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**MEMORANDUM**

<b>ATTENTION</b>	Senate	<b>DATE</b>	January 10, 2020
<b>FROM</b>	Wade Parkhouse, Chair Senate Committee on Undergraduate Studies	<b>PAGES</b>	1/2
<b>RE:</b>	Program Changes		

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**For information:**

Acting under delegated authority at its meeting of January 9, 2020 SCUS approved the following curriculum revisions effective Fall 2020.

**a. Faculty of Applied Sciences (SCUS 20-03)****1. School of Computing Science**

- (i) Changes to the internal transfer requirements for the Software Systems Major

**2. School of Mechatronic Systems Engineering**

- (i) Changes to the internal transfer requirements for the Mechatronic Systems Engineering Honours

**b. Beedie School of Business (SCUS 20-04)**

- (i) Description changes to the:

- Business Technology Management Certificate
- Business Analytics & Decision Making Certificate
- Innovation & Entrepreneurship Certificate

- (ii) Lower division requirement changes to the:

- Business Administration Major and Honours
- Business and Communication Joint Major
- Business and Geography Joint Major
- Business and Psychology Joint Major
- Information Systems in Business Administration and Computing Science Joint Major
- Business and Economics Joint Honours
- Business Administration Minor programs

- (iii) Changes to the Major and Minor admission requirements

## **c. Faculty of Science (SCUS 20-05)**

### **1. Department of Biomedical Physiology and Kinesiology**

- (i) Upper division requirement changes to the Behavioural Neuroscience Bachelor of Science Major and Honours programs
- (ii) Upper division requirement changes to the Kinesiology Bachelor of Science Major and Honours programs
- (iii) Upper division requirement changes to the Biomedical Physiology Minor program

### **2. Department of Mathematics**

- (i) Upper and lower division requirement changes to the Applied Mathematics Major and Honours programs
- (ii) Upper division requirement changes to the Mathematics and Computing Science Bachelor of Science Joint Major and Joint Honours programs
- (iii) Upper division requirement changes to the Mathematics Bachelor of Science Major program
- (iv) Upper and lower division requirement changes to the Mathematics Bachelor of Science Honours program

### **3. Department of Molecular Biology and Biochemistry**

- (i) Upper division requirement changes to the:
  - Molecular Biology and Biochemistry Bachelor of Science Major and Honours programs (Summer 2020)
  - Molecular Biology and Biochemistry and Computing Science Bachelor of Science Joint Major and Joint Honours programs (Summer 2020)
- (ii) Requirement changes to the Genomics Certificate program (Summer2020)

### **4. Department of Physics**

- (i) Upper and lower division requirement changes to the:
  - Physics Major
    - Applied Physics Bachelor of Science
    - Biological Physics Bachelor of Science
    - Chemical Physics Bachelor of Science
    - Physics Bachelor of Science
  - Physics Honours
    - Applied Physics Bachelor of Science
    - Biological Physics Bachelor of Science
    - Chemical Physics Bachelor of Science
    - Mathematical Physics Bachelor of Science
    - Physics Bachelor of Science

Senators wishing to consult a more detailed report of curriculum revisions may do so on the Senate Docushare repository at <https://docushare.sfu.ca/dsweb/View/Collection-12682>.

**Calendar Entry Change**  
**Software Systems in Computing Science, Faculty of Applied Sciences**

Rationale for change:

To harmonize the internal transfer requirements of both the Computing Science Major and Software Systems Major.

About a year ago, the internal transfer requirements for the Computing Science Major were changed (effective Fall 2019). Before this, the internal transfer requirements for Software Systems and Computing Science were the same. We would like to make this change so that once again they are the same for both majors.

Effective term and year:

Fall 2020

The following program(s) will be affected by these changes:

Software Systems Major (Bachelor of Science)

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

~~Internal Transfer~~

~~Internal transfer allows students to transfer, within Simon Fraser University, from one faculty to another.~~

~~Simon Fraser University students applying for School of Computing Science admission are selected on the basis of an admission Computing Related Grade Point Average (CRGPA) and Cumulative Grade Point Average (CGPA). The CRGPA is calculated over the best three courses chosen as follows:~~

- ~~• two computing courses chosen from: (CMPT 125, 129 or 135), CMPT 225, (CMPT 275 or 276), CMPT 295~~
- ~~• one mathematics course chosen from: MACM 101, MACM 201~~

~~No course may be included in the average if it is a duplicate of any previous course completed at Simon Fraser University or elsewhere. All three courses must be completed prior to application.~~

~~The average for admission based on internal transfer is competitive and the school sets a competitive average each semester.~~

~~The CRGPA minimum average is 2.67 and the CGPA minimum average is 2.40 – the competitive averages will never be below these minima.~~

**Internal Transfer**

**Internal transfer allows students to transfer, within Simon Fraser University, from one faculty to another.**

**Simon Fraser University students applying for School of Computing Science admission are selected on the basis of an admission Computing Related Grade Point Average (CRGPA) and Cumulative Grade Point Average (CGPA). The CRGPA is computed from all courses the student has taken from the following: (CMPT 120, 128 or 130), (CMPT 125, 129 or 135), CMPT 225, (CMPT 275 or 276), CMPT 295, CMPT 300, CMPT 307, MACM 101, MACM 201, MACM 316. Applicants must have completed at least one MACM course and at least two CMPT courses from this list before applying. At least two courses used in the CRGPA calculation must have been taken at SFU.**

**No course may be included in the average if it is a duplicate of any previous course completed at Simon Fraser University or elsewhere.**

**The average for admission based on internal transfer is competitive and the school sets competitive averages each term.**

**The CRGPA minimum average is 2.67 and the CGPA minimum average is 2.40 - the competitive averages will never be below these minima.**

**Calendar Entry Change**  
**Mechatronics, Faculty of Applied Sciences**

Rationale for change:

Harmonize the internal transfer requirements so that the requirements for MSE honours and MSE major are the same.

Effective term and year: Fall 2020

The following program(s) will be affected by these changes:

Honours, Mechatronic Systems Engineering Bachelor of Applied Science

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

**Internal Transfer from Another Simon Fraser University Program**

~~Simon Fraser University students who wish to transfer to Mechatronic Systems Engineering from another faculty must have a Simon Fraser University cumulative grade point average (CGPA) of at least 2.5 and must have been enrolled in at least 12 Simon Fraser University units in the term prior to requesting the transfer to the School of Mechatronic Systems Engineering.~~

- a CGPA of at least 2.67 (B-)
- registration in at least 12 units in the term prior to admission
- no more than 5 repeats
- meeting high school admission requirements

**Former MSE students wishing to gain re-entry to the MSE program require, at minimum**

- completion of at least 100 units
- a term GPA of at least 2.67 (B-) in each of the two preceding terms
- a minimum CGPA of 2.0
- registration in at least 12 units in the term prior to admission, six of which must be from the Faculty of Science or the Faculty of Applied Sciences

**Calendar Entry Change**  
**Beedie School of Business Undergraduate Program**

Rationale for change:

We are adding clear GPA requirements to the certificate page. This GPA information appears on our Grade requirements page, but adding it to this page puts all the information in one location for students.

We are also updating the limitations. This language mirrors language in the certificate credential definition and clarifies that students cannot apply courses/credits for one certificate to another certificate as well.

Effective term and year:

Fall 2020

The following program(s) will be affected by these changes:

Business Technology Management Certificate

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

Business Technology Management  
CERTIFICATE

**Limitations**

(...)

~~Additionally,~~ Units applied to one certificate **may be applied also to major or minor programs of a bachelor’s degree under the normal regulations governing those programs but** may not be applied to another Simon Fraser University certificate or diploma, ~~as noted here.~~

**Grade Requirements**

In addition to normal university grade point average requirements, the Beedie School of Business requires a minimum 2.30 overall SFU Business course grade point average for entry into all 300 and 400 division business courses.

For a course to be accepted as fulfilling a prerequisite, or for a lower division requirement, or for a core course to be accepted in a student's program in business, a student must have obtained a minimum grade of C- (C minus).

**A minimum grade point average of 2.00 calculated on all courses applied towards the certificate is required for graduation from a business certificate.**

**Calendar Entry Change  
Beedie School of Business Undergraduate Programs**

<p>Rationale for change:</p> <p>We are adding clear GPA requirements to the certificate page. This GPA information appears on our Grade requirements page, but adding it to this page puts all the information in one location for students.</p> <p>We are also updating the limitations. This language mirrors language in the certificate credential definition and clarifies that students cannot apply courses/credits for one certificate to another certificate as well.</p>
<p>Effective term and year: Fall 2020</p>
<p>The following program(s) will be affected by these changes:</p> <p>Business Analytics &amp; Decision Making Certificate</p>

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

<p><b>Limitations</b> (...) Additionally, Units applied to one certificate <b>may be applied also to major or minor programs of a bachelor’s degree under the normal regulations governing those programs but</b> may not be applied to another Simon Fraser University certificate or diploma, <del>as noted here</del>.</p> <p><b>Grade Requirements</b> In addition to normal university grade point average requirements, the Beedie School of Business requires a minimum 2.30 overall SFU Business course grade point average for entry into all 300 and 400 division business courses.</p> <p>For a course to be accepted as fulfilling a prerequisite, or for a lower division requirement, or for a core course to be accepted in a student's program in business, a student must have obtained a minimum grade of C- (C minus).</p> <p><b>A minimum grade point average of 2.00 calculated on all courses applied towards the certificate is required for graduation from a business certificate.</b></p>
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**Calendar Entry Change**  
**Beedie School of Business Undergraduate Programs**

<p>Rationale for change:</p> <p>We are adding clear GPA requirements to the certificate page. This GPA information appears on our Grade requirements page, but adding it to this page puts all the information in one location for students.</p> <p>We are also updating the limitations. This language mirrors language in the certificate credential definition and clarifies that students cannot apply courses/credits for one certificate to another certificate as well.</p>
<p>Effective term and year: Fall 2020</p>
<p>The following program(s) will be affected by these changes:</p> <p>Innovation &amp; Entrepreneurship Certificate</p>

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

<p>Limitations (...)</p> <p><del>Additionally,</del> Units applied to one certificate <b>may be applied also to major or minor programs of a bachelor’s degree under the normal regulations governing those programs but</b> may not be applied to another Simon Fraser University certificate or diploma., <del>as noted here.</del></p> <p>Grade Requirements</p> <p>In addition to normal university grade point average requirements, the Beedie School of Business requires a minimum 2.30 overall SFU Business course grade point average for entry into all 300 and 400 division business courses.</p> <p>For a course to be accepted as fulfilling a prerequisite, or for a lower division requirement, or for a core course to be accepted in a student's program in business, a student must have obtained a minimum grade of C- (C minus).</p> <p><b>A minimum grade point average of 2.00 calculated on all courses applied towards the certificate is required for graduation from a business certificate.</b></p>
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**Calendar Entry Change**

**Name of Program or Name of Faculty**

<p>Rationale for change: The addition of WL 105 (3) World Literature Lab, PHIL 110 (3) Intro to Logic &amp; Reasoning, PHIL 150 (3) Great works in the History of Philosophy into the options for the lower-division requirements in Business would provide students with additional options for courses that achieve the writing and critical thinking goals of the ENGL/WL/PHIL requirements of Beedie’s business programs.</p>
<p>Effective term and year: Fall 2020</p>
<p>The following program(s) will be affected by these changes: Business Administration Major Business Administration Honours Business and Communication Joint Major Business and Geography Joint Major Business and Psychology Joint Major Information Systems in Business Administration and Computing Science Joint Major Business and Economics Joint Honours</p>

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

<p>ENGL 111W - Literary Classics in English (3) ENGL 112W - Literature Now (3) ENGL 113W - Literature and Performance (3) ENGL 114W - Language and Purpose (3) ENGL 115W - Literature and Culture (3) ENGL 199W - Writing to Persuade (3) PHIL 100W - Knowledge and Reality (3) PHIL 105 - Critical Thinking (3) <b>PHIL 110 - Introduction to Logic and Reasoning (3)</b> PHIL 120W - Moral and Legal Problems (3) <b>PHIL 150 - Great Works in the History of Philosophy (3)</b> WL 101W - Writing in World Literature (3) WL 103W - Early World Literatures (3) WL 104W - Modern World Literatures (3) <b>WL 105W - World Literature Lab (3)</b></p>
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**Calendar Entry Change**

**Name of Program or Name of Faculty**

Rationale for change:

The addition of WL 105 (3) World Literature Lab, PHIL 110 (3) Intro to Logic & Reasoning, PHIL 150 (3) Great works in the History of Philosophy would provide students with additional options for courses that achieve the writing and critical thinking goals of the ENGL/WL/PHIL requirements of Beedie's business programs.

Effective term and year:

Fall 2020

The following program(s) will be affected by these changes:

Business Administration Minor

**Calendar Change:** "to" and "from" sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

Lower Division Requirements

Students complete all of

BUS 200 - Business Fundamentals (3)  
 BUS 233 - Introduction to Business Law and Ethics (3)  
 BUS 237 - Introduction to Business Technology Management (3)  
 BUS 251 - Financial Accounting I (3)  
 BUS 272 - Behaviour in Organizations (3)  
 ECON 103 - Principles of Microeconomics (4)

and one of\*

ECON 105 - Principles of Macroeconomics (4)  
 ENGL 111W - Literary Classics in English (3)  
 ENGL 112W - Literature Now (3)  
 ENGL 113W - Literature and Performance (3)  
 ENGL 114W - Language and Purpose (3)  
 ENGL 115W - Literature and Culture (3)  
 ENGL 199W - Writing to Persuade (3)  
 PHIL 100W - Knowledge and Reality (3)  
 PHIL 105 - Critical Thinking (3)  
**PHIL 110 - Introduction to Logic and Reasoning (3)**  
 PHIL 120W - Moral and Legal Problems (3)  
**PHIL 150- Great Works in the History of Philosophy (3)**  
 WL 101W - Writing in World Literature (3)



WL 103W - Early World Literatures (3)  
WL 104W - Modern World Literatures (3)  
**WL 105W - World Literature Lab (3)**

\* any one of these courses may be replaced by any three unspecified transfer units in English or in ENGL-Writing at the 100- or 200-level.

