

# Major Program Modification

## *B.Sc.(Hons) in Physical Science*

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### 1. Introduction

#### a. Background on existing program

The Faculty of Science would like to propose modifications to the B.Sc. (Honours) Physical Science program, most notably an expansion to the breadth of core requirements, and a program name change. The proposed modifications have been outlined further in section 1.b. of this document.

The B.Sc. (Honours) in Physical Science program was approved for offer before separate programs in Chemistry, Physics and Mathematics were put into place. The program was originally designed to have specializations in these three disciplines, but the specializations became redundant when the B.Sc. programs in Chemistry, Physics and Applied and Industrial Mathematics were approved for offer. However, in the Physical Science program, students have the option of not choosing a specialization, which distinguishes itself from these programs, and all the other programs currently offered by the Faculty of Science. It was for this reason that the Physical Science program was not discontinued. In particular, it offered students, who preferred not to focus on a single discipline, an additional degree option, and it offered an option to students who were having difficulty completing the degree requirements of a discipline specific program. Also, initially, the combination of Science and Management was only approved for offer in conjunction with the Biological Sciences and Physical Science degrees. Thus, students from Physics, Chemistry or Mathematics, who wished to pursue this option, were required to transfer into the Physical Science program. However, since 2014, students have been able to take the combination of Management with any Science program, which resulted in a drop in the enrolment in the Physical Science program.

An important mandate for UOIT and the Faculty of Science is to develop pathways from College diplomas to university degree programs. Due to the intense nature and hierarchical pre-requisite structure of Science programs, this has proven very difficult; currently there are only two College pathways into degree programs offered by the Faculty of Science. Success may be more likely if pathways are created into more general, discipline non-specific, degrees such as the Physical Science program. Unfortunately, this has not been the case with the Physical Science program. There are two main reasons for this. First, the program is restrictive in which disciplines may count toward degree credit; there is currently a requirement that a certain number of courses be Chemistry, Physics or Mathematics courses. Second, since the degree was originally created to offer specializations, the 4<sup>th</sup>-year level course requirement forces depth in a particular discipline rather than allowing for breadth across all Science disciplines. This depth requirement effectively restricts differentiation of the Physical

Science program from the discipline specific programs; students are still required to focus on a particular discipline in order to have the pre-requisites required to take a sufficient number of 4<sup>th</sup>-year courses.

Throughout the existence of the Physical Science program, enrolment has been low. Over the last 5 years, there have been at most 6 students registered in the program at any one time. Since the combination of Science and Management became available with all Science programs, the enrolment has dropped to 2, and currently there is only 1 student registered in the program, who is anticipated to be eligible to graduate at the end of Fall 2015. No new students will be accepted into the program until the proposed changes have come into effect.

Clearly, the program, as it is, is not meeting the needs of the Faculty. However, with the proposed changes, it will be able to serve as a degree that will 1) be amenable to the creation of pathways, 2) increase retention, in particular, for students who are unsuccessful in certain higher-level core courses in their discipline specific program, and 3) be a viable option for students who do not want to specialize in a particular discipline.

#### **b. Overview of new program component**

We propose to expand the breadth of the program to include the biological and environmental sciences, as a complement to the areas of Chemistry, Physics and Mathematics on which the current program focusses. In particular, we propose to eliminate the requirement that the additional Science credits be taken exclusively from Chemistry, Physics or Mathematics, and instead allow for the possibility for the student to achieve these credits from any Science course. Consequently, we propose to change the name of the program to B.Sc. (Honours) in Science - Complementary Studies.

Along with this change, we propose to introduce an explicit breadth requirement. Specifically, the modifications include the new requirement that the student must complete 2000 level courses in at least 4 of the 6 Science disciplines (Biology, Chemistry, Computer Science, Environmental Science, Mathematics, and Physics), and must complete higher level courses (3000 or 4000 level) in at least 2 of the 6 disciplines. In order to accommodate for the increased breadth, the number of 4000 level courses that are required will be reduced from 4 to 2; the number of higher level courses (3000 or 4000 level) that are required remains unchanged at 12. We believe this degree differentiates itself from the standard, discipline-specific programs in its breadth, and therefore, the current level of depth is not necessary for this degree.

No change has been made to the first-year core Science courses.

We also propose to change the elective requirements to align more closely with other Science programs. Specifically, we propose to require 4 electives (12 credit hours) from outside the Faculty of Science, and allow for 4 general electives, which can be courses either from inside or outside the Faculty of Science.

