

# Bioengineering - Graduate Programs

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## Objectives

The Biomedical Engineering Program is jointly offered by The University of Texas at Arlington and The University of Texas Southwestern Medical Center at Dallas (UT Southwestern). Research and teaching efforts of various departments in the biological, engineering, mathematical, physical, and medical sciences of both institutions are coordinated through the Committee on Graduate Studies in Biomedical Engineering. The goal of the program is to prepare students for bioengineering careers requiring skills in research, development, and teaching in a variety of settings in industry, in hospitals, in research facilities of educational and medical institutions and in government regulatory agencies. Internships are aimed to further prepare students for careers in the bioengineering industry.

The program includes coursework and research in medical imaging, biosensors, physiological control systems, biomedical signal processing, biomedical instrumentation, rehabilitation, orthopedics, biomechanics, biomaterials and tissue engineering and neurosciences. Specifically, during the first year of their studies, students in the master's and doctoral programs must select one of the concentration tracks in Bioengineering:

- a. Bioinstrumentation
- b. Biomaterials/Tissue Engineering
- c. Biomechanics
- d. Medical Imaging
- e. Nanomedicine/Nanoengineering

A track advisor is available to advise students on the relevant courses and the research opportunities in each track.

## Master's Program

The master's program is based upon graduate level work in Bioengineering, life sciences and related physical sciences.

## Doctoral Program

The doctoral program is based upon graduate level work in Bioengineering, and extensive graduate training in the life sciences and related physical sciences. The program is aimed at the development of professional biomedical engineers capable of independent research.

## Fast Track Programs for a Master's Degree in Biomedical Engineering

The Fast Track program enables outstanding undergraduate students in either Biomedical Engineering, or Physics, Biochemistry or Mathematics to receive dual undergraduate and graduate course credit leading to receiving both a Bachelor of Science Degree in either Biomedical Engineering, Physics, Biochemistry or Mathematics and a Master's Degree in Biomedical Engineering. See the departmental advisors for additional information on these programs.

## Graduate Certificate in Design and Development of Regulated Medical Devices

This certificate provides the students with knowledge of how to conduct and document design of medical products that comply with the governing requirements of the medical product regulatory agencies.

## Description

Bioengineers use quantitative methods and innovation to analyze and to solve problems in biology and medicine. Students choose the Bioengineering field to serve people, to partake in the challenge and excitement of working with living systems, and to apply advanced technology to complex problems of medical care. Through this program, students learn the essentials of life science, engineering theory, and the analytical and practical tools that enable them to be successful in the biotechnology and Bioengineering industries. The program includes coursework in the basic sciences, core engineering, Bioengineering, and advanced biotechnology disciplines. Both didactic classroom lectures and hands-on laboratory experience are emphasized. Additionally, students are required to take general educational courses in literature, fine arts, history, political science, and social science.

## Career Opportunities

The program prepares students as biomedical engineers for careers in industry, in hospitals, in research facilities of educational and medical institutions, and in government regulatory agencies. It also provides a solid foundation for those wishing to continue for advanced degrees. For those planning to pursue a medical degree, this cross-disciplinary curriculum offers a solid foundation in engineering, which is an advantage in preparing for a medical career.

See the UT Arlington [Undergraduate Catalog](http://www.uta.edu/catalog/) (<http://www.uta.edu/catalog/>) for a more detailed description of this program.

## Continuation

The Biomedical Engineering Graduate Program has established certain policies to fulfill its responsibility to graduate highly qualified professional engineers. In addition to the requirements of the Graduate School listed in this catalog under Advanced Degrees and Requirements, each bioengineering graduate student who wants to continue in the program must:

- a. Maintain at least an overall GPA of 3.0 from all coursework, and
- b. Demonstrate suitability for professional engineering practice.