**Calendar Entry Change**

**Name of Program or Name of Faculty**

<p>Rationale for change: The addition of WL 105 (3) World Literature Lab, PHIL 110 (3) Intro to Logic &amp; Reasoning, PHIL 150 (3) Great works in the History of Philosophy would provide students with additional options for courses that achieve the writing and critical thinking goals of the ENGL/WL/PHIL requirements of Beedie’s business programs.</p>
<p>Effective term and year: Fall 2020</p>
<p>The following program(s) will be affected by these changes: Beedie School of Business Admission Requirements <a href="https://www.sfu.ca/students/calendar/2020/spring/faculties-research/faculty-business/course-access-info-and-grade-requirements.html">https://www.sfu.ca/students/calendar/2020/spring/faculties-research/faculty-business/course-access-info-and-grade-requirements.html</a></p>

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

<p>Admission Requirements Major Admission Requirements For admission to the major program within the Beedie School of Business, students will be competitively selected from one of the following four streams.</p> <p><b>DIRECT FROM SECONDARY SCHOOL</b> Secondary school graduates, or students with fewer than 24 units of transferable coursework from another post-secondary institution, will be competitively selected for admission in the fall and spring terms (only), based on the general Simon Fraser University admission requirements, faculty specific admission requirements, and a supplemental application. The supplemental application may include:</p> <p>An explanation of extra-curricular experience (i.e. in the areas of: athletics, arts, community leadership/involvement, work experience, and/or entrepreneurship) Short answer questions Online video interview Reference, with at least one being academic in nature</p> <p><b>EXTERNAL TRANSFER – DIRECT FROM A RECOGNIZED POST-SECONDARY INSTITUTION</b> A portion of the annual admission will be competitively selected from students transferring from recognized post-secondary institutions who meet the university admission</p>
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requirements and have completed all of the eight lower division courses required for admission\*\*. Students may also be required to submit a supplemental application for consideration. Of the required courses, a maximum of 2 of the 8 courses may be repeated one time each for admission.

The supplemental application may include:

An explanation of extra-curricular experience (i.e. in the areas of: athletics, arts, community leadership/involvement, work experience, and/or entrepreneurship)

Short answer questions

Online video interview

References, with at least one being academic in nature

**INTERNAL TRANSFER – ALL COURSES AT SIMON FRASER UNIVERSITY OR A COMBINATION OF SIMON FRASER UNIVERSITY AND OTHER POST-SECONDARY COURSES**

A portion of the annual admission will be competitively selected from students who have completed all of their courses at Simon Fraser University, including the eight lower division courses required for admission\*\*. Students may also be required to submit a supplemental application for consideration. Of the required courses, a maximum of 2 of the 8 courses may be repeated one time each for admission.

The supplemental application may include:

An explanation of extra-curricular experience (i.e. in the areas of: athletics, arts, community leadership/involvement, work experience, and/or entrepreneurship)

Short answer questions

Online video interview

References, with at least one being academic in nature

Please note that students must meet minimum GPA requirements in order to be considered for admission to the Beedie School of Business. These requirements are listed on the internal transfer website. Prospective students should also review and meet the Beedie School of Business grade requirements, which are listed here.

\*\*The eight lower division courses required for admission are as follows:

BUS 237-3 Introduction to Business Technology Management

BUS 251-3 Financial Accounting I

BUS 272-3 Behaviour in Organizations

ECON 103-4 Principles of Microeconomics

ECON 105-4 Principles of Macroeconomics

and one of:

BUS 232-4 Data and Decisions I

STAT 270-3 Introduction to Probability and Statistics

and one of:



MATH 150-4 Calculus I with Review  
MATH 151-3 Calculus I  
MATH 154-3 Calculus I for the Biological Sciences  
MATH 157-3 Calculus I for the Social Sciences  
and one of ^:

ENGL 111W-3 Literary Classics in English  
ENGL 112W-3 Literature Now  
ENGL 113W-3 Literature and Performance  
ENGL 114W-3 Language and Purpose  
ENGL 115W-3 Literature and Culture  
ENGL 199W-3 Introduction to University Writing  
PHIL 100W-3 Knowledge and Reality  
PHIL 105-3 Critical Thinking  
**PHIL 110-3 Introduction to Logic and Reasoning**  
PHIL 120W-3 Moral Problems  
**PHIL 150-3 Great Works in the History of Philosophy**  
WL 101W-3 Writing About Literature  
WL 103W-3 Pre-Modern World Literature  
WL 104W-3 Modern World Literature  
**WL 105W-3 World Literature Lab**

^ any one of these courses may be replaced by any three unspecified transfer units in English or in ENGL-Writing at the 100- or 200-level.

#### APPLICATION PROCEDURES

Students applying directly from a secondary school or an external post-secondary institution should apply to the faculty at the same time that they apply for admission to the University.

Internal transfer applicants should apply to the faculty during the term in which the admission requirements are completed.

Students not accepted upon initial application may reapply. Unsuccessful applicants are permitted to appeal.

#### APPLICATION DEADLINES

Visit <http://beedie.sfu.ca/bba/apply> for application deadlines.

#### Joint Major Admission Requirements

All students wishing to pursue a joint major with the Beedie School of Business and another department/faculty must be admissible to both programs that comprise the joint major.



**DIRECT FROM SECONDARY SCHOOL OR EXTERNAL TRANSFER - DIRECT FROM A RECOGNIZED POST-SECONDARY INSTITUTION**

Students must first gain admission to the Beedie School of Business through the secondary school or the external post-secondary institution application process described above. Once attending SFU, the student must satisfy the admission requirements listed for the non-Business portion of the joint major program in order to have their Business plan changed from a major to a joint major. Students should consult with both Beedie and the accompanying joint major department/faculty before applying to the joint major program.

**COURSES COMPLETED AT SIMON FRASER UNIVERSITY ONLY, OR BOTH SFU AND ANOTHER POST-SECONDARY INSTITUTION(S)**

Students admitted to an SFU faculty outside of the Beedie School of Business must be admissible to both the Beedie School of Business via internal transfer (as described in the major admission requirements above) and the other program that comprises that particular joint major (except in the case of the Psychology and Business Joint Major Program).

When applying to Beedie, students will be competitively selected for admission based on the specific course requirements for the particular joint major program and a supplemental application form. Students should consult both Beedie and the accompanying joint major department/faculty before applying to the joint major program.

Please note that students must meet minimum GPA requirements in order to be considered for admission to the Beedie School of Business. These requirements are listed on the internal transfer website. Prospective students should also review and meet the Beedie School of Business grade requirements, which are listed in the SFU calendar.

For further details on the required courses for admission, please refer to the specific business joint major program requirements.

**APPLICATION PROCEDURES**

Students applying directly from a secondary school or an external post-secondary institution should apply to the faculty at the same time that they apply for admission to the University.

Internal transfer applicants should apply to the faculty during the term in which the admission requirements are completed.

Students not accepted upon initial application may reapply. Unsuccessful applicants are permitted to appeal.

**APPLICATION DEADLINES**

Visit <http://beedie.sfu.ca/bba/apply> for application deadlines.

### Minor Admission Requirements

To be considered for admission to the minor, students must have completed each lower division required course with a minimum C- grade. For admission to the minor program within the Beedie School of Business, students will be selected competitively from one of the following two streams.

#### ALL COURSES COMPLETED AT SIMON FRASER UNIVERSITY

A portion of the annual admission to the minor program will be selected from students who have completed all of their required courses for admission at Simon Fraser University. Students will be selected competitively based on the grades achieved in the 5 lower division required courses\*\*\*. Of the required courses, a maximum of 2 of the 5 courses may be repeated for admission. Note that a minimum overall SFU Business grade point average of 2.00 is also required for admission to the business minor program.

#### COURSES COMPLETED AT BOTH SIMON FRASER UNIVERSITY AND OTHER POST-SECONDARY INSTITUTION

A portion of the annual admission to the minor program will be selected from students who have completed some courses at Simon Fraser University and some at other post-secondary institutions, including the required lower division courses. Students will be selected competitively based on the grades achieved in the 5 lower division required courses\*\*\* earned at Simon Fraser University and other institutions. Of the required courses, a maximum of 2 of the 5 courses may be repeated for admission. Note that a minimum overall SFU Business course grade point average of 2.00 is also required for admission to the business minor program.

\*\*\* five lower division courses are as follows:

BUS 237-3 Introduction to Business Technology Management  
 BUS 251-3 Financial Accounting I  
 BUS 272-3 Behaviour in Organizations  
 ECON 103-4 Principles of Microeconomics  
 and one of \*\*\*\*

ECON 105-4 Principles of Macroeconomics  
 ENGL 111W -3 Literary Classics in English  
 ENGL 112W -3 Literature Now  
 ENGL 113W -3 Literature and Performance  
 ENGL 114W -3 Language and Purpose  
 ENGL 115W -3 Literature and Culture  
 ENGL 199W -3 Introduction to University Writing  
 PHIL 100W-3 Knowledge and Reality  
 PHIL 105-3 Critical Thinking  
**PHIL 110-3 Introduction to Logic and Reasoning**  
 PHIL 120W-3 Moral Problems



**PHIL 150-3 Great Works in the History of Philosophy**

WL 101W-3 Writing About Literature

WL 103W-3 Pre-Modern World Literature

WL 104W-3 Modern World Literature

**WL 105W-3 World Literature Lab**

\*\*\*\* any one of these courses may be replaced by any three unspecified transfer units in English or in ENGL-Writing at the 100- or 200- level.

**APPLICATION PROCEDURES**

Applicants should apply to the faculty during the term in which the lower division requirements are completed. Students not accepted upon initial application may reapply. Unsuccessful applicants may appeal through the faculty admissions appeals committee.

**APPLICATION DEADLINES**

Visit <http://beedie.sfu.ca/bba/apply> for applications deadlines.

**Calendar Entry Change**  
**Biomedical Physiology and Kinesiology**  
**Psychology**

Rationale for change: Editorial addition to maintain consistency with other BPK major and honours programs and the Psychology section of Behavioural Neuroscience major and Honours programs and to increase clarity for students.

Effective term and year: Fall 2020

The following program(s) will be affected by these changes:

**Behavioural Neuroscience Major**  
**Behavioural Neuroscience Honours**

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

Upper Division Requirements

BIOMEDICAL PHYSIOLOGY AND KINESIOLOGY

...

and three additional units selected from the following

- BISC 405 - Neurobiology (3)
- BPK 304W – Inquiry and Measurement in Biomedical Physiology and Kinesiology (3)
- BPK 336 - Histology (3)
- BPK 407 - Human Physiology Laboratory (3)
- BPK 415 - Neural Control of Movement (3) \*
- BPK 446 - Neurological Disorders (3) \*
- BPK 448 - Rehabilitation of Movement Control (3) \*
- BPK 496 - Directed Study Literature (3)  or BPK 498 - Directed Study Experiential (3) 

\*if not counted above

^Topic must be relevant to Behavioural Neuroscience

...



**Calendar Entry Change:** remove BPK 324  
**Biomedical Physiology and Kinesiology, Faculty of Science**

Rationale for change: BPK 417W will no longer be offered, BPK will continue to offer BPK 417.

Effective term and year: Fall 2020

The following program(s) will be affected by these changes:  
Kinesiology Major and Honours

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

Upper Division Requirements

...

Active Health and Rehabilitation Concentration

...

and four of

...

**BPK 412 - Molecular Cardiac Physiology (3)**

**BPK 415 - Neural Control of Movement (3)**

**BPK 417~~W~~ - Obesity, Adipocyte Function and Weight Management (3)**

**BPK 420 - Selected Topics in Biomedical Physiology and Kinesiology I (3) ^**

...

**Calendar Entry Change:** remove BPK 324  
**Biomedical Physiology and Kinesiology, Faculty of Science**

Rationale for change: BPK 324 has never been offered and there is no plan to offer it.

Effective term and year: Fall 2020

The following program(s) will be affected by these changes:  
Biomedical Physiology Minor

**Calendar Change:** "to" and "from" sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

...

Upper Division Requirements

Students complete ~~both~~ all of

BPK 305 - Human Physiology I (3)

BPK 306 - Human Physiology II (3)

~~and one of~~

~~BPK 324 - Principles of Human Anatomy (3)~~

BPK 325 - Basic Human Anatomy (3)

...



