

**ADD, CHANGE OR DELETE UNIT, PROGRAM REQUIREMENTS, OR ACADEMIC POLICIES**

Complete this form consistent with the instructions in Academic Policy 1622.20. Use the form to add, change, or delete a program or unit or to change program policies. Proposed additions and changes must be consistent with Academic Policies 1100.40 and 1621.10 and any other policies which apply.

**SECTION I: Approvals**

Department / Program Chair	Date Submitted	Graduate Council Chair	Date
College Dean	Date	Faculty Senate Chair	Date
Honors College Dean	Date	Provost	Date
Core Curriculum Committee	Date	Board of Trustees Approval/Notification Date	
University Course and Programs Committee	Date	Arkansas Higher Education Coordinating Board Approval/Notification Date	

**SECTION II: Profile Data - Required Information and Name Change Information**

Academic Unit:  Major/Field of Study  Minor  Other Unit \_\_\_\_\_  Policy  
 Level:  Undergraduate  Graduate  Law Effective Catalog Year 2012

Program changes are effective with the next available catalog. See Academic Policy Series 1622.20

Current Name **BSBE, Biological Engineering**

College, School, Division **ENGR**

Department Code **BAEG**

Current Code (6 digit Alpha) **BENGBS**

Proposed Code (6 digit Alpha) \_\_\_\_\_

Prior approval from the Office of the Registrar is required.

Interdisciplinary Program

CIP Code **14.0301**

Prior assignment from Office of Institutional Research is required.

Proposed Name \_\_\_\_\_

When a program name is changed, enrollment of current students reflects the new name.

**SECTION III: Add a New Program/Unit**

For new program proposals, complete Sections II and VII and use as a cover sheet for a full program proposal as described in 'Criteria and Procedures for Preparing Proposals for New Programs in Arkansas.' ADHE  
[http://www.adhe.edu/divisions/academicaffairs/Pages/aa\\_academicproposals.aspx](http://www.adhe.edu/divisions/academicaffairs/Pages/aa_academicproposals.aspx)

Program proposal uses courses offered by another academic college, and that college dean's office has been notified. The signature of the dean of that academic college is required here: \_\_\_\_\_

**SECTION IV: Eliminate an Existing Program/Unit**

Code/Name \_\_\_\_\_ Effective Catalog Year \_\_\_\_\_

No new students admitted to program after Term: \_\_\_\_ Year: \_\_\_\_\_

Allow students in program to complete under this program until Term: \_\_\_\_ Year: \_\_\_\_\_

**SECTION V: Proposed Changes to an Existing Program or Program Policies**

Insert here a statement of the exact changes to be made:

**There are 8 specific changes to the BENGBS:**

**1) Eliminate options (concentrations): biomedical, ecological, biotechnology.**  
**(New program will have no concentrations.)**

**2) Add new required BENG Courses:** \_\_\_\_\_

**BENG 2632, Biological Engineering Design Studio (modification of BENG 2612)**

**BENG 2643, Biological Engineering Methods (modification of BENG 2622)**

**BENG 3653, Global Bio-Energy Engineering**

**BENG 3933, Watershed Sustainability**

**BENG 3733, Transport Phenomena (modification of BENG 4733)**

**BENG 3743, Food and Bio-Products Systems Engineering**

**BENG 4103, Measurements and Controls for Biological Systems (modification of BENG 3104)**

**BENG 4663, Sustainable Biosystems Design**

**3) Add Other Required Courses:**

**CVEG 3223, Hydrology**

**ELEG 3903, Electric Circuits Machines**

**BIOL 3863/61L, General Ecology w/ Lab**

**4) Eliminate Required Courses:**

**BENG 2612, Design Studio II**

**BENG 2622, Design Studio III**

**BENG 3104, Instrumentation**

**BENG 3712, Properties of Biological Materials**

**BENG 3803, Mechanical Design in Biological Engineering**

**BENG 4733, Kinetics and Transport Phenomena**

**GNEG 1122, Intro to CAD**

**MEEG 3013, Mechanics of Materials**

**5) Make Adjustment to Electives:**

**BENG Design Electives: 6 hours eliminated**

**Engineering Electives: 6 hours reduced to 3 hours**

**Technical Electives: 6 hours reduced to 3 hours**

**6) No longer require 6 hours of upper level Humanities/FineArts and Social Sciences, but will require 18 hour University core in the areas of Fine Arts/Humanities, U.S. History and Social Sciences, as per recent College of Engineering decision.**