#### **c. How the new program components fit into broader array of program offerings**

The proposed changes will enable this program to serve a purpose that no other program in the Faculty of Science is capable of serving. It will facilitate the creation of College diploma to university degree

pathways. It will increase retention by allowing students an alternative pathway to satisfying the requirements of a degree in Science. Previously, this option had been achieved through a 3-year Science pass degree (non-Honours). However, this degree has recently been discontinued, as it was not providing sufficient value to the students. The changes to this degree will also provide an option for students who prefer to study a broader range of fields in Science.

## 2. Degree Requirements

### a. Program learning outcomes

The proposed modifications to the degree requirements fit well with the program learning outcomes, and require only slight editorial amendments to reflect the expanded breadth of the program. No major changes or additions/deletions to the learning outcomes are required.

*The graduate has reliably demonstrated the ability to:*

1. apply knowledge and understanding of the concepts, theories, and principles of **biology**, chemistry, computer science, mathematics and physics as they relate to theoretical and practical problems in the physical and biological sciences
2. explore the current state of knowledge in **biological**, physical and mathematical sciences, and investigate innovative solutions to significant related scientific problems
3. utilize knowledge to analyze, evaluate, and apply the scientific concepts, techniques or processes needed in the study and application of **biological**, physical and mathematical sciences
4. communicate effectively in written, spoken and visual format with both technical experts and members of the general public on science issues
5. examine the social, cultural, ethical, environmental, safety and economic consequences of developments in the **biological**, physical and mathematical sciences and related technologies, in local, national and global contexts
6. understand and utilize contemporary laboratory and measurement techniques, procedures, safety protocols and equipment necessary for conduct of work in the **biological**, physical and mathematical sciences
7. plan and implement experiments and investigations, critically examine the results and draw valid conclusions
8. observe, understand and predict the occurrence of natural phenomena and the behavior of human-made or human influenced systems
9. apply to scientific study, an appreciation for the level of uncertainty in experimental results and theoretical predictions
10. apply relevant numerical skills including statistical analysis as necessary for the analysis of **biological** and physical data
11. use current information technology to access, store and retrieve information, to acquire and process data, and to analyze and solve problems
12. contribute as effective participant in multidisciplinary and multi-cultural teams, in both membership and leadership roles
13. recognize and value the alternative outlooks that people from various social, ethnic and religious backgrounds may bring to scientific endeavours

14. understand management and/or business practices relevant to employment situations, including the importance of quality management and quality performance.
15. have well developed strategies to update knowledge, maintain and enhance learning

### b. Admission requirements

At this time, admission will be through a College pathway program or by internal application only. Students will not be permitted direct entry to the program from high school. Admission through a pathway will require an application to a specific pathway, where admission requirements are specific to the pathway. Internal applications can only be from students already registered in the Faculty of Science, and admission will require Faculty approval. The Faculty of Science may choose to examine opening admission to this program directly from highschool at a later date.

### c. Program structure

The Bachelor of Science (Honours) in Science – Complementary Studies requires the completion of 120 credit hours (40 courses) as indicated below:

#### Science Core (15 courses – 45 credit hours)

This includes:

- 9 core first-year level science courses:
  - o Biology (BIOL 1010/1011, BIOL 1020/1021)
  - o Chemistry (CHEM 1010, CHEM 1020)
  - o Physics (PHYS 1010/1030, PHYS 1020/1040)
  - o Mathematics (MATH 1000/1010, MATH 1020)
  - o Computing Science (CSCI 1030/1040)
- one additional second year level course (2000 series) in each of four of the six science disciplines (Biology, Chemistry, Physics, Mathematics, Computing Science and Environmental Science); one of these four courses must include Statistics and Probability, STAT 2010/2020,
- one additional third or fourth year course (3000 or 4000 series) in each of two of the six science disciplines.

#### Additional Science Credits (17 courses – 51 credit hours)

Students must successfully complete an additional 17 courses (51 credit hours) in Science. Of these, at least 10 courses (30 credit hours) must be at the third (3000 series) or fourth (4000 series) year level, including at least 2 courses (6 credit hours) at the fourth (4000 series) year level.

#### Electives

Students must complete 24 elective credit hours. At least 12 elective credit hours (4 courses) must be in courses outside the Faculty of Science. Students must take an additional 12 credit hours (4 courses) in general electives (offered by the Faculty of Science or outside the Faculty of Science).

