

BIOMECHANICAL ENGINEERING UNDERGRADUATE MAJOR

COVID-19-Related Degree Requirement Changes

Grading

The Biomechanical Engineering program counts all courses taken in academic year 2020-21 with a grade of 'CR' (credit) or 'S' (satisfactory) towards satisfaction of undergraduate degree requirements that normally require a letter grade.

Other Undergraduate Policies

The Biomechanical Engineering program encourages students to take courses for letter grades when possible in order to have complete records for use when seeking future opportunities, including employment in industry and students seeking to apply for graduate studies. Per University policy, students can change grading basis through the end of Week 8 in all four quarters in 2020-21. Students are encouraged to reach out directly to Biomechanical Engineering Program Director, Marc Elliot Levenston <levenston@stanford.edu>, for questions about petitions, especially in situations related to COVID-19 policies and grading basis

Biomechanical Engineering (BME)

Completion of the undergraduate program in Biomechanical Engineering leads to the conferral of the Bachelor of Science in Engineering. The subplan "Biomechanical Engineering" appears on the transcript and on the diploma.

Mission of the Undergraduate Program in Biomechanical Engineering

The mission of the undergraduate program in Biomechanical Engineering is to help students address health science challenges by applying engineering mechanics and design to the fields of biology and medicine. The program is interdisciplinary in nature, integrating engineering course work with biology and clinical medicine. Research and teaching in this discipline focus primarily on neuromuscular, musculoskeletal, cardiovascular, and cell and tissue biomechanics. This major prepares students for graduate studies in bioengineering, biomechanics, medicine or related areas.

Requirements

	Units
Mathematics	21
21 units minimum; CME sequence is recommended, but MATH sequence is acceptable; see Basic Requirement 1 ¹	
CME 102/ ENGR 155A	Ordinary Differential Equations for Engineers
or MATH 53	Ordinary Differential Equations with Linear Algebra
Select one of the following:	
CME 106/ ENGR 155C	Introduction to Probability and Statistics for Engineers
STATS 110	Statistical Methods in Engineering and the Physical Sciences
STATS 116	Theory of Probability
STATS 141	Biostatistics
Science (22 units Minimum)	
CHEM 31M	Chemical Principles: From Molecules to Solids (or CHEM 31A & CHEM 31B)

PHYSICS 41	Mechanics	4
Biology or Human Biology A/B core courses ²		8-10
BIO 45	Introduction to Laboratory Research in Cell and Molecular Biology	4
or BIOE 44	Fundamentals for Engineering Biology Lab	

Technology in Society

One course required; BIOE 131 satisfies both TiS and WIM requirements. TiS course must be on School of Engineering Approved Courses list in the UGHB the year taken

Engineering Topics (Engineering Science and Design)

Engineering Fundamentals (minimum two courses; see Basic Requirement 3):

ENGR 14	Intro to Solid Mechanics	3
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Pick one of the following:

ENGR 80	Introduction to Bioengineering (Engineering Living Matter)	
ENGR 50M	Introduction to Materials Science, Biomaterials Emphasis	

Engineering Depth

ENGR 15	Dynamics	3
ME 30	Engineering Thermodynamics	3
ME 70	Introductory Fluids Engineering	3
ME 80	Mechanics of Materials	3
ME 389	Biomechanical Research Symposium ⁴	1

Mechanical Engineering/ Biomechanical Engineering Depth

Students are encouraged to carefully select ME and BME depth courses that complement each other and form a cohesive plan of study.

