BIOLOGICAL AND AGRICULTURAL ENGINEERING (BAEG), DEPARTMENT OF

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Biological & Agricultural Engineering Faculty
• Professors Gardisser, Griffis, Li, Loewer, VanDevender, Verma
• Associate Professors Carrier, Chaubey, Costello, Haggard, Kim, Matlock, Tacker
• Assistant Professors Bajwa, Kavdia, Osborn, Ye
• Adjunct Professors Ang, Clausen, Deaton, Ingles,
• Adjunct Associate Professors Beitle, Yang
• Adjunct Assistant Professors Howell, Shafirstein, Wimberly

Biomedical Engineering Faculty
• Distinguished Professor Varadan
• University Professor Schmitt
• Professors Ang, Clausen, Deaton, Durdik, Fritsch, Kirby, Li, Verma,
• Associate Professors Barlow, Beitle, Carrier, Couvillion, El-Shenawee, Kim, Matlock, Tung
• Assistant Professors Bajwa, Heymsfield, Kavdia, Osborn, Teo, Ye
• Research Assistant Professor Burgers

Web: http://www.baeg.uark.edu/BME

Degrees Conferred:
M.S.B.E. (BENG) in Biological Engineering
M.S.B.M.E. (BENG) in Biomedical Engineering
M.S.En.E. (ENEG) in Environmental Engineering, in collaboration with Civil Engineering (See Environmental Engineering)
M.S.E. (BENG) in Engineering (See Engineering)
Ph.D. (BENG) in Engineering (See Engineering)

Biological Engineering (BENG)

Primary Areas of Faculty Research: Biomedical Engineering –nanomedicine, tissue engineering, organ regeneration and its clinical application, bioinstrumentation, biosensing/medical Imaging, medical electronics, physiological modeling, biomechanics, and rehabilitation engineering.

Biotechnology Engineering - biotechnology at the micro and nano scale, food processing, food safety and security, developing new products from biomaterials, and biotransformation to synthesize industrial and pharmaceutical products.

Ecological Engineering – integrates ecological principles into the design of sustainable systems to treat, remediate, and prevent pollution to the environment. Applications include mathematical modeling of watershed process, stream restoration, watershed management, water and wastewater treatment design, ecological services management, urban greenway design and enclosed ecosystem design.

Requirements for the Master of Science Degree: (Minimum 30 hours) In addition to the requirements of the Graduate School and the graduate faculty in Engineering, the following departmental requirements must be satisfied for the M.S.B.E. degree:

1. Candidates are required to complete not less than 24 semester hours of course work acceptable to the committee and a minimum of six semester hours of thesis.

2. The minimum acceptable grade on a graduate course is "C."
3. Prior to acceptance into the program a candidate must, in consultation with the department head, identify a professor who is willing to serve as the major professor. During the first semester, the candidate must, in consultation with the major professor and department head, select a graduate committee. The candidate will, in consultation with the committee, prepare a written graduate program of study that will achieve the candidate's objectives.
4. Candidates must prepare a paper suitable for submission to a refereed journal from research done for a thesis or BENG 500V.

Biomedical Engineering (BME)

Degree Conferred:
M.S. Biomedical Engineering (MSBME)

The Master of Science in Biomedical Engineering is a multidisciplinary degree program designed for students from a multitude of academic areas. Regardless of undergraduate discipline, each candidate for the degree must complete a number of basic undergraduate engineering courses. In general, graduates of engineering programs will have completed most, if not all, of these courses and can expect to be accepted with little or no undergraduate prerequisite requirements. However, the prerequisite requirements for graduates of programs other than engineering can be quite significant. To more readily accommodate students with diverse academic backgrounds, qualified undergraduate students at the University can apply for acceptance into an integrated undergraduate/graduate program of study after completing 72 credit hours towards the baccalaureate degree. The integrated undergraduate/graduate program allows the student to complete some graduate requirements prior to completion of the baccalaureate degree and receive full admission to the Graduate School. The integrated program consists of four elements: 1) the requirements for the baccalaureate degree sought by the student, 2) a program of general education, mathematics, science, and basic engineering topics, 3) an 18 credit hour series of basic biomedical engineering to provide a breadth of knowledge in the general subject matter, and 4) completion of graduate credit in a defined area of biomedical engineering specialization. Depending upon the baccalaureate, there can be significant overlap between the requirements of elements 1, 2, and 3. For example, with appropriate course selection, an engineering B.S. degree can fulfill all requirements of elements 1, 2, and 3.
Program Objectives: The Educational Objective of the MSBME program is to produce graduates who are prepared for further education and/or to pursue careers in the biomedical engineering industry, public or private organizations.

Primary Areas of Faculty Research: Bioimaging and Biosensing; Bioinformatics and Computational Biology; Tissue Engineering and Biomaterials; Bio-MEMS/Nanotechnology.

