College of Engineering

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575-7455

Associate Deans
4188 Bell Engineering Center
575-6010

Assistant Deans
3189 Bell Engineering Center
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Henderson State University

Undergraduate Programs and Services
Student Information
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Recruitment and Retention
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Scholarship Officer
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Cooperative Education
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Engineering Research Center
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World Wide Web
http://www.engr.uark.edu

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MISSION STATEMENT AND HISTORY

The College of Engineering adds personal, social and economic value through engineering education. Value is added through four separate but highly integrated activities:

- Undergraduate Education
- Graduate Education and Research
- Continuing Education and Technology Transfer
- Technology-based Business Incubation and Job Creation

Programmatic activities focus largely on six areas of emphasis:

- Biological, Chemical and Food Processing
- Database and Telecommunications
- Electronics Manufacturing
- Environmental and Ecosystems Analysis
- Materials and Manufacturing
- Transportation, Logistics and Infrastructure

Extensive information about the College of Engineering is available in the form of two-page summaries that may be downloaded in printed form from the college publications Web page <http://www/engr.uark.edu>. These summaries provide overviews of each programmatic activity and area of emphasis and includes information about faculty, facilities, programs of study, advisory groups, centers, research capabilities, special programs, distance education, professional development, and opportunities for partnerships with the college.

Statement of Purpose

Recognizing that the University of Arkansas, Fayetteville, is a land-grant institution with consequent responsibilities in teaching, research and service, and realizing that these are mutually dependent and necessary responsibilities, the College of Engineering adopts and seeks to fulfill the following statements of purpose.

Undergraduate Education

To offer a high-quality course of instruction involving classroom, laboratory and extracurricular activities that will result in professionals qualified to begin careers in the field of engineering and prepared to assume responsible places of leadership in society.

Graduate Education

To offer state-of-the-art coursework and research experiences which result in all graduates being capable of independent analysis and design, and all Ph.D. graduates capable of extending the state-of-the-art in their areas of expertise.

Continuing Education

To provide local, regional, national and international seminars, symposia, short courses and credit courses to engineers and others in the technical community to help them further their formal education and keep abreast of new developments in technology.

Technology Development

To assist actively and vigorously in the growth and development of the State of Arkansas and the nation by performing research and development of state-of-the-art technology, by updating the existing technology within industrial circles, by providing educational support services and by attracting and creating new industry.

External Relations

To communicate effectively with the college's various constituencies to establish and maintain long-term relationships which lead to increased support for quality programs in teaching, research and service.

Internal Relations

To actively involve engineering faculty in University, college and department governance and functions.

Historical Benchmarks

As the only comprehensive engineering program in Arkansas, the College of Engineering offers undergraduate, graduate and doctoral degrees through seven academic departments. UA engineering programs have been continuously accredited by the Accreditation Board of Engineering and Technology (ABET) since 1936.

The college has a long and distinguished history —

1871 the University was established
1873 the first courses in civil engineering were offered
1888 the first civil engineering degree was awarded
1897 a separate civil engineering department and a department of electrical engineering was established
1903 a department of mechanical engineering was established and a chemical engineering curriculum was established in the department of chemistry
1913 the College of Engineering was organized as a college of the University
1920 the Engineering Experiment Station was established by the state legislature to investigate and study engineering problems of general interest to Arkansas
1928 the first master's degree in engineering was awarded
1945 chemical engineering became part of the College of Engineering
1948 the departments of agricultural engineering and industrial engineering were established
1958 a Doctor of Philosophy degree was approved
1966 a curriculum in engineering science was offered
1975 the Engineering Extension Center was formed to provide continuing education opportunities to practicing engineers
1976 a computer science engineering program was initiated within the industrial engineering department
1980 the engineering science curriculum was merged with the mechanical engineering curriculum
1982 the college took possession of an empty manufacturing plant that evolved into the Engineering Research Center
1985 computer science engineering became a separate department and the Arkansas Center for Technology Transfer was established
1986 the Engineering Distance Education Center was created to offer off-campus engineering education and the GENESIS Technology Incubator was established
1989 The department of agricultural engineering became the department of biological and agricultural engineering
1991 the computer science engineering department name was changed to computer systems engineering
1997 the Engineering Distance Education Center was expanded to include undergraduate course offerings
1998 computer systems engineering merged with the computer science department housed in the J. William Fulbright College of Arts and Sciences, which created the department of computer science and computer engineering
2001 the biological and agricultural engineering program name was changed to biological engineering

The following distinguished educators have served the College as dean:

William N. Gladson	1913-1936
George P. Stocker	1936-1948
George F. Branigan	1948-1971
Loren R. Heiple	1971-1979
James E. Halligan	1979-1982
Neil M. Schmitt	1983-1996
Otto J. Loewer	1996-Present

PROGRAMMATIC ACTIVITIES

Undergraduate Education

Undergraduate education is a core mission of the College of Engineering. A full array of accredited undergraduate degrees is offered in outstanding teaching facilities and laboratories. The college faculty brings considerable industrial experience to the classroom, thus adding to the value of the formal course work. Students who graduate from any of the college's undergraduate programs can be confident that they have received an engineering education of exceptionally high quality that makes them nationally and internationally competitive in the marketplace of their respective disciplines.