## Calendar Entry Change

### Name of Program or Name of Faculty

Rationale for change: These are editorial changes reflecting the renumbering of MATH 310 and introduction of new optional classes.
Effective term and year: Fall 2020
The following program(s) will be affected by these changes: Applied Mathematics Major

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

<h2>Program Requirements</h2> <p>Students complete 120 units, as specified below.</p> <h3>Lower Division Requirements</h3> <p>Students complete the following:</p> <p>both of</p> <p>CMPT 120 - Introduction to Computing Science and Programming I (3) CMPT 129 - Introduction to Computing Science and Programming for Mathematics and Statistics (3)</p> <p>(Students transferring into a math program should contact the math undergraduate advisor if they have already completed equivalent courses.)</p> <p>or both of</p> <p>CMPT 130 - Introduction to Computer Programming I (3) CMPT 135 - Introduction to Computer Programming II (3)</p> <p>and all of</p> <p>MACM 203 - Computing with Linear Algebra (2) +</p>
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MACM 204 - Computing with Calculus (2) +  
 MATH 242 - Introduction to Analysis I (3)  
 MATH 251 - Calculus III (3)  
 MATH 252 - Vector Calculus (3)  
**MATH 260 - Introduction to Ordinary Differential Equations (3)**  
 STAT 270 - Introduction to Probability and Statistics (3)

and one of

MATH 150 - Calculus I with Review (4)  
 MATH 151 - Calculus I (3)  
 MATH 154 - Calculus I for the Biological Sciences (3) \*\*  
 MATH 157 - Calculus I for the Social Sciences (3) \*\*

and one of

MATH 152 - Calculus II (3) \*  
 MATH 155 - Calculus II for the Biological Sciences (3) \*\*  
 MATH 158 - Calculus II for the Social Sciences (3) \*\*

and one of

MATH 232 - Applied Linear Algebra (3) \*\*  
 MATH 240 - Algebra I: Linear Algebra (3)

and one of

PHYS 120 - Mechanics and Modern Physics (3)  
 PHYS 125 - Mechanics and Special Relativity (3)  
 PHYS 140 - Studio Physics - Mechanics and Modern Physics (4)

and one of

PHYS 121 - Optics, Electricity and Magnetism (3)  
 PHYS 126 - Electricity, Magnetism and Light (3)  
 PHYS 141 - Studio Physics - Optics, Electricity and Magnetism (4)

and at least one of

CMPT 225 - Data Structures and Programming (3)  
 ENSC 220 - Electric Circuits I (4)  
 MACM 201 - Discrete Mathematics II (3)  
 MSE 250 - Electric Circuits I (4)  
 PHYS 211 - Intermediate Mechanics (3)  
 STAT 285 - Intermediate Probability and Statistics (3)

+ The following substitutions are also permitted.

They may not also be used to satisfy the upper division requirements below.

MACM 409 - Numerical Linear Algebra: Algorithms, Implementation and Applications (3) for MACM 203.

MACM 401 - Introduction to Computer Algebra (3) for MACM 204.

MACM 442 - Cryptography (3) for MACM 204.

\* strongly recommended

\*\* with a B grade or better

### Upper Division Requirements

Students complete a minimum of 30 units, including all of

MACM 316 - Numerical Analysis I (3)

~~MATH 310 - Introduction to Ordinary Differential Equations (3)~~

MATH 314 - Introduction to Fourier Methods and Partial Differential Equations (3)

MATH 320 - Introduction to Analysis II (3)

MATH 322 - Complex Variables (3)

MATH 418 - Partial Differential Equations (3)

and at least one of

~~MATH 461 - Continuous Mathematical Models (3)~~

**MATH 426 - Probability (3)**

MATH 462 - Fluid Dynamics (3)

MATH 467 - Dynamical Systems (3)

**MATH 475 - Mathematical Topics in Data Science**

and at least two of

MACM 401 - Introduction to Computer Algebra (3)

MACM 409 - Numerical Linear Algebra: Algorithms, Implementation and Applications (3)

MACM 416 - Numerical Analysis II (3)

MATH 308 - Linear Optimization (3)

MATH 309 - Continuous Optimization (3)

MATH 338 - Advanced Linear Algebra (3)

MATH 343 - Applied Discrete Mathematics (3)

MATH 345 - Introduction to Graph Theory (3)  
**MATH 348 – Introduction to Probabilistic Models (3)**  
 MATH 419 - Linear Analysis (3)  
 MATH 424 - Complex Analysis (3)  
 MATH 425 - Real Analysis (3)  
**MATH 426 – Probability (3)**  
~~MATH 461 – Continuous Mathematical Models (3)~~  
 MATH 462 - Fluid Dynamics (3)  
 MATH 467 - Dynamical Systems (3)  
 MATH 470 - Variational Calculus (3)  
**MATH 475 – Mathematical Topics in Data Science**  
 MATH 495 - Selected Topics in Applied Mathematics (3)  
 PHYS 413 - Advanced Mechanics (3)  
 STAT 380 - Introduction to Stochastic Processes (3)

and one additional upper division MATH or MACM course, or any pre-approved quantitative upper division course offered by the Faculties of Applied Sciences, Arts and Social Sciences, Beedie School of Business or Faculty of Science. This course, if other than MATH or MACM, must be pre-approved by a department advisor. Students are encouraged to explore the option of completing courses outside the department and to discuss possibilities with a department advisor. Choices from the third group ("at least two of") must not include the course used to satisfy the second group ("at least one of"). At least three of the courses used to satisfy the upper division requirements must be at the 400 division.

NOTE: SFU students enrolled in the Accelerated Master's degree program within the Department of Mathematics may apply a maximum of 10 graduate course units, taken while completing the bachelor's degree, towards the upper division undergraduate electives of the bachelor's program and the requirements of the master's degree. For more information go to: <http://www.sfu.ca/dean-gradstudies/future/academicprograms/AcceleratedMasters.html>.



### Calendar Entry Change

#### Name of Program or Name of Faculty

Rationale for change:

These are editorial changes reflecting the renumbering of MATH 310 and introduction of new optional classes.

Effective term and year: Fall 2020

The following program(s) will be affected by these changes:

Applied Mathematics Honours

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

### Program Requirements

Students complete 120 units, as specified below.

#### Lower Division Requirements

Students complete 40 units, including either

both of

CMPT 120 - Introduction to Computing Science and Programming I (3)

CMPT 129 - Introduction to Computing Science and Programming for Mathematics and Statistics (3)

(Students transferring into a math program should contact the math undergraduate advisor if they have already completed equivalent courses.)

or both of

CMPT 130 - Introduction to Computer Programming I (3)

CMPT 135 - Introduction to Computer Programming II (3)

and all of

MACM 203 - Computing with Linear Algebra (2) +  
 MACM 204 - Computing with Calculus (2) +  
 MATH 242 - Introduction to Analysis I (3)  
 MATH 251 - Calculus III (3)  
 MATH 252 - Vector Calculus (3)  
**MATH 260 - Introduction to Ordinary Differential Equations (3)**  
 STAT 270 - Introduction to Probability and Statistics (3)

and one of

PHYS 120 - Mechanics and Modern Physics (3)  
 PHYS 125 - Mechanics and Special Relativity (3)  
 PHYS 140 - Studio Physics - Mechanics and Modern Physics (4)

and one of

PHYS 121 - Optics, Electricity and Magnetism (3)  
 PHYS 126 - Electricity, Magnetism and Light (3)  
 PHYS 141 - Studio Physics - Optics, Electricity and Magnetism (4)

and one of

MATH 150 - Calculus I with Review (4)  
 MATH 151 - Calculus I (3) \*  
 MATH 154 - Calculus I for the Biological Sciences (3) \*\*  
 MATH 157 - Calculus I for the Social Sciences (3) \*\*

and one of

MATH 152 - Calculus II (3) \*  
 MATH 155 - Calculus II for the Biological Sciences (3) \*\*  
 MATH 158 - Calculus II for the Social Sciences (3) \*\*

and one of

MATH 232 - Applied Linear Algebra (3) \*\*  
 MATH 240 - Algebra I: Linear Algebra (3) \*

and at least one of

CMPT 225 - Data Structures and Programming (3)  
 ENSC 220 - Electric Circuits I (4)  
 MACM 201 - Discrete Mathematics II (3)  
 MSE 250 - Electric Circuits I (4)  
 PHYS 211 - Intermediate Mechanics (3)

STAT 285 - Intermediate Probability and Statistics (3)

\* strongly recommended

\*\* with a B grade or better

+ The following substitutions are also permitted. They may not be used to satisfy the upper division requirements below. MACM 409 - Numerical Linear Algebra: Algorithms, Implementation and Applications (3) for MACM 203. MACM 401 - Introduction to Computer Algebra (3) for MACM 204. MACM 442 - Cryptography (3) for MACM 204.

### Upper Division Requirements

Students complete 48 units, including all of

MACM 316 - Numerical Analysis I (3)

~~MATH 310 - Introduction to Ordinary Differential Equations (3)~~

MATH 314 - Introduction to Fourier Methods and Partial Differential Equations (3)

MATH 320 - Introduction to Analysis II (3)

MATH 322 - Complex Variables (3)

MATH 418 - Partial Differential Equations (3)

MATH 498 - Communication and Research Skills in the Mathematical Sciences (1)

MATH 499W - Honours Research Project (5)

and at least one of

MATH 308 - Linear Optimization (3)

MATH 309 - Continuous Optimization (3)

~~and at least one of~~

~~MATH 461 - Continuous Mathematical Models (3)~~

~~MATH 462 - Fluid Dynamics (3)~~

~~MATH 467 - Dynamical Systems (3)~~

~~and at least one of~~

~~MACM 409 - Numerical Linear Algebra: Algorithms, Implementation and Applications (3)~~

~~MACM 416 - Numerical Analysis II (3)~~

~~MATH 470 - Variational Calculus (3)~~

**And at least two of**

**MACM 409 - Numerical Linear Algebra: Algorithms, Implementation and Applications (3)**

**MACM 416 – Numerical Analysis II (3)**

**MATH 426 – Probability (3)**

**MATH 462 – Fluid Dynamics (3)**

**MATH 467 – Dynamical Systems (3)**

**MATH 475 – Mathematical Topics in Data Science (3)**

**MATH 495 – Special Topics in Applied Mathematics (3)**

and at least fifteen more upper division units, of which at least three must be chosen from the 400 level. These fifteen units may be selected from any MATH or MACM courses or from

CMPT 464 - Geometric Modelling in Computer Graphics (3)

PHYS 395 - Computational Physics (3)

PHYS 413 - Advanced Mechanics (3)

STAT 380 - Introduction to Stochastic Processes (3)

NOTE: SFU students enrolled in the Accelerated Master's degree program within the Department of Mathematics may apply a maximum of 10 graduate course units, taken while completing the bachelor's degree, towards the electives or upper division requirements in the bachelor's program and the requirements of the master's degree. For more information go to: <http://www.sfu.ca/dean-gradstudies/future/academicprograms/AcceleratedMasters.html>



## Calendar Entry Change

### Name of Program or Name of Faculty

**Rationale for change:**

These are editorial changes reflecting the renumbering of MATH 310 and introduction of new optional classes.

Effective term and year: Fall 2020

The following program(s) will be affected by these changes:  
Mathematics and Computing Science (MACM) Joint Major

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

## Program Requirements

Students complete 120 units as specified below.

Course and prerequisite admission is subject to departmental requirements.

Faculty of Applied Sciences residency requirements apply to the computing science courses used toward the program. The program is subject to Faculty of Science and University regulations.

### Lower Division Requirements

Complete all three of

CMPT 120 - Introduction to Computing Science and Programming I (3)

CMPT 125 - Introduction to Computing Science and Programming II (3)

CMPT 127 - Computing Laboratory (3)

or both of

CMPT 130 - Introduction to Computer Programming I (3)

CMPT 135 - Introduction to Computer Programming II (3)

and all of



CMPT 225 - Data Structures and Programming (3)  
CMPT 295 - Introduction to Computer Systems (3)  
MACM 101 - Discrete Mathematics I (3)  
MACM 201 - Discrete Mathematics II (3)  
MATH 242 - Introduction to Analysis I (3)  
MATH 251 - Calculus III (3)  
STAT 270 - Introduction to Probability and Statistics (3)

and either

CMPT 276 - Introduction to Software Engineering (3)

or both of

MACM 203 - Computing with Linear Algebra (2) +  
MACM 204 - Computing with Calculus (2) +

and one of

MATH 150 - Calculus I with Review (4)  
MATH 151 - Calculus I (3) \*  
MATH 154 - Calculus I for the Biological Sciences (3) \*\*  
MATH 157 - Calculus I for the Social Sciences (3) \*\*

and one of

MATH 152 - Calculus II (3) \*  
MATH 155 - Calculus II for the Biological Sciences (3) \*\*  
MATH 158 - Calculus II for the Social Sciences (3) \*\*

and one of

MATH 232 - Applied Linear Algebra (3) \*\*  
MATH 240 - Algebra I: Linear Algebra (3) \*

\* strongly recommended

\*\* with a B grade or better

+ The following substitutions are also permitted. They may not also be used to satisfy the upper division requirements below. MACM 409 - Numerical Linear Algebra: Algorithms, Implementation and Application (3) for MACM 203. MACM 401 - Introduction to Computer Algebra (3) for MACM 204. MACM 442 - Cryptography (3) for MACM 204.



## Upper Division Requirements

Students complete at least 45 units, including all of

CMPT 307 - Data Structures and Algorithms (3)

MACM 316 - Numerical Analysis I (3)

MATH 340 - Algebra II: Rings and Fields (3)

and one of

CMPT 300 - Operating Systems I (3)

CMPT 371 - Data Communications and Networking (3)

CMPT 379 - Principles of Compiler Design (3)

and one of

MATH 308 - Linear Optimization (3)

**MATH 309 - Continuous Optimization (3)**

~~MATH 310 - Introduction to Ordinary Differential Equations (3)~~

MATH 345 - Introduction to Graph Theory (3)

**MATH 348 - Introduction to Probabilistic Models (3)**

and additional work is required to total 21 upper division MATH and 24 upper division CMPT units. MACM are counted in an alternating fashion toward the MATH and CMPT requirements, starting with the first MACM course completed, counting toward either MATH or CMPT. Twelve units must be at the 400 division or higher, including at least three units each of CMPT and MATH.



## Calendar Entry Change

### Name of Program or Name of Faculty

**Rationale for change:**

These are editorial changes reflecting the renumbering of MATH 310 and introduction of new optional classes.

Effective term and year: Fall 2020

The following program(s) will be affected by these changes:  
Mathematics and Computing Science (MACM) Joint Honours

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

### Program Requirements

The program is subject to Faculty of Science and University regulations. Course and prerequisite admission is subject to departmental requirements.

