Biomedical Engineering

Chair: Jianyi Zhang, MD, PhD
Associate Chair of Education: Alan Eberhardt, PhD

Degree Offered: Bachelor of Science in Biomedical Engineering

Accreditation: The Bachelor of Science in Biomedical Engineering degree program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the commission's General Criteria and Program Criteria for Bioengineering and Biomedical and Similarly Named Engineering Programs.

Website: https://www.uab.edu/engineering/bme/undergraduate

Program Director: Alan Eberhardt, PhD
Email: aeberhar@uab.edu
Phone: 205-934-8420

Biomedical engineering (BME) is the application of engineering principles and technology to the solution of problems in the life sciences and medicine. Biomedical engineers create knowledge and develop technologies that improve healthcare delivery and patient outcomes with an emphasis on reducing healthcare costs. Graduates create and apply knowledge at the interface of life sciences and engineering for the benefit of society. The BME undergraduate program prepares graduates to be immediately productive and able to adapt to a rapidly changing environment. The curriculum includes engineering core courses, mathematics, calculus-based physics, biology, chemistry, humanities, social and behavioral sciences, biomedical engineering core courses and electives. The curriculum culminates in a capstone design experience where student teams apply knowledge to solve real-world engineering problems. A bachelor's degree in BME from UAB provides a foundation in biomedical implants and devices, biomaterials, biocomputing, biotransport, and biomedical instrumentation to compete in an increasingly technical medical field, and also prepares students for graduate school, medical school, or professional school.

Admission

Freshmen with an ACT score of 28 or higher (or SAT equivalent) and a high school GPA of 3.00 or higher may be admitted directly to the Biomedical Engineering program. Please refer to the School of Engineering overview for policies regarding admission; change of major; transfer credit; transient status; dual degree programs; reasonable progress; academic warning, probation, and suspension; reinstatement appeals; and graduation requirements.

Academic Warning, Probation, and Readmission

BME students must maintain an institutional (UAB) GPA of at least 2.50. First-term BME freshmen students who have an institutional GPA below 2.50 will be placed on academic warning in BME. If their institutional GPA is not at least 2.50 after the next term enrolled, they will be placed on academic probation in BME. BME undergraduates (other than first-term freshmen) who do not have an institutional GPA of at least 2.50 will be placed on BME academic probation. If at the end of the next term in which they enroll, their institutional GPA is not at least 2.50, they will be reclassified as Undeclared Engineering. To be re-admitted to the BME program, a student must have an institutional GPA of at least 3.00 and make a formal application for readmission.

Program and Graduation Requirements

BME students must have an institutional GPA of at least 2.50 and have completed at least 64 hours of coursework applicable to their degree before they may register for 300-level and 400-level BME courses. BME students must also have an institutional GPA of 2.50 or higher and have earned a grade of C or better in all BME courses to graduate.

Please note the Residency Requirement on the Majors tab.

Non-Majors Enrolled in BME Coursework

In addition to fulfilling course prerequisites, non-BME students (including pre-BME students and students seeking a BME minor) who wish to enroll in 300-level and 400-level BME courses must have an institutional (UAB) GPA of at least 3.00 or permission of the BME Undergraduate Program Director. Non-BME majors may not enroll in BME 423, BME 498, or BME 499.

BME Minors

Please refer to the Minors tab on the School of Engineering’s Overview page in this catalog for information specific to BME minors.

Vision

To be an internationally recognized, research-oriented Department of Biomedical Engineering: a top choice for undergraduate and graduate education.

Mission

The Department of Biomedical Engineering provides leadership in teaching the principles of engineering and biology and in conducting research that will translate new discoveries in biological engineering science to the fields of public health and clinical medicine. These efforts will enable us to identify new solutions to critical challenges in health care and the life sciences.