**7) Allow either [CHEM 1103 OR CHEM 1113 (Chemistry for Engineers I)] and [CHEM 1123/1121L OR CHEM 1133/1131L (Chemistry for Engineers II)] for degree credit. This is in response to new courses developed by CHBC for engineering majors.**

**8) Eliminate the allowable substitution of BIOL 2533/2531L (Cell Biology w/Lab) for BIOL 2013/2011L (Microbiology). All students must now take Microbiology.**

Check if either of these boxes apply and provide the necessary signature:

- Program change proposal adds courses offered by another academic college, and that college dean's office has been notified. The signature of the dean of that academic college is required here: \_\_\_\_\_
- Program change proposal deletes courses offered by another academic college, and that college dean's office has been notified. The signature of the dean of that academic college is required here: \_\_\_\_\_

Check all the boxes that apply and complete the required sections of the form:

- Change of Name and Code (Complete only sections I, II, V and VII.)
- Change Course Requirements: (Complete all sections of the form except "Proposed Name" in II, section III, and section IV.)
- Change Delivery Site/Method (Complete all sections of the form except "Proposed Name" in II, section III, and section

IV.)

Change Total Hours (Complete all sections of the form except “Proposed Name” in II, section III, and section IV.)

Change in Program Policies

## **SECTION VI: Justification**

*Justify this change and state its likely effect on any other degree program (including those outside the school or college). Identify any program or program components (other than courses) to be eliminated if this program is implemented. (Program and course change forms must also be submitted for such related changes.)*

**With the anticipated creation of a new BS in Biomedical Engineering, the BS in Biological Engineering program is being adjusted to focus on engineering applied to sustainable food, water and energy. There is a need to educate engineers who can analyze broad system impacts on environmental stewardship and sustainable practices to support a growing world population. Understanding linkages between food, water and energy are critical to management of finite resources. Increasing demands upon these resources will lead to higher value and economic opportunities for regions with abundant water, land and mild climates. Biological Engineering graduates will play a key role in understanding, identifying, designing and managing optimal systems. The proposed changes to the degree will help implement this vision. This change is not expected to significantly affect any other programs.**

## **SECTION VII: Catalog Text and Format**

*In the box below, insert the current catalog text which is to be changed, with changes highlighted with the color yellow. Include all proposed changes identified in Section V. Only changes explicitly stated in Section V will be considered for approval by the University Course and Programs Committee, the Graduate Council and the Faculty Senate. If you are proposing a new program, give proposed text with all of the elements listed below. If you are proposing modified text, include these elements as appropriate.*

**Include the following elements, in order, in the catalog text for proposed undergraduate program(s) or program changes:**

- State complete major/program name
- Briefly define or describe the major/program or discipline.
- Identify typical career goals or paths for graduates. (Optional)
- State admission requirements (if any) for entry or entry into upper/advanced level of major/program.
- Identify location in catalog of university, college/school, and department/program requirements which the student must meet in addition to hours in the major, but do not restate these requirements.
- State course requirements in the major and any allied areas, giving number of hours and specific courses; specify electives or elective areas and give numbers of hours and courses in elective pools or categories; identify any other course requirements.
- State any other requirements (required GPA, internship, exit exam, project, thesis, etc.).
- Identify name and requirements for each concentration (if any).
- Specify whether a minor or other program component is allowed or required and provide details.
- State eight-semester plan requirements

**For minors, state requirements in terms of hours, required courses, electives, etc.**

**For graduate program/units, include elements (as needed) parallel to those listed for undergraduate programs above.**

**For Law School program/units, prepare text consistent with current catalog style.**

**For centers, prepare text consistent with current catalog style.**

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- Professors Carrier, Griffis, Haggard, Kim, Li, Loewer, Matlock, VanDevender, Verma
- Associate Professors Bajwa (S.), Costello, Osborn, Ye
- Assistant Professors Jin, Liang, Sadaka, Saraswat, Zaharoff
- Adjunct Professors Ang, Beitle, Clausen, Deaton, Ingels, Raper
- Adjunct Associate Professors Shafirstein, Yang
- Adjunct Assistant Professors Bajwa (D.), Hestekin (C.), Howell, Thorbole, Wimberly

Our mission is: Healthy People, Healthy Planet. We focus on engineering design that promotes sustainable production, processing and management of food, water and energy. Biological Engineers improve people's lives today and help assure a sustainable quality of life for tomorrow. They create solutions to problems by coupling living systems (human, plant, animal, environmental, food, and microbial) with the tools of engineering and biotechnology. Biological engineers improve human health; ensure a safe, nutritious food supply; and secure a healthy and safe environment. A bachelor of science degree in biological engineering is a job-ready degree with opportunities in many industries, government agencies, and consulting firms. It is also excellent preparation for medical, veterinary, dental or other health science professional school as well as M.S. and/or Ph.D. studies in engineering or other areas.

