Department of Biomedical Engineering
Undergraduate Handbook

2015-2016

Last Updated: July 6, 2015

Department of Biomedical Engineering
University of Arkansas
120 John A. White Jr. Engineering Hall
Fayetteville, Arkansas 72701

*This document is intended to be a guide to students in the biomedical engineering program. Students should refer to the University Catalog of Studies for official degree requirements.
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Introduction

**Biomedical engineering** encompasses the creation, design, and operation, of processes / technology related to the broad field of human healthcare. The profession traditionally has focused on applications related to the development of instrumentation and diagnostic equipment, discovery of novel treatment options, production of new therapeutics, and the elucidation of underlying biophysical phenomena. Newer applications of biomedical engineering take advantage of the ever deepening understanding of human physiology and molecular genetics, as related to prevention, detection, and treatment of medical conditions.

The **program objectives** of the Biomedical Engineering undergraduate program are to produce graduates who are capable of:

- succeeding in the practice of engineering or other professional activities, and
- succeeding in post baccalaureate studies.

 Completion of the degree requirements provides for the following **educational outcomes**:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- an ability to function on multidisciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in global, economic, environmental, and societal contexts
- a recognition of the need for, and an ability to engage in life-long learning
- a knowledge of contemporary issues
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

These educational outcomes are experienced within the context of biology and physiology appropriate to solving problems at the interface of engineering and biology.
Faculty

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Facilities

Engineering Research Center (ENRC)
State-of-the art research facilities of our faculty are located in the Engineering Research Center (ENRC) at 535 W Research Center Blvd, approximately 2 miles south from the main campus. Shuttles are available for travel back and forth from BELL to ENRC. Please refer to the shuttle schedule for more information.

BMEG Teaching Laboratory
BMEG Teaching Laboratory is located at ENGR 119, and is used for BMEG laboratory courses such as Bioinstrumentation, Biomaterials, Biomolecular Engineering, Systems and Signals Analysis and Biomedical Microscopy.

BMEG Design Laboratory
BMEG Design Laboratory is located at ENGR 113, and is used by students enrolled in Biomedical Design Courses. The laboratory is fully equipped with the resources needed to design, fabricate and test biomedical prototypes.

BMEG Computer Lab
BMEG Computer Lab is located at ENGR 109, and is available for all BMEG students to use during and after hours

vLab
Students can access latest versions of several computer lab software (e.g. MATLAB) virtually from any computer through vLab, a virtual Windows desktop provided by the IT services. Please refer to the website (http://vlab.uark.edu/) for instructions and a list of available software.
# Biomedical Engineering Curriculum

## Catalog Required Biomedical Engineering Curriculum

### Freshman Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Spring Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENG 1111 Introduction to Engineering I</td>
<td>GENG 1121 Introduction to Engineering II</td>
</tr>
<tr>
<td>MATH 2554 Calculus I</td>
<td>MATH 2564 Calculus II</td>
</tr>
<tr>
<td>CHEM 1103 University Chemistry I</td>
<td>Freshman Science Elective with lab*</td>
</tr>
<tr>
<td>PHYS 2054 University Physics I</td>
<td>HIST 2003 or HSIT 2013 or PLSC 2003</td>
</tr>
<tr>
<td>ENGL 1013 English Composition I</td>
<td>ENGL 1023 English Composition II</td>
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<td>15</td>
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</tbody>
</table>