Program Educational Objectives

Graduates of the Biomedical Engineering undergraduate program will have:

1. Gained admission to graduate or professional school, or gained employment in engineering and/or health related professions and
2. Pursued opportunities for professional growth, development, and service

Student Outcomes

Upon completion of the BSBME degree program, our graduates will have:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Bachelor of Science in Biomedical Engineering

Major in Biomedical Engineering

Requirements                                      | Hours |
---                                               | ---   |
As a part of Blazer Core Curriculum take the following courses: | 12    |
MA 125 Calculus I                                 |       |
& 125L and Calculus I Lab                         |       |
PH 221 General Physics I                          |       |
& 221L and General Physics Laboratory I           |       |
& 221R and General Physics I Recitation           |       |
PH 222 General Physics II                         |       |
& 222L and General Physics Laboratory II          |       |
& 222R and General Physics II - Recitation        |       |
Other Required Courses                             | 77    |
BME 310 Biomaterials                              |       |
BME 210 Engineering in Biology                    |       |
BME 312 Biocomputing                              |       |
BME 313 Bioinstrumentation                        |       |
BME 333 Biomechanics of Solids                    |       |
BME 350 Biological Transport Phenomena            |       |
BME 370 Integrated Physiology                     |       |
BME 370 Integrated Physiology                     |       |
BME 401 Undergraduate Biomedical Engineering Seminar |     |
BME 423 Living Systems Analysis and Biostatistics |       |
BME 498 Capstone Design I Product Development     |       |
BME 499 Capstone Design II                        |       |
BY 123 Introductory Biology I                     |       |
& 123L and Introductory Biology I Laboratory      |       |
BY 212 Genetics for Biomedical Engineers          |       |
& 212L and Genetics for Biomedical Engineers - Laboratory |     |
or BY 115 Human Anatomy                           |       |
CE 210 Statics                                   |       |
CH 115 General Chemistry I                        |       |
& 115R and General Chemistry I Recitation         |       |
& CH 116 and General Chemistry I Laboratory       |       |
CH 117 General Chemistry II                       |       |
& 117R and General Chemistry II Recitation        |       |
& CH 118 and General Chemistry II Laboratory      |       |
EE 312 Electrical Systems                         |       |
EGR 110 Introduction to Engineering I             |       |
& EGR 111 and Introduction to Engineering II      |       |
or EGR 21 Introduction to Engineering              |       |
EGR 150 Computer Methods in Engineering            |       |
EGR 265 Math Tools for Engineering Problem Solving |       |
MA 126 Calculus II                                |       |
MA 260 Introduction to Linear Algebra             |       |
EGR 103 Computer Aided Graphics and Design        |       |
ME 215 Dynamics & 215R and Dynamics Recitation    |       |
MSE 280 Engineering Materials                     |       |

Biomedical Engineering Electives                  | 9     |
BME 221 Clinical Innovation I                     |       |
BME 289 Undergraduate Research in Biomedical Engineering I |     |
BME 389 Undergraduate Research in Biomedical Engineering II |     |
BME 420 Implant-Tissue Interactions               |       |
BME 435 Tissue Engineering                        |       |
BME 443 Medical Image Processing                  |       |
BME 450 Computational Neuroscience               |       |
BME 461 Bioelectric Phenomena                     |       |
BME 462 Cardiac Electrophysiology                 |       |
BME 471 Continuum Mechanics of Solids             |       |
BME 472 Industrial Bioprocessing and Biomanufacturing |     |
BME 489 Undergraduate Research in Biomedical Engineering III |     |
BME 490 Special Topics in Biomedical Engineering  |       |
BME 491 Individual Study in Biomedical Engineering |       |
BME 494 Honors Research I                          |       |

Engineering/Math/Science Electives                | 6     |
Select six credit hours from the following or from the list of Biomedical Engineering electives above|
BY 271 Biology of Microorganisms                  |       |
& 271L and Biology of Microorganisms Laboratory   |       |
BY 311 Molecular Genetics                         |       |
BY 330 Cell Biology                               |       |
BY 362 Neurobiology                               |       |
CE 337 Hydraulics                                 |       |
CE 345 Transportation Engineering                |       |
CE 360 Structural Analysis                        |       |
CE 395 Engineering Economics                      |       |
CE 420 Advanced Mechanics                         |       |
CE 433 Solid and Hazardous Wastes Management      |       |
CH 235 Organic Chemistry I                        |       |
& 235R and Organic Chemistry I Recitation         |       |
CH 237 Organic Chemistry II                       |       |
& 237R and Organic Chemistry II Recitation        |       |
CH 355 Quantitative Analysis                      |       |
CH 460 Fundamentals of Biochemistry               |       |
MA 313 Patterns, Functions and Algebraic Reasoning |       |
MA 360 Scientific Programming                     |       |
MA 361 Mathematical Modeling                      |       |
MA 453 Fourier Analysis                           |       |
MA 485 Probability                                |       |
ME 360 Introduction to Mechatronic Systems Engineer |     |
ME 370 Kinematics and Dynamics of Machinery       |       |
ME 371 Machine Design                             |       |
ME 464 Introduction to Finite Element Method      |       |
MSE 281 Physical Materials I                      |       |
& 281L and Physical Materials I Laboratory        |       |
Biomedical Engineering