Biological Engineering is an ABET accredited program leading to the B.S. degree. M.S. and Ph.D. degrees are also offered. The curriculum is under the joint supervision of the dean of the College of Engineering and the dean of the Dale Bumpers College of Agricultural, Food and Life Sciences. The B.S. in Biological Engineering degree is conferred by the College of Engineering and is granted after the successful completion of 128 hours of approved course work.

The educational objectives of the Biological Engineering program are to produce graduates who 1) effectively apply engineering to biological systems and phenomena (plant, animal, human, microbes, and the environment) with demonstrated proficiency in basic professional and personal skills, and 2) are well prepared for: diverse careers in biological engineering, life-long learning, and professional and ethical contributions to society through sustained accomplishments in the numerous areas of application for biological engineering.

Diverse applications of biological engineering can be pursued through elective coursework such as:

- Integrating ecological principles into the design of sustainable systems to treat, remediate, and prevent pollution to the environment. Applications include stream restoration, watershed management, water and wastewater treatment design, ecological services management, urban greenway design and enclosed ecosystem design.
- Food processing, food safety and security, bio-instrumentation and bio-sensing, developing new products from biomaterials, and biotransformation to synthesize industrial and pharmaceutical products.
- Sustainable design and management of finite resources with a broad perspective--local to global and cradle to grave. Life cycle analysis of resource utilization and environmental impacts with a view toward long-term prosperity.
- Biotechnology at the micro and nanoscale, food processing, food safety and security, developing new products from biomaterials, and biotransformation to synthesize industrial and pharmaceutical products.
- Nanomedicine, tissue engineering, organ regeneration and its clinical application, bioinstrumentation, biosensing/ medical imaging, medical electronics, physiological modeling, biomechanics, and rehabilitation engineering.

The B.S. in Biological Engineering degree can lead to careers in consulting, ecological engineering and design, environmental engineering, sustainable agriculture and food production, low impact development, water quality and watershed management, human health, biotechnology, natural resource engineering, nanotechnology, and biofuels development to name but a few.

Each student is required to complete 18 semester hours of approved electives in his or her desired focus area. Six hours must be from the biological engineering design elective courses (listed below). Students must select Biological Engineering (BENG) design electives from one of the pairs shown below. The remaining 12 hours are classified as technical electives and consist mainly of upper division courses in engineering, mathematics, and the sciences as approved by the student's adviser. Any of the design electives shown can also be used as technical electives. The selected technical electives must include at least six hours of upper level engineering courses, either within BENG courses or from other engineering departments. The department maintains a list of approved electives.

Each student is required to complete 6 semester hours of technical/engineering electives that are relevant to their career goals. At least 3 hours must be engineering courses within BENG or other engineering programs. The other three hours can be selected from math, science and other technical areas. Suggested electives are listed below. Students may petition their adviser for other electives which are not explicitly on this list. Courses must provide engineering or technical content that is value-added (i.e., not duplicating or remedial to required courses) and meets career goals of the student.

The design electives and recommended technical elective courses are listed here.

