Note:** this program has deregulated fees, which are incurred after enrolment in the program. Please refer to Arts & Science Registration Instructions for more information.

For additional information, please refer to http://biochemistry.utoronto.ca/bcb

**Description of Proposed Changes:**

**Rationale:**

**Impact:**

**Consultation:**

**Resource Implications:**

**27 Course Modifications:**

**BIO130H1: Molecular and Cell Biology**

**Exclusions:**
<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>BIO230H1: From Genes to Organisms</td>
<td>The genome is the &quot;book of life,&quot; providing instructions to construct an organism. This course introduces genome biology and explores how the building blocks of life are networked into functioning organisms. We will investigate how cells perceive internal and external cues, how gene expression is shaped by this perception, and how these events give rise to tissues, organs, and whole organisms. The Enhanced Laboratory provides the opportunity for greater laboratory skill development in modern investigative techniques and is intended for students interested in conducting their own laboratory research. (Lab Materials Fee: $50). Lab coat and safety glasses are required for use in laboratories; students are responsible for purchasing these items (approximate cost is $25).</td>
</tr>
<tr>
<td>BIO255H1: Cell and Molecular Biology with Advanced Laboratory</td>
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<tr>
<td>BIO260H1: Concepts in Genetics</td>
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</table>
BIO270H1: Animal Physiology I

Contact Hours:
- Previous: Lecture: 24 / Practical: 8
- New: Lecture: 24 / Practical: 9

Description:

Animal physiology is a biological sub-discipline that aims to understand, in physical and chemical terms, how animals work. This course uses examples from throughout the animal kingdom in a comparative approach to introduce and study the physiology of homeostasis and the endocrine system. Accompanying laboratories reinforce the concepts introduced in lectures and provide opportunities for students to experience firsthand the role that experimentation, data collection, interpretation of data, and communication of data plays in the nature of the scientific process. (Lab Materials Fee: $10). Lab coat and safety glasses are required for use in laboratories; students are responsible for purchasing these items (approximate cost is $25).

Prerequisites:
- BIO130H1/BIO150Y1

Rationale:

Consultation:

Resources:

BIO271H1: Animal Physiology II

Contact Hours:
- Previous: Lecture: 24 / Practical: 8
- New: Lecture: 24 / Practical: 9

Description:

Animal physiology is a biological sub-discipline that aims to understand, in physical and chemical terms, how animals work. This course uses examples from throughout the animal kingdom in a comparative approach to introduce and study the physiology of the nervous and cardiorespiratory systems. Accompanying laboratories reinforce the concepts introduced in lectures and provide opportunities for students to experience firsthand the role that experimentation, data collection, interpretation of data, and communication of data plays in the nature of the scientific process. (Lab Materials Fee: $10). Lab coat and safety glasses are required for use in laboratories; students are responsible for purchasing these items (approximate cost is $25).

Rationale:

Consultation:
CSB201H1: Molecular Biology, Biotechnology and You

Exclusions:
BIO130H1, BIO230H1, BIO240H1, BIO250Y1, BIO255H1, BIO255Y1, CSB200Y1

Rationale:

Consultation:

Resources:

CSB202H1: Further Exploration in Biotechnology

Exclusions:
   Previous: BIO230H1, BIO240H1, BIO241H1, BIO250Y1, BIO255H1, BIO255Y1, CSB200Y1
   New: BIO230H1, BIO255H1

Rationale:

Consultation:

Resources:

CSB327H1: Extracellular Matrix Dynamics and Associated Pathologies

Prerequisites:
BIO230H1/(BIO240H1, BIO241H1)/BIO255H1

Rationale:

Consultation:

Resources:

CSB328H1: Developmental Biology

Prerequisites:
BIO230H1/(BIO240H1, BIO241H1)/BIO255H1, BIO260H1/HMB265H1

Rationale:

Consultation:

Resources:
CSB329H1: Stem Cell Biology: Developmental Models and Cell-based Therapeutics

Contact Hours:
- Previous: Lecture: 24
- New: Lecture: 24 / Tutorial: 12

Rationale:

Consultation:

Resources:

CSB330H1: Techniques in Molecular and Cell Biology

Prerequisites:
- BIO230H1/(BIO240H1, BIO241H1)/BIO255H1, BIO260H1/HMB265H1

Rationale:

Consultation:

Resources:

CSB331H1: Advanced Cell Biology I: Cellular Dynamics During Development

Prerequisites:
- BIO230H1/(BIO240H1, BIO241H1)/BIO255H1

Rationale:

Consultation:

Resources:

CSB340H1: Plant Development

Prerequisites:
- BIO230H1/(BIO240H1, BIO241H1)/BIO255H1, BIO260H1 /(HMB265H1 with a minimum grade of 73%)

Rationale:

Consultation:

Resources:

CSB348H1: Laboratory in Comparative Animal Physiology

Description:
Cell and Systems Biology (FAS), Department of

Understanding of the regulation of physiological systems is critical to vertebrates and invertebrates. Student emphasis will experience the nature of physiological investigation while being exposed to a range of the current experimental approaches animal physiologists use to design, test and evaluate hypotheses, and communicate their findings. This course will emphasize being directed towards examining the fundamental characteristics humans share with all animal life and also the physiological adaptations that have permitted species to exploit alternative environmental niches. (Lab Materials Fee: $50). Lab coat and safety glasses are required for use in laboratories; students are responsible for purchasing these items (approximate cost is $25).