Graduate Education and Research

Graduate education and research go hand in hand and are major programmatic activities in each of the seven departments in the College of Engineering. Research coordination is achieved through the Engineering Experiment Station, which was established for that purpose by an act of the Arkansas Legislature in 1920.

The overall goal of graduate education and research in the College of Engineering is to provide engineering solutions to important problems that face our society while, at the same time, educating nationally and internationally competitive students at the cutting edge of technology. Student involvement in research is especially important in that it helps link students to the needs of their future employers. All seven engineering departments—biological and agricultural, chemical, civil, computer science and computer engineering, electrical, industrial, and mechanical—conduct research over a broad spectrum of subjects that fall largely into the college's areas of emphasis (listed above). Funding for research comes primarily through external contracts between the college and its government and industry partners. Much of the external research funding goes to support student employees who work on the various research projects.

Continuing Education and Technology Transfer

The College of Engineering embraces continuing education and technology transfer as programmatic activities that help meet the engineering community's need for life-long learning. In recognition of its responsibilities to the technical community of the state, the College of Engineering formed the Engineering Extension Center on July 1, 1975, to provide continuing educational services for practicing engineers.

The primary objective of this programmatic activity is to provide the very latest information required for maintaining and enhancing the technical competency of the practitioner and helping industry remain economically viable. This is accomplished through various offerings such as seminars, short courses, conferences, consulting and institutes, as well as through regular course offerings. An additional objective is to provide a productive interface among faculty, practitioners and industry.

Technology-based Business Incubation and Job Creation

The College of Engineering is very active in promoting technology-based economic development in Arkansas and the region. The major unit involved in this programmatic activity is the GENESIS Technology Incubator. GENESIS is a national award-winning program located within the Engineering Research Center in close proximity to the college's research laboratories. Office and laboratory space in the Engineering Research Center is rented to companies that satisfy the GENESIS criteria. Companies, for a fee, have access to certain University of Arkansas resources. Companies that become part of the GENESIS program generally are developing technology-based products for the marketplace, and they need access to faculty expertise, highly specialized laboratories, and student employees. The goal of GENESIS is to help companies grow, thus adding more technology-based employment opportunities in the state and region. In fact, since its creation in 1987, GENESIS companies have created a new job in Arkansas about every four working days.

FACILITIES AND LABORATORY FEE

Instructional, Computer, and Laboratory Facilities

Undergraduate instruction in engineering takes place in Bell Engineering Center, Engineering Hall, and the Mechanical Engineering Building. These facilities contain state-of-the-art classrooms and instructional equipment. Undergraduate laboratories are located both on the main campus as well as at the Engineering Research Center. Laboratories offer students hands-on experience relating to the subject matter addressed in the classroom.

The College of Engineering utilizes a wide variety of computing equipment to assist in engineering education. Students have easy access to computers through general computer laboratories or computer facilities located in specialized laboratories within the college. The computers are networked so that all the computing power of the University, including the mainframe computers, can be accessed from the PCs or workstations provided for engineering students. Owning a personal computer is not required; however, it is beneficial.

Laboratory Fee

In order to maintain the College's state-of-the-art instructional and computer laboratories each student enrolled in an engineering course is assessed a laboratory fee for that term. This fee is not only used to purchase and maintain equipment, but to operate and staff the engineering laboratories.

Library

The books and references used by engineering students and faculty are housed principally in the University of Arkansas Mullins Library. This collection is the most useful and comprehensive engineering library in the state. Many publications pertinent to the engineering profession are being added continuously. Mullins Library is the depository for water resources papers, geological survey materials, and NASA publications, as well as other governmental and industrial series.

Engineering Research Center

The 178,000 square foot Engineering Research Center is located approximately two miles south of the main campus. The Center provides the facilities and support services for a wide variety of research activities. The Center houses the Engineering Experiment Station through which the research of individual departments in the college is administered. Centers and Laboratories located at the Engineering Research Center include GENESIS, the High Density Electronics Center, The Arkansas Center for Technology Transfer, the Industrial Training Laboratory, the Center for Interactive Technology, the Systems Technology Laboratory, the Hydrology Laboratory, the Center for Training Transportation Professionals, and the Low-Speed Wind Tunnel Laboratory.

Engineering Distance Education Center

In the spirit of providing quality engineering education that fits the needs of today's students, the College of Engineering offers distance education opportunities for degree-seeking graduate and undergraduate students, surveyors, registered professional engineers, and others who require on-going training.

The Engineering Distance Education Center offers the Master of Science in Engineering degree as a work-at-home series. This is a fully accredited graduate program whose candidates are engineers holding undergraduate degrees. The M.S.E. program is taught by the University of Arkansas College of Engineering's graduate faculty.

The M.S. in Operations Management (MSOM) degree program is available to both civilians and military personnel; classes for this program are held at the College's Graduate

Resident Centers, which are located on the UA campus and at military installations in Arkansas, Tennessee and Florida.