#### **Design Electives:**

BENG 4903 Watershed Eco-Hydrology, and

BENG 4923 Ecological Engineering Design

or

BENG 4703 Biotechnology Engineering, and

BENG 4123 Biosensors and Bioinstrumentation

or

BENG 3213 Biomedical Engineering: Emerging Methods and Applications, and

BENG 4203 Biomedical Engineering Principles

#### **Suggested Engineering Electives:**

BENG 4113, Risk Analysis for Biological Systems

BENG 4123, Biosensors

BENG 4133 Digital Remote Sensing and GIS

BENG 4233 Tissue Engineering

BENG 4243 Biomaterials

BENG 451VH, Honors Thesis

CHEG 3153, Non-Equilibrium Mass Transfer

CHEG 3333, Chemical Engineering Reactor Design

CHEG 4423, Automatic Process Control

CVEG 2053/2051L, Surveying Systems w/Lab

CVEG 3243, Environmental Engineering

CVEG 4243, Environmental Engineering Design

INEG 2313, Applied Probability and Statistics for Engineers I

INEG 2413, Engineering Economic Analysis

MEEG 2013, Dynamics

MEEG 3013, Mechanics of Materials

MEEG 4413, Heat Transfer

#### **Suggested Technical Electives:**

~~BIOL 3404 Comparative Vertebrate Morphology, or~~ BIOL 2443/2441L Human Anatomy  
~~BIOL 3863/3861L General Ecology~~  
~~BIOL 4234 Comparative Physiology, or~~ BIOL 2213/2211L Human Physiology  
~~BIOL 4233 Genomics and Bioinformatics~~  
~~BIOL 4313 Molecular Cell Biology~~  
CHEM 3453/3451L Elements of Physical Chemistry  
CSES 2203 Soil Science  
ENSC 4034 Analysis of Environmental Contaminates  
FDSC 3103 Principles of Food Processing  
FDSC 4123 Food Microbiology  
FDSC 4304 Food Chemistry  
GEOL 1113/1101L, General Geology w/Lab  
~~HESC 3203 Nutrition for Health Professionals and Educators~~  
~~KINS 3353 Mechanics of Human Movement~~  
(or any engineering electives listed above)

The Bachelor of Science in Biological Engineering program is eligible for students who want to participate in an [Eight-Semester Degree Program](#). The plan below lists a semester-by-semester sequence of courses to finish the degree in eight semesters. University core courses for engineering are listed at the bottom of this page. Students may submit a maximum of four (4) hours of "D" in BENG courses for their degree.

Some courses are not offered every semester, so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites. Students should note that BIOL 1543/1541L is a pre- or co-requisite to BENG 2612 2632 in the Fall 2 semester. Students should earn advanced college credit for BIOL 1543/1541L, ~~obtain placement permission from the Biological Sciences Department~~ or take the course for non-degree credit.

~~Students must also take ENGL 2003 during the third year or gain exemption.~~

### **Fall Semester Year 1**

1 GNEG 1111 Introduction to Engineering I  
3 ENGL 1013 Composition I  
3 CHEM 1113 University Chemistry for Engineers I (or CHEM 1103)  
4 MATH 2554 Calculus I  
4 PHYS 2054 University Physics I  
**15 Semester hours**

### **Spring Semester Year 1**

1 GNEG 1121 Introduction to Engineering II  
3 ENGL 1023 Technical Composition II  
4 Freshman Engineering Science Elective\*  
4 MATH 2564 Calculus II  
HIST 2002 or HIST 2013 or PLSC 2003  
**15 Semester hours**

### **Fall Semester Year 2**

2 BENG 2632 Biological Engr Design Studio  
~~2 BENG 2612 Biological Engr Design Studio II~~  
4 MATH 2574 Calculus III  
4 CHEM 3603/3601L Organic Chemistry I w/Lab  
4 Sophomore Science Elective \*\*