| Rationale: |
| Consultation: |
| Resources: |

**CSB349H1: Eukaryotic Gene Expression**

**Prerequisites:**
BIO230H1/(BIO240H1, BIO241H1)/BIO255H1, BIO260H1/HMB265H1

**Rationale:**

**Consultation:**

**Resources:**

**CSB350H1: Laboratory in Molecular Plant Biology**

**Prerequisites:**
BIO230H1/(BIO240H1, BIO241H1)/BIO255H1

**Rationale:**

**Consultation:**

**Resources:**

**CSB351Y1: Introductory Virology**

**Prerequisites:**
BIO230H1/BIO240H1/BIO241H1/BIO255H1

**Rationale:**

**Consultation:**

**Resources:**
## CSB352H1: Bioinformatic Methods

**Prerequisites:**
- BIO230H1/(BIO240H1, BIO241H1)/BIO255H1, BIO260H1/HMB265H1

**Rationale:**

**Consultation:**

**Resources:**

## CSB353H1: Plant-Microorganism Interactions and Plant Immunity

**Prerequisites:**
- BIO230H1/(BIO240H1, BIO241H1)/BIO255H1

**Rationale:**

**Consultation:**

**Resources:**

## CSB445H1: Topics in Sleep Research

**Contact Hours:**
- **Previous:** Lecture: 6 / Seminar: 30
- **New:** Lecture: 3 / Seminar: 33

**Rationale:**

**Consultation:**

**Resources:**

## CSB450H1: Proteomics in Systems Biology

**Prerequisites:**
- BIO230H1/(BIO240H1, BIO241H1)/BIO255H1, BCH210H1

**Rationale:**

**Consultation:**

**Resources:**

## CSB472H1: Computational Genomics and Bioinformatics

**Prerequisites:**
- BIO230H1/(BIO240H1, BIO241H1)/BIO255H1
CSB473H1: Chemical Genomics

**Prerequisites:**
BIO230H1/BIO240H1, BIO241H1/BIO255H1, BIO260H1/HMB265H1, CHM247H1/CHM249H1/any 300+ CHM course

**Rationale:**

**Consultation:**

**Resources:**

CSB491H1: Team-Based Research: Research in Cell and Molecular Biology

**Description:**

CSB491H1 will build on molecular biology and biochemistry approaches acquired in CSB350H1 to investigate the role of metabolic enzymes in plants. Students will work participating in teams to address a specific aspect of a research project. They this course will develop laboratory and team-work skills that are desirable for them to function in a research laboratory and in the workplace. The course will integrate current molecular biology techniques, including designing and characterizing mutants made with CRISPR/Cas9, identifying protein interactors, and performing structural and mechanistic analysis of metabolic enzymes. (Lab Materials Fee $50). Lab coat and safety glasses are required for use in laboratories; students are responsible for purchasing these items (approximate cost is $25).

**Rationale:**

**Consultation:**

**Resources:**

CSB497H1: Independent Research in Cell and Systems Biology I

**Abbreviated Title:**
CSB Independent Indep Research I

**Description:**

An original research project (a literature review alone is not sufficient) requiring the prior consent of a member of the Department to supervise the project. The topic is to be mutually agreed upon by the student and supervisor. They must arrange the time, place, and provision of any materials and submit to the Undergraduate Office a signed form of agreement outlining details prior to being enrolled. In the Fall or Winter sessions, a commitment of 8-10 hours per week is expected for research and related course activities. If spread over both the Fall and Winter sessions, a commitment of 4-5 hours per
week is expected. In the Summer Session, the number of hours doubles per week (e.g., 16-20 for F or S, or 8-10 for Y) as the length of the term is halved compared to the Fall or Winter term. Many students spend more than this amount of time as they become immersed in their project. This course is normally open only to fourth year students with adequate background in Cell and Systems Biology. Course requirements include a final report, and either an oral presentation (Summer and Fall sessions) or a poster presentation (Winter session). Two Monthly workshops on scientific research are scheduled and highly recommended. Details for enrollment are available at http://csb.utoronto.ca/undergraduate-studies/undergraduate-courses/undergraduate-course-level-400/. (Lab Materials Fee:$25). Not eligible for CR/NCR option.

Rationale:

Consultation:

Resources:

CSB498Y1: Independent Research in Cell and Systems Biology I

Abbreviated Title:
CSB Independent Research I

Description:

An original research project (a literature review alone is not sufficient) requiring the prior consent of a member of the Department to supervise the project. The topic is to be mutually agreed upon by the student and supervisor. They must arrange the time, place, and provision of any materials and submit to the Undergraduate Office a signed form of agreement outlining details prior to being enrolled. In the Fall/Winter session, a commitment of 8-10 hours per week is expected for research and related course activities. In the Summer session, the number of hours doubles (16-20 per week) as the length of the term is halved. This course is normally open only to fourth year students with adequate background in Cell and Systems Biology. Course requirements include a final report and either an oral presentation (Summer session) or a poster presentation (Fall/Winter session). Four Monthly workshops on scientific research are scheduled and highly recommended. Details for enrollment are available at http://csb.utoronto.ca/undergraduate-studies/undergraduate-courses/undergraduate-course-level-400/. (Lab Materials Fee:$50). Not eligible for CR/NCR option.

Rationale:

Consultation:

Resources:
3 Minor Program Modifications:

Focus in Computer Systems

Completion Requirements:

Required Courses:

1. †: CSC244H1, CSC343H1, CSC367H1, CSC443H1, CSC469H1
2. 1.0 FCE from the following: CSC358H1, CSC443H1, CSC458H1
3. CSC488H1

‡: 1.0 FCE from the following: CSC358H1 CSC385H1/CSC372H1/CSC458H1 (if not taken in list 2) ECE385H1, CSC324H1 CSC358H1, CSC385H1, CSC488H1

Suggested Related Courses:

1. †: CSC301H1, CSC309H1, CSC367H1, CSC410H1
2. ‡: ECE489H1

‡: Relevant courses offered at UTM: CSC347H5, CSC423H5, CSC427H5
3.

‡: Relevant courses offered by Engineering: ECE454H1, ECE568H1

Description of Proposed Changes:

Rearranged required and recommended courses to remove old numbers and better reflect our offerings.

Rationale:

Impact:

Consultation:

Discussed and approved by CS UGC October 2018.

Resource Implications:

Focus in Game Design

Enrolment Requirements:

Enrolment in the Computer Science Specialist Program(ASSPE1689).

Completion Requirements:
Required courses:

1. + CSC300H1, CSC301H1, CSC318H1; **CSC324H1**, CSC384H1, CSC418H1, CSC404H1

Suggested Related Courses:

1. **CSC303H1**, CSC304H1, **CSC358H1**, CSC458H1, CSC428H1,
2. ± MUS300H1, CIN212H1/INI222H1, CIN432H1/INI465H1, ENG235H1
3. ± ECO326H1, RSM482H1/MGT2056H

Description of Proposed Changes:

Rationale:

Impact:

Consultation:

Discussed and approved by CS UGC October 2018.