### Sophomore Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Spring Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMG 2613 Introduction to BME</td>
<td>BMG 2813 Biomechanical Engineering</td>
</tr>
<tr>
<td>Sophomore Science Elective with Lab**</td>
<td>BMG 2904 Biomedical Instrumentation</td>
</tr>
<tr>
<td>MATH 2574 Calculus III</td>
<td>MATH 2584 Differential Equations</td>
</tr>
<tr>
<td>BIOL 1543/41L Principles of Biology</td>
<td>BIOL 2533 Cell Biology</td>
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<tr>
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<td>Fine Arts Elective</td>
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### Junior Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Spring Semester</th>
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<tbody>
<tr>
<td>BMG 3634 Biomaterials</td>
<td>BMG 3653 Biomed. Model. &amp; Num. Methods</td>
</tr>
<tr>
<td>BMG 3124 Biomed Systems &amp; Signal Analysis</td>
<td>BMG 3824 Biomolecular Engineering</td>
</tr>
<tr>
<td>CHEM 3603/01L Organic Chemistry I</td>
<td>CHEG2133 or MEEG 3503 Fluid Mechanics</td>
</tr>
<tr>
<td>CHEG 2313 or MEEG 2403 Thermodynamics</td>
<td>CHEM 3613/11L Organic Chemistry II</td>
</tr>
<tr>
<td>Social Science Elective</td>
<td>BIOL 2213/11L Human Physiology</td>
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<td>18</td>
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</tbody>
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### Senior Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Spring Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMG 4813 Biomedical Engineering Design I</td>
<td>BMG 4823 Biomedical Engineering Design II</td>
</tr>
<tr>
<td>BMG 4623 Biomedical Transport Phenomena</td>
<td>BMG Elective</td>
</tr>
<tr>
<td>BMG Elective</td>
<td>BMG Elective</td>
</tr>
<tr>
<td>Science Elective</td>
<td>Humanities Elective</td>
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</tbody>
</table>

*The Freshman Engineering Science Elective must be chosen from either CHEM 1123/1121L or PHYS 2074.

**The Sophomore Science Elective must be PHYS 2074 (if CHEM 1123/1121L was chosen as the Freshman Engineering Science Elective) or CHEM 1123/1121L (if PHYS 2074 was chosen as the Freshman Engineering Science Elective. That is, both courses are required for the degree)*
# Pre-Med/Recommended Biomedical Engineering Curriculum

## Freshman Year

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## Sophomore Year

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<tbody>
<tr>
<td>BMEG 2613 Introduction to BME</td>
<td>BMEG 2813 Biomechanical Engineering</td>
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<td>PHYS 2074 University Physics II</td>
<td>BMEG 2904 Biomedical Instrumentation</td>
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<td>MATH 2574 Calculus III</td>
<td>MATH 2584 Differential Equations</td>
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<td>BMEG 3824Biomolecular Engineering</td>
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<td>CHEG2133 or MEEG 3503 Fluid Mechanics</td>
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<td>BIOL 2213/1L Human Physiology</td>
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<td>BMEG 4623 Biomedical Transport Phenomena</td>
<td>BMEG Elective</td>
</tr>
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<td>BMEG Elective</td>
<td>Humanities Elective</td>
</tr>
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<td>BMEG Elective</td>
<td>Social Science Elective</td>
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<td>Social Science Elective</td>
<td>HIST 2003 or HSIT 2013 or PLSC 2003</td>
</tr>
<tr>
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</tr>
</tbody>
</table>
Science Electives
BIOL 2323 General Genetics (Fa)  
BIOL 2443 Human Anatomy (Sp, Su, Fa)  
BIOL 2013 General Microbiology (Sp, Su, Fa)  
BIOL 4263 Cell Physiology (Fa)  
BIOL 4313 Molecular Cell Biology (Sp)  
BIOL 4653 Cancer Biology (Fa)  
BIOL 4713 Basic Immunology (Sp);  
CHEM 2263 Analytical Chemistry (Sp, Fa)  
CHEM 2613 Organic Physiological Chemistry (Sp, Su)  
CHEM 3203 Forensic Chemistry (Fa)  
CHEM 3453 Elements of Physical Chemistry (Fa)  
CHEM 2613 Organic Physiological Chemistry (Sp, Su)  
CHEM 3504 Physical Chemistry I (Fa)  
CHEM 3514 Physical Chemistry II (Sp)  
CHEM 3813 Introduction to Biochemistry (Su, Fa)  
CHEM 4813H Honors Biochemistry I (Fa)  
CHEM 4843H Honors Biochemistry II (Sp)

