The Biotechnology/Biomanufacturing Program at Mount Wachusett Community College provides students with the opportunity to earn an Associate’s in Science degree in Biotechnology. Upon completion of this program, students are prepared for transfer to a four-year institution or for positions in many manufacturing settings. During the course of study, students will develop occupational knowledge and the laboratory skills necessary to succeed in the technical field of biotechnology. The Biotechnology degree includes the Mass STEM Transfer block.

The Analytical Laboratory Quality Systems certificate program is under curriculum review. Some Analytical Laboratory Quality Systems courses will be offered during the 2018/2019 academic year. New student applications to the Analytical Laboratory Quality Systems certificate program will not be accepted for the 2018/2019 academic year.

BIOTECHNOLOGY/BIOMANUFACTURING (BTD)

This program is designed to prepare students to transfer in biotechnology or biological sciences with an A.S. degree in Biotechnology and Mass Transfer benefits. It will give the students the first two years of a typical biotechnology or biology program so they are well-prepared for transfer. Since many of these classes are two-semester sequential courses, it is recommended that students start this program in the fall.

### Year 1

**Fall**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 109</td>
<td>Biology I</td>
<td>4</td>
</tr>
<tr>
<td>CHE 107</td>
<td>General Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>ENG 101</td>
<td>College Writing I</td>
<td>3</td>
</tr>
<tr>
<td>MAT 162</td>
<td>Introduction to Functions Modeling (Formerly MAT 134)</td>
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**Spring**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tr>
<td>CHE 108</td>
<td>General Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>MAT 163</td>
<td>Pre-Calculus</td>
<td>4</td>
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<tr>
<td>ENG 102</td>
<td>College Writing II</td>
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<tr>
<td>BTC 101</td>
<td>Introduction To Biotechnology I</td>
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**Year 2**

**Fall**

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>CHE 207</td>
<td>Organic Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>Humanities Elective ¹</td>
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<td>3</td>
</tr>
<tr>
<td>Social Science Elective ²</td>
<td></td>
<td>3</td>
</tr>
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<td>Humanities Elective ¹</td>
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<tr>
<td>BIO 205</td>
<td>Microbiology</td>
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</table>

**Spring**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSY 105</td>
<td>Introduction To Psychology</td>
<td>3</td>
</tr>
<tr>
<td>CHE 208</td>
<td>Organic Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>BTC 170</td>
<td>Cell Culture Techniques</td>
<td>4</td>
</tr>
<tr>
<td>BIO 210</td>
<td>Genetics</td>
<td>4</td>
</tr>
</tbody>
</table>

**Total Credits:** 62

1 Humanities Electives: See Elective Courses by Abbreviation (http://catalog.mwcc.edu/associateddegreesandcertificatelistandotheroptions#electivecoursesbyabbreviationtext).

2 Social Science Electives: See Elective Courses by Abbreviation (http://catalog.mwcc.edu/associateddegreesandcertificatelistandotheroptions#electivecoursesbyabbreviationtext). **Either a behavioral or non-behavioral social science may be chosen.**

See Biotechnology/Biomanufacturing program student learning outcomes and technical standards.

**Transfer options**

For transfer options, please click here. (http://catalog.mwcc.edu/academicresources/#transferinformationtext) It is recommended that you also consult with your academic advisor.
MASSTransfer
Students who plan to transfer to a Massachusetts state university or a University of Massachusetts campus may be eligible to transfer under the MassTransfer agreement, which provides transfer advantages to those who qualify.

Please click here for MassTransfer information (http://www.mass.edu/masstransfer)

Program Student Learning Outcomes for BTD
Upon graduation from this program, students shall have the ability to:

• Use the language of biotechnology.
• Explain the basic biological and chemical principles underlying biotechnology and various biomanufacturing processes.
• Perform the basic laboratory skills used in biotechnology and biomanufacturing.
• Complete various documents using proper documentation standards for an FDA regulate, cGMP compliant industry.
• Perform the mathematical and computational operations involved in biotechnology.