Resource Implications:

**Focus in Theory of Computation**

**Description:**

(4.5 FCEs + 2.0 FCEs from required Specialist courses)

Why is it easy to sort a list of numbers, but hard to break Internet encryption schemes? Is finding a solution to a problem harder than checking that a solution is correct? Can we find good approximate solutions, even when the exact solutions seem out of reach? Theory of Computation studies the inherent complexity of fundamental algorithmic problems. On one hand, we develop ground-breaking efficient data structures and algorithms. On the other, we have yet to develop good algorithms for many problems despite decades of effort, and for these problems we strive to prove no time- or space-efficient algorithms will ever solve them. While the field has seen some successful impossibility results, there are still many problems (such problems—such as those underlying modern cryptography and security) for which we do not know either efficient algorithms or strong lower bounds!

This focus takes a rigorous, mathematical approach to computational problem-solving: students will gain a deep understanding of algorithm paradigms and measures of problem complexity, and develop the skills necessary to convey abstract ideas with precision and clarity. Many of our students go on to graduate studies and sophisticated algorithmic work in industry. This focus has natural ties with many branches of mathematics and is the foundation of many computer science fields. Consequently, our students often apply their theoretical knowledge to other fields of interest.

We strongly encourage taking the enriched theory courses (CSC240H1, CSC265H1) as well as specialist/major versions of the MAT requirements for our focus. (Depending on courses selected for points 4 & 5, students may need to complete...
Completion Requirements:

Required Courses:

1. MAT137Y1/MAT157Y1/MAT237Y1 (Note: If MAT237Y1 is used here, it cannot be counted as part of the 2.0 FCEs for point 4, below.)
2. CSC463H1
3. 2.0 FCEs from the following: CSC304H1, CSC336H1, CSC438H1, CSC448H1, CSC473H1; MAT309H1, MAT332H1, MAT344H1; at UTM: CSC322H5/MAT302H5, CSC422H5; graduate courses: CSC2221H1, CSC2401H1, CSC2410H1, CSC2412H1, CSC2420H1, CSC2421H1, CSC2426H1, CSC2451H1, CSC2556H1 (note that students must petition to take a graduate course)
4. 2.0 FCEs from the following: APM236H1/MIE262H1, MIE263H1, APM421H1, APM461H1, MAT224H1/MAT247H1, MAT237Y1/MAT257Y1, MAT244H1/MAT267H1, MAT301H1/MAT347Y1, MAT315H1, MAT327H1, MAT334H1/MAT354H1, MAT335H1, MAT337H1/MAT357H1, any 400-level MAT course, STA248H1/STA261H1, STA347H1

Notes:

1. Students who complete an independent study project (CSC494H1/CSC495H1) under the supervision of a faculty member from the Theory group may request to substitute one of CSC494H1/CSC495H1 for one of the courses in list 3 above. This request must be made directly to the department's Undergraduate Office.
2. Students who complete a graduate Topics course in Theory may request to count it towards the completion of list 3 above. This request must be made directly to the department's Undergraduate Office.

Recommended Courses:

1. Students are strongly encouraged to take the enriched theory courses: CSC240H1 and CSC265H1, rather than their regular counterparts: CSC165H1/CSC236H1 and CSC263H1, respectively.

Description of Proposed Changes:

Rationale:

Impact:

Consultation:

Discussed and approved by CS UGC October 2018.

Resource Implications:

5 Course Modifications:

CSC240H1: Enriched Introduction to the Theory of Computation

Description:
The rigorous application of logic and proof techniques to Computer Science. Propositional and predicate logic; mathematical induction and other basic proof techniques; correctness proofs for iterative and recursive algorithms; recurrence equations and their solutions (including the Master Theorem); introduction to automata and formal languages. This course covers the same topics as CSC236H1, together with selected material from CSC165H1, but at a faster pace, in greater depth and with more rigour, and with more challenging assignments. Greater emphasis will be placed on proofs and theoretical analysis. Certain topics briefly mentioned in CSC165H1 or CSC236H1 may be covered in more detail in this course, and some additional topics may also be covered.

NOTES NOTE:

1. If you completed CSC165H1 with a course grade less than 85, you should take CSC236H1 instead of CSC240H1.
2. Students may go to their college to drop down from CSC240H1 to CSC165H1 (or to CSC236H1 if they have already passed CSC165H1). See above for the drop down deadline.

Rationale:
Discussed and approved by CS UGC October 2018.

Resources:

CSC304H1: Algorithmic Game Theory and Mechanism Design

Description:
A mathematical and computational introduction to game theory and mechanism design. Analysis of topics include games in matrix and extensive form, equilibria in games and computation of price of anarchy. Design and analysis mechanisms with monetary transfers (such as, matching markets, auctions). Design and analysis of mechanisms without monetary transfers (such as, network externalities, tipping points, voting and matching) theory. This course is intended for economics, mathematics, and computer science students.

Rationale:
Updating the description to reflect recent changes in the course content (mostly the focus on particular topics).

Consultation:
Discussions within the Computer Science Undergraduate Committee.

Resources:

CSC343H1: Introduction to Databases

Contact Hours:
Previous: Lecture: 24 / Tutorial: 12
New: Lecture: 36

Prerequisites:
CSC165H1/CSC240H1/(MAT135H1, MAT136H1)/MAT135Y1/MAT137Y1/MAT157Y1; CSC207H1. Prerequisite for Engineering students only: ECE345H1/ESC190H1/CSC190H1/CSC192H1

Rationale:
Majority of course is taught in inverted format; no separate tutorial required.
## Computer Science (FAS), Department of

**Consultation:**
- Discussed and approved by CS UGC October 2018.

**Resources:**

### CSC465H1: Formal Methods in Software Design

**Recommended Preparation:**
- **Previous:** CSC463H1
- **New:**

**Rationale:**

**Consultation:**
- Discussed and approved by CS UGC October 2018.

**Resources:**

### CSC485H1: Computational Linguistics

**Prerequisites:**
- **Previous:** STA247H1 / STA255H1/STA257H1 or familiarity with basic probability theory, including Bayes' theorem; CSC207H1/CSC209H1 or proficiency in Python and software development.
- **New:** STA247H1 / STA255H1/STA257H1; CSC209H1

**Rationale:**

**Consultation:**
- Discussed and approved by CS UGC October 2018.

**Resources:**
3 Minor Program Modifications:

Earth and Environmental Systems Major

Completion Requirements:

(8 full courses or their equivalent including at least 2.0 FCE at 300+ series with at least 0.5 FCE at 400 level series.)

