

# Biotechnology Science and Engineering, PhD

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## Biotechnology Science & Engineering

### Degree

Doctor of Philosophy

#### Program Coordinator

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### Adjunct Faculty

More than 10 scientists from NASA's Marshall Space Flight Center (Space Science Laboratory) and local biotechnology companies in Huntsville serve as adjunct faculty to the program and have expertise in at least one of the thrust areas of Biotechnology Science and Engineering.

### Mission

The Biotechnology Science and Engineering Graduate Program (B.S.E.) is an interdisciplinary program of the University of Alabama in Huntsville concerned with research and scholarly activity in the diverse areas of biotechnology. The program's mission is to provide Ph.D. level graduates who are broadly trained in the areas of science and engineering pertinent to biotechnology and who will benefit the economic, educational, and cultural development of Alabama. Graduates of the program are expected to be able to make significant contributions to biotechnology in academic, governmental, and business settings.

Biotechnology is not a single area of study itself, but is a multidisciplinary field concerned with the practical application of biological organisms and their subcellular components to industrial or service manufacturing, to environmental management and health and medicine. It is, in essence, a series of enabling technologies drawn from the fields of microbiology, cellular biology, molecular biology, genetics, biochemistry, immunology, fermentation technology, environmental science and engineering which allow one to synthesize, breakdown or transform materials to suit human needs. Biotechnology ("Current Trends in Chemical Technology, Business, and Employment," American Chemical Society, Washington, DC. 1998) can therefore be defined as the safe study and manipulation of biological molecules for development of products or techniques for medical and industrial application. Although biotechnology in the broadest sense is not new, the current ability and demand for manipulating living organisms or their subcellular components to provide useful products, processes or services has reached new heights. Modern biotechnology has resulted from scientific scrutiny of old and familiar processes and from new advances in molecular biology, genetic engineering and fermentation technologies.

The future industrial landscape will continue to include research, development and the manufacturing of products such as proteins and nucleic acids that will be based wholly or in large part on biological processes. The interdisciplinary program in Biotechnology Science and Engineering will provide broad training in sciences and engineering dealing with the handling and the processing of macromolecules and living systems. Students will receive advanced training in one of three specializations:

1. Structural Biology,
2. Biomolecular Sciences or
3. Bioprocess Engineering.

The principal core of instructors and research advisors are drawn from the Departments of Biological Sciences, Chemistry, and Chemical and Materials Engineering. The program includes significant involvement from local biotechnology companies as well as NASA's Marshall Space Flight Center.

In addition to a set of core courses, the Ph.D. program requires the successful completion of a comprehensive exam, seminar attendance, the preparation of a U.S. National Institutes of Health (NIH) or National Science Foundation style research proposal, oral presentations and defense of a dissertation describing original research. It is the intent of the program to produce internationally competitive graduates who will make significant contributions to the field of biotechnology.

### Admission Requirements

Applicants may be unconditionally admitted to the program if they have:

1. A bachelor's degree in science or engineering from an approved college or university;
2. A minimum grade point average (GPA) of 3.0 overall;

3. A combined score of 300 on the verbal, quantitative and analytical sections and at least 3.0 in the writing section of the Graduate Record Examination (GRE).
4. A TOEFL (iBT) score of: all sub-scores equal to or greater than 18 OR IELTS score of: all sub-scores equal to or greater than 6.0 for international students.

Applicants may be admitted conditionally if they do not meet these requirements but indicate the potential for success in the Biotechnology Science and Engineering program. Applicants must have knowledge from coursework in the areas of general biology, cell biology, genetics and molecular biology, general and organic chemistry, physics and calculus to satisfy the prerequisites of calculus-based physical or biophysical chemistry. Students with deficiencies in any of these areas may be admitted only conditionally pending remedy of the deficiencies.

To obtain a Ph.D. in Biotechnology Science and Engineering, the student must satisfy all requirements of the School of Graduate Studies as well as those of the Biotechnology Science and Engineering Program.

The requirements are as follows:

### 1. Successfully complete the core courses:

CHE 561	BIOSEPARATIONS RECOMBI TECH/PR	3
CH 561	BIOCHEMISTRY I	3
CH 562	BIOCHEMISTRY II	3
BYS 519	GENE STRUCTURE & FUNCTION	3
BYS 543	MOLECULAR BIOLOGY OF THE CELL	3
<b>Total Semester Hours</b>		<b>15</b>

### 2. Pass the Preliminary Examination

Each student must pass the preliminary examination which has to be taken at the end of the first summer of residence, and will cover materials from the core courses in the areas of Biochemistry, Cellular and Molecular Genetics and Bioprocessing/Bioseparations. Students will take examinations in all three areas during the first attempt. Students are required to repeat only the part of the exams that they did not pass. Students will have a maximum of two attempts to pass the preliminary examination. Appeals to this policy must be filed with the Director of the Biotechnology Program who will consult with the Graduate Dean and the Deans of the Colleges of Engineering and Science.

### 3. Choose a dissertation advisor and committee

Students who qualify for the Ph.D. program by passing the preliminary examination will choose a dissertation advisor and a Supervisory Committee during the fall semester of their second year. The committee will meet for the first time with the student to review the initial research goals (Research Start Meeting).

### 4. Write and defend a research proposal

In consultation with the dissertation advisor and committee, the student will begin working on a research project which will subsequently lead to an NIH or NSF style proposal. This written proposal will be submitted to the committee by the middle of the second summer. By the first semester of the third year, the student will defend this proposal in a seminar, followed by questions from committee members (Annual Research Appraisal I) (ARA-I). Successful completion of the written and oral presentation of the dissertation proposal constitutes the School of Graduate Studies Qualifying Examination.

### 5. Complete an acceptable program of study

The program of study will consist of at least 48 semester hours of coursework at the graduate level including the core courses required to prepare for the preliminary examinations and courses required to prepare the student to conduct original research in their area of study. Students must register for a total of three semester hours of seminar. A maximum of three seminar semester hours may be considered towards fulfillment of the graduate course requirements. A minimum of 18 semester hours of BSE 799 must be included in the program of study.

### 6. Complete and defend a research dissertation

During the fall semesters of the next two years, students will meet with their advisors and committee for research appraisals (ARA). Following these annual evaluations, the student will begin writing the dissertation and plan to defend it before the fifth year after passing the preliminary examination. The primary dissertation advisor and the committee have the discretion to allow students to defend the dissertation earlier if the work is of high quality and sufficient progress has been made toward the goals stated in the research proposal.

All requirements for the Ph.D. must be completed in no more than five years after the approval of the Research Proposal (ARA-I).