At such time as questions are raised by bioengineering graduate faculty regarding either of the above, the student will be notified and will be provided the opportunity to respond to the Committee on Graduate Studies in Bioengineering. The Committee on Graduate Studies will review the student's performance and make a recommendation concerning the student's eligibility to continue in the program. Appeal of a decision on continuation may be made through normal procedures outlined in the section of this catalog entitled "Grievances Other than Grades."

## Master's Admission

Application for admission should be made at either UT Arlington or UT Southwestern. Normally, the institution through which the student applies and is admitted is the student's home institution. In addition to admission requirements of the Graduate School, the bachelor's degree held by applicants to the program may be in engineering, biological, physical, or mathematical sciences. Depending on the applicant's background, some preparatory coursework may be required, prior to admission into the program. The UT Arlington Biomedical Engineering Program uses the following guidelines in the admission review process:

### Unconditional Admission

- a. Minimum undergraduate GPA of 3.0 in the last 60 hours of undergraduate work in an engineering discipline as calculated by the Graduate School.
- b. GRE with total score (quantitative plus verbal) equal to or greater than 301 is preferred. Applicants from non-ABET accredited programs are required to take the GRE. Applicants from ABET accredited programs are not required to take the GRE. However, taking the GRE is strongly recommended for consideration of potential financial assistance.
- c. A total TOEFL score of 79 or better for Internet-based testing for international applicants whose native language is not English.

### Probationary Admission

- a. If an applicant meets any one of the above items 1, or 2 and also provides three letters of recommendation from persons with relevant academic credentials.
- b. A total TOEFL score of 79 or better for Internet-based testing for international applicants whose native language is not English.

### Provisional Admission

An applicant who is unable to supply all required documents prior to the admission deadline, but who otherwise appears to meet admission requirements may be granted provisional admission.

### Deferral

If an applicant does not present adequate evidence of meeting admission requirements, the admission decision may be deferred until admission records are complete or the requirements are met.

### Denial

A candidate may be denied admission if he/she has less than satisfactory performance in two out of the three admission criteria, excluding TOEFL.

## Degree Requirements

### Master of Science Degree Plans

Students in the Thesis Degree plan must complete a minimum of 30 credit hours, including 6 hours of thesis. Students in the Thesis-Substitute Degree plan must complete a minimum of 30 credit hours as specified below.

#### Required Bioengineering

For thesis-option, one laboratory course in bioengineering, such as BE 5324 or BE 5365 or BE 5373 or BE 5382 approved by the graduate advisor, is required. For thesis-substitute-option, two laboratory courses are required

3-6

#### Bioengineering

Select five of the following (consistent with the student's track of study and approval of the Graduate Advisor):

|         |                                                    |   |
|---------|----------------------------------------------------|---|
| BE 5300 | SELECTED TOPICS IN BIOENGINEERING                  | 3 |
| BE 5310 | BIOMECHANICS AND FLUID FLOW WITH COMPUTATIONAL LAB | 3 |
| BE 5312 | TISSUE BIOMECHANICS AND BIOENGINEERING             | 3 |
| BE 5314 | BIOMEDICAL IMPLANTS                                | 3 |