1. 2.0 FCE foundation science courses: 2.0 FCE selected from JEG100H1/ESS102H, BIO120H1/BIO130H1, CHM135H1/CHM139H, CHM136H1/CHM138H, PHY131H1, PHY132H1, MAT135H1, ENV237H1/ENV238H1

2. 3.0 FCE core courses:

   • 1.0 FCE at 200 level: ESS261H1, ESS262H1 (NOTE: ESS261H and ESS262H1 may be taken in either order.)
   • 1.0 FCE at 300 level: ESS345H1, ESS361H1/ESS362H1/GGR305H1
   • 0.5 FCE field course: ESS410H1/ESS450H1/GGR390H1
   • 0.5 FCE capstone course: ESS461H1/ESS462H1/ESS463H1/ESS464H1

3. 3.0 FCE elective courses:

   In addition to the above core courses, you need to take 3 FCE electives. This requirement can be satisfied by any of the Earth Sciences Courses listed in categories A to F below. The following clusters of courses are neither mutually exclusive nor meant to limit choice but intended to show logical course complements. These are not POSt requirements; rather the clusters are presented to aid students in course selection according to their interests.

a) Earth Surface Processes
ESS241H1, ESS311H1, ESS331H1, ESS445H1, GGR201H1, GGR205H1, GGR272H1

b) Paleoclimate
ESS331H1, ESS361H1, ESS362H1, ESS461H1, ESS464H1, ENV234H1, GGR305H1

c) Biogeochemistry
ESS223H1/ENV233H, ESS311H1, ESS312H1, ESS362H1, ESS410H1, ESS462H1

d) Global Environmental Change
ESS362H1, ESS462H1, ESS463H1, GGR203H1, GGR314H1, PHY392H1

e) Quarternary Science
ANT314H1, ANT315H1, ANT409H1, ANT419H1, ESS461H1

f) Other Relevant Courses
ESS221H1, ESS222H1, JGA305H1, ESS450H1, GGR337H1, ENV337H1, JSC301H1, ESS381H1, ESS399Y0, ESS481H1, ESS490H1, ESS491H1/ESS492Y1

Description of Proposed Changes:
   Adding three courses to the list of electives.
Earth Sciences (FAS), Department of

Rationale:

Impact:

Consultation:

Resource Implications:

Geology Specialist

Completion Requirements:

Please consult the [undergraduate handbook](#) for detailed information on this program.

(14 full courses or their equivalent)

5.0 FCE foundation courses:
- CHM151Y1/(CHM135H1, CHM136H1)/(CHM138H1, CHM139H1); MAT135H1 & MAT136H1; (PHY131H1, PHY132H1)/(PHY151H1, PHY152H1); BIO120H1/MAT221H1/MAT223H1; STA220H1/GGR270H1; GGR201H1; CSC108H1/ESS345H1; recommended: ESS262H1/ESS102H1/ or JEG100H

6.0 FCE core courses:
- ENV233H1, ESS221H1, ESS222H1, ESS241H1, ESS261H1, JGA305H1, ESS311H1, ESS312H1, ESS322H1, ESS331H1, ESS441H1, ESS431H1 (previously ESS332)

1.0 FCE field courses:
- ESS330H1, ESS420H1

2.0 FCE electives chosen from:
- ENV234H1, ESS381H1, ESS410H1, ESS423H1, ESS425H1, ESS445H1, ESS461H1, ESS481H1, ESS420H1/ESS490H1, ESS491H1/ESS492Y1, ESS362H1

Description of Proposed Changes:

Rationale:

Impact:

Consultation:

Resource Implications:

Geoscience Minor

Completion Requirements:

(4 full courses or their equivalent, with at least 1.0 FCE at 300+ series.)
1. 1.0 FCE of 100-series CHM, BIO, or PHY courses.

2. 2.0 FCE of 100- or 200-level ESS courses (excluding ESS103H1, ESS104H1, ESS105H1, and ESS205H1; EGG100H1/EES102H recommended).

3. It is however recommended to include at least ESS262H1 or 1.0 FCE of 200-level ESS courses, including ENV234H1 or EGG100H1.

3.4. 1.0 FCE of 300/400 level ESS courses, including JGA305H1.

Be aware of course prerequisites, check clusters of courses listed for the geoscience major program, and consult the geology undergraduate handbook for logical course progressions.

Description of Proposed Changes:

Rationale:

Impact:

Consultation:

Resource Implications:

3 Course Modifications:

**ESS234H1: Introduction to Geological Field Methods**

Prerequisites:
- ESS222H1, ESS241H1, ESS262H1

Rationale:

Consultation:

Resources:

**ESS311H1: Earth System Chemistry 2: Aqueous Geochemistry**

Prerequisites:
- ESS223H1, ESS211H1/ENV233H1

Rationale:

Consultation:

Resources:
# ESS441H1: Advanced Structural Geology

| Prerequisites: | **ESS222H1, ESS234H1, ESS241H1, ESS331H1** and **8.0 ± 0 FCE of 300-level ESS/PHY courses including JGA205H1** |
| Rationale: | |
| Consultation: | |
| Resources: | |
2 Minor Program Modifications:

Forest Conservation Science Specialist

Completion Requirements:

(12 full courses or their equivalent, including at least 3.5 300-series courses and 2.0 400-series courses; other equivalent and approved courses offered by other Faculties, University of Toronto Mississauga or University of Toronto Scarborough may be eligible for inclusion.)