Faculty of Applied Sciences residency requirements apply to the computing science courses used toward the program.

Students complete at least 120 units of which at least 60 units are at the upper division level as specified below.

### Lower Division Requirements

Students complete at least 43-47 units, including all three of

CMPT 120 - Introduction to Computing Science and Programming I (3) \*  
CMPT 125 - Introduction to Computing Science and Programming II (3) \*  
CMPT 127 - Computing Laboratory (3)

or both of

CMPT 130 - Introduction to Computer Programming I (3)  
CMPT 135 - Introduction to Computer Programming II (3)

and all of

CMPT 225 - Data Structures and Programming (3)  
 CMPT 276 - Introduction to Software Engineering (3)  
 CMPT 295 - Introduction to Computer Systems (3)  
 MACM 101 - Discrete Mathematics I (3)  
 MACM 201 - Discrete Mathematics II (3)  
 MACM 203 - Computing with Linear Algebra (2) +  
 MACM 204 - Computing with Calculus (2) +  
 MATH 242 - Introduction to Analysis I (3)  
 MATH 251 - Calculus III (3)  
 STAT 270 - Introduction to Probability and Statistics (3)

and one of

MATH 150 - Calculus I with Review (4)  
 MATH 151 - Calculus I (3) \*\*  
 MATH 154 - Calculus I for the Biological Sciences (3) ++  
 MATH 157 - Calculus I for the Social Sciences (3) ++

and one of

MATH 152 - Calculus II (3) \*\*  
 MATH 155 - Calculus II for the Biological Sciences (3) ++  
 MATH 158 - Calculus II for the Social Sciences (3) ++

and one of

MATH 232 - Applied Linear Algebra (3) ++  
 MATH 240 - Algebra I: Linear Algebra (3) \*\*

\*\* strongly recommended

+ The following substitutions are also permitted. They may not also be used to satisfy the upper division requirements. MACM 409 - Numerical Linear Algebra: Algorithms, Implementation and Applications (3) for MACM 203. MACM 401 - Introduction to Computer Algebra (3) for MACM 204. MACM 442 - Cryptography (3) for MACM 204.

++ with a B grade or better

### Upper Division Requirements

Students complete 54 units, including all of

CMPT 307 - Data Structures and Algorithms (3)  
 CMPT 308 - Computability and Complexity (3)  
 CMPT 405 - Design and Analysis of Computing Algorithms (3)  
 MACM 316 - Numerical Analysis I (3)  
 MATH 308 - Linear Optimization (3)  
 MATH 340 - Algebra II: Rings and Fields (3)  
 MATH 345 - Introduction to Graph Theory (3)

and one of

CMPT 300 - Operating Systems I (3)  
 CMPT 371 - Data Communications and Networking (3)

and one of

CMPT 361 - Introduction to Computer Graphics (3)  
 CMPT 379 - Principles of Compiler Design (3)

and one of

MATH 309 - Continuous Optimization (3)  
~~MATH 310 - Introduction to Ordinary Differential Equations (3)~~  
**MATH 348 - Introduction to Probabilistic Models (3)**  
**MATH 360 - Modelling with Ordinary Differential Equations (3)**

And additional course work to total 27 upper division MATH units and 27 upper division CMPT units including core requirements. MACM courses are counted in an alternating fashion towards the MATH and CMPT requirements, starting with the first MACM course completed counting towards either MATH or CMPT. Eighteen units must be completed at the 400 division or higher, including at least six units each of CMPT and MATH.

Students are encouraged to take either

CMPT 498 - Honours Research Project (6)

or both of

MATH 498 - Communication and Research Skills in the Mathematical Sciences (1)  
 MATH 499W - Honours Research Project (5)

**Calendar Entry Change**

**Name of Program or Name of Faculty**

Rationale for change:

These are editorial changes reflecting the renumbering of MATH 310 and introduction of new optional classes.

Effective term and year: Fall 2020

The following program(s) will be affected by these changes:

Mathematics Major

**Calendar Change:** "to" and "from" sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

**Program Requirements**

Students complete 120 units, as specified below.

**Lower Division Requirements**

Students complete

both of

CMPT 120 - Introduction to Computing Science and Programming I (3)

CMPT 129 - Introduction to Computing Science and Programming for Mathematics and Statistics (3)

(Students transferring into a math program should contact the math undergraduate advisor if they have already completed equivalent courses.)

or both of

CMPT 130 - Introduction to Computer Programming I (3)

CMPT 135 - Introduction to Computer Programming II (3)

and all of

MACM 101 - Discrete Mathematics I (3)  
 MACM 201 - Discrete Mathematics II (3)  
 MACM 203 - Computing with Linear Algebra (2) +  
 MACM 204 - Computing with Calculus (2) +  
 MATH 242 - Introduction to Analysis I (3)  
 MATH 251 - Calculus III (3)  
 STAT 270 - Introduction to Probability and Statistics (3)

and one of

MATH 150 - Calculus I with Review (4)  
 MATH 151 - Calculus I (3) \*  
 MATH 154 - Calculus I for the Biological Sciences (3) \*\*  
 MATH 157 - Calculus I for the Social Sciences (3) \*\*

and one of

MATH 152 - Calculus II (3) \*  
 MATH 155 - Calculus II for the Biological Sciences (3) \*\*  
 MATH 158 - Calculus II for the Social Sciences (3) \*\*

and one of

MATH 232 - Applied Linear Algebra (3) \*\*  
 MATH 240 - Algebra I: Linear Algebra (3) \*

+ The following substitutions are also permitted. They may not also be used to satisfy the upper division requirements below.

MACM 409 - Numerical Linear Algebra: Algorithms, Implementation and Applications (3) for MACM 203.

MACM 401 - Introduction to Computer Algebra (3) for MACM 204.

MACM 442 - Cryptography (3) for MACM 204.

\* strongly recommended

\*\* with a B grade or better

### Upper Division Requirements

Students complete a minimum of 30 program units, including the 15 outlined below.

MATH 340 - Algebra II: Rings and Fields (3)

and one of

MATH 343 - Applied Discrete Mathematics (3)  
 MATH 345 - Introduction to Graph Theory (3)  
 MATH 408 - Discrete Optimization (3)  
 MATH 443 - Combinatorial Theory (3)  
 MATH 447 - Coding Theory (3)

and one of

MATH 320 - Introduction to Analysis II (3)  
 MATH 322 - Complex Variables (3)

and one of

MATH 338 - Advanced Linear Algebra (3)  
 MATH 341 - Algebra III: Groups (3)  
 MATH 342 - Elementary Number Theory (3)

and one of

~~MATH 310 - Introduction to Ordinary Differential Equations (3)~~  
**MATH 309 - Continuous Optimization (3)**  
**MATH 348 - Introduction to Probabilistic Models (3)**  
**MATH 360 - Modelling with Ordinary Differential Equations (3)**  
 MACM 316 - Numerical Analysis I (3)

The remaining 15 units can be chosen from any upper division MATH or MACM course. Up to 6 of the 15 units can be chosen from the list below.

PHYS 413 - Advanced Mechanics (3)

Any upper division STAT course except for STAT 302, STAT 305, STAT 310, STAT 311, STAT 320, and STAT 403.

Within the 30 program units, students must complete 9 units of 400 level course work, as outlined below (excluding directed studies, job practicum, or honours essay courses):

- 6 units of MATH or MACM courses
- 3 units of courses from the list of PHYS and STAT courses above (within the 6 allowed units) or 3 units of any other MATH or MACM course.

NOTE: SFU students enrolled in the Accelerated Master's degree program within the Department of Mathematics may apply a maximum of 10 graduate course units, taken



while completing the bachelor's degree, towards the electives or upper division requirements in the bachelor's program and the requirements of the master's degree. For more information go to: <http://www.sfu.ca/dean-gradstudies/future/academicprograms/AcceleratedMasters.html>

### Calendar Entry Change

#### Name of Program or Name of Faculty

Rationale for change:

These are editorial changes reflecting the renumbering of MATH 310 and introduction of new optional classes.

Effective term and year: Fall 2020

The following program(s) will be affected by these changes:

Mathematics Honours

**Calendar Change:** "to" and "from" sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

## Program Requirements

Students complete 120 units, as specified below.

### Lower Division Requirements

Students complete either

both of

CMPT 120 - Introduction to Computing Science and Programming I (3)

CMPT 129 - Introduction to Computing Science and Programming for Mathematics and Statistics (3)

(Students transferring into a math program should contact the math undergraduate advisor if they have already completed equivalent courses.)

or both of

CMPT 130 - Introduction to Computer Programming I (3)

CMPT 135 - Introduction to Computer Programming II (3)

and all of

MACM 101 - Discrete Mathematics I (3)  
 MACM 201 - Discrete Mathematics II (3)  
 MACM 203 - Computing with Linear Algebra (2) +  
 MACM 204 - Computing with Calculus (2) +  
 MATH 242 - Introduction to Analysis I (3)  
 MATH 251 - Calculus III (3)  
 MATH 252 - Vector Calculus (3)  
**MATH 260 - Introduction to Ordinary Differential Equations (3)**  
 STAT 270 - Introduction to Probability and Statistics (3)

and one of

MATH 150 - Calculus I with Review (4)  
 MATH 151 - Calculus I (3) \*  
 MATH 154 - Calculus I for the Biological Sciences (3) \*\*  
 MATH 157 - Calculus I for the Social Sciences (3) \*\*

and one of

MATH 152 - Calculus II (3) \*  
 MATH 155 - Calculus II for the Biological Sciences (3) \*\*  
 MATH 158 - Calculus II for the Social Sciences (3) \*\*

and one of

MATH 232 - Applied Linear Algebra (3) \*\*  
 MATH 240 - Algebra I: Linear Algebra (3) \*

and at least one of

CMPT 225 - Data Structures and Programming (3)  
 STAT 285 - Intermediate Probability and Statistics (3)

+The following substitutions are also permitted.

They may not be used to satisfy the upper division requirements below.

MACM 409 - Numerical Linear Algebra: Algorithms, Implementation and Applications (3)  
 for MACM 203.

MACM 401 - Introduction to Computer Algebra (3) for MACM 204.

MACM 442 - Cryptography (3) for MACM 204.

\* strongly recommended

\*\* with a B grade or better

## Upper Division Requirements

Students complete at least 48 units of which at least 15 must be at the 400 level. Students complete all of

~~MATH 310 - Introduction to Ordinary Differential Equations (3)~~

MATH 320 - Introduction to Analysis II (3)

MATH 322 - Complex Variables (3)

MATH 340 - Algebra II: Rings and Fields (3)

MATH 341 - Algebra III: Groups (3)

MATH 498 - Communication and Research Skills in the Mathematical Sciences (1)

MATH 499W - Honours Research Project (5)

and one of

MATH 343 - Applied Discrete Mathematics (3)

MATH 345 - Introduction to Graph Theory (3)

MATH 408 - Discrete Optimization (3)

MATH 443 - Combinatorial Theory (3)

MATH 447 - Coding Theory (3)

In addition to the above core requirement of 24 units, students must complete the requirements for at least one of the three concentrations below.

### **ALGEBRA AND NUMBER THEORY CONCENTRATION**

Students complete at least 9 units from the following list of which at least 3 units must be at the 400 level.

MATH 338 - Advanced Linear Algebra (3)

MATH 342 - Elementary Number Theory (3)

MATH 440 - Galois Theory (3)

MATH 441 - Commutative Algebra and Algebraic Geometry (3)

MATH 443 - Combinatorial Theory (3)

MATH 447 - Coding Theory (3)

MACM 401 - Introduction to Computer Algebra (3)

MACM 442 - Cryptography (3)

**ANALYSIS AND OPTIMIZATION CONCENTRATION**

Students complete at least 9 units from the following list of which at least 3 units must be at the 400 level.

- MACM 316 - Numerical Analysis I (3)
- MATH 308 - Linear Optimization (3)
- MATH 309 - Continuous Optimization (3)
- MATH 314 - Introduction to Fourier Methods and Partial Differential Equations (3)
- MATH 408 - Discrete Optimization (3)
- MATH 418 - Partial Differential Equations (3)
- MATH 419 - Linear Analysis (3)
- ~~MATH 424 - Complex Analysis (3)~~
- MATH 425 - Real Analysis (3)
- MATH 426 - Probability**

**DISCRETE MATHEMATICS CONCENTRATION**

Students complete

- CMPT 225 - Data Structures and Programming (3)

and at least 9 units from the following list of which at least 3 units must be at the 400 level.

- MACM 442 - Cryptography (3)
- MATH 343 - Applied Discrete Mathematics (3)
- MATH 345 - Introduction to Graph Theory (3)
- MATH 408 - Discrete Optimization (3)
- MATH 443 - Combinatorial Theory (3)
- MATH 445 - Graph Theory (3)
- MATH 447 - Coding Theory (3)
- MATH 448 - Network Flows (3)
- CMPT 307 - Data Structures and Algorithms (3)
- CMPT 405 - Design and Analysis of Computing Algorithms (3)

**ADDITIONAL ELECTIVES**

Students must complete an additional 15 upper division units. These units can be any upper division MATH or MACM courses or taken from the following list.

- STAT 380 - Introduction to Stochastic Processes (3)
- PHYS 413 - Advanced Mechanics (3)



They may include additional courses from the three Concentrations. The total number of 400 level units must be at least 15.

NOTE: SFU students enrolled in the Accelerated Master's degree program within the Department of Mathematics may apply a maximum of 10 graduate course units, taken while completing the bachelor's degree, towards the electives or upper division requirements in the bachelor's program and the requirements of the master's degree. For more information go to: <http://www.sfu.ca/dean-gradstudies/future/academicprograms/AcceleratedMasters.html>



### Calendar Entry Change

**Name of Program or Name of Faculty:** Molecular Biology and Biochemistry (MBB)

Rationale for change:

New course MBB 460 to be added to the list of 6 required UD courses.