MSE 380 Thermodynamics of Materials
MSE 401 Materials Processing
MSE 430 Polymeric Materials
& 430L Polymeric Materials Laboratory
PH 475 Introduction to Biophysics I
PH 487 Nanoscale Science and Applications
RHB 400 Introduction to Rehabilitation Science

**Total Hours**: 104

1. A maximum of 3 hours of combined credit from BME 289, BME 389, and/or BME 489 may be applied to the degree.
2. With approval of the BME Undergraduate Program Director; a maximum of 3 hours of BME 491 or BME 494 may be used for elective credit.
3. Student must be enrolled in BME Honors Program.
4. Other elective courses may be selected with the approval of the BME Undergraduate Program Director.
5. Students may also replace EGR 265 and a math/science elective with MA 227 and MA 252.
6. 128 hours minimum for BSBME degree.

**Residency Requirement**

In addition to UAB’s residency requirement, to earn a bachelor of science in biomedical engineering from UAB, the BME department requires that students complete the following courses at UAB:

**Requirements**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME 423</td>
<td>3</td>
</tr>
<tr>
<td>BME 498</td>
<td>3</td>
</tr>
<tr>
<td>BME 499</td>
<td>3</td>
</tr>
<tr>
<td>Additional 400-level BME Elective</td>
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</tr>
<tr>
<td><strong>Total Hours</strong></td>
<td>12</td>
</tr>
</tbody>
</table>

**Concentration in Biomechanics**

Students seeking the degree of BSBME may add a concentration in Biomechanics by appropriate selection of their Mathematics/Science/Engineering Electives (3 credit hours), Engineering Elective (3 credit hours), and BME Electives (6 credit hours).

**Requirements**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME 471</td>
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</tr>
<tr>
<td>BME 617</td>
<td>3</td>
</tr>
<tr>
<td>ME 464</td>
<td>3</td>
</tr>
<tr>
<td>RHB 490</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Hours</strong></td>
<td>12</td>
</tr>
</tbody>
</table>

**Concentration in Biomaterials/Tissue Engineering**

Students seeking the degree of BSBME may add a concentration in Biomaterials/Tissue Engineering by appropriate selections of their Mathematics/Science/Engineering Elective (3 credit hours), Engineering Elective (3 credit hours), and BME Electives (6 credit hours).

**Requirements**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME 420</td>
<td>3</td>
</tr>
<tr>
<td>BME 435</td>
<td>3</td>
</tr>
</tbody>
</table>

**Elective Courses**

Select one of the following:

- BY 311 Molecular Genetics
- BY 330 Cell Biology
- BY 431 Principles of DNA Technology
- MSE 381 Physical Materials II
- MSE 382 Mechanical Behavior of Materials
- MSE 401 Materials Processing
- MSE 408 Nanobiomaterials
- MSE 413 Composite Materials
- MSE 430 Polymeric Materials
- MSE 464 Metals and Alloys
- MSE 470 Ceramic Materials
- MSE 484 Electronic, Magnetic, and Thermal Prop of Materials
- PH 487 Nanoscale Science and Applications

**Total Hours**: 13

Please refer to the School of Engineering Overview for School policies related to admission, academic progress, reasonable progress toward degree, and graduation.