|         |                                                                    |   |
|---------|--------------------------------------------------------------------|---|
| BE 5315 | FUNDAMENTALS OF BIOMOLECULAR ENGINEERING                           | 3 |
| BE 5324 | BIOMEDICAL OPTICS LABORATORY                                       | 3 |
| BE 5325 | FLUORESCENCE MICROSCOPY                                            | 3 |
| BE 5326 | TISSUE ULTRASOUND OPTICAL IMAGING                                  | 3 |
| BE 5327 | TISSUE OPTICS                                                      | 3 |
| BE 5329 | NEURAL ENGINEERING                                                 | 3 |
| BE 5331 | POLYMERS AND BIOCOMPATIBILITY                                      | 3 |
| BE 5333 | NANO BIOMATERIALS AND LIVING-SYSTEMS INTERACTION                   | 3 |
| BE 5337 | TRANSPORT PHENOMENA IN BIOMEDICAL ENGINEERING                      | 3 |
| BE 5343 | IMAGE PROCESSING WITH MATLAB: APPLICATIONS IN MEDICINE AND BIOLOGY | 3 |
| BE 5344 | BIOINSTRUMENTATION I                                               | 3 |
| BE 5346 | MEDICAL IMAGING                                                    | 3 |
| BE 5352 | DIGITAL PROCESSING OF BIOLOGICAL SIGNALS                           | 3 |
| BE 5361 | BIOMATERIALS AND BLOOD COMPATIBILITY                               | 3 |
| BE 5364 | TISSUE ENGINEERING LECTURE                                         | 3 |
| BE 5365 | TISSUE ENGINEERING LAB                                             | 3 |
| BE 5366 | PROCESS CONTROL IN BIOTECHNOLOGY                                   | 3 |
| BE 5370 | BIOMATERIAL - LIVING SYSTEMS INTERACTION                           | 3 |
| BE 5372 | DRUG DELIVERY                                                      | 3 |
| BE 5373 | FORMULATION AND CHARACTERIZATION OF DRUG DELIVERY SYSTEMS          | 3 |
| BE 5382 | LABORATORY PRINCIPLES                                              | 3 |
| BE 5385 | STEM CELL TISSUE ENGINEERING                                       | 3 |
| BE 5386 | MEDICAL PRODUCT DESIGN CONTROL AND RISK MANAGEMENT                 | 3 |
| BE 5387 | MEDICAL DEVICE PROTOTYPE DEVELOPMENT                               | 3 |
| BE 5388 | MEDICAL PRODUCT DESIGN AND DEVELOPMENT                             | 3 |
| BE 5390 | RESEARCH PROJECT                                                   | 3 |

**Engineering**

Select one course from Bioengineering or other engineering departments, with the approval of the Graduate Advisor 3

**Required Life Sciences**

BE 5309 HUMAN PHYSIOLOGY IN BIOENGINEERING 3

One Three-Credit-Hour approved Life Science course. 3

**Thesis Plan**

BE 5698 THESIS (at the semester in which the student expects to submit and defend the thesis) 6

**Thesis Substitute Plan**

One Three-Credit-Hour BE elective course 3

One Three-Credit-Hour Biostatistics Course 3

After completion, the student will receive his or her Masters Degree in Biomedical Engineering.

## Doctoral Admission

In addition to admission requirements of the Graduate School, the bachelor's degree held by applicants to the program may be in engineering, biological, physical, or mathematical sciences. Depending on the applicant's background, some preparatory coursework may be required, prior to admission into the program. The UT Arlington Biomedical Engineering program uses the following guidelines in the admission review process:

### Unconditional Admission

1. Minimum GPA of 3.4 in the last 60 hours taken in the major field of study of engineering or physical sciences as calculated by the Graduate School.
- b. GRE Total (quantitative plus verbal) must be greater than 308 with a verbal score of 146 or better.
- c. Three favorable letters of recommendation.
- d. A total TOEFL score of 79 or better for Internet-based testing for international applicants whose native language is not English.

## Probationary Admission

- a. If an applicant meets any two of the above items 1, 2, and 3.
- b. A total TOEFL score of 79 or better for Internet-based testing for international applicants whose native language is not English.

## Provisional Admission

An applicant who is unable to supply all required documents prior to the admission deadline, but who otherwise appears to meet admission requirements may be granted provisional admission.

## Deferral

If an applicant does not present adequate evidence of meeting admission requirements, the admission decision may be deferred until admission records are complete or the requirements are met.

## Denial

A candidate may be denied admission if he/she has less than satisfactory performance in two out of the three admission criteria, excluding TOEFL.

## Fellowship

No additional requirements besides the information published by the Graduate School.