Application to Integrated Program: Application for acceptance into the integrated undergraduate/graduate program may be submitted either directly to the Program Director and Department Head, or by referral from the student's undergraduate academic department. Requests for acceptance into the integrated program will be approved only with concurrence from the student's undergraduate academic department. Once accepted, the student must apply for admission to the Graduate School through normal application procedures. The applicant must identify a biomedical engineering faculty adviser who will help develop the integrated course of study. After completing 90 credit hours of study towards the baccalaureate degree, students accepted into the integrated degree program may concurrently enroll in undergraduate and graduate level courses. Such enrollment must be consistent with the integrated course of study developed with the faculty adviser.

Admission Criteria: The following are the minimum criteria for admission to the M.S.BME. degree program:
GPA: 3.00 or higher
TOEFL: 213 or higher
GRE Scores: The minimum to be considered for admission is 1000 (Quantitative + Verbal).

Degree Requirements: All M.S.BME. degree candidates, regardless of previous degree status, must demonstrate completion of the Basic Engineering Education and Biomedical Engineering Breadth requirements listed below. Candidates who do not possess a degree from a program accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET) must also satisfy the basic level ABET accreditation requirements. These include completion of no less than 48 credit hours of approved engineering topics and demonstrating, to the satisfaction of the student's graduate study committee, that he/she possesses those abilities and characteristics required of graduates from ABET accredited engineering programs. This shall include the completion of a course that concentrates on a major design project and that results in

the production of a design report or other design product as appropriate. The design project must build on and require engineering knowledge and skills from previous course work and must incorporate engineering standards and realistic constraints. The course selected to satisfy this requirement is subject to the approval of the student's graduate study committee. Exceptions to these degree requirements may be requested by means of a petition outlining the reasons for the exceptions and presenting an alternate plan for completing the program. The petition shall be subject to the approval of the student's graduate study committee and the Program Director and Department Head. Credit for courses taken at another institution is subject to the approval of the Program Director and Department Head. In particular, advanced engineering courses (3000, 4000, and 5000-level at the University of Arkansas) normally will not be accepted for transfer from institutions or degree programs that are not accredited by ABET.

I. Basic Engineering Education Requirements

General Education Recommended Courses	Credit Hours
Humanities/social science	15
Acceptable to undergraduate program	
English composition	6
ENGL 1013 and 1023	
Mathematics and Basic Science Recommended Courses	
Calculus & differential equations	16
MATH 2554, MATH 2564, MATH 2574, & MATH 3404	
General Chemistry	4
CHEM 1123 & 1121L	
University Physics (calculus based)	4
PHYS 2054 & PHYS 2050L	
Microbiology	4
BIOL 2013 & BIOL 2011L	
Organic Chemistry	4
CHEM 3603 and CHEM 3601L	
Biochemistry	3
CHEM 3803	
Human Anatomy	4
BIOL 2443 & BIOL2441L	
Human Physiology	4
BIOL 2213 & BIOL 2211L	
Cell Biology	4
BIOL 2533 & BIOL 2531L	
Basic Engineering Topics Recommended Courses	
Statics	3
MEEG 2003	
Mechanics of Materials	3
MEEG 3103	
Fluid Mechanics 3	3
CHEG 2133 or MEEG 3503	
Circuits	3
ELEG 2103 & ELEG 2101L	
Electronics	3
BENG 4103	
Thermodynamics	3
MEEG 2403 or CHEG 2313	

II. Biomedical Engineering Breadth Requirements (18 hours)

Required Topics Recommended Courses

Biomedical Engineering Principles BENG 4203	3
Tissue and Cell Engineering BENG 5233	3
Introduction to Bioinformatics BENG 5213	3
Bio-MEMS BENG 5253	3
Mathematical Modeling of Physiological Systems BENG 5203	3
Transport Phenomena BENG 3733	3
Mechanical Design BENG 3803	3
Biosensors and Bioinstrumentation BENG 4123	3
Biological Reactor Systems Design BENG 4623	3
Instrumentation BENG 4103	3
Properties of Biological Materials BENG 3712	3

Topics	
Biomedical Control Systems	3
Reaction Kinetics	3
Signal/Image Processing	3
Control Systems/Theory	3
Biomedical Engineering Physiology	3
Engineering Statistics/Probability	3
Biomechanics	3

III. Biomedical Engineering Specialization (M.S.BME. graduate program)

Thesis Option: 30 hours of graduate-level course work including 16 hours of core courses as identified below, plus 8 hours of courses from one of the specialty areas identified below, plus 6 hours of research resulting in a written Master's Thesis.

Non-Thesis Option: 33 hours of graduate-level course work including 16 hours of core courses as identified below, plus 14 hours from one of the specialty areas identified below, plus 3 hours of independent study resulting in a written Master's Report.