BMEG Electives
BIOL 4167 Dynamic Models in Biology (Irr)  
BIOL 4233 Genomics and Bioniformatics (Sp)  
BMEG 4504 Biomedical Microscopy (Irr)  
BMEG 4243 Advanced Biomaterials and Biocompatibility (Sp)  
BMEG 4103L/M Nanotechnology Laboratory (Fa)  
BMEG 4213 Cell and Tissue Mechanics (Irr)  
BMEG 4413 Tissue Engineering (Irr)  
BMEG 470V Special Topics in Biomedical Engineering (Irr) : Varies by semester  
BMEG 460V Individual Study *  
BMEG 460VH Honors Individual Study *  
BMEG 450VH Honors Thesis*  
Biomedical engineering-related courses in College of Engineering (4000 or above) approved by advisor and undergraduate coordinator  
* Between BMEG 460V, 460VH and 450VH, up to 3 hours total may be counted towards a BMEG elective requirement.
Fine Arts, Humanities Requirement (6 hours)
Select 3 hours each from categories “a” and “b"

**a. Fine Arts:**
- ARCH 1003 Basic Course in the Arts: Architecture Lecture
- ARHS 1003 Basic Course in the Arts: Art Lecture
- COMM 1003 Basic Course in the Arts: Film Lecture
- DANC 1003 Basic Course in the Arts: Movement and Dance
- DRAM 1003 Theater Appreciation
- LARC 1003 Basic Course in the Arts: The American Landscape
- MLIT 1003 Basic Course in the Arts: Music Lecture
- MLIT 1013 Music Lecture for Music Majors

**b. Humanities**
- Any intermediate I foreign language*
- ARCH 1013 Diversity and Design
- CLST 1003 Intro to Classical Studies: Greece
- CLST 1013 Intro to Classical Studies: Rome
- COMM 1233 Media, Community and Citizenship
- HUMN 1124H Honors Equilibrium of Cultures, 500-1600
- HUMN 2003 Intro to Gender Studies
- HUMN 2124H Honors Twentieth Century Global Culture
- PHIL 2003 Intro to Philosophy
- PHIL 2103 Intro to Ethics
- PHIL 2203 Logic
- PHIL 3103 Ethics and the Professions
- WLIT 1113 World Literature I
- WLIT 1123 World Literature I

*Typically numbered 2003. See Department of World Languages, Literatures and Cultures in the J. William Fulbright College of Arts and Sciences chapter in the Undergraduate Catalog.

Social Sciences Requirement (9 hours)
Select from at least two different fields of study

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGEC 1103</td>
<td>Principles of Agricultural Microeconomics</td>
</tr>
<tr>
<td>AGEC 2103</td>
<td>Principles of Agricultural Macroeconomics</td>
</tr>
<tr>
<td>ANTH 1023</td>
<td>Intro to Cultural Anthropology</td>
</tr>
<tr>
<td>COMM 1023</td>
<td>Communication in a Diverse World</td>
</tr>
<tr>
<td>ECON 2013</td>
<td>Principles of Macroeconomics</td>
</tr>
<tr>
<td>ECON 2023</td>
<td>Principles of Microeconomics</td>
</tr>
<tr>
<td>ECON 2143</td>
<td>Basic Economics: Theory and Practice</td>
</tr>
<tr>
<td>GEOG 1123</td>
<td>Human Geography</td>
</tr>
<tr>
<td>GEOG 2003</td>
<td>World Regional Geography</td>
</tr>
<tr>
<td>HESC 1403</td>
<td>Life Span Development</td>
</tr>
<tr>
<td>HESC 2413</td>
<td>Family Relations</td>
</tr>
<tr>
<td>HIST 1113</td>
<td>Institutions and Ideas of World Civilizations I</td>
</tr>
<tr>
<td>HIST 1123</td>
<td>Institutions and Ideas of World Civilizations II</td>
</tr>
<tr>
<td>HIST 2003</td>
<td>History of the American People to 1877**</td>
</tr>
<tr>
<td>HIST 2013</td>
<td>History of the American People 1877 to Present**</td>
</tr>
<tr>
<td>HUMN 1114H</td>
<td>Honors Roots of Culture to 500 C.E.</td>
</tr>
<tr>
<td>HUMN 2114H</td>
<td>Honors Birth of Modern Culture, 1600-1900</td>
</tr>
<tr>
<td>PLSC 2003</td>
<td>American National Government**</td>
</tr>
<tr>
<td>PLSC 2013</td>
<td>Intro to Comparative Politics</td>
</tr>
<tr>
<td>PLSC 2203</td>
<td>State and Local Government</td>
</tr>
<tr>
<td>PSYC 2003</td>
<td>General Psychology</td>
</tr>
<tr>
<td>RESM 2853</td>
<td>Leisure and Society</td>
</tr>
<tr>
<td>RSOC 2603</td>
<td>Rural Sociology</td>
</tr>
<tr>
<td>SOCI 2013</td>
<td>General Sociology</td>
</tr>
<tr>
<td>SOCI 2033</td>
<td>Social Problems</td>
</tr>
</tbody>
</table>