First Year:
BIO120H1; plus 2.5 first year Science FCEs (GGR101H1; CHM135H1, CHM136H1 recommended)

Second Year:
1. ENV234H1; FOR200H1, FOR201H1
2. 1.0 FCE from ECO220Y1, ECO227Y1; GGR270H1, GGR271H1; STA220H1, STA221H1
3. 1.0 FCE from BIO220H1, BIO251H1, BIO260H1; GGR205H1, GGR206H1, GGR272H1, GGR273H1; PHL273H1; ENV221H1, ENV222H1; ENV234H1, ENV237H1, ENV238H1

Third Year:
1. FOR301H1, FOR305H1; 1.0 FCE from FOR300H1, FOR302H1, FOR303H1, FOR306H1, FOR307H1, FOR310H1; ENV334H1
2. 0.5 FCE from EEB319H1, EEB321H1, EEB323H1, EEB328H1; CSB340H1
3. 1.0 FCE from EEB324H1, EEB365H1, EEB386H1, EEB388H1; GGR305H1, GGR314H1; ENV320H1, ENV322H1, ENV323H1

Fourth Year:
1. FOR400Y1, FOR401H1
2. 0.5 FCE from FOR403H1, FOR405H1, FOR410H1, FOR413H1, FOR416H1, FOR417H1, FOR418H1, FOR419H1, FOR420H1, FOR423H1; ENV347H1; JFG470H1, JFG475H1; EEB403H1, EEB406H1, EEB407H1

Note: If the FOR301H1 is not on offer, a student may use a substitute field or research course from another department. Contact the Forestry Undergraduate Administrator for details and confirmation.

Description of Proposed Changes:
We wanted to leave a note advising students that if the FOR301H1 is not currently available, then there are other options.

Rationale:
To let student know there are other options.

Impact:

Consultation:

Resource Implications:

Forest Conservation Specialist

Completion Requirements:
(12 full courses or their equivalent, including at least 3.0 300-series courses and 2.5 400-series courses; other equivalent and approved courses offered by other Faculties, University of Toronto Mississauga or University of Toronto Scarborough may be eligible for inclusion.)

First Year:
BIO120H1; plus 1.5 first year Social Science FCEs

Second Year:
1. ENV234H1; FOR200H1, FOR201H1
2. 1.0 FCE from ECO220Y1, ECO227Y1; GGR270H1; STA220H1, STA221H1, STA255H1
3. 1.0 FCE from ANT204H1; ENV221H1, ENV222H1; GGR223H1; INS201Y1; PHL273H1

Third Year:
1. FOR301H1, FOR305H1; At least 1.0 FCE from FOR300H1, FOR302H1, FOR303H1, FOR306H1, FOR307H1, FOR310H1; EEB321H1
2. At least 1.0 FCE from JGE321H1, JGE331H1; ENV320H1, ENV323H1, ENV347H1; GGR321H1

Fourth Year:
1. FOR400Y1, FOR401H1
2. 1.0 FCE from ANT450H1; FOR403H1, FOR416H1, FOR417H1, FOR418H1; ENV421H1, ENV422H1, ENV440H1; JFG470H1, JFG475H1; GGR416H1

An additional 1.0 FCE can be taken from any 3rd or 4th year elective listed above.

Note: If the FOR301H1 is not on offer, a student may use a substitute field or research course from another department. Contact the Forestry Undergraduate Administrator for details and confirmation.

Description of Proposed Changes:
We wanted to leave a note advising students that if the FOR301H1 is not currently available, then there are other options.

Rationale:
To let student know there are other options.

Impact:

Consultation:

Resource Implications:

1 Course Modification:

FOR416H1: Urban Forestry and Green Infrastructure

Title:
Urban Forestry and Green Urban Infrastructure

Abbreviated Title:
Green Urban Infrastructure Forest Cons
<table>
<thead>
<tr>
<th>Rationale:</th>
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<tr>
<td>The professor would like to change the name of the course as the FOR416 is a joint course with Engineering's FOR421, and having the same name would lessen confusion as some students believe they are two completely different courses.</td>
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<th>Consultation:</th>
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<th>Resources:</th>
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7 Course Modifications:

**GGR201H1: Geomorphology**

<table>
<thead>
<tr>
<th>Exclusions:</th>
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<tr>
<td>Previous:</td>
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<tr>
<td>New: GGR201H5</td>
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</table>

**Rationale:**

**Consultation:**

**Resources:**

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**GGR206H1: Introduction to Hydrology**

<table>
<thead>
<tr>
<th>Contact Hours:</th>
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<tbody>
<tr>
<td>Previous: Lecture: 30 / Tutorial: 4</td>
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<tr>
<td>New: Lecture: 30 / Practical: 4</td>
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</tbody>
</table>

**Rationale:**

**Consultation:**

**Resources:**

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**GGR305H1: Biogeography**

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<tr>
<th>Exclusions:</th>
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<tr>
<td>Previous:</td>
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<tr>
<td>New: GGR305H5</td>
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**Rationale:**

**Consultation:**

**Resources:**

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**GGR314H1: Global Warming**

<table>
<thead>
<tr>
<th>Exclusions:</th>
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<tr>
<td>Previous:</td>
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<tr>
<td>New: GGR377H5</td>
</tr>
</tbody>
</table>

**Rationale:**

**Consultation:**
## GGR337H1: Environmental Remote Sensing

**Exclusions:**
- Previous:
- New: GGR337H5

**Rationale:**

**Consultation:**

**Resources:**

## GGR386H1: Special Topics in Geographic Information Systems

**Prerequisites:**
- Previous:
  - New: GGR272H1

**Rationale:**

**Consultation:**

**Resources:**

## JEG100H1: Introduction to Physical Geography and Earth Science

**Exclusions:**
- GGR100H1, ESS102H1, ESS262H1, EESA06H3

**Rationale:**

**Consultation:**

**Resources:**
### 2 Minor Program Modifications:

#### Mathematics & Its Applications Specialist (Probability/Statistics)

**Completion Requirements:**

(11.5-13.0 FCE, including at least 1.0 FCE at the 400 level)

**Core Courses:**

**First Year:**
(CSC108H1, CSC148H1)/CSC150H1; MAT137Y1/MAT157Y1, MAT223H1/MAT240H1, MAT224H1/MAT247H1

**Second Year:**

MAT224H1/MAT247H1; MAT235Y1/MAT237Y1/MAT257Y1, MAT246H1 (waived for students taking MAT157Y1), MAT244H1/MAT267H1; STA257H1

**Second and Higher Years:**

1. At least 0.5 FCE with a significant emphasis on ethics and social responsibility: ENV333H1/ETH201H1/ETH210H1/ETH220H1/HPH200H1/IMC200H1/JPH441H1/PHL265H1/PHL273H1/PHL275H1/PHL281H1 or another H course approved by the Department. Note: Students may use the CR/NCR option with this H course and have it count toward the program. Students in the VIC program may also use VIC172Y1.