**Curriculum for the Bachelor of Science in Biomedical Engineering (BSBME)**

**Freshman**

<table>
<thead>
<tr>
<th>First Term</th>
<th>Hours</th>
<th>Second Term</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH 115</td>
<td>4</td>
<td>BY 123</td>
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</tr>
<tr>
<td>&amp; 115R</td>
<td></td>
<td>&amp; 123L</td>
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</tr>
<tr>
<td>&amp; CH 116</td>
<td></td>
<td>EGR 110</td>
<td>4</td>
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</tr>
<tr>
<td>MA 125</td>
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<td>&amp; 117R</td>
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<tr>
<td>&amp; 125L</td>
<td></td>
<td>&amp; CH 118</td>
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</tr>
<tr>
<td>ME 102</td>
<td>2</td>
<td>MA 126</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total Hours</strong></td>
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<td><strong>Total Hours</strong></td>
<td>16</td>
</tr>
</tbody>
</table>

**Sophomore**

<table>
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<th>First Term</th>
<th>Hours</th>
<th>Second Term</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BY 212</td>
<td>4</td>
<td>EGR 150</td>
<td>3</td>
</tr>
<tr>
<td>&amp; 212L</td>
<td></td>
<td>&amp; BME 210</td>
<td>3</td>
</tr>
<tr>
<td>&amp; 221L</td>
<td></td>
<td>&amp; CE 210</td>
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<tr>
<td>PH 221</td>
<td></td>
<td>&amp; 221L</td>
<td></td>
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<tr>
<td>MA 260</td>
<td>3</td>
<td>EE 312</td>
<td>3</td>
</tr>
<tr>
<td>MSE 280</td>
<td>3</td>
<td>PH 222</td>
<td>4</td>
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<tr>
<td>&amp; 222L</td>
<td></td>
<td>&amp; 222R</td>
<td></td>
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<tr>
<td><strong>Total Hours</strong></td>
<td>18</td>
<td><strong>Total Hours</strong></td>
<td>16</td>
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</tbody>
</table>

**Junior**

<table>
<thead>
<tr>
<th>First Term</th>
<th>Hours</th>
<th>Second Term</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME 310</td>
<td>3</td>
<td>BME 333</td>
<td>3</td>
</tr>
<tr>
<td>BME 312</td>
<td>3</td>
<td>BME 350</td>
<td>3</td>
</tr>
<tr>
<td>BME 313</td>
<td>3</td>
<td>BME 423</td>
<td>3</td>
</tr>
<tr>
<td>BME 370</td>
<td>3</td>
<td>3 Biomedical Engineering Elective</td>
<td>3</td>
</tr>
</tbody>
</table>
Prerequisites:
- Physical, chemical and mechanical properties of biomaterials. BME 310. Biomaterials. 3 Hours. Grade: C or
- have sophomore standing. Undergraduate research experiences in biomedical engineering. Must
- innovation in the context of a business proposal/presentation. clinical innovation and develop skills in written and oral communication of
- The goals of this class are to develop an understanding of the concept of
- Application of engineering to the study of biology on the cellular and
- The goals of this class are to develop an understanding of the concept of
- Application of mechanics of solids principles to biomedical engineering
- MA 252
- Basic mechanisms and mathematical analysis of transport processes
- Basic mechanisms and mathematical analysis of transport processes
- An introduction to instrumentation used to make biological and physiological measurements. Techniques include acquisition and analysis of bioelectric signals and instrument control.
- Application of mechanics of solids principles to biomedical engineering problems; stress-strain of bone, viscoelasticity and constitutive equations of tissues, mechanics of the cell, introduction to molecular mechanics.
- Basic mechanisms and mathematical analysis of transport processes with biological and biomedical applications. Analysis of flow, transport and reaction processes for biological fluids and biological molecules with applications towards development of artificial organs, drug delivery systems and tissue engineering products.
- Integrated Physiology will introduce undergraduate students to
- Undergraduate research experiences in biomedical applications. Physical, chemical and mechanical properties of biomaterials. Prerequisites: MSE 280 [Min Grade: C] and BME 210 [Min Grade: C]
- Introduction to computational techniques used in biomedical engineering. Prerequisites: EGR 150 [Min Grade: C] and EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C]) and MA 260 [Min Grade: C] (Can be taken Concurrently)
- An introduction to instrumentation used to make biological and physiological measurements. Techniques include acquisition and analysis of bioelectric signals and instrument control.

Courses

**BME 011. Undergraduate Internship in BME. 0 Hours.**
Engineering internship experience in preparation for the student's intended career. Students in a university recognized cooperative education experience should register for COP 011 or COP 012.