## Degree Requirements

### Doctor of Philosophy Degree Plan

The Ph.D. degree program consists of a minimum of 47 credit hours beyond the bachelor's degree level and includes the courses as specified below.

#### Required Bioengineering

Ph.D. Seminar for at least three semesters:

|                                                          |                               |   |
|----------------------------------------------------------|-------------------------------|---|
| BE 6101                                                  | PhD SEMINAR IN BIOENGINEERING | 1 |
| BE 6102                                                  | PhD SEMINAR IN BIOENGINEERING | 1 |
| BE 6103                                                  | PhD SEMINAR IN BIOENGINEERING | 1 |
| Laboratory Course (BE 5324, BE 5365, BE 5373 or BE 5382) |                               | 3 |

#### Elective Bioengineering

Select five of the following:

|         |                                                                    |   |
|---------|--------------------------------------------------------------------|---|
| BE 5300 | SELECTED TOPICS IN BIOENGINEERING                                  | 3 |
| BE 5310 | BIOMECHANICS AND FLUID FLOW WITH COMPUTATIONAL LAB                 | 3 |
| BE 5312 | TISSUE BIOMECHANICS AND BIOENGINEERING                             | 3 |
| BE 5314 | BIOMEDICAL IMPLANTS                                                | 3 |
| BE 5315 | FUNDAMENTALS OF BIOMOLECULAR ENGINEERING                           | 3 |
| BE 5324 | BIOMEDICAL OPTICS LABORATORY                                       | 3 |
| BE 5325 | FLUORESCENCE MICROSCOPY                                            | 3 |
| BE 5326 | TISSUE ULTRASOUND OPTICAL IMAGING                                  | 3 |
| BE 5327 | TISSUE OPTICS                                                      | 3 |
| BE 5329 | NEURAL ENGINEERING                                                 | 3 |
| BE 5331 | POLYMERS AND BIOCOMPATIBILITY                                      | 3 |
| BE 5333 | NANO BIOMATERIALS AND LIVING-SYSTEMS INTERACTION                   | 3 |
| BE 5337 | TRANSPORT PHENOMENA IN BIOMEDICAL ENGINEERING                      | 3 |
| BE 5343 | IMAGE PROCESSING WITH MATLAB: APPLICATIONS IN MEDICINE AND BIOLOGY | 3 |
| BE 5344 | BIOINSTRUMENTATION I                                               | 3 |
| BE 5346 | MEDICAL IMAGING                                                    | 3 |
| BE 5347 | PRINCIPLES OF FUNCTIONAL MAGNETIC RESONANCE IMAGING                | 3 |
| BE 5352 | DIGITAL PROCESSING OF BIOLOGICAL SIGNALS                           | 3 |
| BE 5361 | BIOMATERIALS AND BLOOD COMPATIBILITY                               | 3 |
| BE 5364 | TISSUE ENGINEERING LECTURE                                         | 3 |
| BE 5365 | TISSUE ENGINEERING LAB                                             | 3 |
| BE 5366 | PROCESS CONTROL IN BIOTECHNOLOGY                                   | 3 |
| BE 5370 | BIOMATERIAL - LIVING SYSTEMS INTERACTION                           | 3 |
| BE 5372 | DRUG DELIVERY                                                      | 3 |

|         |                                                           |   |
|---------|-----------------------------------------------------------|---|
| BE 5373 | FORMULATION AND CHARACTERIZATION OF DRUG DELIVERY SYSTEMS | 3 |
| BE 5382 | LABORATORY PRINCIPLES                                     | 3 |
| BE 5385 | STEM CELL TISSUE ENGINEERING                              | 3 |
| BE 5388 | MEDICAL PRODUCT DESIGN AND DEVELOPMENT                    | 3 |

Other courses with the approval of the Graduate Advisor

#### Elective (3 credit hours)

One Three-Hour-Course from other engineering departments or a life science course with the approval of the Graduate Advisor 3

#### Life Sciences (9 Credit Hours)

BE 5309 HUMAN PHYSIOLOGY IN BIOENGINEERING 3

Select one of the following: 3

Cell Physiology

Neuroscience

Tumor Physiology

Select one of the following: 3

Biochemistry

Molecular Biology

Immunology

#### Mathematics, Statistics, Computer and Physical Sciences

One Three-Credit-Hour Biostatistics course as approved by the Graduate Advisor.