Core Courses:

BENG 5203 Mathematical Modeling of Physiological Systems
BENG 5801 Graduate Seminar
BENG 5103 Advanced Instrumentation in Biological Engineering
BENG 5703 Design and Analysis of Experiments for Eng, Research or
BENG 5223 Biomedical Engineering Research Internship
6 hours of Advanced Science Courses chosen from the list below

Advanced Science Courses:

CHEM 5813
CHEM 5843
CHEM 6873
CHEM 6883
BIOL 5263

BIOL 5334
BIOL 5423
MBIO 5343
ZOOL 5514
ZOOL 5544
KINS 5323
KINS 5333
KINS 5513
KINS 5523
KINS 5543
KINS 6323
KINS 6343
PHYS 5123
PHYS 5133

Specialty Areas and Approved Courses: Students are expected to select the required hours of graduate courses from one of the four following specialty areas and listing of approved courses. Other courses will be considered on petition to the student's graduate study committee and the Director and Department Head.

Bioimaging and Biosensing:
Recommended Courses
BENG 4123 Biosensors and Bioinstrumentation
CENG/ELEG 5683 Image Processing
Elective Courses (one elective and two advanced science courses may come from the following)
ELEG 4603 Digital Signal Processing Systems
ELEG 5673 Pattern Recognition
INEG 4533 Applications of Machine vision
CHEM 4213 Instrumental Analysis
CHEM 5223 Chemical Instrumentation
CHEM 5243 Electrochemcial Methods of Analysis
CHEM 5253 Spectrochemical Methods of Analysis
ANAT 5203 Neurophysiology Recording Techniques (UAMS)
PHYO 5063 Molecular Biophysics (UAMS)
PHYO 510V Radiation Biology (UAMS)

Tissue Engineering and Biomaterials:
Recommended Courses
BENG/CSCE 5213 Introduction to Bioinformatics
CENG 5003/CSCE 5043 Artificial Intelligence
Elective Courses (one elective and two advanced science courses may come from the following)
CSCE 5123 Databased Management Systems
BIOL 5263 Cell Physiology/BIOL 5261L(Lab)
BIOL 5334 Biochemical Genetics
CHEM 5813 Biochemistry I
CHEM 5843 Biochemistry II
MATH 4153 Mathematical Modeling
ANAT/MBIM/PATH/PHYO 5114 Gene Expression (UAMS)
BIOC 5103 Biochemistry and Molecular Biology (UAMS)
MBIM 5904 Genetics and Pathogenesis (UAMS)
PATH 5043 Molecular and Biochemical Pathology (UAMS)
PHYO 5063 Molecular Biophysics (UAMS)

Bioinformatics and Computational Biology:

Recommended Courses

BENG 5233 Tissue and Cell Engineering

BENG 5243 Biomaterials

Elective Courses (one elective and two advanced science courses may come from the following)

BENG 4113 Risk Analysis for Biological Engineering

CHEG 5013 Membrane Separation and System Design

CHEG 5513 Biochemical Engineering Fundamentals

MEEG 5303 Physical Metallurgy

MEEG 5393 Engineering Materials Topics

CHEM 5813 Biochemistry I

CHEM 5843 Biochemistry II

MBIO 4714 Basic Immunology/MBIO 4710L (Lab)

MBIO 5343 Advanced Immunology

KINS 5323 Biomechanics I

KINS 6323 Biomechanics II

ANAT 5026 Microscopic Anatomy (UAMS)

ANAT/MBIM/PATH/PHYO 5114 Gene Expression (UAMS)

PCOL 5033 General Principles of Pharmacology and Toxicology (UAMS)

PCOL 5063 Toxicology for Graduate Students (UAMS)

PHSC 5033 Pharmaceutics for Graduate Students (UAMS)

PHSC 517V Advanced Biopharmaceutics and Pharmacokinetics (UAMS)

PHYO 5063 Molecular Biophysics (UAMS)

PHYO 510V Radiation Biology (UAMS)

Bio-MEMS and Nano-Biotechnology:

Recommended Courses

BENG 5253 Bio-MEMS

MEPH 5713 Advanced Nanomaterials Chemistry

Elective Courses (one elective and two advanced science courses may come from the following)

MEEG 591V Nanomanufacturing: Materials and Processes

MEPH 5723 Science of Nanostructures

BIOL 5334 Biochemical Genetics

CHEM 5813 Biochemistry I

CHEM 5843 Biochemistry II

CHEM 6873 Molecular Biochemistry

PHYO 5063 Molecular Biophysics (UAMS)

At least 18 of the 30+ credit hours presented for the M.S.BME. must be 5000-level or higher, and the cumulative grade-point average on all graduate courses presented for the degree must be at least 3.00. The cumulative grade point average on the basic engineering education and biomedical engineering breadth courses must be at least 2.70.

Candidates for the degree must pass a comprehensive final examination that will include either a defense of the candidate's thesis or a presentation and discussion of the candidate's Master's Report. The examination is to be prepared and administered by the student's graduate adviser.