**Higher Years:**
MAT301H1, MAT334H1

**NOTE:**
1. Students planning to take specific fourth year courses should ensure that they have the necessary second and third year prerequisites.

#### Probability/Statistics Concentration:

1. APM346H1/MAT351Y1/APM462H1; MAT337H1; STA261H1, STA302H1, STA347H1, STA352Y1/(STA452H1, STA453H1)
2. Additional 1.0 FCE at the 300+level from APM/MAT/STA
3. Two of: STA437H1, STA442H1, STA447H1, STA457H1

**Description of Proposed Changes:**

**Rationale:**

**Impact:**

**Consultation:**

**Resource Implications:**
Mathematics Major

Completion Requirements:

(7.5 full courses or their equivalent. These must include at least 2.5 full course equivalent (FCE) at the 300+ level. Of those 2.5 FCE, at least 0.5 FCE must be at the 400 level).

First Year:
(MAT135H1, MAT136H1)/MAT137Y1/MAT157Y1, MAT223H1/MAT240H1, MAT224H1/MAT247H1

Second Year:
MAT224H1/MAT247H1; MAT235Y1/MAT237Y1/MAT257Y1, MAT244H1, MAT246H1

NOTE:
1. MAT224H1 may be taken in first year

Second and Higher Years:
1. At least 0.5 FCE with a significant emphasis on ethics and social responsibility: ENV333H1/ETH201H1/ETH210H1/ETH220H1/HPH254H1/PHL265H1/PHL273H1/PHL275H1/PHL281H1 or another H course approved by the Department. Note: Students may use the CR/NCR option with this H course and have it count toward the program. Students in the VIC program may use VIC172Y1.

Higher Years:
1. MAT301H1, MAT309H1/MAT315H1, MAT334H1
2. Additional 0.5 FCE at the 200+ level from: ACT240H1/ACT230H1 APM236H1, MAT309H1/MAT315H1/MAT335H1/MAT337H1, STA247H1/STA257H1
3. Additional 0.5 FCE at the 300+ level from: APM346H1, APM462H1, MAT309H1, MAT315H1, MAT332H1/MAT344H1, MAT335H1, MAT337H1, MAT363H1, MAT475H1, HPS390H1, HPS391H1, PSL432H1
4. MAT401H1/MAT402H1 or any other MAT/APM 400-level course

NOTES:
1. Students using MAT157Y1 towards the first year program requirements must replace the exclusion course MAT246H1 with a different H level MAT/APM course at the 200+ level.

2. In the major program, higher level courses within the same topic are acceptable substitutions. With a judicious choice of courses, usually including introductory computer science, students can fulfill the requirements for a double major in mathematics and one of several other disciplines.

3. Students planning to take specific fourth year courses should ensure that they have the necessary second and third year prerequisites.

4. Students interested in becoming K-12 teachers should consider applying to the combined degree program --- a six-year program that leads to an Honours Bachelor of Science (H B Sc) from the University of Toronto and a Master of Teaching (M T) from the Ontario Institute for Studies in Education (OISE). The HBSc part of this program involves completing a Math Major, a Minor in Education and Society (offered by Victoria College) and a Minor in an area that would lead to a second "teachable" subject. Please see the Victoria College website for more information.

Description of Proposed Changes:

Rationale:

Impact:
24 Course Modifications:

APM346H1: Partial Differential Equations

Prerequisites:
MAT235Y1/MAT235Y5/(MATB41H3, MATB42H3)/MAT237Y1/(MATB41H3, MATB42H3, MATB43H3)/MAT237Y5/MAT257Y1, MAT244H1/MAT244H5/MAT267H1

Rationale:
Consultation:
Resources:

MAT138H1: Introduction to Proofs

Description:
The goal of this course is for students to become comfortable with abstraction, rigour, logic, and proofs. They will practice reading and understanding mathematical statements, analyzing definitions and properties, formulating conjectures and generalizations, providing and writing reasonable and precise arguments, writing modelling and critiquing solving proofs. The instructor may use specific mathematical content, which could vary from year to year, to practice these skills. This course is aimed to students interested in the creative character of mathematics, particularly those planning to take any of our proof-oriented courses, and is an excellent preparation for MAT137Y1, MAT157Y1, MAT237Y1, or MAT240H1; and other proof-oriented courses.

Note: students may take this course concurrently with MAT157Y1 or MAT137Y1, or prior to registering in MAT157Y1 or MAT137Y1. This course can also be used by students who had already taken MAT136H1 and wish to bridge the gap to MAT237Y1.

Rationale:
Clarification of content and of one of the purposes, "This course can also be used by students who had already taken MAT136 and wish to bridge the gap to MAT237".

Consultation:
Internal in the math department, with former course instructors and with the MAT237 course coordinator.

Resources:
None.

MAT157Y1: Analysis I

Exclusions:
MAT137Y1, MAT157Y5, MAT195H1, & MAT197H1
**MAT221H1: Applied Linear Algebra**

**Exclusions:**
MAT223H1, MATA23H3, MAT223H5, MAT224H1, MAT240H1, MAT240H5, MAT247H1, MAT247H5

**Rationale:**
In discussions with the MAT237 course coordinator and with recent MAT138 instructors and in our undergraduate committee, we have agreed that the main obstructions for MAT136 graduates to take MAT237 in lack of experience with proofs, and that a reasonable mark in MAT138 remedies that.