**BME 210. Engineering in Biology. 3 Hours.**
Application of engineering to the study of biology on the cellular and molecular level. Engineering solutions in genomics, proteomics, and nanotechnology to investigate cellular and molecular process. Prerequisites: BY 123 [Min Grade: C]

**BME 221. Clinical Innovation I. 3 Hours.**
The goals of this class are to develop an understanding of the concept of clinical innovation and develop skills in written and oral communication of innovation in the context of a business proposal/presentation.

**BME 289. Undergraduate Research in Biomedical Engineering I. 1 Hour.**
Undergraduate research experiences in biomedical engineering. Must have sophomore standing. Prerequisites: EGR 200 [Min Grade: C] or EGR 111 [Min Grade: C] or HC 111 [Min Grade: C] or HC 120 [Min Grade: C] and (MA 125 [Min Grade: C] or MA 225 [Min Grade: C])

**BME 310. Biomaterials. 3 Hours.**
Introduction to wide range of materials used for biomedical applications. Physical, chemical and mechanical properties of biomaterials. Prerequisites: MSE 280 [Min Grade: C] and BME 210 [Min Grade: C]
BME 423. Living Systems Analysis and Biostatistics. 3 Hours.
Basic concepts and techniques of measurement processing and analysis of data from living systems. Statistics, analysis of variance and regression analysis. Emphasis is placed on data analysis and presentation of group projects.
Prerequisites: BME 312 [Min Grade: C]

BME 424. Current Topics in Stem Cell Engineering. 3 Hours.
This course is designed for students interested in the field of stem cells, regenerative medicine, and tissue engineering using stem cells and stem cell derived cells. The course will introduce the role of stem cells in tissue growth and development, the theory behind the design and in vitro construction of tissue and organ replacements, and the applications of biomedical engineering principles to the treatment of tissue-specific diseases. Students will have hands on experience on culturing and analyzing stem cells, stem cell differentiation, analysis of functional and physiological properties of differentiated cells, and fabricating basic engineered-tissues.
Prerequisites: BY 123 [Min Grade: C] and (BY 210 [Min Grade: C] or BY 212 [Min Grade: C] or BY 115 [Min Grade: C])

BME 435. Tissue Engineering. 3 Hours.
Principles underlying strategies for regenerative medicine such as stem-cell based therapy, scaffold design, proteins or genes delivery, roles of extracellular matrix, cell-materials interactions, angiogenesis, tissue transplantation, mechanical stimulus and nanotechnology.
Prerequisites: BME 310 [Min Grade: C] or BME 311 [Min Grade: C]

BME 443. Medical Image Processing. 3 Hours.
Fundamental topics of medical image processing to practical applications using conventional computer software.
Prerequisites: BME 312 [Min Grade: C](Can be taken Concurrently) and PH 222 [Min Grade: C]

BME 444. Machine Learning for Biomedical Engineering Applications. 3 Hours.
This course provides the introduction to the practical aspects of machine learning such that the students can apply some basic machine learning techniques in simple biomedical engineering problems. The course also provides the principle of machine learning ‘thinking process’ for the next machine learning – AI courses and more in-depth machine learning studies. By ’thinking process’, at the beginning, it is better to view machine learning like human learning. Students who have experience with Data Mining may further understand the fundamental differences between Machine Learning and Data Mining, although these two fields share many concepts and techniques. Also, the student will learn fundamental theories in machine learning to be able to develop new machine learning techniques and research machine learning in biomedical engineering.
Prerequisites: EGR 150 [Min Grade: C]

BME 450. Computational Neuroscience. 3 Hours.
This course examines the computational principles used by the nervous system. Topics include: biophysics of axon and synapse, sensory coding (with an emphasis on vision and audition), planning and decision-making, and synthesis of motor responses. There will be an emphasis on systems approach throughout. Homework includes simulations.
Prerequisites: BME 312 [Min Grade: C]

BME 461. Bioelectric Phenomena. 3 Hours.
Quantitative methods in electrophysiology with focus on using simulations to examine responses in electrically excitable cell types.
Prerequisites: BME 312 [Min Grade: C]

BME 462. Cardiac Electrophysiology. 3 Hours.
Experimental and computational method on cardiac electrophysiology, ionic current, action potentials, electrical propagation, the electrocardiogram, electromechanical coupling, cardiac arrhythmias, effects of electric fields in cardiac tissue, defibrillation and ablation.
Prerequisites: BME 312 [Min Grade: C]