Effective term and year:

Summer 2020

The following program(s) will be affected by these changes:

Major, Honours

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

and a minimum of six courses chosen from the following list, three of which must be 400-level courses. There is no upper limit on the quantity in this list that can be completed.

HSCI 442 - Immunology Laboratory (4)

MBB 323 - Introduction to Physical Biochemistry (3)

MBB 324 - Protein Biochemistry (3)

MBB 326 - Introduction to the Immune System (3)

MBB 342 - Introductory Genomics and Bioinformatics (3)

MBB 402 - Developmental Biology of Cell Signalling (3)

MBB 420 - Selected Topics in Contemporary Biochemistry (3)

MBB 421 - Nucleic Acids (3)

MBB 422 - Biomembranes (3)

MBB 423 - Protein Structure and Function (3)

MBB 424 - Membrane Transport Mechanisms (3)

MBB 427 - Immune Responses in Health and Disease (3)

MBB 428 - Microbial Pathogenesis (3)

MBB 429 - RNA-mediated Gene Regulation (3)

MBB 430 - Mechanisms of Secretory Transport (3)

MBB 431 - Cells and the Environment (3)

MBB 432 - Advanced Molecular Biology Techniques (4)

MBB 433 - Epithelial Cell Biology (3)

MBB 436 - Gene Expression (3)

MBB 438 - Human Molecular Genetics (3)

MBB 440 - Selected Topics in Contemporary Molecular Biology (3)

MBB 441 - Bioinformatics (3)

MBB 443 - Protein Biogenesis and Degradation (3)

MBB 446 - The Molecular Biology of Cancer (3)

**MBB 460 Selected Topics in Bioinformatics and Genomics (3)**



MBB 461 - Comparative Genomics (3)  
MBB 462 - Human Genomics (3)  
MBB 463 - Forensic Genomics (3)  
MBB 464 - From Genome to System (3)

**Calendar Entry Change**

**Name of Program or Name of Faculty:** Molecular Biology and Biochemistry (MBB)

Rationale for change:  
New course MBB 460-3 (Selected Topics in Bioinformatics and Genomics) to be added to the list of 3 required UD courses.

Effective term and year:  
Summer 2020

The following program(s) will be affected by these changes:  
MBB/Computing Science Joint Major, Joint Honours

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

and at least three of  
 CMPT 413 - Computational Linguistics (3)  
 CMPT 419 - Special Topics in Artificial Intelligence (3)  
 CMPT 454 - Database Systems II (3)  
 MBB 438 - Human Molecular Genetics (3)  
 MBB 441 - Bioinformatics (3)  
**MBB 460 Selected Topics in Bioinformatics and Genomics (3)**  
 MBB 461 - Comparative Genomics (3)  
 MBB 462 - Human Genomics (3)  
 MBB 463 - Forensic Genomics (3)  
 MBB 464 - From Genome to System (3)



### Calendar Entry Change

**Name of Program or Name of Faculty:** Molecular Biology and Biochemistry (MBB)

Rationale for change:  
New course MBB 460-3 (Selected Topics in Bioinformatics and Genomics) to be added to the list of 3 required UD genomics-centered courses.

Effective term and year:  
Summer 2020

The following program(s) will be affected by these changes:  
Genomics Certificate

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

and three of  
BISC 424 - Applied Genomics (3)  
BISC 471 - Special Topics in Cells, Molecules and Physiology (3) #  
BISC 472 - Special Topics in Cells, Molecules and Physiology (3) #  
BISC 473 - Special Topics in Ecology, Evolution and Conservation (3) #  
MBB 420 - Selected Topics in Contemporary Biochemistry (3) #  
MBB 440 - Selected Topics in Contemporary Molecular Biology (3) #  
MBB 441 - Bioinformatics (3)  
**MBB 460 Selected Topics in Bioinformatics and Genomics (3)**  
MBB 461 - Comparative Genomics (3)  
MBB 462 - Human Genomics (3)  
MBB 463 - Forensic Genomics (3)  
MBB 464 - From Genome to System (3)

# course must be in an area related to genomics and must be approved by the MBB academic advisor

\* courses require additional prerequisites

**Calendar Entry Change**  
**Applied Physics - Bachelor of Science**

<p>Rationale for change:</p> <p>We are updating program requirements because of recent changes to courses including</p> <ul style="list-style-type: none"> <li>• changes to course number for MATH 310 -&gt; MATH 260,</li> <li>• changes to the second year lab sequence (PHYS 231/233)</li> <li>• remove courses no longer offered (CHEM 123/124, CMPT 102, MATH 125/126)</li> </ul> <p>We are updating our computing requirements to reflect emphasis on Python in the curriculum.</p> <p>The number of units required is not necessary as all units are specified.</p>
<p>Effective term and year:</p> <p>Fall 2020</p>
<p>The following program(s) will be affected by these changes:</p> <p>APPH Majors</p>

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

<p><b>Program Requirements</b></p> <p><del>Students complete 120 units, as specified below.</del></p> <p>Students should enroll in the co-operative education program to acquire valuable industrial experience.</p> <p><b>Lower Division Requirements</b></p> <p><del>Students must complete</del> <b>Complete all of</b></p> <p><b>CHEM 121 - General Chemistry and Laboratory I (4)</b></p> <p><b>CHEM 122 - General Chemistry II (2)</b></p> <p>CHEM 126 - General Chemistry Laboratory II (2)</p> <p><b>MATH 152 - Calculus II (3)</b></p> <p>MATH 251 - Calculus III (3)</p> <p>MATH 252 - Vector Calculus (3)</p> <p><b>MATH 260 - Introduction to Ordinary Differential Equations (3)</b></p> <p>PHYS 132 - Physics Laboratory I (1) *</p> <p>PHYS 133 - Physics Laboratory II (1) *</p>
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PHYS 201 - Physics Undergraduate Seminar (1)  
PHYS 211 - Intermediate Mechanics (3)  
~~PHYS 231 - Physics Laboratory III (3)~~  
PHYS 233 - Physics Laboratory IV III (3)  
**PHYS 234 - Physics Laboratory IV (3)**  
PHYS 255 - Vibrations and Waves (3)  
PHYS 285 - Introduction to Relativity and Quantum Mechanics (3)  
and one of  
~~CHEM 121 - General Chemistry and Laboratory I (4)~~  
~~CHEM 123 - Enriched Chemistry I and Laboratory (4)~~  
and one of  
~~CHEM 122 - General Chemistry II (2)~~  
~~CHEM 124 - Enriched Chemistry II (3)~~  
and one of  
~~MATH 125 - Introduction to Mathematical Methods in the Physical Sciences I (3)~~  
MATH 150 - Calculus I with Review (4)  
MATH 151 - Calculus I (3)  
and one of  
~~MATH 126 - Introduction to Mathematical Methods in the Physical Sciences II (3)~~  
~~MATH 152 - Calculus II (3)~~  
and one of  
MATH 232 - Applied Linear Algebra (3)  
MATH 240 - Algebra I: Linear Algebra (3)  
and one of  
PHYS 120 - Mechanics and Modern Physics (3)  
PHYS 125 - Mechanics and Special Relativity (3) +  
PHYS 140 - Studio Physics - Mechanics and Modern Physics (4) \*  
and one of  
PHYS 121 - Optics, Electricity and Magnetism (3)  
PHYS 126 - Electricity, Magnetism and Light (3) +  
PHYS 141 - Studio Physics - Optics, Electricity and Magnetism (4) \*  
and 9 units chosen from  
MACM 101 - Discrete Mathematics I (3)  
~~CMPT 102 - Introduction to Scientific Computer Programming (3)~~  
CMPT 120 - Introduction to Computing Science and Programming I (3) \*\*  
CMPT 125 - Introduction to Computing Science and Programming II (3)  
CMPT 127 - Computing Laboratory (3)  
CMPT 128 - Introduction to Computing Science and Programming for Engineers (3)  
CMPT 129 - Introduction to Computing Science and Programming for Mathematics and  
Statistics (3)  
or any 200-level CMPT course

\* students with credit for PHYS 140 and 141 are not required to complete PHYS 132 or  
PHYS 133



\*\* students with computing experience may be able to test out of CMPT 120  
+ recommended

### Upper Division Requirements

~~Students complete a total of 36 units, including all of~~

#### **Complete all of**

~~MATH 310 - Introduction to Ordinary Differential Equations (3)~~

PHYS 321 - Intermediate Electricity and Magnetism (3)

PHYS 326 - Electronics and Instrumentation (4)

PHYS 332W - Advanced Physics Laboratory I (4)

PHYS 344 - Thermal Physics (3)

PHYS 385 - Quantum Mechanics I (3)

PHYS 421 - Electromagnetic Waves (3)

and 13 units selected from

CHEM 340 - Materials Chemistry (3)

ENSC 426 - High Frequency Electronics (4)

ENSC 495 - Introduction to Microelectronic Fabrication (4) \*\*

MATH 462 - Fluid Dynamics (3)

NUSC 341 - Introduction to Radiochemistry (3)

NUSC 346 - Radiochemistry Laboratory (3)

PHYS 365 - Semiconductor Device Physics (3)

PHYS 395 - Computational Physics (3) + or MACM 316 - Numerical Analysis I (3)

PHYS 431 - Advanced Physics Laboratory II (4)

PHYS 455 - Modern Optics (3)

PHYS 465 - Solid State Physics (3)

\*\* the prerequisite ENSC 222 can be replaced by PHYS 326  
+ recommended

**Calendar Entry Change**  
**Biological Physics - Bachelor of Science**

Rationale for change:

We are updating program requirements because of recent course changes including

- changes to course number for MATH 310,
- changes to the second year lab sequence (PHYS 231/233)
- remove courses no longer offered (CHEM 123/124, MATH 125/126, PHYS 130)

We are adding a recommendation that students complete an introductory computing course.

The number of units required is not necessary as all units are specified.

Effective term and year:

Fall 2020

The following program(s) will be affected by these changes:

BIPH Majors

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

**Program Requirements**

~~Students complete 120 units, as specified below.~~

**Students are strongly encouraged to complete CMPT 120 – Introduction to Computing Science and Programming, in addition to the following requirements.**

**Lower Division Requirements**

~~Students complete a minimum total of 65 units, including~~

**Complete all of**

BISC 101 - General Biology (4)

BISC 102 - General Biology (4)

BISC 202 - Genetics (3)

**CHEM 121 - General Chemistry and Laboratory I (4)**

**CHEM 122 - General Chemistry II (2)**

CHEM 281 - Organic Chemistry I (4)

CHEM 282 - Organic Chemistry II (2)

**MATH 152 - Calculus II (3)**



MATH 251 - Calculus III (3)  
MATH 252 - Vector Calculus (3)  
**MATH 260 - Introduction to Ordinary Differential Equations (3)**  
MBB 222 - Molecular Biology and Biochemistry (3)  
MBB 231 - Cellular Biology and Biochemistry (3)  
**PHYS 132 - Physics Laboratory I (1) \***  
**PHYS 133 - Physics Laboratory II (1) \***  
PHYS 201 - Physics Undergraduate Seminar (1)  
PHYS 211 - Intermediate Mechanics (3)  
PHYS 2343 - Physics Laboratory III (3)  
PHYS 255 - Vibrations and Waves (3)  
~~and one of~~  
~~CHEM 121 - General Chemistry and Laboratory I (4)~~  
~~CHEM 123 - Enriched Chemistry I and Laboratory (4)~~  
~~and one of~~  
~~CHEM 122 - General Chemistry II (2)~~  
~~CHEM 124 - Enriched Chemistry II (3)~~  
~~and one of~~  
~~MATH 125 - Introduction to Mathematical Methods in the Physical Sciences I (3)~~  
MATH 150 - Calculus I with Review (4)  
MATH 151 - Calculus I (3)  
~~and one of~~  
~~MATH 126 - Introduction to Mathematical Methods in the Physical Sciences II (3)~~  
~~MATH 152 - Calculus II (3)~~  
~~and one of~~  
MATH 232 - Applied Linear Algebra (3)  
MATH 240 - Algebra I: Linear Algebra (3)  
~~and one of~~  
CHEM 260 - Atoms, Molecules, Spectroscopy (4)  
PHYS 285 - Introduction to Relativity and Quantum Mechanics (3)  
~~and one of~~  
PHYS 101 - Physics for the Life Sciences I (3)  
PHYS 120 - Mechanics and Modern Physics (3)  
PHYS 125 - Mechanics and Special Relativity (3) +  
PHYS 140 - Studio Physics - Mechanics and Modern Physics (4) \*  
~~and one of~~  
PHYS 102 - Physics for the Life Sciences II (3)  
PHYS 121 - Optics, Electricity and Magnetism (3)  
PHYS 126 - Electricity, Magnetism and Light (3) +  
PHYS 141 - Studio Physics - Optics, Electricity and Magnetism (4) \*  
~~and either~~  
~~PHYS 130 - Physics for the Life Sciences Laboratory (2)~~  
~~or both of~~



~~PHYS 132 - Physics Laboratory I (1)~~

~~PHYS 133 - Physics Laboratory II (1)~~

\* students with credit for PHYS 140 and 141 are not required to complete PHYS 132 or 133 + recommended

### Upper Division Requirements

~~Students must Complete all of~~

~~MATH 310 - Introduction to Ordinary Differential Equations (3)~~

MBB 322 - Molecular Physiology (3)

MBB 331 - Molecular Biology (4)

PHYS 321 - Intermediate Electricity and Magnetism (3)

PHYS 332W - Advanced Physics Laboratory I (4)