3 MEEG 2003 Statics

~~2 GNEG 1122 Introduction to CAD~~

17 Semester hours

### **Spring Semester Year 2**

3 BENG 2643 Biological Engineering Design Methods

~~2 BENG 2622 Biological Engineering Design Studio III~~

4 MATH 2584 Differential Equations

4 CHEM 3613/3611L Organic Chemistry II w/Lab

3 CVEG 3213, Hydraulics (OR MEEG 3503 OR CHEG 2133)

3 MEEG 2403 Thermodynamics (OR CHEG 2313)

17 Semester hours

### **Fall Semester Year 3**

3 BENG 3723 Unit Operations in Biological Engr

3 BENG 3733 Transport Phenomena in Biological Systems

3 CHEM 3813 Introduction to Biochemistry

4 BIOL 2013/2011L General Microbiology w/Lab \*\*\*

3 CVEG 3223 Hydrology

~~2 BENG 3712 Engineering Properties of Biological Materials~~

~~3 MEEG 3013 Mechanics of Materials~~

16 Semester hours

### **Spring Semester Year 3**

3 BENG 3653 Global Bio-Energy Engineering

3 BENG 3743, Bio-Product Systems Engineering

3 BENG 3933 Watershed Sustainability

4 BIOL 3863/3861L General Ecology w/Lab

3 ELEG 3903 Electric Circuits and Machines

~~3 BENG 3803 Mechanical Design in Biological Engr~~

~~4 BENG 3104 Electronic Instrumentation for Biological Systems~~

~~3 BENG Design Elective~~

16 Semester hours

### **Fall Semester Year 4**

3 BENG 4813 Senior Biological Engineering Design I

3 BENG 4663 Sustainable Biosystems Design

3 BENG 4103 Measurements and Controls for Biological Systems

~~3 BENG 4733 Transport Phenomena in Biological Systems~~

~~3 BENG Design Elective~~

3 Humanities Elective (from University/State core list)

3 Social Science Elective (from University/State core list)

15 Semester hours

### **Spring Semester Year 4**

2 BENG 4822 Senior Biological Engineering Design II

~~6 3 Engineering Elective~~

3 Fine Arts Elective (from University/State core list)

3 Social Science Elective (from University/State core list)

3 Social Science Elective (from University/State core list)

~~6 3 Technical Elective~~

17 Semester hours

## 128 Total hours

\* The Freshman Engineering Science Elective must be chosen from either (CHEM 1133/1131L or CHEM 1123/1121L) or PHYS 2074.

\*\* The Sophomore Science Elective must be: PHYS 2074 if (CHEM 1133/1131L or CHEM 11232/1121L) was chosen as the Freshman Engineering Elective; or (CHEM 1133/1131L or CHEM 1123/1121L) if PHYS 2074 was chosen as the Freshman Engineering Science Elective. That is, both courses are required for the degree.

\*\*\* Students may substitute BIOL 2533 (Cell Biology) and BIOL 2531L (Cell Biology Lab) for BIOL 2013 and BIOL 2011L.

## Core Requirements

The University of Arkansas has adopted University Core Requirements (sometimes called State Minimum Core) of 35 semester-credit-hours of general education courses that are required of all baccalaureate degree candidates. This is in compliance with Arkansas Act 98 of 1989 and the subsequent action of the Arkansas State Board of Higher Education. Beginning in the fall semester of 1991, all state institutions of higher education in Arkansas have a 35-hour minimum core requirement with specified hours in each of six academic areas. The University and the College of Engineering have identified those courses that meet the minimum requirement, and they are listed in the chart below.

Students should consult the requirements for specific departments and programs when choosing courses for use in the University Core.

Every student in the College of Engineering is required to complete a minimum of 18 semester hours in the humanities and social sciences. Six semester hours must be at the 3000 level or above. A list of approved upper-level humanities/social science courses is available in departmental offices and the dean's office.

No more than nine semester hours from any single discipline may be presented for degree credit. To meet the University Core requirements, the total number of hours (both upper level and lower level) in the fine arts/humanities courses must be at least six, and the social science hours must total at least nine (in addition to the U.S. history or government requirement). The six hours of courses at the 3000 and 4000 level may be in the fine arts and humanities area, the social science area, or divided between the two areas. Since some of the humanities and social science courses are specified in some of the curricula, e.g., ECON 2143 in chemical and mechanical engineering, the student should consult the curriculum of the department in which he or she is enrolled prior to selecting upper-level electives.

## Specific University Core Requirements for Engineering Students

### English – 6 hours

ENGL 1013 Composition I

ENGL 1023 Technical Composition II (ENGL 1023 Composition II may be taken in lieu of Technical Composition II)

### Mathematics – 4 hours

MATH 2554 Calculus I

### Science – 8 hours

PHYS 2054 University Physics I

PHYS 2074 University Physics II or

CHEM 1123, 1121L University Chemistry II

### U.S. History or Government – 3 hours

HIST 2003 History of American People to 1877

HIST 2013 History of American People 1877 to Present

PLSC 2003 American National Government



**Fine Arts and Humanities – 6 hours**

**Social Sciences – 9 hours**

Six hours of Fine Arts, Humanities and Social Sciences must be upper level courses (3000-4000 level). A list of approved courses is available in departmental offices.

**SECTION VIII: Action Recorded by Registrar's Office**

PROGRAM INVENTORY/DARS

PGRM \_\_\_\_\_ SUBJ \_\_\_\_\_ CIP \_\_\_\_\_ CRTS \_\_\_\_\_

DGRE \_\_\_\_\_ PGCT \_\_\_\_\_ OFFC&CRTY VALID \_\_\_\_\_

REPORTING CODES

PROG. DEF. \_\_\_\_\_ REQ. DEF. \_\_\_\_\_  
Initials \_\_\_\_\_ Date \_\_\_\_\_

**Distribution**

Notification to:

- (1) College
- (2) Department
- (3) Admissions
- (4) Institutional Research
- (5) Continuing Education
- (6) Graduate School
- (7) Treasurer
- (8) Undergraduate Program Committee

5/12/08