Technical Standards for BTD
Students entering this program must be able to demonstrate the ability to:

• Comprehend textbook material at a college level.
• Communicate and assimilate information either in spoken, printed, signed, or computer voice format.
• Gather, analyze, and draw conclusions from data.
• Stand for a minimum of two hours.
• Differentiate by touch: hotness/coldness, wetness/dryness, and hardness/softness.
• Use the small muscle dexterity necessary to do such tasks as gloving, gowning, and operating controls on laboratory instrumentation.
• Respond promptly to spoken words, as well as monitor signals and instrument alarms.
• Identify behaviors that would endanger a person’s life or safety and intervene quickly in a crisis situation with an appropriate solution.
• Remain calm, rational, decisive, and in control at all times, especially during emergency situations.
• Manipulate small parts, and make fine hand adjustments to machines and test equipment.
• Operate a computer.

For general information about technical standards and accommodation, see Technical Standards. (http://catalog.mwcc.edu/academicresources/academicandgradingpolicies/technicalstandards)

AQS Analytical Lab Quality Courses
AQS 110. Introduction Metrology. 4 Credits.
This course provides an introduction to the concepts used in STEM disciplines and manufacturing processes to ensure defined procedures are used to deliver results for materials of known and sufficient quality. Prerequisites: ENG 098, FYE 101, MAT 096, RDG 098 or placement.

AQS 115. Quality Systems and Auditing Principles. 3 Credits.
This course provides an introduction to various industry (both manufacturing and service), international and U.S. regulatory quality system standards. This course will also provide instruction on the audit process and principles. Prerequisites: ENG 098, MAT 096 (or placement). ENG 101 is recommended. Fall.

AQS 200. Conducting Root Cause Investigations. 3 Credits.
This course will provide the student with problem solving skills by exploring the process of conducting an investigation. The quality system tools used to document and facilitate an understanding of the problem and potential solutions will be studied. Prerequisites: ENG 098 (or placement); MAT 162 (or higher). ENG 101 and AQS 110 are recommended.
BTC BIOTECHNOLOGY/BIOMANUFACTURING COURSES

BTC 101. Introduction To Biotechnology I. 4 Credits.
Topics in this course are designed to acquaint students with the diverse field of biotechnology and to develop fundamental skills in the common laboratory techniques used in biotechnology. Students will learn about the history of biotechnology, job opportunities in biotechnology, recombinant DNA and protein products, microbial biotechnology, plant biotechnology, DNA fingerprinting and forensic analysis. Current ethical issues such as stem cell research and cloning will also be discussed. Lab sessions will be hands-on experiences revolving around and applying the topics listed in the lab section of the syllabus. Prerequisites: ENG 098, FYE 101, MAT 096 or higher (or corequisite), RDG 098, or placement. Spring.

BTC 102. Introduction to Biotechnology II. 4 Credits.
Topics in this course are designed to acquaint students with the diverse field of biotechnology and to develop fundamental skills in the set-up of typical growth plates and media used in standard culturing of microorganisms or tissue culture, as well as preparation of common solutions and reagents. Topics will also include microbial biotechnology, plant biotechnology, medical biotechnology, DNA fingerprinting and forensic analysis. Current ethical issues, such as stem cell research and cloning, will also be discussed. Lab sessions will be hands-on experiences revolving around and applying the topics listed in the lab section of the syllabus. Prerequisites: ENG 098, FYE 101, MAT 096 or higher (or corequisite), RDG 098, or placement.

BTC 110. Biotechnology Experience: Concepts And Procedures. 4 Credits.
The first of two experiential, cornerstone courses in biotechnology. The course begins by introducing the student to the role of the technician in biotechnology and GLP (or Good Laboratory Principles). An exploration of the principles of molecular genetics will be provided, including lecture topics in transcription, translation and protein expression in prokaryotes, and eukaryotes. Included in the course will be a hands-on exposure to biotechnology research tools and protocols used for DNA isolation, gene cloning, gene expression and regulation, gene sequencing, and mRNA isolation. Lab sessions will be hands on experiences revolving around and applying the topics listed in the lab section of the syllabus. Prerequisites: BTC 101, BTC 102 with a C or better.

