Minor Program Adjustment

Faculty: Science	**Date**: November 20, 2017
Program: Double major in Applied and Industrial Mathematics & Physics (B.Sc. Hons)	
Undergraduate: ☒	**Graduate**: ☐

Motion: That CPRC approve the updates to the existing double major in Applied and Industrial Mathematics & Physics, in order to better reflect the current program requirements in both the Applied and Industrial Mathematics and Physics – Comprehensive programs respectively.

Proposal Brief

Summary of the proposed change:

In order to bring the double major in Applied and Industrial Mathematics and Physics up to date with the program requirements for the primary (Applied and Industrial Mathematics) and secondary (Physics – Comprehensive) major programs, we propose the following changes:

- Replace CSCI 1030U – Introduction to Computer Science with CSCI 1040U – Introduction to Programming for Scientists
- Add BIOL 1011U – Introduction to Cellular & Molecular Biology, and BIOL 1021U – Introduction to Organismal Biology & Ecology, to the BIOL options in first year.
- Move PHY 2060U – Modern Physics to Winter of first year (reflective of the Physics – Comprehensive program map).
- Move STAT 2010U – Statistics and Probability for Physical Science to Winter semester second year (reflective of the current Physics – Comprehensive program map).
- Move PHY 2050U – Thermodynamics and Heat Transfer to Fall semester second year (reflective of the current Physics – Comprehensive program map).
- Move PHY 2010U – Electricity and Magnetism I to Winter semester second year.
- Replace MATH 3040U – Optimization, MATH 3070U – Algebraic Structures, MATH 4030U – Applied Functional Analysis, and MATH 4041U – Topics in Applied Mathematics I with "Applied and Industrial Mathematics Electives" (reflective of the current Applied and Industrial Mathematics program map).
- Move PHY 3040U – Mathematical Physics to the Fall semester third year (reflective of the current Physics – Comprehensive program map).
- Move PHY 2040U – Mechanics II to Winter semester third year.
- Move PHY 3010U – Statistical Mechanics to Winter semester fourth year (reflective of the current Physics – Comprehensive program map).
- Replace PHY 3060U – Fluid Mechanics and PHY 4030U – Topics in Contemporary Physics with "Senior Physics Electives" (reflective of the current Physics – Comprehensive program map).

These changes meet the nomenclature requirements for a double major, and adhere to the double-counting course restrictions with 12 credit hours being double-counted.

Description of the ways in which the proposed change will enhance the program and/or opportunities for students

The proposed changes bring the double major in Applied and Industrial Mathematics & Physics inline with the current requirements for the respective primary and secondary majors. By doing so, students now have more flexibility and options in their upper year course selection (through the inclusion of "subject area electives" instead of prescribed courses). Similarly, the restructuring of the existing program map ensures courses are better placed in terms of content and prerequisite knowledge.

Process of consultation with other units if the change(s) involves students, staff, and/or faculty from other programs or courses

These changes were discussed between the Mathematics and Physics areas, as well as with the Science Academic Advising Office.

Analysis of financial and enrolment implications

No additional financial resources are required, as all courses included in the double-major program map are already part of the individual major programs.

Proposed Implementation Date (state term, e.g. Fall 2017)
Fall 2018

Transition Plan (include a plan for all current students in the program, by year level)

There are currently no students registered in the double-major program so no transition plan is required. The proposed changes to the program map should make it easier for students to enter the double major between second and third year.

Calendar Copy and/or Program Maps (highlight revisions to existing curriculum)

Note: We will not be including this program in the 2018-19 Academic Calendar pending further changes. The double major option will continue to be referenced in the descriptions for the Applied and Industrial Mathematics and Physics programs respectively. Students can contact the Science Academic Advising Office for more information about the program.

Program Map

Year 1

Semester 1 (15 credit hours)
- One of:
  - BIOL 1010U – Biology I **or**
  - BIOL 1011U – Introduction to Cellular & Molecular Biology
- CHEM 1010U – Chemistry I
- ~~CSCI 1030U – Introduction to Computer Science with C++~~

- CSCI 1040U – Introduction to Programming for Scientists
- One of:
    - MATH 1000U – Introductory Calculus **or**
    - MATH 1010U – Calculus I
- One of:
    - PHY 1010U – Physics I **or**
    - PHY 1030U – Introductory Physics

Semester 2 (15 credit hours)
- One of:
    - BIOL 1020U – Biology II **or**
    - BIOL 1021U – Introduction to Organismal Biology & Ecology **or**
    - CHEM 1020U – Chemistry II
- MATH 1020U – Calculus II
- MATH 2050U – Linear Algebra
- PHY 1020U – Physics II
- PHY 2060U – Modern Physics
- ~~Elective~~

Year 2

Semester 1 (15 credit hours)
- CSCI 2000U – Practical Computing for Scientists
- MATH 2015U – Calculus III
- MATH 2080U – Discrete Mathematics
- PHY 2030U – Mechanics I
- PHY 2050U – Thermodynamics and Heat Transfer
- ~~STAT 2010U – Statistics and Probability for Physical Science~~

