Biomanufacturing (MS)

Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Science in Biomanufacturing" without focus area track specifications.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
<th>Counts towards</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEC 575</td>
<td>Global Regulatory Affairs for Medical Products</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>BEC 577</td>
<td>Advanced Biomanufacturing and Biocatalysis</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>BEC 590</td>
<td>Industry Practicum in Biomanufacturing (two semesters)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>BEC 601</td>
<td>Biomanufacturing Seminar (two semesters)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>BEC 620</td>
<td>Leadership and Preparation for Industry Internship in Biomanufacturing</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>ST 511</td>
<td>Statistical Methods For Researchers I</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>BEC 669</td>
<td>Biomanufacturing Research Projects</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>BEC 515</td>
<td>Biopharmaceutical Product Characterization Techniques</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>or BEC 588</td>
<td>Animal Cell Culture Engineering</td>
<td>2</td>
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</tbody>
</table>

Focus Area Track 6

Select courses from a category listed under "Focus Area Track Courses" below

Professional Courses 6

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
<th>Counts towards</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUS 554</td>
<td>Project Management</td>
<td>2</td>
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</tbody>
</table>

Select one of the following courses:

MBA 585 Molecular Biology for Biomanufacturing 2

MBA 545 Cell Line Development for Biomanufacturing 2

BEC 532 Foundations of Downstream Processing and Formulation 2

Focus Area Tracks

Upstream Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
<th>Counts towards</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 563</td>
<td>Fermentation of Recombinant Microorganisms</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>BBS 526</td>
<td>Upstream Biomanufacturing Laboratory</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>BEC 580</td>
<td>cGMP Fermentation Operations</td>
<td>2</td>
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</tr>
</tbody>
</table>

Total Hours 6

Elective Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
<th>Counts towards</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBA 586</td>
<td>Legal, Regulatory and Ethical Issues in Life Science Industries</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>MBA 590</td>
<td>Special Topics In Business Management</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>BUS 501</td>
<td>Strategic Management Foundations</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>COM 563</td>
<td>Public Relations Theory</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>COM 598</td>
<td>Special Topics In Communication (Intro to Science Communication: Theory/Practice)</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Select three credit hours from "Elective Courses" listed below each focus area category

Total Hours 37

1. BEC 601 must be repeated twice for a total of two credit hours.
2. BEC 669 must be repeated twice for a total of four credit hours.
### Downstream Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
<th>Counts towards</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEC 532</td>
<td>Foundations of Downstream Processing and Formulation</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>BEC 536</td>
<td>Introduction to Downstream Process Development</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>BEC 585</td>
<td>cGMP Downstream Operations</td>
<td>2</td>
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</table>

**Total Hours**: 6

### Elective Courses

**Select three credits of the following courses:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
<th>Counts towards</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEC 525</td>
<td>Molecular Biology for Biomanufacturing</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>BEC 545</td>
<td>Cell Line Development for Biomanufacturing</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>CHE 563</td>
<td>Fermentation of Recombinant Microorganisms</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>BBS 526</td>
<td>Upstream Biomanufacturing Laboratory</td>
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</table>

### Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelor's/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

### Faculty

#### Full Professors

- Ruben G. Carbonell
- Amy Michele Grunden
- Harold Henry Lamb
- Paul Edward Mozdziak
- Balaji M. Rao
- Heike Inge Ada Sederoff
- John Douglas Sheppard

#### Associate Professors

- Paul T. Hamilton
Gavin John Williams

**Assistant Professors**
Stefano Menegatti

**Practice/Research/Teaching Professors**
Kirill Efimenko
Gary Louis Gilleskie
Imara Yasmin Perera
John H. van Zanten

**Emeritus Faculty**
Michael Carl Flickinger