BTC 120. Biotechnology Experience: Biomanufacturing. 4 Credits.
The second of two experiential courses, this course begins by introducing the student to the proteins and companies of biotechnology. In the remainder of the course students use bacteria, mammalian, and yeast cells to produce human proteins using tools and standard manufacturing operating procedures of biotechnology, including upstream and downstream processing of proteins, and quality control of protein production. Lab sessions will be hands-on experiences revolving around and applying the topics listed in the lab section of the syllabus. Prerequisites: BTC 101 with a grade of C or better, BTC 102 (or corequisite). Spring.

BTC 170. Cell Culture Techniques. 4 Credits.
This lecture/laboratory course will provide students with a solid understanding of basic sterile and aseptic cell culture techniques through the growth and maintenance of both normal and transformed adherent and suspension mammalian cells. Topics include sterile culture techniques, trypsinization and media supplementation, subculturing, cell counting, determining viability and growth curves, cryopreservation, and research applications using cell cultures. Prerequisite: BIO 109; BTC 101 with a C or better. Spring.

BTC 185. Industrial Microbiology. 4 Credits.
This course covers the principles of various processes associated with the production and recovery of different byproducts derived from prokaryotes and eukaryotes. Topics include the classification of microorganisms, media development, instrumentation, fermentation principles, mammalian and insect cell propagation, product recovery, protein purification, and the principles of current good manufacturing practices (cGMP). Lab sessions will be hands on experiences revolving around and applying the topics listed in the lab section of the syllabus. Prerequisite: BTC 101 with a C or better OR AQS 110, and BTC 102 with a C or better.

BTC 190. Principles of Protein Purification. 4 Credits.
The biopharmaceutical industry is focused on producing proteins as drugs to treat diseases. This course will investigate the relationship between protein structure and function, present basic methods of protein purification, and demonstrate how protein composition influences the method of purification. The concept of pH and buffers will be discussed in detail in relation to protein purification. Students will be exposed to these concepts in lecture, readings, and the lab. Lab sessions will be hands on experiences revolving around and applying the topics listed in the lab section of the syllabus. Prerequisites: BTC 101, BTC 102 (or corequisite), CHE 107.

BTC 191. Quality and Compliance. 3 Credits.
Good Manufacturing Practice regulations (cGMPs) apply to pharmaceutical, biotech and medical device products regulated by FDA. This course explores the content and interpretation of the regulations, with emphasis on the necessary practices, procedures and documentation required to achieve full compliance. The course will utilize case studies to facilitate interpretation and application of regulations. All participants will gain a fundamental knowledge of the basis of cGMP regulations, and the necessity of implementing them in daily operations. Additionally, this course is intended to give participants an introduction to the cGMP regulations and their application to laboratory activities, manufacturing processes and support functions, as well as demonstrate the need for thorough and comprehensive GMP training and documentation. The course also provides participants with an understanding of common
terminology and the role GMPs play in their day-to-day responsibilities. Consequences of non-compliance will be examined to underline the importance of implementing and maintaining a robust cGMP posture. Prerequisites: BTC 101 with a C or better OR AQS 110 and BTC 102 with a C or better.

**BTC 200. Biotechnology Seminar. 3 Credits.**
This is a capstone course taken in the last semester before graduation after all of the BTC courses have been successfully completed. This course will provide an in-depth review of the entire process of producing a biologic drug. Students will examine current research being conducted in the biotech industry and explore cGMP regulations through examination of FDA warning letters. As a capstone course, students will be expected to demonstrate mastery and integration of previous BTC major coursework. Prerequisites: BTC 101 and BTC 102 with a C or better; BTC 120, BTC 170(or co-requisite). Spring.