Professional development and continuing education credits can be earned through the College of Engineering's Professional Development Center. These courses provide ongoing training on technical and engineering topics for Professional Engineers, land surveyors, and others in the technical and engineering professions.

ENGINEERING PROGRAM

Engineering is one of the most rewarding of the major professions. Engineers have been primarily responsible for the present high standard of living and for the security of the nation in times of peace and war. Engineering graduates must have a background of sound mathematic, scientific and economic principles and must be acquainted with industrial practices in their chosen field before they can assume responsibility in the profession. Many engineering graduates become managers and leaders in the public and private sectors because of the problem-solving skills that were developed as part of an engineering education.

The freshman curriculum stresses a basic foundation in mathematics, physics and chemistry, which will be required in later years. The sophomore, junior and senior years are spent in a strong concentration on the student's chosen field, with emphasis on industrial applications of classroom and laboratory work. By the selection of electives, a student can concentrate in depth in a particular subject, have the flexibility to study several subjects, and minor in an area of interest. Provision is made for electives in the humanities and social sciences as a means of providing a well-rounded education.

The College of Engineering offers undergraduate programs leading to the Bachelor of Science (B.S.) degree, graduate programs leading to the Master of Science (M.S.) degree, and a program of advanced study leading to the Doctor of Philosophy (Ph.D.) degree.

DEGREES OFFERED

The College of Engineering offers curricula accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET) leading to the following baccalaureate degrees:

- Bachelor of Science in Biological Engineering (B.S.B.E.)
- Bachelor of Science in Chemical Engineering (B.S.Ch.E.)
- Bachelor of Science in Civil Engineering (B.S.C.E.)
- Bachelor of Science in Computer Engineering (B.S.Cmp.E.)
- Bachelor of Science in Electrical Engineering (B.S.E.E.)
- Bachelor of Science in Industrial Engineering (B.S.I.E.)
- Bachelor of Science in Mechanical Engineering (B.S.M.E.)

Students can be awarded a second bachelor's degree in engineering by satisfying all the requirements for both degrees. In doing this, the student must complete a minimum of 30 semester hours of studies for the second degree, which are not used to satisfy any requirement for the first degree.

ADMISSION REQUIREMENTS

Freshmen admitted to the University of Arkansas, Fayetteville, are eligible to enroll in the College of Engineering.

Computer Skills

Future students are strongly encouraged to take a one-year high school course in basic computer skills, which should include at a minimum: 1) basic use of a common operating system, 2) word processing, and 3) use of a spread sheet. All engineering departments either recommend or require that incoming students deficient in these skills take a specified remedial course. Taking high school courses in engineering drawing and computer programming also is beneficial and strongly encouraged.

International Students

Before being admitted to the electrical engineering program or the computer engineering program, international students will be required to present a score of 50 or higher on the Test of Spoken English (TSE) exam and either a score of 1000 or higher on the SAT, or a score of 25 or higher on the ACT.

Transfer of Credit

In addition to the University policies controlling the granting of credit for course work taken at other institutions, the following policies apply to students entering the College of Engineering.

1. All courses taken at another institution are subject to approval by the Dean of the College of Engineering and the head of the degree-granting department. Credit from all institutions must be approved on a course-by-course basis to ensure its acceptability in fulfilling requirements for a degree in engineering. In making this evaluation, the student may be required by the dean and/or department head to produce catalogs from the institution from which the student is transferring that contain descriptions of the courses for which credit is expected in an engineering discipline.

2. Advanced (3000- and 4000-level at the University of Arkansas) engineering courses may not normally be transferred from institutions that do not have engineering programs accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).

3. No degree credit will be granted for any course taken at another institution in which the student's grade in that course was not the equivalent of at least 2.00 on a 4.00 grading system.

Three-Two Transfer Plan

The College of Engineering recognizes that a graduate engineer, to be of full service to his community, must be educated in the social sciences and humanities as well as in technical subjects. The practice of industry to elevate engineers to managerial and administrative positions emphasizes the desirability of a broad educational background. Likewise, most universities within Arkansas do not offer a degree in engineering. Accordingly, the College of Engineering of the University of Arkansas has entered into a cooperative program with several Arkansas "partner" universities to provide for a five-year combined course of study that leads to a Bachelor of Arts/Bachelor of Science degree from the partner university and an engineering degree from the University of Arkansas. Typically, a student spends the first three years at the partner university and then completes an engineering curriculum in two years at the University of Arkansas. After four years of study under the combined program the student is awarded the Bachelor of Arts/Bachelor of Science degree by the partner university. At the end of the fifth year, the student is awarded the Bachelor of Science in an engineering discipline by the University of Arkansas.

COLLEGE SCHOLARSHIPS

The College of Engineering, and its departments, awards a number of scholarships to its current students, incoming freshman, and transfer students each year. These awards are based primarily upon academic performance while others are available to students with exceptional ability and/or financial need. Scholarship applications are available from the College's Scholarship Officer in the Dean's Office. Students filing an application by the appropriate deadline will be considered for all scholarships administered by the College of Engineering.

