BIOTECHNOLOGY AND CHEMICAL SCIENCE, MS

The Master of Science degree in Biotechnology and Chemical Science (BTCS) prepares students for work in a variety of professional settings, including the food science, cosmetics, biopharmaceutical, and biotechnology industries, or for academic research and graduate study. It is an interdisciplinary program in which a student may concentrate in biotechnology, biotechnology management, biopharmaceutical technology or chemical science. The program is appropriate for students holding a baccalaureate degree in Biology, Biochemistry, Chemistry, or related sciences, or for those who have taken the prerequisite undergraduate courses. Applicants who are preparing for medical, dental or veterinary schools are encouraged to apply for the MA in Biomedical Science or the MS in Biology at Roosevelt University.

The objectives of the MS BTCS degree program are to provide practical laboratory skills and a strong conceptual foundation in the many overlapping disciplines that comprise biotechnology, and to prepare students for the application of these skills in the workplace. Students in the program receive:

- Theoretical and practical training through a rigorous, flexible and broad-based graduate curriculum including chemistry, biology, biochemistry, biopharmaceuticals and/or management coursework.
- Direct experience with laboratory techniques and research methods used in the commercial and academic research settings.
- Advising and mentoring from experienced faculty from across the university.
- Academic, volunteer, research and/or internship opportunities that enhance students' skills and prepare them to advance in their chosen field.

Course work for this program is regularly offered during evening hours and on Saturdays, affording an opportunity to those employed full-time to extend their professional training. The program is primarily course-based, though research opportunities are available under the sponsorship of university faculty. A research thesis (with co-sponsorship by College of Pharmacy faculty) is an integral and required component of the Biopharmaceutical Technology concentration, and is optional for students in the Biotechnology and Chemical Science concentrations.

Admission

Applicants should consult the general requirements for admission to graduate programs in the College of Arts and Sciences covered on the university web site. Other admissions requirements for international applicants are defined by the Office of International Programs. Graduate faculty members will evaluate each applicant's individual record of academic achievement, professional experience and self-assessment. Weakness in one or a few areas of preparation will not preclude a positive admission decision.

Application Materials

- Graduate application: Application to the College of Arts & Sciences at Roosevelt University.
- Official transcript(s): Official transcripts from all undergraduate and graduate institutions attended.
- Resume/Curriculum vitae: Students should provide a detailed account of their academic and extracurricular experiences. Include employment, teaching, leadership and research experiences as appropriate.

- Personal statement: This brief (one-page) personal statement conveys the student's motivation for his/her chosen career. If the student has a personal statement from a central admissions service, they may submit this statement.
- Two letters of recommendation: Two letters of recommendation appropriate for a professional school application. Referees may include professors, academic advisors, employment supervisors, or others familiar with the students' preparation for graduate study.
- Official GRE score (recommended): Official score in the Graduate Record Exam or another of the graduate admissions tests that is no more than three years old.

Prerequisites

Applicants to the MS BTCS program must hold a baccalaureate degree with a minimum cumulative GPA of 3.0 (4.0 scale) and must have completed the academic requirements described below.

- All students: General Chemistry (2 semesters), Organic Chemistry (2 semesters)
- Biotechnology concentration: Introductory Cellular and Molecular Biology (BIOI 301 CELLULAR & MOLECULAR BIOLOGY or equivalent)
- Biotechnology Management concentration: Introductory Cellular and Molecular Biology (BIOI 301 CELLULAR & MOLECULAR BIOLOGY or equivalent), Statistics (business statistics or biostatistics), Calculus (1 or 2 semesters, including business calculus or calculus for health sciences).
- Biopharmaceutical Technology concentration: Introductory Cellular and Molecular Biology (BIOI 301 CELLULAR & MOLECULAR BIOLOGY or equivalent), Biochemistry (BCHM 355 BIOCHEMISTRY or equivalent), Calculus (2 semesters).
- Chemical Science concentration: Calculus (2 semesters), Physics with Calculus, Quantitative Chemistry (CHEM 237 QUANTITATIVE ENVIRONMENTAL ANALYSIS or equivalent)

Students lacking these prerequisites may be admitted provisionally until they have been completed satisfactorily (grade of B- or better). None of the prerequisite courses may be used toward fulfilling the requirements for the master's degree.

Graduate transfer credit toward the degree must be approved by the graduate program director and is limited to nine credit hours.

