BIOLOGICAL ENGINEERING PROGRAM CO-OP (BIOE:C)

School of Engineering, College of Engineering and Physical Sciences

Students interested in problems requiring the application of knowledge from both the biological sciences and engineering will find a challenge as a Biological Engineer. This field of engineering is the application of principles, methods and concepts of biology to systems and tools, ranging in scale from molecular to ecosystem level. This field combines engineering principles with life sciences to design creative solutions for biological systems, with applications ranging from pharmaceutical and food manufacturing, bioconversions to reduce waste, and production of sustainable, bio-based materials. For example, a Biological Engineer concentrating on biotechnology might design and manage bioreactors to improve their productivity. A Biological Engineering graduate can pursue a career in a number of exciting fields, including food safety, bio-instrumentation, diagnostics and sensorics in bio-systems, biomechanics and ergonomics.

Program Requirements

The Co-op program in Biological Engineering is a five year program, including five work terms. Students must follow the academic work schedule as outlined below (also found on the Co-operative Education website: https://www.recruitguelph.ca/cecs/).

Biological Engineering Academic and Co-op Work Term Schedule

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall</th>
<th>Winter</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Academic Semester 1</td>
<td>Academic Semester 2</td>
<td>Off</td>
</tr>
<tr>
<td>2</td>
<td>Academic Semester 3</td>
<td>Academic Semester 4</td>
<td>COOP*1000 Work Term I</td>
</tr>
<tr>
<td>3</td>
<td>Academic Semester 5</td>
<td>COOP*2000 Work Term II</td>
<td>COOP*3000 Work Term III</td>
</tr>
<tr>
<td>4</td>
<td>Academic Semester 6</td>
<td>Academic Semester 7</td>
<td>COOP*4000 Work Term IV</td>
</tr>
<tr>
<td>5</td>
<td>COOP*5000 Work Term V</td>
<td>Academic Semester 8</td>
<td>N/A</td>
</tr>
</tbody>
</table>

To be eligible to continue in the Co-op program, students must meet a minimum 70% cumulative average requirement after second semester, as well as meet all work term requirements. Please refer to the Co-operative Education program policy with respect to work term performance grading, work term report grading and program completion requirements.

For additional program information students should consult with their Co-op Co-ordinator and Co-op Faculty Advisor, listed on the Co-operative Education web site.

Credit Summary

(26.00 Total Credits)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Core Courses</td>
<td></td>
<td>19.25</td>
</tr>
<tr>
<td>BIOE-1 Biological Engineering Electives</td>
<td></td>
<td>1.75</td>
</tr>
<tr>
<td>Complementary Studies Electives</td>
<td></td>
<td>2.00</td>
</tr>
</tbody>
</table>

Free Electives 0.50
Co-op Work Terms 2.50

Total Credits 26

The recommended program sequence is outlined below.

