FORENSIC PHYSICS SPECIALIZATION IN BACHELOR OF SCIENCE IN PHYSICS PROGRAM

Proposed Program Title:
Bachelor of Science (Honours) in Physics – Specialization in Forensic Physics

Proposed Credential Nomenclature:
B.Sc. (Honours) in Physics

Disciplines/Fields of Study:
Forensic Physics

Is a work experience/work placement term required for degree completion?
An optional workplace experience has been proposed for all science programs and once approved will be made available in 2007.

Anticipated Program Start Date:
First-year entry in September 2007.

Program Learning Outcomes and Curriculum Design
All the attributes of the original Physics program are retained, including program learning outcomes, the majority of course content and sequencing and the maintenance of appropriate degree level standards. One new course in Forensic Physics has been added.

Additional program learning outcome specific to this specialization:

• acquire specialized knowledge and understanding of the concepts, theories and principles of physics as they relate to the practice of forensic science

Resource Requirements
UOIT has specialized labs and equipment in existing Forensic Science facilities. A modest amount of specialized equipment as described in the course outline will be needed for the new course. A small enhancement of library holdings will be needed as well. The proposed specialization is expected to be a very cost-effective addition to the UOIT science offerings in physics and forensic science.

Projected Enrolment and Faculty Growth
Projected steady-state enrolment is 15 students per year entering the program. Since there is only one new course required for the program, the additional faculty resource requirements are minimal.
Bachelor of Science (Honours) in Physics – Specialization in Forensic Physics

Description of the proposed specialization

Introduction

A number of areas of Physics are of key importance to forensic analysis; among these are ballistics of bullets and other projectiles, the collisions of vehicles, the physics of explosions, and bloodstain patterns. Due to the complexity of these phenomena, specialized educational background and skills are required to analyze them. The general practice in the Forensic community is to hire Physics graduates who have a deep and broad background in Physics, and train them in the required elements of Forensics. There is a growing awareness of the need for educational programs to train specialists in this area, and this is the main reason for introducing this specialization within our Physics program. Internationally, there are very few undergraduate programs that address Forensic Physics; from a web search we have found two physics-based programs, along the lines of what we are proposing here, at the University of Sussex (which offers both a BSc and an MPhys) and at Nottingham Trent University, UK, and another in Canberra, Australia; we have found a program in the USA, at the University of Southern Mississippi which has a primary focus on Forensic Science with an emphasis (equivalent to our minor) in Physics, but this does not offer the deep physics knowledge that the Forensic community seeks. We have also found a number of individual courses on Forensic Physics. By being the first university in Canada to offer a Forensic Physics specialization based on a full BSc (Honours) Physics program we hope to establish UOIT as a leader in this field.

The Faculty of Science currently offers undergraduate honours degrees in both Physics and Forensic Science. The BSc (Honours) in Physics (Forensic Physics specialization) will build on both of these programs to produce a new stream within the Physics program that focuses on forensic physics. This will be basically a Physics degree with its electives drawn from the Forensic Science program and one new course in Physics. Except for the new Physics course, all the other courses in this new specialization are currently being offered in either the Physics or Forensic Science programs.

The Program

The specialization in forensic physics builds on the current program leading to the BSc (Honours) in Physics. It adds one new physics course, Forensic Physics, to the existing physics courses in the current honours physics program to provide specialized experience in applications of physics most likely to be encountered in forensic cases; it also adds five existing courses from the Forensic Science program that deal with general topics of interest for all branches of investigation – an Introduction to Forensic Science, Crime Scene Science, Criminalistics, Law for Forensic Scientists, and Advanced Topics in Forensic Science.

Course descriptions for these courses which have already been assessed in the approved BSc in Forensic Science are provided on the next page.
COURSE DESCRIPTIONS FOR PREVIOUSLY ASSESSED COURSES

FSCI 1010U Introductory Forensic Science. This course introduces Forensic Science to students with no prior knowledge of the subject. Having completed the course, the student will be aware of the multidisciplinary nature of forensic science, how a case is studied, the use of scientific techniques in case investigations and the presentation of evidence in court. The student will be encouraged to develop a critical approach to assessing evidence. Lect: 3hrs. Tutorial: 2hrs Bi-Weekly

FSCI 2010U Crime Scene Science. This course introduces students to all the processes that occur at a crime scene. Students will be taught crime scene procedures, from the photography of the scene and record keeping at the scene through to the preservation and collection of evidence from crime scenes. This will include techniques for the recovery of fingerprints, footwear marks, and tool marks and the collection and correct packaging of items such as hairs, fibers, glass and paint. Students will also be introduced to the legal and documentary framework that accompanies the collection and preservation of evidence. In addition to theoretical knowledge, students will experience the practicalities of searching for and recovering evidence from crime scenes. The evidence will be examined and considered in terms of the amount of information that can be obtained from the analysis. The module will stress the multidisciplinary nature of forensic investigations and integrate legal, practical and scientific aspects of crime scene investigations. Lect: 3hrs, Lab: 3 hrs Bi-Weekly, Other: 3hrs Bi-Weekly. Pre-requisites: FSCI 1010U Introductory Forensic Science, and clear standing in one of the Forensic Science, Forensic Physics or Digital Forensics programs.