COOPERATIVE EDUCATION

The Cooperative Education (Co-op) Program provides a unique opportunity for an engineering student to complement on-campus engineering education with professional practice in industry. A participant begins sometime

after the freshman year by alternating periods on campus as a full time student with periods off-campus in industry doing engineering work with appropriate guidance and supervision from practicing engineers. Depending on the individual situation, three to five work assignments may be meshed with the undergraduate academic work on a year-round basis. The Co-op student often returns to the same employer for all work assignments.

The Co-op Program allows a participating student to integrate industrial experience with formal academic training, earn a substantial part or all of remaining college expenses, gain professional practice in engineering, and try a tentative career choice at a stage when change can readily be made in the academic program.

During each work period, the student registers for one hour of cooperative education, listed under General Engineering. These hours may be used to satisfy any free elective hours in the curricula. In some cases, with the consent of the department head, a student may use an advanced course to satisfy a technical elective hour.

Normally, a student is eligible to participate in the Co-op Program after completing one year of appropriate engineering study or specific entry-level course work in the chosen area of study with a minimum cumulative grade-point average of 2.25.

HONORARY AND PROFESSIONAL ORGANIZATIONS

The following are honorary-scholarship and professional societies to which engineering students at the University of Arkansas may aspire:

- Tau Beta Pi (Engineering)
- Alpha Epsilon (Biological/Agricultural Engineering)
- Omega Chi Epsilon (Chemical Engineering)
- Chi Epsilon (Civil Engineering)
- Eta Kappa Nu (Electrical Engineering)
- Alpha Pi Mu (Industrial Engineering)
- Pi Tau Sigma (Mechanical Engineering)
- Alpha Chi Sigma (Chemistry)
- Phi Eta Sigma (freshmen)
- Phi Kappa Phi (juniors and seniors)
- Pi Mu Epsilon (Mathematics)
- Theta Tau, professional engineering fraternity, maintains a chapter house on the campus and is active in University and College affairs
- Phi Sigma Rho, a newly established professional engineering sorority

Several national engineering societies are listed below and maintain student branches in the College of Engineering, each under the auspices of a professor in the related department.

- American Society of Civil Engineers
- American Society of Hispanic Engineers
- American Society of Mechanical Engineers
- Institute of Electrical and Electronics Engineers
- Institute of Chemical Engineers
- American Society of Agricultural Engineers
- Institute of Industrial Engineers
- International Microelectronics and Packaging Society
- National Society of Black Engineers
- Society of American Military Engineers
- Society of Automotive Engineers

The college is also home to the Women in Engineering student group.

ACADEMIC REGULATIONS

Students are expected to keep themselves informed concerning current regulations, policies, and program requirements in their fields of study and must meet all requirements of the degree programs in which they are enrolled. Courses that are modified or added to a curriculum and that are incorporated into the curriculum at a level beyond that at which a student is enrolled may become graduation requirements for that student. Courses that are incorporated into the curriculum at a level lower than the one at which the student is enrolled are not required for that student.

Eligibility

Only students enrolled in the College of Engineering or enrolled in programs in which curricula require engineering courses will be allowed to take engineering courses. Exceptions to this requirement must be approved by the dean of engineering. This does not apply to graduate students.

Pre-Professional Program

Engineering students follow essentially the same schedule of courses during the freshman year regardless of their intended field of specialization. Certain courses normally taken in the first year comprise the pre-professional curriculum.

The pre-professional curriculum consists of the following courses:

	HOURS
ENGL 1013, Composition I	3
ENGL 1023, Technical Composition II	3
CHEM 1103, CHEM 1101L, CHEM 1123, CHEM 1121L, University Chemistry I & II and Labs	8
MATH 2554, Calculus I	4
MATH 2564, Calculus II	4
Total semester hours	**22**

Satisfactory completion of the pre-professional curriculum is a prerequisite for enrollment in any 2000-level or higher engineering course. Satisfactory completion is defined as a grade of "C" or better in each course or, alternatively, a grade-point average of at least 2.20 for the courses comprising the pre-professional curriculum. Some departments have higher requirements and those are described in the following paragraph. If courses are repeated, all attempts are included in the computation of the grade-point average.

Additional courses are included in the pre-professional curriculum for some engineering programs.

- Electrical engineering students must complete PHYS 2054/2050L, Univ. Physics I (and laboratory) in addition to the above college pre-professional requirements.
- Industrial engineering students must complete INEG 1103, Principles of Industrial Engineering rather than CHEM 1123/1121L in the college pre-professional requirements.
- Computer engineering students must complete CENG 1113/1111L, Intro. to Computers, rather than CHEM 1123/1121L in the college pre-professional requirements.

Satisfactory completion for electrical engineering and industrial engineering students is defined as a grade of "C" or better in each course and a grade-point average of at least 2.50 for the courses comprising the pre-professional curriculum. Satisfactory completion for computer engineering students is defined as a grade of "C" or better in each course and a grade-point average of at least 2.75 for the courses comprising the pre-professional curriculum. If courses are repeated, the best attempt is used in computing the grade-point average.