**Consultation:**

**Resources:**

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**MAT223H1: Linear Algebra I**

**Exclusions:**
MATA23H3, MAT223H5, MAT224H1, MAT240H1, MAT240H5, MAT247H1, MAT247H5

**Rationale:**

**Consultation:**

**Resources:**

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**MAT235Y1: Calculus II**

**Prerequisites:**
(MAT135H1/MATA30H3/MATA31H3, MAT136H1/MATA36H3/MATA37H3)/MAT135Y5/MAT137Y1/
MAT137Y5/MAT157Y1/MAT157Y5

**Rationale:**

**Consultation:**

**Resources:**

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**MAT237Y1: Multivariable Calculus**

**Prerequisites:**
MAT137Y1/MAT157Y1/(MAT135H1, MAT136H1 (90%))/(MAT136H1 (70%), MAT138H1 (70%)), MAT223H1/
MAT240H1

**Rationale:**

In discussions with the MAT237 course coordinator and with recent MAT138 instructors and in our undergraduate committee, we have agreed that the main obstructions for MAT136 graduates to take MAT237 in lack of experience with proofs, and that a reasonable mark in MAT138 remedies that.
### MAT244H1: Introduction to Ordinary Differential Equations

**Prerequisites:**  

**Rationale:**

**Consultation:**

**Resources:**

### MAT247H1: Algebra II

**Prerequisites:**  
MAT240H1/MAT240H5

**Rationale:**

**Consultation:**

**Resources:**

### MAT257Y1: Analysis II

**Prerequisites:**  
MAT157Y1/MAT157Y5, MAT247H1/MAT247H5

**Rationale:**

**Consultation:**

**Resources:**

### MAT267H1: Advanced Ordinary Differential Equations

**Prerequisites:**  
MAT157Y1/MAT157Y5, MAT247H1/MAT247H5

**Rationale:**

**Consultation:**

**Resources:**
MAT309H1: Introduction to Mathematical Logic

Prerequisites:
MAT223H1/MATA23H3/MAT223H5/MAT240H1/MAT240H5, MAT235Y1/MAT235Y5/(MATB41H3, MATB42H3)/MAT237Y1/(MATB41H3, MATB42H3, MATB43H3)/MAT237Y5, MAT246H1/CSC236H1/CSC240H1
(These Prerequisites will be waived for students who have MAT257Y1)

Rationale:

Consultation:

Resources:

MAT315H1: Introduction to Number Theory

Prerequisites:

Rationale:

Consultation:

Resources:

MAT327H1: Introduction to Topology

Prerequisites:
MAT157Y1/MAT157Y5/(MAT237Y1/(MATB41H3, MATB42H3, MATB43H3)/MAT237Y5, MAT246H1 and permission of the instructor).

Rationale:

Consultation:

Resources:

MAT329Y1: Concepts in Elementary Mathematics

Prerequisites:
MAT137Y1/MAT138H1/MAT223H1/MAT246H1 and any 5.0 FCE with a CGPA of at least 2.5

Rationale:
Instructor's experience shows that 5.0 FCE of "maturity" is sufficient, and the current pre-req of 7 FCE deters potential qualified students.

Consultation:
Course instructor, departmental undergraduate committee.

Resources:
### MAT332H1: Introduction to Graph Theory

**Prerequisites:**
- MAT224H1/MATB24H3/MAT224H5/MAT247H1/MAT245H5

**Rationale:**

**Consultation:**

**Resources:**

### MAT334H1: Complex Variables

**Prerequisites:**
- MAT223H1/MATA23H3/MAT223H5/MAT240H1/MAT240H5, MAT235Y1/MAT235Y5/(MATB41H3, MATB42H3) /MAT237Y1/(MATB41H3, MATB42H3, MATB43H3)/MAT237Y5/MAT257Y1

**Rationale:**

**Consultation:**

**Resources:**

### MAT335H1: Chaos, Fractals and Dynamics

**Prerequisites:**
- MAT137Y1/(MATA30H3, MATA31H3, MATA37H3)/MAT137Y5/MAT157Y1/MAT157Y5/MAT235Y1/
  MAT235Y5/(MATB41H3, MATB42H3)/MAT237Y1/(MATB41H3, MATB42H3 200-level calculus, MATB43H3)/
  MAT237Y5/MAT223H1/MATA23H3/MAT223H5/MAT240H1/MAT240H5

**Rationale:**

**Consultation:**

**Resources:**

### MAT336H1: Elements of Analysis

**Prerequisites:**
- MAT223H1/MATA23H3/MAT223H5/MAT240H1/MAT240H5, MAT235Y1/MAT235Y5/(MATB41H3, MATB42H3) /MAT237Y1/(MATB41H3, MATB42H3, MATB43H3)/MAT237Y5

**Rationale:**

**Consultation:**

**Resources:**
### MAT337H1: Introduction to Real Analysis

**Prerequisites:**
- MAT224H1/MATB24H3/MAT224H5/MAT247H1/MAT247H5, MAT235Y1/MAT235Y5/(MATB41H3, MATB42H3)/MAT237Y1/(MATB41H3, MATB42H3, MATB43H3)/MAT237Y5, MAT246H1; NOTE: These Prerequisites will be waived for students who have MAT257Y1

**Rationale:**

**Consultation:**

**Resources:**

### MAT344H1: Introduction to Combinatorics

**Prerequisites:**
- MAT223H1/MATA23H3/MAT223H5/MAT240H1/MAT240H5

**Rationale:**

**Consultation:**

**Resources:**

### MAT347Y1: Groups, Rings and Fields

**Prerequisites:**
- MAT257Y1/(85% in MAT247H1/MAT247H5)

**Rationale:**

**Consultation:**

**Resources:**

### MAT363H1: Geometry of Curves and Surfaces

**Prerequisites:**
- MAT224H1/MATB24H3/MAT224H5/MAT247H1/MAT247H5, MAT237Y1/(MATB41H3, MATB42H3, MATB43H3)/MAT237Y5/MAT257Y1 (MAT257Y1 can be taken concurrently)