Advising

New students must meet with the graduate program director upon admission to the graduate program. Each graduate student is required to meet with a graduate advisor at least once each semester to select courses and update their academic plan. Students in the Biopharmaceutical Technology concentration and others who have an interest in independent research should consult with their advisors during the first semester to discuss research and thesis opportunities.

Requirements

The MS in Biotechnology and Chemical Science requires a minimum of 36 credit hours, at least 27 of which must be completed at Roosevelt University. Students may choose concentrations in Biotechnology, Biotechnology Management, Biopharmaceutical Technology or Chemical Science.
Interdisciplinary and Required Coursework

- **Biotechnology**: At least 20 credit hours in biology (BIOL) and eight credit hours in chemical science (CHEM). A maximum of 6 credit hours or two courses in biochemistry (BCHM) will be accepted toward this requirement. BIOL 480 APPLICATIONS OF BIOTECHNOLOGY, BIOL 482 BIOTECHNOLOGY INDUSTRY PRACTICE and research experience are required.

- **Biotechnology Management**: Specific requirements in natural science, industry practice and management are described in the concentration course listing below. Contact the graduate program director for up-to-date course availability for this concentration.

- **Biopharmaceutical Technology**: Specific requirements in biology, biochemistry and pharmaceutical science are described in the concentration course listing below. A research thesis is required. Contact the graduate program director for up-to-date course availability for this concentration.

- **Chemical Science**: At least 20 credit hours in chemical science (CHEM) and eight credit hours in biological science (BIOL). A maximum of 6 credit hours or two courses in biochemistry (BCHM) will be accepted toward this requirement. CHEM 493 CHEMISTRY SEMINAR and research experience are required.

Research and Independent Study Opportunities

All students in the Biotechnology and Chemical Science degree program must complete three credit hours of research training by enrolling in either Research in Biology, Chemistry, or Biochemistry under the sponsorship of a faculty member (BIOL 492 RESEARCH IN BIOLOGY/BCHM 492 RESEARCH IN BIOCHEMISTRY/CHEM 492 RESEARCH IN CHEMISTRY) or in the scheduled Research Methods course (BIOL 468 RESEARCH METHODS). It is recommended that BIOL 492 RESEARCH IN BIOLOGY/BCHM 492 RESEARCH IN BIOCHEMISTRY/CHEM 492 RESEARCH IN CHEMISTRY be taken for 3 credit hours in a single term, but it may be taken in increments to total 3 credit hours.

A research thesis is an integral and required component of the Biopharmaceutical Technology concentration, and is optional for students in the Biotechnology and Chemical Science concentrations. In addition to the independent research courses listed above, thesis candidates will register for up to 6 additional credit hours of research credit (BIOL 485 THESIS/BCHM 485 THESIS/CHEM 485 THESIS).

Independent study in literature research (BIOL 495 INDEPENDENT STUDY/CHEM 495 INDEPENDENT STUDY) and course by arrangement options are also available to all students. These options are included in the total graduate credit hours but do not substitute for research requirements. No more than 12 total credit hours may result from independent study and research, unless approved by the graduate program director.

**Recommended Courses**

Coursework may be chosen from the appropriate list below or from other scheduled courses in BIOL, CHEM or BCHM at the 400-level, following consultation with an academic advisor.

**Biotechnology Concentration**

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<tr>
<td>BIOL 480</td>
<td>APPLICATIONS OF BIOTECHNOLOGY</td>
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<tr>
<td>BIOL 482</td>
<td>BIOTECHNOLOGY INDUSTRY PRACTICE</td>
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**Core Research**

- BIOL 492 RESEARCH IN BIOLOGY
- or BIOL 468 RESEARCH METHODS

**Electives**

**Biology (at least 11 credits required)**

- BIOL 449 INTRODUCTION TO BIONANOTECHNOLOGY
- BIOL 451 GENERAL GENETICS
- BIOL 453 MOLECULAR BIOLOGY
- BIOL 458 CELL BIOLOGY
- BIOL 460 MICROBIOLOGY
- BIOL 461 INFORMATION TECHNOLOGY FOR SCIENCES
- BIOL 463 INTRODUCTION TO GENOME ANALYSIS
- BIOL 467 IMMUNOLOGY
- BIOL 485 THESIS
- BIOL 495 INDEPENDENT STUDY

**Chemistry (3-8 credits toward CHEM requirement)**

- CHEM 418 SYNTHETIC ORGANIC CHEMISTRY
- CHEM 447 ADVANCED INORGANIC CHEMISTRY LAB
- CHEM 437 INSTRUMENTAL ANALYSIS
- CHEM 452 MEDICINAL CHEMISTRY
- CHEM 481 POLYMER CHEMISTRY