Students who enroll in 2000-level or higher engineering courses without satisfactorily completing the pre-professional program will be administratively dropped from those courses. Limited exceptions can be made by the department head with the approval of the dean when extenuating circumstances exist that are beyond the control of the student.

During the second, third, and fourth years of work the student pursues a prescribed curriculum of technical and non-technical courses as preparation for professional practice in a chosen engineering field.

Honors Program

The College of Engineering has established an honors program to challenge superior students with an accelerated and more in-depth academic program, and to provide a structure for working more closely with faculty members and other students in a team environment.

An honors program is highly recommended for individuals planning academic or research related careers that require considerable critical and original independent thinking. To participate in the honors program, a student must have a grade-point average of 3.50 or higher on the first 60 hours of degree credit and must maintain that minimum to completion of the bachelor's degree. Details are available in departmental offices.

State Minimum Core, Humanities and Social Sciences Requirements

Every student seeking a baccalaureate degree from the College of Engineering must satisfy the University courses that qualify for the State Minimum Core requirements and the humanities and social sciences requirements of the College of Engineering. The University Core requirements for the University of Arkansas are listed on page 41. 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-level or above may be in the fine arts/humanities area, the social science area, or divided between the two areas. Since some of the humanities/social science courses are specified in some of the curricula, e.g., ECON 2143 in chemical, industrial, and mechanical engineering, the student should consult the curriculum of the department in which he/she is enrolled prior to selecting upper-level electives.

Specific University Core Requirements for Engineering Students

	HOURS
English	6
ENGL 1013, Composition I	
ENGL 1023, Technical Comp. II (ENGL 1023, Composition II, may be taken in lieu of Technical Composition II.)	
U.S. History or Government	3
Select from list on page 42	
Mathematics	4
MATH 2554, Calculus I	4
Science	8
PHYS 2054/2050L, Univ Physics I	
PHYS 2074/2070L, Univ Physics II	
Fine Arts/Humanities	6
Select from list on page 41 and from list of approved upper-level humanities/social science courses. (See adviser.)	
Social Sciences	9

Special Courses

The curricula outlined on the following pages will be followed by the majority of engineering students. There are, however, courses in several departments, such as English, Western civilization, and mathematics, for students who qualify for honors courses. For students not ready to pursue the regular courses in the engineering curriculum, certain preparatory courses in English, mathematics, and chemistry are offered on the basis of placement scores.

College Policy on Academic Ethics

The purpose of this policy statement is to define and encourage a uniform application of rules and regulations regarding academic ethics throughout the College of Engineering. Unethical conduct undermines the pursuit of the educational goals of this institution and erodes the honor, ability, and reputation of its graduates. This policy is intended to promote an academic climate wherein the full potential of each student can be realized and recognized.

Code of Ethics

Students in the College of Engineering are obligated to comply with pertinent provisions of the Code of Ethics applicable to professional practice following graduation. The Code requires "honesty, impartiality, fairness, and equity," and "adherence to the highest principles of ethical conduct." Most particularly, it states that engineers shall

1. be objective and truthful in professional reports, statements, or testimony,
2. not falsify or permit misrepresentation of their academic or professional qualifications,
3. give credit for engineering work to those whom credit is due,
4. not compete unfairly with other engineers by attempting to obtain employment or advancement by improper or questionable methods,
5. avoid any act tending to promote their own interest at the expense of the dignity and integrity of the profession.

Examples of Unethical Conduct

Pursuant to these provisions, the faculty of the College of Engineering considers the following to be specific examples of unethical conduct:

1. Submission, as one's own, of any work prepared totally or in part by someone else.
2. Plagiarism, i.e., the unacknowledged incorporation of another person's work, either verbatim or in substance, in work submitted for credit.
3. Unauthorized collaboration with another person in preparing work submitted for credit.
4. Unauthorized submission, for credit, of work previously credited in another course.
5. Unauthorized alteration of work submitted for re-grading.
6. The use of unauthorized materials or aids during examinations.
7. Copying from the examination paper of another student or giving aid to, or seeking aid from, another student during an examination.
8. Using, obtaining, or attempting to obtain by any means the whole or any part of an unadministered examination, or of information pertaining thereto.
9. Taking, or attempting to take, an examination for another student, or allowing another student to take or attempt to take an examination for oneself.
10. Any conduct expressly stated to be unethical by the instructor in a particular course.
11. Aiding, abetting, or condoning unethical conduct on the part of another student.

Strict adherence to the foregoing Code of Ethics is a requirement for graduation from the College of Engineering.

Faculty Response to Acts of Unethical Conduct

Upon becoming aware of unethical conduct, the faculty member should:

1. Collect and/or prepare appropriate documentation of the act. Examples of suitable documents are (a) reproduced copies of examinations, papers, or reports that establish unethical conduct; (b) signed written statements regarding unethical conduct by another student. (This means may be used by students to initiate action in cases of unethical conduct.)

2. Inform the student of any action to be taken in response to unethical conduct. Possible actions include (a) reduction of grade; the faculty member may decide to reduce the grade on a particular test or assignment or to

assign a failing grade for the course; (b) request the College of Engineering Academic Ethics Board to rule that the student does not meet the requirements for graduation.