PHYS 347 - Introduction to Biological Physics (3)

PHYS 385 - Quantum Mechanics I (3)

and one of

CHEM 360 - Thermodynamics and Chemical Kinetics (3)

MBB 323 - Introduction to Physical Biochemistry (3)

PHYS 344 - Thermal Physics (3)

and upper division MBB or PHYS courses to reach a minimum total of 40 units. BISC 421 and MATH 462 may be included in this requirement. The following courses are suggested:

BISC 421 - Models in Biology: From Molecules to Migration (3)

MATH 462 - Fluid Dynamics (3)

MBB 308 - Molecular Biology Laboratory (3)

MBB 309W - Biochemistry Laboratory (4)

MBB 321 - Intermediary Metabolism (3)

MBB 342 - Introductory Genomics and Bioinformatics (3)

MBB 421 - Nucleic Acids (3)

MBB 422 - Biomembranes (3)

MBB 423 - Protein Structure and Function (3)

MBB 491 - Directed Research I (5)

PHYS 395 - Computational Physics (3)

PHYS 413 - Advanced Mechanics (3)

PHYS 445 - Statistical Physics (3)

PHYS 455 - Modern Optics (3)

PHYS 492 - Special Topics in Physics (3)

**Calendar Entry Change**  
**Chemical Physics - Bachelor of Science**

<p>Rationale for change:</p> <p>We are updating programs because of recent course changes including</p> <ul style="list-style-type: none"> <li>• changes to course number for MATH 310,</li> <li>• changes to the second year lab sequence (PHYS 231/233)</li> <li>• remove courses no longer offered (CHEM 123/124, CMPT 102, MATH 125/126, PHYS 130)</li> </ul> <p>We are adding a recommendation that students complete an introductory computing course. The number of units required is not necessary as all units are specified.</p>
<p>Effective term and year:</p> <p>Fall 2020</p>
<p>The following program(s) will be affected by these changes:</p> <p>CHPH Majors</p>

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

<p><b>Program Requirements</b></p> <p><del>Students complete 120 units, as specified below.</del> Students are strongly encouraged to complete <b>CMPT 120 – Introduction to Computing Science and Programming</b> at least three lower division computing science units, in addition to the following requirements.</p> <p><b>Lower Division Requirements</b></p> <p><del>Students complete a minimum total of 60 units, including all of</del> <b>Complete all of</b></p> <p><b>CHEM 121 - General Chemistry and Laboratory I (4)</b> <b>CHEM 122 - General Chemistry II (2)</b> CHEM 126 - General Chemistry Laboratory II (2) CHEM 215 - Introduction to Analytical Chemistry (4) CHEM 230 - Inorganic Chemistry (3) CHEM 236W - Inorganic Chemistry Laboratory (3)</p>
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CHEM 266 - Physical Chemistry Laboratory I (2)  
CHEM 281 - Organic Chemistry I (4)  
**MATH 152 - Calculus II (3)**  
MATH 251 - Calculus III (3)  
MATH 252 - Vector Calculus (3)  
**MATH 260 - Introduction to Ordinary Differential Equations (3)**  
PHYS 132 - Physics Laboratory I (1) \*  
PHYS 133 - Physics Laboratory II (1) \*  
PHYS 201 - Physics Undergraduate Seminar (1)  
PHYS 211 - Intermediate Mechanics (3)  
PHYS 2343 - Physics Laboratory III (3)  
PHYS 255 - Vibrations and Waves (3)  
and one of  
~~CHEM 121 - General Chemistry and Laboratory I (4)~~  
~~CHEM 123 - Enriched Chemistry I and Laboratory (4)~~  
and one of  
~~CHEM 122 - General Chemistry II (2)~~  
~~CHEM 124 - Enriched Chemistry II (3)~~  
and one of  
~~MATH 125 - Introduction to Mathematical Methods in the Physical Sciences I (3)~~  
MATH 150 - Calculus I with Review (4)  
MATH 151 - Calculus I (3)  
and one of  
~~MATH 126 - Introduction to Mathematical Methods in the Physical Sciences II (3)~~  
~~MATH 152 - Calculus II (3)~~  
and one of  
MATH 232 - Applied Linear Algebra (3)  
MATH 240 - Algebra I: Linear Algebra (3)  
and one of  
CHEM 260 - Atoms, Molecules, Spectroscopy (4)  
PHYS 285 - Introduction to Relativity and Quantum Mechanics (3)  
and one of  
PHYS 120 - Mechanics and Modern Physics (3)  
PHYS 125 - Mechanics and Special Relativity (3) +  
PHYS 140 - Studio Physics - Mechanics and Modern Physics (4) \*  
and one of  
PHYS 121 - Optics, Electricity and Magnetism (3)  
PHYS 126 - Electricity, Magnetism and Light (3) +  
PHYS 141 - Studio Physics - Optics, Electricity and Magnetism (4) \*  
\* students with credit for PHYS 140 and 141 are not required to complete PHYS 132 or 133  
+ recommended

### Upper Division Requirements

~~Students complete a minimum total of 40 units, including all of~~



**Complete all of**

CHEM 340 - Materials Chemistry (3)

CHEM 462 - Molecular Spectroscopy (3)

~~MATH 310 - Introduction to Ordinary Differential Equations (3)~~

PHYS 321 - Intermediate Electricity and Magnetism (3)

and one of

PHYS 326 - Electronics and Instrumentation (4)

PHYS 332W - Advanced Physics Laboratory I (4)

and one of

CHEM 360 - Thermodynamics and Chemical Kinetics (3)

PHYS 344 - Thermal Physics (3)

and one of

CHEM 460 - Advanced Physical Chemistry (3)

PHYS 445 - Statistical Physics (3)

and one of

CHEM 364 - Quantum Chemistry (3)

PHYS 385 - Quantum Mechanics I (3)

and upper division chemistry, nuclear science or physics units chosen to total the number of upper division units to 40, and maintain a minimum of 15 upper division units in both chemistry and physics. A maximum of 6 units from the research courses CHEM 481, 483 and 484 and PHYS 432 may be used to satisfy the aforementioned 15 units of upper division credit.

**Calendar Entry Change  
Physics - Bachelor of Science**

<p>Rationale for change:</p> <p>We are updating program requirements because of recent changes to courses including</p> <ul style="list-style-type: none"> <li>• changes to course number for MATH 310 -&gt; MATH 260</li> <li>• changes to the second year lab sequence (PHYS 231/233 -&gt; PHYS 233/234)</li> <li>• remove courses no longer offered (CHEM 123/124, CMPT 102, MATH 125/126, PHYS 130)</li> </ul> <p>We are also updating our computing requirement to reflect use of Python in our curriculum including adding an option for students to take our third year physics course, PHYS 395, in lieu of other computing courses.</p> <p>The number of units required is not necessary as all units are specified.</p>
<p>Effective term and year:</p> <p>Fall 2020</p>
<p>The following program(s) will be affected by these changes:</p> <p>PHYS Majors</p>

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

<p><b>Program Requirements</b></p> <p><del>Students complete 120 units, as specified below.</del></p> <p><b>Lower Division Requirements</b></p> <p><del>Students must</del> Complete all of</p> <p><b>CHEM 121 - General Chemistry and Laboratory I (4)</b></p> <p><b>CHEM 122 - General Chemistry II (2)</b></p> <p><b>CMPT 120 - Introduction to Computing Science and Programming I (3) **</b></p> <p><b>MATH 152 - Calculus II (3)</b></p> <p>MATH 251 - Calculus III (3)</p> <p>MATH 252 - Vector Calculus (3)</p> <p><b>MATH 260 - Introduction to Ordinary Differential Equations (3)</b></p> <p>PHYS 132 - Physics Laboratory I (1) *</p> <p>PHYS 133 - Physics Laboratory II (1) *</p>
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PHYS 201 - Physics Undergraduate Seminar (1)  
 PHYS 211 - Intermediate Mechanics (3)  
~~PHYS 231 - Physics Laboratory III (3)~~  
 PHYS 233 - Physics Laboratory IV ~~III~~ (3)  
**PHYS 234 - Physics Laboratory IV (3)**  
 PHYS 255 - Vibrations and Waves (3)  
 PHYS 285 - Introduction to Relativity and Quantum Mechanics (3)  
 and one of  
~~CHEM 121 - General Chemistry and Laboratory I (4)~~  
~~CHEM 123 - Enriched Chemistry I and Laboratory (4)~~  
 and one of  
~~CHEM 122 - General Chemistry II (2)~~  
~~CHEM 124 - Enriched Chemistry II (3)~~  
 and either both of  
~~CMPT 102 - Introduction to Scientific Computer Programming (3) or CMPT 120~~  
~~- Introduction to Computing Science and Programming I (3) \*\*~~  
 CMPT 129 - Introduction to Computing Science and Programming for Mathematics and  
 Statistics (3)  
 or ~~MACM 203 - Computing with Linear Algebra (2)~~  
 or all of both of  
~~CMPT 120 - Introduction to Computing Science and Programming I (3) \*\*~~  
 CMPT 125 - Introduction to Computing Science and Programming II (3)  
 CMPT 127 - Computing Laboratory (3)  
**or**  
**MACM 203 - Computing with Linear Algebra (2)**  
**or**  
**PHYS 395 - Computational Physics**  
 and one of  
~~MATH 125 - Introduction to Mathematical Methods in the Physical Sciences-I (3)~~  
 MATH 150 - Calculus I with Review (4)  
 MATH 151 - Calculus I (3)  
 and one of  
~~MATH 126 - Introduction to Mathematical Methods in the Physical Sciences-II (3)~~  
~~MATH 152 - Calculus II (3)~~  
 and one of  
 MATH 232 - Applied Linear Algebra (3)  
 MATH 240 - Algebra I: Linear Algebra (3)  
 and one of  
 PHYS 120 - Mechanics and Modern Physics (3)  
 PHYS 125 - Mechanics and Special Relativity (3) +  
 PHYS 140 - Studio Physics - Mechanics and Modern Physics (4) \*  
 and one of  
 PHYS 121 - Optics, Electricity and Magnetism (3)  
 PHYS 126 - Electricity, Magnetism and Light (3) +



PHYS 141 - Studio Physics - Optics, Electricity and Magnetism (4) \*

\* students with credit for PHYS 140 and 141 are not required to complete PHYS 132 or 133

\*\* students with computing experience may be able to test out of CMPT 120 to satisfy this requirement

+ recommended

### Upper Division Requirements

~~Students complete a minimum total of 31 units, including all of~~

#### **Complete all of**

~~MATH 310 - Introduction to Ordinary Differential Equations (3)~~

PHYS 321 - Intermediate Electricity and Magnetism (3)

PHYS 332W - Advanced Physics Laboratory I (4)

PHYS 344 - Thermal Physics (3)

PHYS 385 - Quantum Mechanics I (3)

**and**

~~In addition,~~ a minimum of 15 other upper division physics units ~~must be completed~~ to satisfy the physics subject area requirements for a major.

**Calendar Entry Change**  
**Applied Physics - Bachelor of Science**

<p>Rationale for change:</p> <p>We are updating program requirements because of recent changes to courses including</p> <ul style="list-style-type: none"> <li>• changes to course number for MATH 310 -&gt; MATH 260,</li> <li>• changes to the second year lab sequence (PHYS 231/233)</li> <li>• remove courses no longer offered (CHEM 123/124, CMPT 102, MATH 125/126)</li> </ul> <p>We are updating our computing requirements to reflect emphasis on Python in the curriculum.</p> <p>The number of units required is not necessary as all units are specified.</p>
<p>Effective term and year:</p> <p>Fall 2020</p>
<p>The following program(s) will be affected by these changes:</p> <p>APPH Honours</p>

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

<p><b>Program Requirements</b>  <del>Students complete 121 units, as specified below.</del>          Students should enroll in the co-operative education program to acquire valuable industrial experience.</p> <p><b>Lower Division Requirements</b>  <del>Students must complete</del> <b>Complete all of</b>  <b>CHEM 121 - General Chemistry and Laboratory I (4)</b>  <b>CHEM 122 - General Chemistry II (2)</b>          CHEM 126 - General Chemistry Laboratory II (2)  <b>MATH 152 - Calculus II (3)</b>          MATH 251 - Calculus III (3)          MATH 252 - Vector Calculus (3)  <b>MATH 260 - Introduction to Ordinary Differential Equations (3)</b>          PHYS 132 - Physics Laboratory I (1) *          PHYS 133 - Physics Laboratory II (1) *</p>
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PHYS 201 - Physics Undergraduate Seminar (1)  
PHYS 211 - Intermediate Mechanics (3)  
~~PHYS 231 - Physics Laboratory III (3)~~  
PHYS 233 - Physics Laboratory ~~IV~~ **III** (3)  
**PHYS 234 - Physics Laboratory IV (3)**  
PHYS 255 - Vibrations and Waves (3)  
PHYS 285 - Introduction to Relativity and Quantum Mechanics (3)  
and one of  
~~CHEM 121 - General Chemistry and Laboratory I (4)~~  
~~CHEM 123 - Enriched Chemistry I and Laboratory (4)~~  
and one of  
~~CHEM 122 - General Chemistry II (2)~~  
~~CHEM 124 - Enriched Chemistry II (3)~~  
and one of  
~~MATH 125 - Introduction to Mathematical Methods in the Physical Sciences I (3)~~  
MATH 150 - Calculus I with Review (4)  
MATH 151 - Calculus I (3)  
and one of  
~~MATH 126 - Introduction to Mathematical Methods in the Physical Sciences II (3)~~  
~~MATH 152 - Calculus II (3)~~  
and one of  
MATH 232 - Applied Linear Algebra (3)  
MATH 240 - Algebra I: Linear Algebra (3)  
and one of  
PHYS 120 - Mechanics and Modern Physics (3)  
PHYS 125 - Mechanics and Special Relativity (3) +  
PHYS 140 - Studio Physics - Mechanics and Modern Physics (4) \*  
and one of  
PHYS 121 - Optics, Electricity and Magnetism (3)  
PHYS 126 - Electricity, Magnetism and Light (3) +  
PHYS 141 - Studio Physics - Optics, Electricity and Magnetism (4) \*  
and 9 units chosen from  
MACM 101 - Discrete Mathematics I (3)  
~~CMPT 102 - Introduction to Scientific Computer Programming (3)~~  
CMPT 120 - Introduction to Computing Science and Programming I (3) \*\*  
CMPT 125 - Introduction to Computing Science and Programming II (3)  
CMPT 127 - Computing Laboratory (3)  
CMPT 128 - Introduction to Computing Science and Programming for Engineers (3)  
CMPT 129 - Introduction to Computing Science and Programming for Mathematics and  
Statistics (3)  
or any 200-level CMPT course

