# Biomanufacturing (Minor)

To see more about what you will learn in this program, visit the Learning Outcomes website (https://apps.oirp.ncsu.edu/pgas/)!

The Minor in Biomanufacturing is intended to provide new graduates with the knowledge base and hands-on skills that will prepare them to quickly contribute to a cGMP biomanufacturing operation in significant ways and should reduce the time needed for on-the-job training in those operations. Interested students should contact the representatives listed below.

## Administration of the Minor in Biomanufacturing

The BTEC staff will hold primary responsibility for administration of the Minor in Biomanufacturing Information about the Minor and application materials will be handled by an Administrative Assistant and the Assistant Director for Student Coordination will be the primary contact and academic advisor for the students who elect to enroll in the Minor.

## Contacts

For additional information about the Minor in Biomanufacturing contact:

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***SIS Code: 14BTECM***

## Plan Requirements

Requirements for the undergraduate Minor in Biomanufacturing include a **minimum of 15 credit hours** as specified below. All courses must be completed with a grade of "C-" or higher.

**Prerequisite Courses to Enter the Minor:** All students must complete both CH 101 Chemistry - A Molecular Science and BIO 183 Introductory Biology: Cellular and Molecular Biology.

Additional prerequisite courses in CH 221 Organic Chemistry I and CH 223 Organic Chemistry II will be required to complete the minor. Courses must be completed with a grade of C- or better.

| Code | Title | Hours | Counts towards |
|---|---|---|---|
| **Required Courses** | | | |
| **Introductory Seminar:** | | **1** | |
| BEC 220 | Introduction to Drug Development and Careers in Biomanufacturing | | |
| **Basic Microbiology Laboratory Course:** | | **1-4** | |
| Select one of the following: | | | |
| BEC 425 | Molecular Biology for Biomanufacturing | | |
| BIT 410 | Manipulation of Recombinant DNA | | |
| MB 352 | General Microbiology Laboratory | | |
| or MB 354 | Inquiry-Guided Microbiology Lab | | |
| **Base Biomanufacturing Sequence:** | | **4** | |
| BEC/CHE 463 | Fermentation of Recombinant Microorganisms | | |
| BEC 330 | Principles and Applications of Bioseparations | | |
| **Biomanufacturing Specialization:** | | **4** | |
| Select one specialization area: | | | |
| Upstream Operations: | | | |
| BEC 426 & BEC 480 | Upstream Biomanufacturing Laboratory and cGMP Fermentation Operations | | |
| Downstream Operations: | | | |
| BEC 436 & BEC 485 | Introduction to Downstream Process Development and cGMP Downstream Operations | | |
| **Elective Courses:** | | **5** | |
| Select 5 credits of the following: | | | |
| Any 4** or 5** Level BEC course | | | |
| BEC/BBS 426 | Upstream Biomanufacturing Laboratory | | |
| BEC 436 | Introduction to Downstream Process Development | | |
| BEC 445 | Cell Line Development for Biomanufacturing | | |
| BEC/CHE 448 | Bioreactor Design | | |
| BEC/CHE 462 | Fundamentals of Bio-Nanotechnology | | |
| BEC 475 | Global Regulatory Affairs for Medical Products | | |
| BEC 480 | cGMP Fermentation Operations | | |

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| BEC/BME 483 | Tissue Engineering Technologies | |
| BEC 485 | cGMP Downstream Operations | |
| BEC/CHE 488 | Animal Cell Culture Engineering | |
| BEC 495 | Special Topics in Biomanufacturing | |
| BEC 497 | Biomanufacturing Research Projects | |
| BEC 515 | Biopharmaceutical Product Characterization Techniques | |
| BAE 425 | Industrial Microbiology and Bioprocessing | |
| BCH 351 | General Biochemistry | |
| or BCH 451 | Principles of Biochemistry | |
| BIT 410 | Manipulation of Recombinant DNA | |
| BIT 466 | Animal Cell Culture Techniques | |
| GN 311 | Principles of Genetics | |
| MB 455 | Microbial Biotechnology | |
| **Total Hours** | | **15-18** |