** If not selected to meet the three hours of U.S. History requirement

Please refer to the [Undergraduate Course Catalog](#) for more complete information on degree requirements and academic policy.
Biomedical Engineering Curriculum Flowchart
Please refer to the Student Resources section on the BMEG departmental website for the most up-to-date curriculum flowchart.

Advising Procedures
At the beginning of the sophomore year, each student is assigned an adviser to help select courses that fit within the required program of study and to assure that courses are taken in the appropriate sequence. Prior to registering for the next semester, each student must meet with his/her adviser to go over the progress and to select courses. Students will not be able to register unless their adviser removes the advising hold in ISIS.

Procedures to complete before seeing your adviser:

1. Fill out/update your Biomedical Engineering Undergraduate Advising Sheet with all course credits you have earned. Bring this form to advising. It will be submitted to the adviser at advising.
2. Refer to the Biomedical Engineering Undergraduate Flow Chart and select courses for next semester and enter these into the Advising Sheet. Look up courses in ISIS and/or the Undergraduate Course Catalog for a complete, up-to-date listing of pre-requisites and co-requisites.
3. Using ISIS, access the Schedule of Classes and prepare a trial schedule. Make sure required course pre-requisites are complete and that you sign up for course co-requisites.
4. In ISIS, check your assigned advisor before your advising session.
5. Check the group advising schedule provided by the Program Coordinator by email and plan on attending one of the sessions. It is strongly suggested that students attend a group advising session to ensure that their advising holds are removed in time for registration.
6. If you are unable to attend the group advising sessions, contact your assigned adviser to schedule an individual appointment ASAP. Do not wait until the last minute to contact your adviser.
7. Remember that all registration holds (negative service indicators) must be removed before you can register. Such holds include advising holds but can also be financial holds from Parking and Transit, Student Health Center, or the Treasurer’s Office. Once all holds are removed, you may register in ISIS during your assigned registration period.

Academic advising is a service provided by the University to assist students in making thoughtful decisions related to their academic experiences, and maximizing their educational and career opportunities. Our faculty advisers do their best to work with you, but remember that the student possesses the final responsibility for successful completion of a degree.
Registration

ISIS
The University requires students to use ISIS to view the schedule of classes and to register for classes. For assistance with ISIS for registration, contact the Registrar’s Office (575-5451) or ISIS help.

Registration periods
Students must register during one of the formal registration periods. Visit ISIS to view your available registration dates.

Schedule Changes and Add/Drop
Students can make changes to their schedules (add and/or drop courses) using ISIS during the first five class days of the semester. A student may drop a full-semester course during the first 10 class days without having the drop shown on the official academic record. After the first 10 class days, and before the drop deadline of the semester, a student may drop a course, but a mark of “W” (withdrawal) will be recorded. For fee refund schedules and add/drop deadlines for specific semesters, refer to the Academic Semester Calendar at the Registrar’s Office.