\* students with credit for PHYS 140 and 141 are not required to complete PHYS 132 or 133

\*\* students with computing experience may be able to test out of CMPT 120

+ recommended

### Upper Division Requirements

~~Students have the option of various specialized upper division courses, as shown below.~~  
~~Students complete a minimum total of 53 units, including~~

#### **Complete all of**

~~MATH 310 - Introduction to Ordinary Differential Equations (3)~~

PHYS 321 - Intermediate Electricity and Magnetism (3)

PHYS 326 - Electronics and Instrumentation (4)

PHYS 332W - Advanced Physics Laboratory I (4)

PHYS 344 - Thermal Physics (3)

PHYS 384 - Methods of Theoretical Physics I (3)

PHYS 385 - Quantum Mechanics I (3)

PHYS 421 - Electromagnetic Waves (3)

PHYS 431 - Advanced Physics Laboratory II (4)

PHYS 432 - Undergraduate Honours Thesis (6) ++

and a minimum of 17 additional units chosen from

CHEM 340 - Materials Chemistry (3)

ENSC 426 - High Frequency Electronics (4)

ENSC 495 - Introduction to Microelectronic Fabrication (4) \*\*

MATH 462 - Fluid Dynamics (3)

NUSC 341 - Introduction to Radiochemistry (3)

NUSC 346 - Radiochemistry Laboratory (3)

PHYS 365 - Semiconductor Device Physics (3)

PHYS 395 - Computational Physics (3) \* or MACM 316 - Numerical Analysis I (3)

PHYS 455 - Modern Optics (3)

PHYS 465 - Solid State Physics (3)

Students considering physics graduate programs should also complete

PHYS 413 - Advanced Mechanics (3)

PHYS 415 - Quantum Mechanics II (3)

PHYS 445 - Statistical Physics (3)

\* recommended

\*\* the prerequisite ENSC 222 can be replaced by PHYS 326

++ should be based on an industrially motivated project

**Calendar Entry Change**  
**Biological Physics - Bachelor of Science**

<p>Rationale for change:</p> <p>We are updating program requirements because of recent course changes including</p> <ul style="list-style-type: none"> <li>• changes to course number for MATH 310,</li> <li>• changes to the second year lab sequence (PHYS 231/233)</li> <li>• remove courses no longer offered (CHEM 123/124, MATH 125/126, PHYS 130)</li> </ul> <p>We are adding a recommendation that students complete an introductory computing course.</p> <p>The number of units required is not necessary as all units are specified.</p>
<p>Effective term and year:</p> <p>Fall 2020</p>
<p>The following program(s) will be affected by these changes:</p> <p>BIPH Honours</p>

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

<p><b>Program Requirements</b></p> <p><del>Students complete 126 units, as specified below.</del></p> <p><b>Students are strongly encouraged to complete CMPT 120 – Introduction to Computing Science and Programming, in addition to the following requirements.</b></p> <p><b>Lower Division Requirements</b></p> <p><del>Students complete a minimum total of 65 units, including all of</del></p> <p><b>Complete all of</b></p> <p>BISC 101 - General Biology (4)</p> <p>BISC 102 - General Biology (4)</p> <p>BISC 202 - Genetics (3)</p> <p><b>CHEM 121 - General Chemistry and Laboratory I (4)</b></p> <p><b>CHEM 122 - General Chemistry II (2)</b></p> <p>CHEM 281 - Organic Chemistry I (4)</p> <p>CHEM 282 - Organic Chemistry II (2)</p> <p><b>MATH 152 - Calculus II (3)</b></p>
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MATH 251 - Calculus III (3)  
MATH 252 - Vector Calculus (3)  
**MATH 260 - Introduction to Ordinary Differential Equations (3)**  
MBB 222 - Molecular Biology and Biochemistry (3)  
MBB 231 - Cellular Biology and Biochemistry (3)  
**PHYS 132 - Physics Laboratory I (1) \***  
**PHYS 133 - Physics Laboratory II (1) \***  
PHYS 201 - Physics Undergraduate Seminar (1)  
PHYS 211 - Intermediate Mechanics (3)  
~~PHYS 231 - Physics Laboratory III (3)~~  
PHYS 255 - Vibrations and Waves (3)  
~~and one of~~  
~~CHEM 121 - General Chemistry and Laboratory I (4)~~  
~~CHEM 123 - Enriched Chemistry I and Laboratory (4)~~  
~~and one of~~  
~~CHEM 122 - General Chemistry II (2)~~  
~~CHEM 124 - Enriched Chemistry II (3)~~  
~~and one of~~  
~~MATH 125 - Introduction to Mathematical Methods in the Physical Sciences I (3)~~  
MATH 150 - Calculus I with Review (4)  
MATH 151 - Calculus I (3)  
~~and one of~~  
~~MATH 126 - Introduction to Mathematical Methods in the Physical Sciences II (3)~~  
~~MATH 152 - Calculus II (3)~~  
~~and one of~~  
MATH 232 - Applied Linear Algebra (3)  
MATH 240 - Algebra I: Linear Algebra (3)  
~~and one of~~  
CHEM 260 - Atoms, Molecules, Spectroscopy (4)  
PHYS 285 - Introduction to Relativity and Quantum Mechanics (3)  
~~and one of~~  
PHYS 101 - Physics for the Life Sciences I (3)  
PHYS 120 - Mechanics and Modern Physics (3)  
PHYS 125 - Mechanics and Special Relativity (3) +  
PHYS 140 - Studio Physics - Mechanics and Modern Physics (4) \*  
~~and one of~~  
PHYS 102 - Physics for the Life Sciences II (3)  
PHYS 121 - Optics, Electricity and Magnetism (3)  
PHYS 126 - Electricity, Magnetism and Light (3) +  
PHYS 141 - Studio Physics - Optics, Electricity and Magnetism (4) \*  
~~and either~~  
~~PHYS 130 - Physics for the Life Sciences Laboratory (2)~~  
~~or both of~~  
~~PHYS 132 - Physics Laboratory I (1)\*~~

~~PHYS 133 - Physics Laboratory II (1)\*~~

\* students with credit for PHYS 140 and 141 are not required to complete PHYS 132 or 133 + recommended

Upper Division Requirements

~~Students must Complete all of~~

~~MATH 310 - Introduction to Ordinary Differential Equations (3)~~

MBB 322 - Molecular Physiology (3)

MBB 331 - Molecular Biology (4)

PHYS 321 - Intermediate Electricity and Magnetism (3)

PHYS 332W - Advanced Physics Laboratory I (4)

PHYS 347 - Introduction to Biological Physics (3)

PHYS 385 - Quantum Mechanics I (3)

and one of

CHEM 360 - Thermodynamics and Chemical Kinetics (3)

MBB 323 - Introduction to Physical Biochemistry (3)

PHYS 344 - Thermal Physics (3)

and either OPTION A or OPTION B:

OPTION A

Students who choose this option will complete either

all of

MBB 308 - Molecular Biology Laboratory (3)

MBB 309W - Biochemistry Laboratory (4)

MBB 481 - Directed Research - Honours Thesis (5)

MBB 482 - Directed Research - Honours Research Performance (5)

MBB 483 - Directed Research - Honours Thesis Defense (5)

or

all of

MBB 308 - Molecular Biology Laboratory (3)

MBB 309W - Biochemistry Laboratory (4)

MBB 491 - Directed Research I (5)

MBB 492 - Directed Research II (10)

OPTION B

Students who choose this option will complete all of

PHYS 384 - Methods of Theoretical Physics I (3)

PHYS 415 - Quantum Mechanics II (3)

PHYS 421 - Electromagnetic Waves (3)

PHYS 432 - Undergraduate Honours Thesis (6)

PHYS 445 - Statistical Physics (3)

and upper division MBB or PHYS courses to reach a minimum total of ~~49~~**48** units. BISC 421 and MATH 462 may be included in this requirement. The following courses are suggested:  
BISC 421 - Models in Biology: From Molecules to Migration (3)



MATH 462 - Fluid Dynamics (3)  
MBB 308 - Molecular Biology Laboratory (3)  
MBB 309W - Biochemistry Laboratory (4)  
MBB 321 - Intermediary Metabolism (3)  
MBB 342 - Introductory Genomics and Bioinformatics (3)  
MBB 421 - Nucleic Acids (3)  
MBB 422 - Biomembranes (3)  
MBB 423 - Protein Structure and Function (3)  
PHYS 395 - Computational Physics (3)  
PHYS 413 - Advanced Mechanics (3)  
PHYS 445 - Statistical Physics (3)  
PHYS 455 - Modern Optics (3)  
PHYS 492 - Special Topics in Physics (3)

**Calendar Entry Change**  
**Chemical Physics - Bachelor of Science**

<p>Rationale for change:</p> <p>We are updating programs because of recent course changes including</p> <ul style="list-style-type: none"> <li>• changes to course number for MATH 310,</li> <li>• changes to the second year lab sequence (PHYS 231/233)</li> <li>• remove courses no longer offered (CHEM 123/124, CMPT 102, MATH 125/126, PHYS 130)</li> </ul> <p>We are adding a recommendation that students complete an introductory computing course. The number of units required is not necessary as all units are specified.</p>
<p>Effective term and year:</p> <p>Fall 2020</p>
<p>The following program(s) will be affected by these changes:</p> <p>CHPH Honours</p>

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

<p><b>Program Requirements</b></p> <p><del>Students complete 123 units, as specified below.</del></p> <p>Students are strongly encouraged to complete <b>CMPT 120 – Introduction to Computing Science and Programming</b> <del>at least three lower division computing science units,</del> in addition to the following requirements.</p> <p><b>Lower Division Requirements</b></p> <p><del>Students complete a minimum total of 60 units, including all of</del></p> <p><b>Complete all of</b></p> <p><b>CHEM 121 - General Chemistry and Laboratory I (4)</b></p> <p><b>CHEM 122 - General Chemistry II (2)</b></p> <p>CHEM 126 - General Chemistry Laboratory II (2)</p> <p>CHEM 215 - Introduction to Analytical Chemistry (4)</p> <p>CHEM 230 - Inorganic Chemistry (3)</p> <p>CHEM 236W - Inorganic Chemistry Laboratory (3)</p>
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CHEM 266 - Physical Chemistry Laboratory I (2)  
CHEM 281 - Organic Chemistry I (4)  
**MATH 152 - Calculus II (3)**  
MATH 251 - Calculus III (3)  
MATH 252 - Vector Calculus (3)  
**MATH 260 - Introduction to Ordinary Differential Equations (3)**  
PHYS 132 - Physics Laboratory I (1) \*  
PHYS 133 - Physics Laboratory II (1) \*  
PHYS 201 - Physics Undergraduate Seminar (1)  
PHYS 211 - Intermediate Mechanics (3)  
PHYS 2343 - Physics Laboratory III (3)  
PHYS 255 - Vibrations and Waves (3)  
and one of  
~~CHEM 121 - General Chemistry and Laboratory I (4)~~  
~~CHEM 123 - Enriched Chemistry I and Laboratory (4)~~  
and one of  
~~CHEM 122 - General Chemistry II (2)~~  
~~CHEM 124 - Enriched Chemistry II (3)~~  
and one of  
~~MATH 125 - Introduction to Mathematical Methods in the Physical Sciences I (3)~~  
MATH 150 - Calculus I with Review (4)  
MATH 151 - Calculus I (3)  
and one of  
~~MATH 126 - Introduction to Mathematical Methods in the Physical Sciences II (3)~~  
~~MATH 152 - Calculus II (3)~~  
and one of  
MATH 232 - Applied Linear Algebra (3)  
MATH 240 - Algebra I: Linear Algebra (3)  
and one of  
CHEM 260 - Atoms, Molecules, Spectroscopy (4)  
PHYS 285 - Introduction to Relativity and Quantum Mechanics (3)  
and one of  
PHYS 120 - Mechanics and Modern Physics (3)  
PHYS 125 - Mechanics and Special Relativity (3) +  
PHYS 140 - Studio Physics - Mechanics and Modern Physics (4) \*  
and one of  
PHYS 121 - Optics, Electricity and Magnetism (3)  
PHYS 126 - Electricity, Magnetism and Light (3) +  
PHYS 141 - Studio Physics - Optics, Electricity and Magnetism (4) \*  
\* students with credit for PHYS 140 and 141 are not required to complete PHYS 132 or 133  
+ recommended

### Upper Division Requirements

Students complete 51 units, including all of



**Complete all of**

CHEM 340 - Materials Chemistry (3)

CHEM 366W - Physical Chemistry Laboratory II (3) ++

CHEM 462 - Molecular Spectroscopy (3)

~~MATH 310 - Introduction to Ordinary Differential Equations (3)~~

PHYS 321 - Intermediate Electricity and Magnetism (3)

PHYS 384 - Methods of Theoretical Physics I (3)

PHYS 415 - Quantum Mechanics II (3)

PHYS 421 - Electromagnetic Waves (3)

and one of

CHEM 360 - Thermodynamics and Chemical Kinetics (3)

PHYS 344 - Thermal Physics (3)

and one of

CHEM 460 - Advanced Physical Chemistry (3)

PHYS 445 - Statistical Physics (3)

and one of

CHEM 364 - Quantum Chemistry (3)

PHYS 385 - Quantum Mechanics I (3)

and one of

CHEM 440 - Solid State Materials Chemistry (3)

PHYS 465 - Solid State Physics (3)

and one of

CHEM 481 - Undergraduate Research (5)

PHYS 432 - Undergraduate Honours Thesis (6)

and one of

PHYS 326 - Electronics and Instrumentation (4)

PHYS 332W - Advanced Physics Laboratory I (4)

and upper division CHEM, NUSC or PHYS units chosen to bring the total upper division units to ~~51~~**48**, and maintain a minimum of 21 upper division units in both chemistry and physics. A maximum of 11 units from the research courses CHEM 481, 483 and 484 and PHYS 432 may be used to satisfy the aforementioned 21 units of upper division credit.