FSCI 3010U Criminalistics Building on the material introduced in Crime Scene Science, this course provides experience of major crime scene investigation, such as aggravated burglaries and sexual or violent offences. Importantly it also provides the principles of the laboratory based searching and recovery of evidence and the techniques and principles involved in the analysis of forensic evidence, such as hair, glass, toolmarks, footwear and tire marks, handwriting and document analysis, firearms examination and ballistics, fingerprints. Lect: 3hrs, Lab: 3 hrs Bi-Weekly, Other: 2hrs Bi-Weekly. Prerequisite: Successful completion of year 3, semester 1 in one of the Forensic Science, Forensic Physics or Digital Forensics programs.

FSCI 4050U Law for Forensic Scientists This course explores aspects of criminal law, with the goal of understanding forensic science within a legal context. Topics include: structure of the courts system and the criminal procedures used in it, roles of the forensic scientist in criminal procedures, rules of evidence, role of expert witness. Lecture: 3hrs, Other: 2hrs Bi-weekly. Prerequisite: Good standing in year 4 of one of the Forensic Science, Forensic Physics or Digital Forensics programs.

FSCI 4060U Advanced Topics in Forensic Science The course builds on techniques covered previously throughout the program and provides an opportunity for students to compare and critically evaluate the use, strengths and limitations of such techniques in forensic cases. In addition, students will be provided with the opportunity to study a range of high technology and emerging forensic science advances, such as electronic, computerized and Bayesian statistical methods for the analysis, interpretation and critical evaluation of forensic evidence. Tutorials: 3hrs. Prerequisite: Good standing in year 4 of one of the Forensic Science, Forensic Physics or Digital Forensics programs.

The program map and a full course outline for the new course are provided on the pages which follow.
<table>
<thead>
<tr>
<th>Year-Sem.</th>
<th>Subject</th>
<th>Subject</th>
<th>Subject</th>
<th>Subject</th>
<th>Subject</th>
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</thead>
<tbody>
<tr>
<td>1-1</td>
<td>MATH 1010U Calculus I</td>
<td>CHEM1010U Chemistry I</td>
<td>PHY1010U Physics I</td>
<td>BIOL1010U Biology I</td>
<td>CSCI 1000U Scientific Computing Tools</td>
</tr>
<tr>
<td>1-2</td>
<td>MATH 1020U Calculus II</td>
<td>CHEM1020U Chemistry II</td>
<td>PHY1020U Physics II</td>
<td>BIOL1020U Biology II</td>
<td>FSCI 1010U Introductory Forensic Science</td>
</tr>
<tr>
<td>3-1</td>
<td>PHY 3010U Statistical Mechanics I</td>
<td>PHY 3020U Quantum Mechanics I</td>
<td>PHY 3030U Electronics</td>
<td>FSCI 3010U Criminalistics</td>
<td>Elective</td>
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<tr>
<td>3-2</td>
<td>PHY 3040U Mathematical Physics</td>
<td>PHY 3050U Waves and Optics</td>
<td>PHY 3060U Fluid Mechanics</td>
<td>Elective</td>
<td>Elective</td>
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<tr>
<td>4-1</td>
<td>PHY 4010U Statistical Mechanics II</td>
<td>PHY 4020U Quantum Mechanics II</td>
<td>PHY 4430U Directed Studies in Physics or PHY 4410U Physics Thesis Project I **</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td>4-2</td>
<td>PHY 4030U Modern Physics</td>
<td>PHY 4120U Forensic Physics</td>
<td>Senior Physics Elective** or PHY 4420U Physics Thesis Project II **</td>
<td>FSCI 4050U Law for Forensic Scientists</td>
<td>FSCI 4060U Advanced Topics in Forensic Science</td>
</tr>
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</table>

**Bold = Courses added for the Forensic Physics specialization.**

**Underlining = Course moved from original placement in Physics program**

**Note 1: Electives and Breadth Requirements**  Students must complete 21 elective credit hours including the senior physics elective. In order to satisfy breadth requirements, the remaining 18 elective credit hours may not be in physics (PHY) courses; at least 12 credit hours must be in courses outside the Faculty of Science and must include BUSI 2000U Collaborative Leadership.