BME 471. Continuum Mechanics of Solids. 3 Hours.
Matrix and tensor mathematics, fundamentals of stress, momentum principles, Cauchy and Piola-Kirchhoff stress tensors, static equilibrium, invariance, measures of strain, Lagrangian and Eulerian formulations, Green and Almansi strain, deformation gradient tensor, infinitesimal strain, constitutive equations, finite strain elasticity, strain energy methods, 2-D Elasticity, Airy Method, viscoelasticity, mechanical behavior of polymers.
Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C]) and (BME 333 [Min Grade: C] or CE 220 [Min Grade: C])

BME 472. Industrial Bioprocessing and Biomanufacturing. 3 Hours.
This course will introduce students to the growing industries related to biomedical, biopharmaceutical and biotechnology. It is targeted to offer the students marketable skills to work in a vital area of economic growth and also convey some of the challenges and opportunities awaiting.
Prerequisites: BME 310 [Min Grade: C](Can be taken Concurrently)

BME 489. Undergraduate Research in Biomedical Engineering Ill. 1-2 Hour.
Undergraduate research experiences in biomedical engineering. Must have senior standing.

BME 490. Special Topics in Biomedical Engineering. 1-3 Hour.
Special Topic in Biomedical Engineering.

BME 491. Individual Study in Biomedical Engineering. 1-6 Hour.
Individual Study in Biomedical Engineering.

BME 494. Honors Research I. 1-3 Hour.
Research experiences for undergraduates enrolled in the departmental honors program. The student should write a proposal and make a presentation based on the proposal.
Prerequisites: EGR 301 [Min Grade: C] or STH 201 [Min Grade: C]

BME 495. Honors Research II. 1-3 Hour.
Research opportunities for undergraduate students in the Biomedical Engineering Honors Program. Research areas include cardiac electrophysiology, brain imaging, biomedical implants, and tissue engineering.
Prerequisites: BME 494 [Min Grade: C]

BME 496. Biomedical Engineering Honors Seminar. 1 Hour.
Must be enrolled in an Honors Program.
BME 498. Capstone Design I Product Development. 3 Hours.
Design and development of medical-products. Through experiential learning, students go through the early phases of engineering design innovation for medical products, starting with clinical immersion to determine a critical health-care need. Engineering students work in multi-disciplinary teams that include students from the School of Business to develop design concepts for both a client-based prototype and a commercializable version. Designs take into account client needs as well as legal, regulatory, and marketing requirements. Business ethics are also covered. Emphasis is placed on communication in both oral and written format to targeted audiences.

Prerequisites: (BME 310 [Min Grade: C] and BME 312 [Min Grade: C]) or (BME 310 [Min Grade: C] and BME 313 [Min Grade: C]) or (BME 310 [Min Grade: C] and BME 333 [Min Grade: C]) or (BME 310 [Min Grade: C] and BME 350 [Min Grade: C]) or (BME 312 [Min Grade: C] and BME 313 [Min Grade: C]) or (BME 312 [Min Grade: C] and BME 333 [Min Grade: C]) or (BME 312 [Min Grade: C] and BME 350 [Min Grade: C]) or (BME 313 [Min Grade: C] and BME 333 [Min Grade: C]) or (BME 313 [Min Grade: C] and BME 350 [Min Grade: C]) or (BME 333 [Min Grade: C] and BME 350 [Min Grade: C]) or (BME 370 [Min Grade: C])

BME 499. Capstone Design II. 3 Hours.
Capstone design project; a continuation of BME 498. Through experiential learning, student teams complete the engineering design process for their client-based prototype incorporating engineering standards and realistic constraints. Student teams develop a business plan to present to potential business partners and product development teams from established companies. Additional skills learned in this part of the design process include: development of business proposals, project planning and scheduling, project execution and resource scheduling, communication of design, and interim and final design reviews. Emphasis is placed on communication of design and design justification in both an oral and written format to targeted audiences.

Prerequisites: BME 498 [Min Grade: C] and BME 310 [Min Grade: C] and BME 312 [Min Grade: C] and BME 313 [Min Grade: C] and BME 333 [Min Grade: C] (Can be taken Concurrently) and BME 350 [Min Grade: C] (Can be taken Concurrently) and BME 423 [Min Grade: C] (Can be taken Concurrently)