Registration Overrides
Students unable to register for Engineering courses due to pending transfer credits causing pre- and co-requisite conflicts, time conflicts or class full may be placed in a course upon case-by-case approval from the course instructor(s) and the undergraduate coordinator within the enrollment period.

If a student needs a temporary override to register for a BMEG course due to pre/co-requisites, class full, and/or instructor permission needed, the student should (for time conflict or non-BMEG courses, see next section):

1. Fill out and submit the Biomedical Engineering Online Course Override Form available through the Student Resources section of the BMEG departmental website.
2. Upon approval from the course instructor and the undergraduate coordinator, the student should be able to register for the course. It is the student’s responsibility to make sure that the credits for pre-requisite courses are transferred in time before the start of the semester. Pre- and co-requisite courses are checked at the beginning of the semester and students not meeting pre-requisites or co-requisites will be dropped from the enrolled course.

If a student needs an override to register for an Engineering course (outside of BMEG) or a BMEG course for reasons due to time conflict, the student should:

1. Fill out the College of Engineering Override Form. Obtain course information directly from ISIS and specifically indicate reason for override in “Comments” section in addition to checking all reasons that apply.
2. Contact the course instructor and obtain his/her approval and signature on the form.
3. Contact the undergraduate coordinator and obtain his/her approval and signature on the form in the section for Department Head’s Approval.
4. Submit the completed override form to the Student Records Office, BELL 3189.

Students that require override for courses outside the College of Engineering should contact the home department of the course for which they are enrolling and follow appropriate procedures required by the department.

Transfer/Study Abroad
- If you are transferring into BMEG from a different department/college/institution, please consult the undergraduate coordinator regarding your course transfers.
- If you wish to obtain credit for a class taken at another institution or by tests, you may look up course equivalencies on the Registrar’s website. Please discuss further questions with your adviser and/or the undergraduate coordinator.

Honors Program
The Honors Program in the Department of Biomedical Engineering is designed for high-ability students who are interested in more vigorous and in-depth academic challenges. In order to graduate from the Honors Program, students must take a minimum of 12 hours of honors courses, with at least 6 of the 12 hours in BMEG including BMEG 450VH Honors Thesis as an honors student in the Department of Biomedical Engineering. Below are the honors courses offered in the BMEG department of which one is required:

- BMEG 3653H Biomedical Modeling and Numerical Methods
- BMEG 3824H Biomolecular Engineering
- BMEG 4623H Biomedical Transport Phenomena

In addition to the honors coursework, honors students are required to complete an honors thesis research project under the direction of a faculty mentor. Please refer to the Biomedical Engineering Honors Program Handbook for more details regarding the requirements and benefits of the Honors Program.
Undergraduate Research
Opportunities are available for undergraduate BMEG students to participate in research. Students can participate through the Honors Program, as well as just by working with an individual faculty member. Refer to the BMEG departmental website for descriptions of research activities within the department. A student may get involved in research by contacting individual faculty members about their research program. Research funding and/or student stipends are available through resources such as SURF (Statewide Undergraduate Research Fellowships) and Honors College Undergraduate Research Grants through the Honors College. Refer to the Honors College website for more information.

Student Organizations

Biomedical Engineering Society (BMES)
Faculty Advisor: Dr. Kartik Balachandran (kbalacha@uark.edu)

The Biomedical Engineering Society at the University of Arkansas promotes the education and advancement of biomedical engineering by engaging members in insightful discussions and organized events. Its goals are to:

1. Introduce current research being conducted by UA professors as well as those from other institutions.
2. Explore professional opportunities in industry, medicine and academia.
3. Provide a networking platform for members to gain experience in biomedical engineering through internships.

Refer to http://www.uark.edu/rso/bmes/ or email at bmes@uark.edu for more information.