++ may substitute PHYS 285 for CHEM 260 as a prerequisite for CHEM 366W



## Calendar Entry Change Mathematical Physics Honours - Bachelor of Science

### Rationale for change:

There are several levels of changes proposed:

- a. The MAPH honours program is quite constrained. Our other joint honours programs (BIPH and CHPH) are set up so that students take the same courses, in both disciplines, through third year. At that point, we give them the opportunity to specialize in one discipline or the other. We figure that, by this stage, they should have decided which discipline they wish to do graduate work, and can specialize accordingly.

This revision of the MAPH program is designed along the same lines. Students take the same courses through the third year and then have more choice in the final year. In this version, students choose either a physics or math option. We hope that this program will be more flexible and allow students to tailor the program to their interests.

- b. Make MATH 240 the required linear algebra course – Math recommends MATH 240 for MAPH students
- c. We are updating program requirements because of recent changes to courses including
  - changes to course number for MATH 310 -> MATH 260
  - changes to the second year lab sequence (PHYS 231/233)
  - remove courses no longer offered (CHEM 123/124, CMPT 102, MATH 125/126, PHYS 130)
- d. Revise computing stream to remove option of CMPT 102 and add option for students to take our third year physics course, PHYS 395
- e. We are removing reference to the number of units required as this is not necessary as all units are specified.

### Effective term and year:

Fall 2020

### The following program(s) will be affected by these changes:

Honours

- Mathematical Physics Honours

**Calendar Change:** “to” and “from” sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.



## Program Requirements

Students complete 120 units, as specified below.

### Lower Division Requirements

Students must Complete all of

**CMPT 120 - Introduction to Computing Science and Programming I (3) \*\***

**MATH 152 - Calculus II (3)**

**MATH 240 - Algebra I: Linear Algebra (3)**

MATH 242 - Introduction to Analysis I (3)

**MATH 260 - Introduction to Ordinary Differential Equations (3)**

MATH 251 - Calculus III (3)

MATH 252 - Vector Calculus (3)

PHYS 132 - Physics Laboratory I (1) \*

PHYS 133 - Physics Laboratory II (1) \*

PHYS 201 - Physics Undergraduate Seminar (1)

PHYS 211 - Intermediate Mechanics (3)

~~PHYS 231 - Physics Laboratory III (3)~~

PHYS 233 - Physics Laboratory ~~IV~~ III (3)

**PHYS 234 - Physics Laboratory IV (3)**

PHYS 255 - Vibrations and Waves (3)

PHYS 285 - Introduction to Relativity and Quantum Mechanics (3)

STAT 270 - Introduction to Probability and Statistics (3)

and either ~~both~~ of

~~CMPT 102 - Introduction to Scientific Computer Programming (3) or CMPT 120~~

~~-Introduction to Computing Science and Programming I (3) \*\*~~

CMPT 129 - Introduction to Computing Science and Programming for Mathematics and Statistics (3)

or ~~all of~~ **both of**

~~CMPT 120 - Introduction to Computing Science and Programming I (3) \*\*~~

CMPT 125 - Introduction to Computing Science and Programming II (3)

CMPT 127 - Computing Laboratory (3)

or

**PHYS 395 - Computational Physics (3)**

and one of

~~MATH 125 - Introduction to Mathematical Methods in the Physical Sciences-I (3)~~

MATH 150 - Calculus I with Review (4)

MATH 151 - Calculus I (3)

and one of

~~MATH 126 - Introduction to Mathematical Methods in the Physical Sciences-II (3)~~

~~MATH 152 - Calculus II (3)~~

and one of

~~MATH 232 - Applied Linear Algebra (3)~~

~~MATH 240 - Algebra I: Linear Algebra (3)~~

and one of

PHYS 120 - Mechanics and Modern Physics (3)

PHYS 125 - Mechanics and Special Relativity (3) +  
 PHYS 140 - Studio Physics - Mechanics and Modern Physics (4) \*  
 and one of  
 PHYS 121 - Optics, Electricity and Magnetism (3)  
 PHYS 126 - Electricity, Magnetism and Light (3) +  
 PHYS 141 - Studio Physics - Optics, Electricity and Magnetism (4) \*

It is recommended that students also complete CHEM 121 and 122.

\* students with credit for PHYS 140 and 141 are not required to complete PHYS 132 or 133

\*\* students with computing experience may be able to test out of CMPT 120

+ recommended

### Upper Division Requirements

~~Students Complete a minimum of 58 units, including all of~~

~~MACM 316 - Numerical Analysis I (3)~~

~~MATH 310 - Introduction to Ordinary Differential Equations (3)~~

~~MATH 320 - Introduction to Analysis II (3)~~

~~MATH 322 - Complex Variables (3)~~

**MATH 340 - Algebra II: Rings and Fields (3)**

~~MATH 418 - Partial Differential Equations (3)~~

~~and one of~~

~~MATH 419 - Linear Analysis (3)~~

~~MATH 424 - Complex Analysis (3)~~

~~MATH 425 - Real Analysis (3)~~

~~and one of~~

~~MATH 461 - Continuous Mathematical Models (3)~~

~~MATH 462 - Fluid Dynamics (3)~~

~~MATH 495 - Selected Topics in Applied Mathematics (3)~~

~~and one of~~

~~MACM 401 - Introduction to Computer Algebra (3)~~

~~MACM 409 - Numerical Linear Algebra: Algorithms, Implementation and Applications (3)~~

~~MACM 416 - Numerical Analysis II (3)~~

~~MATH 467 - Dynamical Systems (3)~~

~~and all of~~

PHYS 321 - Intermediate Electricity and Magnetism (3)

PHYS 332W - Advanced Physics Laboratory I (4)

PHYS 344 - Thermal Physics (3)

PHYS 384 - Methods of Theoretical Physics I (3)

PHYS 385 - Quantum Mechanics I (3)

**and either Option A or Option B**

**Option A**

**Students who choose this option will complete**

PHYS 413 - Advanced Mechanics (3)

PHYS 415 - Quantum Mechanics II (3)

PHYS 421 - Electromagnetic Waves (3)

PHYS 445 - Statistical Physics (3)

**and either 6 units of UD PHYS**

**or PHYS 432 - Undergraduate Honours Thesis (6)**

**and 6 units of UD MATH courses, including 3 units at the 400 level or higher**

and two of

~~PHYS 390 - Introduction to Cosmology and Astrophysics (3)~~

~~PHYS 395 - Computational Physics (3)~~

~~PHYS 432 - Undergraduate Honours Thesis (6)\*~~

~~PHYS 455 - Modern Optics (3)~~

~~PHYS 465 - Solid State Physics (3)~~

~~PHYS 485 - Particle Physics (3)~~

~~PHYS 490 - General Relativity and Gravitation (3)~~

~~\*or both of MATH 498 and MATH 499W~~

**Option B**

**Students who choose this option will complete**

**MATH 498 Communication and Research Skills in the Mathematical Sciences**

**(1)**

**MATH 499W Honours Research Project (5)**

**and 12 units of 400-level MATH courses**

**and 6 units of UD PHYS courses at the 400 level or higher**

**A maximum of 6 units from the research courses MATH 498, 499 and PHYS 432 may be used to satisfy the UD requirements.**

**Calendar Entry Change**  
**Physics - Bachelor of Science**

<p>Rationale for change:</p> <p>We are updating program requirements because of recent changes to courses including</p> <ul style="list-style-type: none"> <li>• changes to course number for MATH 310 -&gt; MATH 260</li> <li>• changes to the second year lab sequence (PHYS 231/233 -&gt; 233/234)</li> <li>• remove courses no longer offered (CHEM 123/124, CMPT 102, MATH 125/126, PHYS 130)</li> </ul> <p>We are also updating our computing requirement to reflect use of Python in our curriculum including adding an option for students to take our third year physics course, PHYS 395, in lieu of other computing courses.</p> <p>The number of units required is not necessary as all units are specified.</p>
<p>Effective term and year:</p> <p>Fall 2020</p>
<p>The following program(s) will be affected by these changes:</p> <p>PHYS Honours</p>

**Calendar Change:** "to" and "from" sections are not required. All deletions should be crossed out as follows: ~~sample~~. All additions should be marked by a **bold**.

<p><b>Program Requirements</b></p> <p><del>Students complete 120 units, as specified below.</del></p> <p><b>Lower Division Requirements</b></p> <p><del>Students must</del> <b>Complete all of</b></p> <p><b>CHEM 121 - General Chemistry and Laboratory I (4)</b></p> <p><b>CHEM 122 - General Chemistry II (2)</b></p> <p><b>CMPT 120 - Introduction to Computing Science and Programming I (3) **</b></p> <p><b>MATH 152 - Calculus II (3)</b></p> <p>MATH 251 - Calculus III (3)</p> <p>MATH 252 - Vector Calculus (3)</p> <p><b>MATH 260 - Introduction to Ordinary Differential Equations (3)</b></p> <p>PHYS 132 - Physics Laboratory I (1) *</p>
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PHYS 133 - Physics Laboratory II (1) \*  
PHYS 201 - Physics Undergraduate Seminar (1)  
PHYS 211 - Intermediate Mechanics (3)  
~~PHYS 231 - Physics Laboratory III (3)~~  
PHYS 233 - Physics Laboratory IV ~~III~~ (3)  
**PHYS 234 - Physics Laboratory IV (3)**  
PHYS 255 - Vibrations and Waves (3)  
PHYS 285 - Introduction to Relativity and Quantum Mechanics (3)  
and one of  
~~CHEM 121 - General Chemistry and Laboratory I (4)~~  
~~CHEM 123 - Enriched Chemistry I and Laboratory (4)~~  
and one of  
~~CHEM 122 - General Chemistry II (2)~~  
~~CHEM 124 - Enriched Chemistry II (3)~~  
and either both of  
~~CMPT 102 - Introduction to Scientific Computer Programming (3) or CMPT 120 -~~  
~~Introduction to Computing Science and Programming I (3) \*\*~~  
CMPT 129 - Introduction to Computing Science and Programming for Mathematics and  
Statistics (3) ~~or~~  
~~or~~  
~~MACM 203 - Computing with Linear Algebra (2)~~  
or all of **both of**  
~~CMPT 120 - Introduction to Computing Science and Programming I (3) \*\*~~  
CMPT 125 - Introduction to Computing Science and Programming II (3) +  
CMPT 127 - Computing Laboratory (3)  
~~or~~  
**MACM 203 - Computing with Linear Algebra (2)**  
~~or~~  
**PHYS 395 - Computational Physics**  
and one of  
~~MATH 125 - Introduction to Mathematical Methods in the Physical Sciences-I (3)~~  
MATH 150 - Calculus I with Review (4)  
MATH 151 - Calculus I (3)  
and one of  
~~MATH 126 - Introduction to Mathematical Methods in the Physical Sciences-II (3)~~  
~~MATH 152 - Calculus II (3)~~  
and one of  
MATH 232 - Applied Linear Algebra (3)  
MATH 240 - Algebra I: Linear Algebra (3)  
and one of  
PHYS 120 - Mechanics and Modern Physics (3)  
PHYS 125 - Mechanics and Special Relativity (3) +  
PHYS 140 - Studio Physics - Mechanics and Modern Physics (4) \*  
and one of



PHYS 121 - Optics, Electricity and Magnetism (3)  
PHYS 126 - Electricity, Magnetism and Light (3) +  
PHYS 141 - Studio Physics - Optics, Electricity and Magnetism (4) \*

\* students with credit for PHYS 140 and 141 are not required to complete PHYS 132 or 133

\*\* students with computing experience may be able to test out of CMPT 120 to satisfy this requirement

+ recommended

### Upper Division Requirements

~~Students complete a minimum total of 53 units, including all of~~

#### **Complete all of**

~~MATH 310 - Introduction to Ordinary Differential Equations (3)~~

PHYS 321 - Intermediate Electricity and Magnetism (3)

PHYS 332W - Advanced Physics Laboratory I (4)

PHYS 344 - Thermal Physics (3)

PHYS 384 - Methods of Theoretical Physics I (3)

PHYS 385 - Quantum Mechanics I (3)

PHYS 413 - Advanced Mechanics (3)

PHYS 415 - Quantum Mechanics II (3)

PHYS 421 - Electromagnetic Waves (3)

PHYS 431 - Advanced Physics Laboratory II (4)

PHYS 432 - Undergraduate Honours Thesis (6)

PHYS 445 - Statistical Physics (3)

and twelve additional upper division units in physics. MATH 462 can be used to meet this requirement. PHYS 346 cannot be used to meet this requirement.