**Rationale:**

**Consultation:**

**Resources:**

### MAT377H1: Mathematical Probability

**Prerequisites:**

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<table>
<thead>
<tr>
<th>Mathematics (FAS), Department of</th>
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<tbody>
<tr>
<td>MAT247H1/MAT247H5, MAT257Y1</td>
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<tr>
<td><strong>Rationale:</strong></td>
</tr>
<tr>
<td><strong>Consultation:</strong></td>
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<tr>
<td><strong>Resources:</strong></td>
</tr>
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</table>
1 Course Modification:

PCL397Y0: Research Abroad in Pharmacology and Toxicology

<table>
<thead>
<tr>
<th>Prerequisites:</th>
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<tbody>
<tr>
<td>PCL201H1 (65%), PCL302H1 (65%), PSL300H1 (65%), PSL301H1 (65%) ; permission from the Undergraduate Coordinator</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommended Preparation:</th>
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<tbody>
<tr>
<td>Previous:</td>
</tr>
<tr>
<td>New: PCL302H1 (65%)</td>
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<tr>
<th>Rationale:</th>
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</table>
| During course enrollment periods exceptions are often made for a variety of course pre-requisites, and many of our faculty make exceptions on these non-essential courses. As such, we have reviewed course pre-requisites and clarified what advanced preparation is required versus what preparation is recommended (or in some cases not even needed). It was perhaps a mistake I made confusing what is important for the program versus what is important for our courses. Although students graduating from the program need to have a strong comprehension in other basic and life sciences, successful completion of specific courses within our programs do NOT rely or require many of these additional courses. Pre-requisites are now focused on what is minimally required and what other courses lay the foundations of knowledge to be successful. 

For this course, we already have second years taking the course regularly and doing well, therefore PCL302H is not required. |

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<thead>
<tr>
<th>Consultation:</th>
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<tbody>
<tr>
<td>Discussed with Department UG Education Committee, FAS Dean UG Pugh and Curriculum Services</td>
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<tr>
<th>Resources:</th>
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</table>
6 Course Modifications:

**PHY358H1: Atoms, Molecules and Solids**

**Abbreviated Title:**
Atoms, Molecules & Solids

**Description:**
Quantum theory of atoms, molecules, and solids; variational principle and perturbation theory; hydrogen and helium atoms; exchange and correlation energies; multielectron atoms; simple molecules; bonding and antibonding orbitals; rotation and vibration of molecules; crystal binding; electron in a periodic potential; reciprocal lattice; Bloch's theorem; nearly-free electron model; Kronig-Penney model; energy bands; metals, semiconductors, and insulators; Fermi surfaces. This course is not a prerequisite for any PHY400-level course.

**Rationale:**

**Consultation:**

**Resources:**

**PHY450H1: Relativistic Electrodynamics**

**Description:**
Previous:
The course illustrates, using classical electromagnetism, how symmetry principles and scaling arguments combine to determine the basic laws of physics. It is shown that the electromagnetic action (from which follow the equations of motion) is uniquely fixed by the principles of special relativity, gauge invariance, and locality. Additional topics include motion of relativistic particles in external electric and magnetic fields, radiation from point charges, and the breakdown of classical electromagnetism.

New:

An introduction to relativistic electrodynamics. Topics include: special relativity, four-vectors and tensors, relativistic dynamics from the Principle of Stationary Action and Maxwell’s equations in Lorentz covariant form. Noether’s theorem for fields and the energy-momentum tensor. Fields of moving charges and electromagnetic radiation: retarded potential, Lienard-Wiechert potentials, multipole expansion, radiation reaction.

**Rationale:**

**Consultation:**

**Resources:**

**PHY452H1: Statistical Mechanics**

**Abbreviated Title:**
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
<th>Rationale</th>
<th>Consultation</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY252H1</td>
<td>Statistical Mechanics</td>
<td>PHY252H1, PHY356H1</td>
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<tr>
<td>PHY256H1</td>
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<tr>
<td>PHY350H1</td>
<td>Laser Physics</td>
<td>PHY350H1, PHY356H1, PHY385H1/ECE318</td>
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<tr>
<td>PHY250H1</td>
<td>Condensed Matter Physics</td>
<td>PHY250H1, PHY256H1, PHY252H1, PHY356H1, PHY250H1</td>
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<tr>
<td>PHY252H1</td>
<td>Advanced Atmospheric Physics</td>
<td>Previous: PHY250H1, New: MAT237Y1/MAT257Y1</td>
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</table>

**Rationale:**

- PHY252H1: Statistical Mechanics
- PHY256H1: Statistical Mechanics
- PHY385H1/ECE318: Laser Physics
- PHY487H1: Condensed Matter Physics
- PHY492H1: Advanced Atmospheric Physics
4 Course Modifications:

PSY331H1: Social Psychology of Emotion

Prerequisites:
PSY201H1 (or exclusion), PSY220H1; and PSY230H1/PSY240H1

Rationale:

Consultation:

Resources:

PSY369H1: Psychobiology Laboratory

Description:

This Formerly numbered PSY399H1, this lab is an introduction to experimental methods in behavioural neuroscience, including neuroanatomical and psychopharmacological methods in rodents. Course projects will cover experimental design, laboratory techniques, data analysis, and scientific writing. Course capacity is limited to 12-15 students and priority is given to PSY Specialists and Research Specialists during the first enrolment period.

Exclusions:
HMB310H1/PSY399H1/PSY369H5 PSY399H5/PSYC06H3

Rationale:

Consultation:

Resources:

PSY421H1: Person Perception

Prerequisites:
PSY201H1 (or exclusion), PSY220H1; PSY230H1/PSY240H1, and PSY270H1 or PSY280H1

Rationale:

Consultation:

Resources:

PSY427H1: Media Psychology

Prerequisites:
PSY201H1 (or equivalent), PSY220H1; and PSY230H1/PSY240H1

Rationale:
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<td>Consultation:</td>
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<td>Resources:</td>
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1 Course Modification:

**COG341H1: Issues on Attention, Perception and Consciousness**

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<th>Prerequisites:</th>
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<tr>
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<td>COG250Y1; COG260H1 COG250Y1 and one of PSY270H1/PHL342H1</td>
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| Rationale:             |                                                                 |
| Consultation:          |                                                                 |
| Resources:             |                                                                 |