**Biochemistry (up to 6 credits toward CHEM requirement)**

- BCHM 420 PHYSICAL CHEMISTRY FOR BIOSCIENCE
- BCHM 444 BIOINORGANIC CHEMISTRY
- BCHM 454 EXPERIMENTAL METHODS IN BIOCHEMISTRY & BIOTECHNOLOGY
- BCHM 457 ADVANCED BIOCHEMISTRY
- BCHM 464 PROTEIN STRUCTURE DETERMINATION
- BCHM 493 BIOCHEMISTRY SEMINAR

**Additional courses may apply - consult graduate advisor for details**

**Total Credit Hours**

36

**Biotechnology Management Concentration**

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**Core Management**

- ACCT 405 ACCOUNTING FOR EXECUTIVES
- BADM 401 GRADUATE BUSINESS ORIENTATION
- FIN 408 FINANCE FOR DECISION MAKERS
- MGMT 407 EXECUTIVE LEADERSHIP
- MKTG 406 MARKETING STRATEGY: THEORY & PRACTICE

**Core Science**

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### Biologica and Chemistry Concentrations

**Biological Concentration**

**Core Courses (including one lab)**
- BIOL 453: MOLECULAR BIOLOGY
- BIOL 468: RESEARCH METHODS
- BCHM 454: EXPERIMENTAL METHODS IN BIOCHEMISTRY & BIOTECHNOLOGY
- BCHM 457: ADVANCED BIOCHEMISTRY
- CHEM 437: INSTRUMENTAL ANALYSIS
- CHEM 444: BIOINORGANIC CHEMISTRY
- Additional courses may apply - consult graduate advisor for details

**Capstone (Select one of the following)**
- BIOL 4XX: Biotechnology Management Project
- BIOL 491: BIOLOGY INTERNSHIP

**Electives**
- 3-5 credits
- BCHM 455: BIOCHEMISTRY
- BCHM 457: ADVANCED BIOCHEMISTRY
- BIOL 467: IMMUNOLOGY
- CHEM 437: INSTRUMENTAL ANALYSIS
- CHEM 444: BIOINORGANIC CHEMISTRY

**Total Credit Hours**: 38-40

### Chemical Sciences Concentration

**Core Research**
- 3 credits
- CHEM 492: RESEARCH IN CHEMISTRY
- or BIOL 468: RESEARCH METHODS

**Core Chemistry**
- 1 credit
- CHEM 493: CHEMISTRY SEMINAR

**Electives**
- Chemistry (at least 16 credits required)
  - CHEM 413: ADVANCED ORGANIC CHEMISTRY
  - CHEM 418: SYNTHETIC ORGANIC CHEMISTRY
  - CHEM 419: ORGANOMETALLIC CHEMISTRY
  - CHEM 423: PHYSICAL CHEMISTRY- ATOMIC & MOLECULAR SPECTROSCOPY
  - CHEM 441: INORGANIC CHEMISTRY
  - CHEM 444: BIOINORGANIC CHEMISTRY
  - CHEM 437: INSTRUMENTAL ANALYSIS
  - CHEM 447: ADVANCED INORGANIC CHEMISTRY LAB
  - CHEM 452: MEDICINAL CHEMISTRY
  - CHEM 481: POLYMER CHEMISTRY
  - CHEM 485: THESIS

**Electives**
- Biology (3-8 credits toward BIOL requirement)
  - BIOL 460: MICROBIOLOGY
  - BIOL 458: CELL BIOLOGY
  - BIOL 467: IMMUNOLOGY
  - CHEM 418: SYNTHETIC ORGANIC CHEMISTRY
  - CHEM 444: BIOINORGANIC CHEMISTRY

**Pharmaceutics**
- PHAR 621: Disperse Systems
- PHAR 625: Pharmaceutical Biotechnology
- PHAR 627: Biopharmaceutics and Drug Disposition

**Pharmacology**
- PHAR 624: Drug Metabolism and Interactions
- PHAR 628: Toxicology
- PHAR 629: Psychopharmacology

**Medicinal Chemistry**
- CHEM 452: MEDICINAL CHEMISTRY
- PHAR 622: Advanced Medicinal Chemistry
- PHAR 623: Drug Development Processes

**Other Pharmacy**
- PHAR 654: Biotherapeutic Drugs
- PHAR 662: Regulatory Science

**Total Credit Hours**: 36