3. Submit a report to the College of Engineering Academic Ethics Board and give a copy of the report to the student(s) involved. Copies of documentation should accompany the report submitted to the Board. (The report will provide protection against repeated offenses in different courses.)

Academic Ethics Board

The purpose of the Academic Ethics Board is to review the academic ethics reports submitted by faculty members and any record of previous infractions. When the circumstances warrant, the board can, by a two-thirds vote, rule that the student does not meet the requirements for graduation from the college as set forth in the engineering catalog. (The board can specify conditions under which the requirements might still be met.)

The board shall be made up of seven tenured engineering faculty members and two students. The faculty members in each department of the College of Engineering shall elect one person from the faculty in their department to serve on the board. Each board member shall serve a two-year term. The Student Engineering Council will appoint the student members to serve staggered two-year terms.

Appeals

A student who wishes to appeal a decision by a faculty member or by the College of Engineering Academic Ethics Board may utilize existing University academic grievance procedures.

DEGREE REQUIREMENTS

The basic requirement for a Bachelor of Science degree in engineering is 126-136 semester hours of academic work, depending on the career field chosen. Students coming from high school with adequate preparation will be able to satisfy this requirement in eight semesters; however, some students require preparatory courses and others choose to enroll in slightly lighter loads and graduate in nine or 10 semesters. Students enrolled in ROTC require an additional 19 semester hours to meet all graduation requirements and graduate in 10 semesters (5 years).

Engineering is a rapidly changing profession, and the departmental curricula are updated continuously to keep pace with these changes. Students entering under this catalog will be required to comply with such curriculum changes to earn their degree. However, the total number of semester hours required for the degree may not be increased, and all work completed in accordance with this catalog prior to the curriculum change will be applied toward the student's degree requirements. Former students of the college must meet the curriculum requirements in effect at the time of their readmission.

Graduation Requirements

In addition to the University Core requirements for graduation (page 41), a candidate for a degree from the College of Engineering must also meet the following requirements:

Candidates for engineering degrees must meet the minimum curricular requirements established by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology.

A candidate for a degree from the College of Engineering must have earned a grade-point average of no less than 2.00 on all courses in the student's major area of study, all engineering courses, and all work completed at the University and presented for the degree. Grades on work taken at other colleges and presented for transfer credit must also meet this standard.

No student will be allowed to graduate if the student has "D" grades in more than 15 percent of all credit earned in this institution and presented to meet the requirements for a degree.

All ROTC classes are elective. Unspecified electives may be satisfied with any course except those courses, or prerequisite courses, needed to satisfy the student's curriculum, and those courses considered remedial to the programs in engineering.

Minors in Other Colleges and Schools

Students in the College of Engineering may pursue an academic minor in other colleges. For example, a minor in business is popular among engineering students. For requirements regarding minors, check the catalog listing for the department offering the minor. Students must notify the College of Engineering dean's office of their intent to pursue a minor.

GRADUATION HONORS

Students who have demonstrated exceptional academic performance in baccalaureate degree programs will be recognized at graduation by the honors designation of *Cum Laude, Magna Cum Laude,* or *Summa Cum Laude*. To earn this distinction, a student must meet the following criteria:

1. At least one-half of the degree course work must have been completed at the University of Arkansas, Fayetteville.

2. For *Cum Laude*, the student must rank in the top 10 percent of the college graduating class. (This corresponds to a grade-point average of 3.60.)

3. For *Magna Cum Laude*, the student must rank in the top 5 percent of the college graduating class. (This corresponds to a grade-point average of 3.75.)

4. For *Summa Cum Laude*, the student must rank in the top two percent of the college graduating class. (This corresponds to a grade-point average of 3.90.)

ELECTRONICS MANUFACTURING

The College of Engineering offers a non-degree Certificate of Achievement in Electronics Manufacturing for students seeking undergraduate or graduate degrees in the College. The objectives of the program are to introduce electronics manufacturing as a career option and to prepare engineers for entry-level participation in the world electronics industry that is characterized by rapid technological change, intense global competition, and team-based project activity. The following courses are available in this program:

- CHEG 5613, Microelectronics Fabrication and Materials
- ELEG 5213, Integrated Circuit Fabrication Technology
- ELEG/MEEG 5273, Electronic Packaging
- ELEG 5293L, Integrated Circuits Fabrications Laboratory
- ELEG/MEEG 6273, Advanced Electronic Packaging
- INEG 4513/ELEG 4273, Electronics Manufacturing Process
- INEG 4533, Applications of Machine Vision
- INEG 4563, Applications of Robotics
- INEG 5423, Engineering in Global Competition
- INEG 5363, Modeling and Analysis of Semiconductor Manufacturing
- MEEG 4443, Thermal and Vibration Analysis and Testing of Electronics
- MEEG 5913, Intro to MEMS
- MEEG 5913, Advanced MEMS
- MEPH 5713/CHEM 6193, Nanotechnology I
- MEPH 5723, Nanotechnology II
- MGMT 5383, Intra/Entrepreneurship of Technology
- Special Topics courses as approved by Microelectronics-Photonics Graduate Program

A student who completes either INEG 4513/ELEG 4273 or INEG 5143, along with and any two of the other program courses, will receive the Certificate of Achievement in Electronics Manufacturing.