Options to complete the ME depth sequence (3 courses, minimum 9 units):⁵

ENGR 105	Feedback Control Design	
ME 102	Foundations of Product Realization	
ME 103	Product Realization: Design and Making	
ME 104	Mechanical Systems Design	
ME 131	Heat Transfer	
ME 133	Intermediate Fluid Mechanics	
ME 151	Introduction to Computational Mechanics	
ME 152	Material Behaviors and Failure Prediction	
ME 161	Dynamic Systems, Vibrations and Control	

Options to complete the BME depth sequence (3 courses, minimum 9 units); (alternative courses may be allowed but only if petitioned for use in advance of being taken)⁵

BIOE 260	Tissue Engineering	
BIOE/ME 285	Computational Modeling in the Cardiovascular System	
ME 234	Introduction to Neuromechanics	
ME 281	Biomechanics of Movement	
ME 283	Introduction to Biomechanics and Mechanobiology	
ME 287	Mechanics of Biological Tissues	
ME 337	Mechanics of Growth	

Total Units 79-83

¹ Math: 21 units required and must include a course in differential equations (CME 102 or MATH 53; one of these required) and a course in calculus-based Statistics (CME 106 Introduction to Probability and Statistics for Engineers or STATS 110 Statistical Methods in Engineering and the Physical Sciences or STATS 116 Theory of Probability or STATS 141 Biostatistics).

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- 2 Students satisfy the Biology requirement by either:
- taking two of the following: BIO 82 Genetics , BIO 83 Biochemistry & Molecular Biology, BIO 84 Physiology or BIO 86 Cell Biology requires BIO 83); or
 - taking two of the following: HUMBIO 2A Genetics, Evolution, and Ecology, HUMBIO 3A Cell and Developmental Biology, or HUMBIO 4A The Human Organism

- 3 There are two options for fulfilling the WIM requirement. The first option is to complete BIOE 131 Ethics in Bioengineering, which also fulfills the TiS requirement. The second option is to perform engineering research over the summer or during the academic year and enroll in 3 units of ENGR 199W Writing of Original Research for Engineers, preferably during the time a student is performing research or the following quarter, to write a technical report on the research. This second option requires an agreement with the student's faculty research supervisor.

- 4 If ME 389 is not offered, other options include BIOE 393, ME 571, or course by petition.

- 5 Courses may only be listed once on the program sheet i.e no double counting. All courses taken for the major must be taken for a letter grade if that option is offered by the instructor. Minimum combined GPA for all courses in Engineering Fundamentals and Depth is 2.0.

- Present the thesis at the Mechanical Engineering Poster Session held in mid-April. If the poster session is not offered or the student does not confer in the Spring, an alternative presentation will be approved on a case by case basis with advisor and BME Program Director approval.

Note: Students may not use work completed towards an honors degree to satisfy BME course requirements

For additional information and sample programs see the Handbook for Undergraduate Engineering Programs (UGHB) (<http://ughb.stanford.edu>).

Honors Program

The School of Engineering offers a program leading to a Bachelor of Science in Engineering: Biomechanical Engineering with Honors. This program provides an opportunity for qualified BME majors to conduct independent study and research related to biomechanical engineering at an advanced level with a faculty mentor.

Honors Criteria:

- GPA of 3.5 or higher in the major
- Arrangement with an ME faculty member (or a faculty member from another department who is approved by the BME Undergraduate Program Director) who agrees to serve as the honors adviser, plus a second faculty member who reads and approves the thesis. The honors adviser must be a member of the Academic Council in the School of Engineering.
- Submit an application to the ME student services office no later than the second week of the term two quarters before anticipated conferral (e.g., Autumn for Spring conferral, Spring for Autumn conferral). An application consists of:
 - A one-page written statement describing the research topic, with signatures indicating approval of both the thesis adviser and thesis reader on a cover page
 - An unofficial Stanford transcript;
- Applications are subject to the review and final approval by the BME Undergraduate Program Director. Applicants and thesis advisers receive written notification when a decision has been made.
- In order to graduate with honors:
 - Declare ENGR-BSH (honors) program in Axxess
 - Maintain 3.5 GPA
 - Submit a completed thesis draft to the adviser by the third week of the quarter in which they intend to confer. Further revisions and final endorsement by the adviser and reader are to be finished by week six, when two bound copies are to be submitted to the Mechanical Engineering student services office. A pdf of the thesis, including the signature page signed by both readers, should also be submitted to the student services officer. Students are sent email instructions on how to archive a permanent electronic copy in Terman Engineering library.