#### Ph.D. Examinations and Dissertation

All doctoral students must satisfactorily complete the following exams at the semester in which the student expects to submit and defend the dissertation:

|         |                                    |   |
|---------|------------------------------------|---|
| BE 6194 | DOCTORAL DIAGNOSTIC EXAMINATION    | 1 |
| BE 6195 | DOCTORAL COMPREHENSIVE EXAMINATION | 1 |
| BE 6999 | DISSERTATION                       | 9 |

Although qualified applicants may be accepted into the Ph.D. program without earning the Master of Science in Biomedical Engineering, all students must satisfactorily pass BE 6194 DOCTORAL DIAGNOSTIC EXAMINATION. This examination will cover all relevant coursework taken by the student. The examination may be written, oral, or both and consists of a timed, written analysis of a major problem in the student's general area of research interest, followed by an oral examination covering the same material. Elements of engineering, physical and biological science, mathematics, computer science and statistics may be included in this examination.

For completion of doctoral degree, a minimum of 38 semester hours of graduate coursework is expected for students entering with an appropriate master's degree, or a minimum of 47 semester hours of graduate coursework is expected for student's entering with a bachelor's degree, as approved by the Committee on Graduate Studies. Additional coursework may be required by the student's doctoral dissertation committee.

For additional information, applicants and students should contact the BE Graduate Advisor for a copy of the "Information Brochure" for related and amplified information about the graduate program. The information can also be found at <http://www.uta.edu/bioengineering/>. After completion, the student will receive his or her PhD in Biomedical Engineering.

## GRADUATE CERTIFICATE IN DESIGN AND DEVELOPMENT OF REGULATED MEDICAL DEVICES

### PROGRAM OBJECTIVE

This certificate provides the students with knowledge of how to conduct and document design of medical products that comply with the governing requirements of the medical product regulatory agencies. Additionally, it provides option to focus on how to market a new medical product and take into consideration the possible environmental impact of the product. Choosing from the elective courses for this certificate, one can become knowledgeable about ethical consideration in developing a new product as well as improving managerial and teamwork skills.

### ADMISSION REQUIREMENTS

Applicants for the certificate need to have one of the following educational backgrounds: 1) Have earned a Bachelor of Science (B.S.) degree in an engineering discipline with a GPA of 2.75 or better; 2) B.S. degree in an engineering or related field with five years of professional engineering work experience; or 3) Rank of graduate student at least M.S. level with a GPA of 3.00 or better.

### ACADEMIC REQUIREMENTS

Students must complete 1) three required courses BE 5386, BE 5387, BE 5388 and 2) two elective courses chosen from the list. The GPA derived from these 5 courses must be 3.0 or higher to graduate. The time limit for the completion of the certificate program is 6 years.

**Required courses**

|         |                                                    |   |
|---------|----------------------------------------------------|---|
| BE 5386 | MEDICAL PRODUCT DESIGN CONTROL AND RISK MANAGEMENT | 3 |
| BE 5387 | MEDICAL DEVICE PROTOTYPE DEVELOPMENT               | 3 |
| BE 5388 | MEDICAL PRODUCT DESIGN AND DEVELOPMENT             | 3 |

**Elected courses (choose two)**

|           |                              |   |
|-----------|------------------------------|---|
| ENGR 5302 | ENGINEERING ENTREPRENEURSHIP | 3 |
| CE 5323   | SUSTAINABLE ENGINEERING      | 3 |
| IE 5338   | HUMAN ENGINEERING            | 3 |