GRADUATE STUDIES

The College of Engineering, in cooperation with the UA Graduate School, offers programs leading to the following degrees:

- Master of Science in Biological and Agricultural Engineering (M.S.B.A.E.)
- Master of Science in Chemical Engineering (M.S.Ch.E.)
- Master of Science in Civil Engineering (M.S.C.E.)
- Master of Science in Computer Engineering (M.S.Cmp.E.)
- Master of Science in Electrical Engineering (M.S.E.E.)
- Master of Science in Engineering (M.S.E.)
- Master of Science in Environmental Engineering (M.S.En.E.)
- Master of Science in Industrial Engineering (M.S.I.E.)
- Master of Science in Mechanical Engineering (M.S.M.E.)
- Master of Science in Operations Research (M.S.O.R.)
- Master of Science in Telecommunications Engineering (M.S.Tc.E.)
- Master of Science in Transportation Engineering (M.S.T.E.)
- Doctor of Philosophy in Engineering (Ph.D.)

In addition, the College of Engineering supports the following interdisciplinary graduate programs:

- Master of Science in Microelectronics-Photonics (M.S.)
- Master of Science in Cellular and Molecular Biology (M.S.)
- Doctor of Philosophy in Microelectronics-Photonics (Ph.D)
- Doctor of Philosophy in Cellular and Molecular Biology (Ph.D.)

Further information concerning these programs can be found in the Graduate School Catalog or in the office of the dean of the Graduate School.

Departments, Degree Programs and Courses

BIOLOGICAL AND AGRICULTURAL ENGINEERING (BENG)

Lalit Verma
Head of the Department
203 Engineering Hall
575-2351

- Professors Griffis, Loewer, Verma
- Associate Professors Carrier, Costello, Li, Vories
- Assistant Professor Bajwa, Chaubey , Kim, Matlock, Osborn
- Research Assistant Professor Murphy
- Adjunct Professors Clausen, Gardisser
- Adjunct Associate Professors Beitle, Deaton, Huitink, Tacker, VanDevender
- Adjunct Assistant Professors Haggard, Howell, Wimberly, Yang

Biological engineering is a science-based curriculum in the department of biological and agricultural engineering leading to the application of engineering principles for design of solutions to problems in biological, food, and agricultural systems. The curriculum is structured to address the wide range of problems associated with protecting the environment, managing natural resources, and the manufacturing, processing, and production of biological products. Students may focus in one of the following areas: food and bioprocess engineering, bioenvironmental engineering, biomechanical engineering, and in pre-medical/biomedical engineering.

Biological engineering prepares a student for advanced study and a wide variety of engineering careers related to biological systems in general and agriculture in particular. Careers are available in both the public and private sector, and include environmental protection, natural resource utilization, food processing, machine design and development, structural design, teaching, research, and consulting.

Biological Engineering faculty have responsibility in the university Land-Grant mission for teaching, research, and extension and have research appointments in the Arkansas Agricultural Experiment Station. The following departmental goals address this three-part mission:

1. To conduct basic and applied cutting-edge research that addresses the present and future needs of the enterprises that require biological engineering and that will support the state, national, and international activities consistent with the vision for the Dale Bumpers College of Agricultural, Food and Life Sciences, the Arkansas Agricultural Experiment Station, and the College of Engineering.
2. To educate biological engineering students to be technically and professionally competent and to meet the requirements for professional engineer registration.
3. To provide graduate education for the Master of Science in Biological and Agricultural Engineering and Ph.D. in Engineering.
4. To maximize performance incentives and encourage the professional growth of the faculty so they may better serve our students and the public.

The educational objectives of the Biological Engineering program are to produce graduates who

1. Effectively apply engineering to biological systems and phenomena (plants, animals, humans, microbes, and the environment) with demonstrated proficiency in basic professional and personal skills.
2. Are well prepared for future challenges in biological engineering, life-long learning, and professional and ethical contributions to society through sustained accomplishments.

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 Bachelor of Science 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.

Areas of Concentration

Each student is required to complete 12 semester hours of approved electives in his or her area of concentration. Six of these hours must be from the biological engineering design elective courses. The remaining 6 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 advisor. The department maintains a list of approved electives.

The areas of technical concentration and the recommended elective courses for each are listed here. Note that additional Biological Engineering Design Elective courses (beyond the 6 hours required) may be taken to satisfy Technical Elective requirements.