\*No more than 14 courses (42 credit hours) may be taken at the first year level.

#### d. Program content

There will be no additional required courses. The content of the program will consist of courses currently being offered.

### 3. Resource Requirements and Business Plan

The enrolment in the program is expected to be approximately 15 students for the first two or three years of the program. This may increase as more College pathways are introduced.

The content of the program will consist of courses already being offered. Furthermore, enrolment will be spread through existing courses, and therefore, it is unlikely that it would be necessary to offer additional sections of any course. Also, given the expected numbers in the program, the existing Faculty of Science personnel will be adequate to cover the administration and advising for the students within the Faculty. Thus, the program modifications will not require any additional resources and/or funding.

The Dean of the Faculty of Science has attested to the availability of the resources required to offer this program, and has indicated it as a priority in achieving the mandate and mission of the Faculty of Science and UOIT.

### 4. Calendar Copy

#### Bachelor of Science (Honours) in Science – Complementary Studies

Students in the Science – Complementary Studies program must successfully complete 120 credit hours according to the following requirements.

##### First-year required science core – 27 credit hours

- BIOL 1010U Biology I: Molecular and Cellular Systems **OR** BIOL 1011U Introductory Cell and Molecular Biology<sup>+</sup>
- BIOL 1020U Biology II: Diversity of Life and Principles of Ecology **OR** BIOL 1021U Introduction to Organismal Biology and Ecology<sup>+</sup>
- CHEM 1010 Chemistry I
- CHEM 1020 Chemistry II
- MATH 1000U Introductory Calculus **OR** MATH 1010U Calculus I<sup>++</sup>
- MATH 1020U Calculus II
- PHY 1030U Introductory Physics **OR** PHY 1010U Physics I<sup>++</sup>
- PHY 1020U Physics II **OR** PHY 1040U Physics for Bioscience<sup>+++</sup>
- CSCI 1030U Introduction to Computer Science **OR** CSCI 1040U Introduction to Programming for Scientists <sup>++++</sup>

**Additional Core courses – 18 credit hours**

These courses must include the following:

- An additional second year level course (2000 series) in each of **four of the six** science disciplines (BIOL, CHEM, PHY, MATH, CSCI and ENVS). One of these four courses **must include** either STAT 2010U Statistics and Probability for Physical Science **OR** STAT 2020U Statistics and Probability for Biological Science.
- An additional third or fourth year course (3000 or 4000 series) in each of **two of the six** science disciplines (BIOL, CHEM, PHY, MATH, CSCI, and ENVS).

**Additional Science courses – 51 credit hours**

Students must successfully complete an additional 51 credit hours in courses offered by the Faculty of Science, in the areas listed below. Of these, at least 30 credit hours must be at the third (3000 series) or fourth (4000 series) year level, including at least 6 credit hours at the fourth (4000 series) year level.

- Biology (BIOL);
- Chemistry (CHEM);
- Computing Science (CSCI);
- Mathematics (MATH and STAT);
- Environmental Science (ENVS);
- Physics (PHY)

**Liberal Studies and non-science courses – 12 credit hours**

Students must complete 12 credit hours in courses not taught within the Faculty of Science.

**General elective courses – 12 credit hours**

Students must complete an additional 12 credit hours in general electives. These courses may be in science or in non-science subjects.

**Note:** No more than 42 credit hours may be taken at the first-year (1000) level.

\*Students who wish to take upper-year Biology courses must take BIOL 1010U and BIOL 1020U

\*\* All students who have completed Grade 12 Advanced Functions (MHF4U) and, Calculus and Vectors (MCV4U) should take MATH 1010U and PHY 1010U. Students without one of these high school courses or equivalent are directed to take MATH 1000U and PHY 1030U.

\*\*\* Students who wish to take upper-year physics courses must take PHY 1020U. However, students who achieve a B standing or higher in PHY 1040U will be permitted to proceed to higher-level physics courses.

\*\*\*\* Students who wish to take upper-year computing science courses must take CSCI 1030U.

**APPROVAL DATES**

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|-------------------------------|----------------------------------|
| Date of submission            | November 2 <sup>nd</sup> , 2015  |
| Curriculum Committee approval | November 4 <sup>th</sup> , 2015  |
| Faculty Council approval      | November 11 <sup>th</sup> , 2015 |
| CPRC approval                 | November 25 <sup>th</sup> , 2015 |
| Academic Council approval     |                                  |