**Note 2: Directed Studies and Thesis Project Courses**  Students who have completed 90 credits of the program are eligible to take Directed Studies in Physics. This course may be offered in either semester, depending on demand. Students may optionally apply to do a two course sequence consisting of Thesis Project in Physics I and II in place of Directed Studies in Physics and a science elective. Opportunities for this option are limited; students must apply to the Science 4th year thesis coordinator by April 30 following completion of the first three years of the program.

**Note 3:** A senior physics elective is defined as any fourth-year physics course not explicitly specified in the program map.
COURSE OUTLINE FOR NEW COURSE IN FORENSIC PHYSICS

COURSE TITLE:  PHY4120U Forensic Physics


Year and Semester:  Year 4 Semester 2

Course Description and Content Outline (by topic):

This course introduces the student to forensic applications of physics, via the study of selected topics. Students will study the physics behind investigative methods used to gather evidence and reconstruct crime events.

The course will include the following topics:

- **Ballistics**
  - Firearms: history and development
  - Internal and external ballistics
  - Flight modelling for bullets and missiles
  - Terminal/wound ballistics and distance of firing

- **Vehicular accident reconstruction**
  - Forensic mechanics
  - Accident dynamics
  - Driving hazard and collision modeling
  - Accident reconstruction

- **Bloodstain analysis**
  - Fluid mechanics of blood
  - Impact spatter groups and patterns
  - Bloodstain analysis
  - Reconstruction

- **Physics of explosions**
  - Physics of explosion hazards
  - Gas phase explosions
  - Aircraft explosions
  - Explosion modeling
  - Recovery of material from the scene of an explosion
  - Analysis of explosives by physics methods (Infrared Spectroscopy, Mass Spectrometry)

Methods of Delivery: 3 hours of lecture per week, 3 hours of laboratory bi-weekly

Student Evaluation: mid-term examination (35%) and final examination (35%), which will test learning outcomes 1-4 listed below. Students will also prepare a written and oral report, based on a paper from the forensics literature, to test learning outcome 5 (30%).
COURSE TITLE: PHY4120U Forensic Physics cont’d

Resources to be purchased/provided by students: Reference sources and internet access (see Textbook requirements below).

Representative Textbooks:

Learning Outcomes:
Students who successfully complete the course have reliably demonstrated the ability to:

1. understand the physics underlying the motion of a bullet or other projectile, vehicular collisions, blood spatter analysis, and explosions
2. apply physics concepts to investigate crime and accident scenes
3. apply a number of analytical and numerical techniques in order to model and reconstruct physical processes involving crime and accident scenes
4. use appropriate laboratory techniques to investigate exhibits
5. critically evaluate published articles, methods and studies on the applications of physics to crime scene investigations

Information about Course Designer/Developer:
Course designed by Dr. S. Forbes, Dr. P. Berg, Dr. A. Chkrebtii, Dr. V. Kapoustine, Dr. J. Perz, Dr. W. Smith, UOIT

List faculty eligible to teach the course: Faculty to be hired and occasional guest lectures will be delivered by forensic science experts working in the field.
COURSE TITLE: PHY4120U Forensic Physics cont’d

Are there any plans to teach all or portions of this course on-line? A course website will be a key resource component.

Faculty Qualifications to teach/supervise the course: Postgraduate degree in Physics with expertise in forensic science.

Classroom requirements: Technology-enhanced classroom with data projector, internet access; physics laboratory

Equipment requirements: Scrap damaged cars, and advanced software for the simulation in bullet motion, vehicular accidents, explosions, fire propagation, as well as blood motion and bloodstain analysis.
Enrolment Projections and Staffing Implications

Projected Enrolment and Faculty Growth

Projected steady-state enrolment is 15 students per year and if resources permit, this number may be increased.

The projected faculty growth supporting the program is given in the following table:

<table>
<thead>
<tr>
<th>Year</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
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<tbody>
<tr>
<td>Students enrolled</td>
<td>15</td>
<td>27</td>
<td>38</td>
<td>47</td>
</tr>
<tr>
<td>New Science Faculty</td>
<td>0</td>
<td>0.25</td>
<td>0.25</td>
<td>0.5</td>
</tr>
</tbody>
</table>

- Annual intake will be 15 students; this should be reasonable to achieve because of general interest in Forensics and the absence of any competing program in Canada.
- Student attrition factors are 0.8, 0.7, and 0.65 in years 2, 3, and 4, all relative to first year.