Semester 2 (15 credit hours)
- MATH 2055U Advanced Linear Algebra and Applications
- MATH 2060U – Differential Equations
- MATH 2072U – Computational Science I
- PHY 2010U – Electricity and Magnetism I
- STAT 2010U – Statistics and Probability for Physical Science
- ~~PHY 2040U – Mechanics II~~
- ~~PHY 2050U – Thermodynamics and Heat Transfer~~

Year 3

Semester 1 (15 credit hours)
- MATH 3020U – Real Analysis
- ~~MATH 3040U – Optimization~~
- MATH 3050U – Mathematical Modelling
- ~~PHY 2060U – Modern Physics~~
- PHY 3040U – Mathematical Physics
- PHY 3050U – Waves and Optics
- Non-Science Elective

Semester 2 (15 credit hours)
- MATH 3060U – Complex Analysis
- PHY 2040U – Mechanics II
- ~~PHY 2010U – Electricity and Magnetism I~~
- ~~PHY 3040U – Mathematical Physics~~
- Applied & Industrial Mathematics Elective
- Non-Science Elective
- Non-Science Elective

Year 4

Semester 1 (15 credit hours)
- MATH 4010U – Dynamical Systems and Chaos
- PHY 3020U – Quantum Mechanics I
- PHY 3080U – Electricity and Magnetism II
- ~~PHY 3010U – Statistical Mechanics I~~
- Senior Physics Elective
- Applied & Industrial Mathematics Elective

Semester 2 (15 credit hours)
- ~~MATH 3070U – Algebraic Structures~~
- MATH 4020U – Computational Science II
- ~~MATH 4030U – Applied Functional Analysis~~
- PHY 3010U – Statistical Mechanics
- PHY 3030U – Electronics
- ~~PHY 3060U – Fluid Dynamics~~
- Senior Physics Elective
- Non-science elective

Year 5

Semester 1 (15 credit hours)
- MATH 4050U – Partial Differential Equations
- PHY 4020U – Quantum Mechanics II
- One of:
    - MATH 4410U – Mathematics Thesis Project I** **or**
    - PHY 4410U – Physics Thesis Project I** **or**
    - Senior Science Elective**
- Senior Physics Elective
- Applied & Industrial Mathematics Elective
- ~~Non-Science Elective~~

Semester 2 (15 credit hours)
- ~~MATH 4041U – Topics in Applied Mathematics I~~
- PHY 4010U – Condensed Matter
- ~~PHY 4030U – Topics in Contemporary Physics~~
- MATH 4060U – Industrial Mathematics

- One of:
    - MATH 4420U – Mathematics Thesis Project II** **or**
    - PHY 4420U – Physics Thesis Project II** **or**
    - Senior Science Elective**
- Senior Physics Elective
- Applied & Industrial Mathematics Elective

Note:
No more than 42 credit hours may be taken at the first-year level

**Thesis Project or Senior Science electives

Students in clear academic standing who have completed 120 credit hours of the double-major program may optionally apply to take a two-course sequence consisting of PHY 4410U – Physics Thesis Project I and PHY 4420U – Physics Thesis Project II, or MATH 4410U – Mathematics Thesis Project I and MATH 4420U – Mathematics Thesis Project II. Students not accepted to take the thesis courses must complete two additional senior science electives instead. A senior science elective is defined as any 3000- or 4000-level science course not specified in the program map, excluding SCIE and ENVS courses. A student meeting the above requirements who does not take PHY 4410U and PHY 4420U, or MATH 4410U and MATH 4420U may optionally apply to take PHY 4430U – Directed Studies in Physics or MATH 4430U – Directed Studies in Mathematics as one of the required senior science electives. Opportunities for the Thesis Project and Directed Studies options are limited; students must apply through Science Advising by March 30 following completion of the first four years of the program.

Recommended senior science electives:
CSCI 3010U – Simulation and Modelling
CSCI 3070U – Analysis and Design of Algorithms
CSCI 3090U – Computer Graphics and Visualization
MATH 3030U – Introduction to Probability Theory
MATH 3040U – Optimization
MATH 3070U – Algebraic Structures
MATH 4030U – Applied Functional Analysis
MATH 4041U – Topics in Applied Mathematics I
MATH 4042U – Topics in Applied Mathematics II
PHY 3060U – Fluid Dynamics
PHY 3900U – Astronomy II
PHY 4030U – Topics in Contemporary Physics
PHY 4040U – Solar Energy and Photovoltaics
PHY 4050U – Emerging Energy Systems
PHY 4080U – Hydrogen-Based Energy Systems and Fuel Cells
PHY 4100U – Medical Physics
PHY 4120U – Forensic Physics Applications
PHY 4910U – Techniques of Modern Astrophysics
PHY 4920U – Cosmology

STAT 3010U – Biostatistics
Attachments

APPROVAL DATES

Curriculum Committee approval	November 22, 2017
Faculty Council approval	December 6, 2017
CPRC Approval	19 January 2018
Submission to Academic Council	27 February 2018