Major (Honours Program)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semester 1 - Fall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM*1040</td>
<td>General Chemistry I</td>
<td>0.50</td>
</tr>
<tr>
<td>ENGG*1100</td>
<td>Engineering and Design I</td>
<td>0.75</td>
</tr>
<tr>
<td>ENGG*1500</td>
<td>Engineering Analysis</td>
<td>0.50</td>
</tr>
<tr>
<td>MATH*1200</td>
<td>Calculus I</td>
<td>0.50</td>
</tr>
<tr>
<td>PHYS*1130</td>
<td>Physics with Applications</td>
<td>0.50</td>
</tr>
<tr>
<td>Semester 2 - Winter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM*1050</td>
<td>General Chemistry II</td>
<td>0.50</td>
</tr>
<tr>
<td>CIS*1500</td>
<td>Introduction to Programming</td>
<td>0.50</td>
</tr>
<tr>
<td>ENGG*1210</td>
<td>Engineering Mechanics I</td>
<td>0.50</td>
</tr>
<tr>
<td>MATH*1210</td>
<td>Calculus II</td>
<td>0.50</td>
</tr>
<tr>
<td>PHYS*1010</td>
<td>Introductory Electricity and Magnetism</td>
<td>0.50</td>
</tr>
<tr>
<td>Semester 3 - Fall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL*1070</td>
<td>Discovering Biodiversity</td>
<td>0.50</td>
</tr>
<tr>
<td>or BIOL*1090</td>
<td>Introduction to Molecular and Cellular Biology</td>
<td>0.50</td>
</tr>
<tr>
<td>BIOL*1080</td>
<td>Biological Concepts of Health</td>
<td>0.50</td>
</tr>
<tr>
<td>COOP*1100</td>
<td>Introduction to Co-operative Education</td>
<td>0.00</td>
</tr>
<tr>
<td>ENGG*2230</td>
<td>Fluid Mechanics</td>
<td>0.50</td>
</tr>
<tr>
<td>ENGG*2400</td>
<td>Engineering Systems Analysis</td>
<td>0.50</td>
</tr>
<tr>
<td>MATH*2270</td>
<td>Applied Differential Equations</td>
<td>0.50</td>
</tr>
<tr>
<td>STAT*2120</td>
<td>Probability and Statistics for Engineers</td>
<td>0.50</td>
</tr>
<tr>
<td>Semester 4 - Winter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOC*2580</td>
<td>Introduction to Biochemistry</td>
<td>0.50</td>
</tr>
<tr>
<td>ENGG*2100</td>
<td>Engineering and Design II</td>
<td>0.75</td>
</tr>
<tr>
<td>ENGG*2120</td>
<td>Material Science</td>
<td>0.50</td>
</tr>
<tr>
<td>ENGG*2450</td>
<td>Electric Circuits</td>
<td>0.50</td>
</tr>
<tr>
<td>ENGG*2660</td>
<td>Biological Engineering Systems I</td>
<td>0.50</td>
</tr>
<tr>
<td>MATH*2130</td>
<td>Numerical Methods</td>
<td>0.50</td>
</tr>
<tr>
<td>Summer Semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COOP*1000</td>
<td>Co-op Work Term I</td>
<td>0.50</td>
</tr>
<tr>
<td>Semester 5 - Fall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGG*3160</td>
<td>Biological Engineering Systems II</td>
<td>0.50</td>
</tr>
<tr>
<td>ENGG*3260</td>
<td>Thermodynamics</td>
<td>0.50</td>
</tr>
<tr>
<td>ENGG*3450</td>
<td>Electronic Devices</td>
<td>0.50</td>
</tr>
<tr>
<td>ENGG*3830</td>
<td>Bio-Process Engineering</td>
<td>0.50</td>
</tr>
<tr>
<td>HIST*1250</td>
<td>Science and Technology in a Global Context</td>
<td>0.50</td>
</tr>
<tr>
<td>0.50 restricted electives</td>
<td></td>
<td>0.50</td>
</tr>
<tr>
<td>Winter Semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COOP*2000</td>
<td>Co-op Work Term II</td>
<td>0.50</td>
</tr>
<tr>
<td>Summer Semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COOP*3000</td>
<td>Co-op Work Term III</td>
<td>0.50</td>
</tr>
<tr>
<td>Semester 6 - Fall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGG*3240</td>
<td>Engineering Economics</td>
<td>0.50</td>
</tr>
<tr>
<td>ENGG*4380</td>
<td>Bioreactor Design</td>
<td>0.75</td>
</tr>
</tbody>
</table>
ENGG*4390  Bio-instrumentation Design  0.75
1.00 restricted electives  1.00

**Semester 7 - Winter**
ENGG*3100  Engineering and Design III  0.75
ENGG*3170  Biomaterials  0.50
ENGG*3430  Heat and Mass Transfer  0.50
ENGG*3440  Process Control  0.50
1.00 restricted electives  1.00

**Summer Semester**
COOP*4000  Co-op Work Term IV  0.50

**Fall Semester**
COOP*5000  Co-op Work Term V  0.50
ENGG*4000  Proposal for Engineering Design IV  0.00

**Semester 8 - Winter**
ENGG*4110  Biological Engineering Design IV  1.00
1.75 restricted electives  1.75

**Restricted Electives**
(see Program Guide for more information)

The Engineering Program requires Biological Engineering students to complete the following combination of elective credits to complete their program:

- 1.75 credits from the BIOE-1 Biological Engineering electives
- 2.00 credits from Complementary Studies electives
- 0.50 credits in Free Electives

Consult the Program Guide for further information on the prerequisite requirements specific to each elective. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.