Bioenvironmental Engineering

Biological Engineering Design Electives:
BENG 4903, Natural Resources Engineering
BENG 4913, Bio-Environmental Engineering
BENG 4923, Nonpoint Source Pollution Engineering
BENG 4623, Biological Reactor Systems Design
BENG 4113, Risk Analysis
BENG 4403, Control Env Struct

Technical electives:
CVEG 3243, Environmental Engineering
CVEG 4243, Environmental Engineering Design
CSES 2203, Soil Science
CSES 4043, Environmental Impact and Fate of Pesticides
BENG 4803, Precision Agr
GEOG 4543, Geog Infor Systems
ENSC 4033, Water Quality Analysis

Food and Bioprocess Engineering

Biological Engineering Design Electives:
BENG 4113, Risk Analysis for Biological Systems
BENG 4123, Biosensors & Bioinstrumentation
BENG 4623, Biological Reactor Systems Design
BENG 4703, Food and Bioprocess Engineering

Technical electives:
FDSC 4304/4300L, Food Chemistry
FDSC 4124/4120L, Food Microbiology
FDSC 3103, Principles of Food Proc.
CHEM 3453/3451L, Elements of Physical Chemistry
MEEG 4413, Heat Transfer
CHEG 4423, Auto. Process Control

Biomechanical Engineering

Biological Engineering Design Electives:
BENG 4113, Risk Analysis for Biological Systems
BENG 4123, Biosensors & Bioinstrumentation
BENG 4703, Food and Bioprocess Engineering

Technical electives:
BENG 4803, Precision Agriculture
MEEG 3103, Mechanisms
MEEG 3113, Vibrations & Machine Dynamics
MEEG 3123, Design Stress Analysis
MEEG 4123, Finite Element Methods in Mechanical Engineering
INEG 4533, Application of Machine Vision

Pre-Medical/Biomedical Engineering

NOTE: Pre-Medical students must take CHEM 3603/3601L, Organic Chemistry I and CHEM 3613/3611L, Organic Chemistry II instead of CHEM 2613/2611L, Organic Physiological Chemistry. This requires special scheduling of courses beginning in the first sophomore semester. See your faculty adviser for this schedule plan.

Biological Engineering Design Electives:
BENG 4113, Risk Analysis for Biological Systems
BENG 4123, Biosensors & Bioinstrumentation
BENG 4623, Biological Reactor Systems Design
BENG 4403, Control Env Struct

Technical electives:
CHEM 3613, Organic Chemistry II
CHEM 3611L, Organic Chemistry II Lab
ZOOL 2404, Comparative Vertebrate Morphology or ZOOL 2443/2441L, Human Anatomy
BIOL 4234, Comparative Physiology or ZOOL 2213/2211L, Human Physiology
BIOL 2533/2531L, Cell Biology
MBIO 4233, Microbial Genetics
KINS 3353, Mech of Human Movement
ELEG 2903, Digital Systems
HESC 3204, Nutrition
MEEG 3103, Mechanisms

The following section contains the list of courses required for the Bachelor of Science in Biological Engineering degree and a suggested sequence. All courses are not offered every semester so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites.

BIOLOGICAL ENGINEERING PROGRAM

Freshman Year - First Semester
2 BENG 1012, Biological Engineering Design Fundamentals I
2 GNEG 1122, Introduction CAD
3 ENGL 1013, Composition I
3 CHEM 1103, University Chemistry I
4 MATH 2554, Calculus I
3 BIOL 1543, Principles of Biology
1 BIOL 1541L, Principles of Biology Lab
18 semester hours

Second Semester
2 BENG 1022, Biological Engineering Design Fundamentals II
3 ENGL 1023, Technical Composition II
3 CHEM 1123, University Chemistry II
1 CHEM 1121L, University Chemistry II Lab
4 MATH 2564, Calculus II
4 PHYS 2054, University Physics I
17 semester hours

Sophomore Year - First Semester
2 BENG 2612, Quantitative Biological Engineering I
4 PHYS 2074, University Physics II
4 MATH 2574, Calculus III
3 MEEG 2003, Statics
3 MBIO 2013, General Microbiology*
1 MBIO 2011L, General Microbiology Lab
17 semester hours

Second Semester
2 BENG 2622, Quantitative Biological Engineering II
2 BENG 3712, Engr Properties of Biol Materials
4 MATH 3404, Differential Equations
3 MEEG 2013, Dynamics
3 MEEG 2403, Thermodynamics
3 CHEM 2613, Organic Physiological Chemistry**
1 CHEM 2611L, Organic Physiological Chemistry Lab
18 semester hours

Junior Year - First Semester
2 BENG 3722, Biological Process Eng I
3 ELEG 2103, Electronic Circuits
1 ELEG 2101L, Electronic Circuits Lab
3 CVEG 3213, Hydraulics or MEEG 3503, Mechanics of Fluids
3 MEEG 3013, Mechanics of Materials
3 CHEM 3813, Intro to Biochemistry
15 semester hours

Second Semester
2 BENG 3732, Biological Process Eng II
3 BENG 3803, Mechanical Design in Biol Engr
3 BENG 4103, Instrumentation in Biological Engr
3 BENG Design elective
3 Humanities/social studies elective
14 semester hours

Senior Year - First Semester
3 BENG 4813, Senior Biological Engineering Design I
3 BENG Design elective
3 Technical elective
6 Humanities/social studies elective
15 semester hours

Second Semester
2 BENG 4822, Senior Biological Eng Design II
9 Humanities/social studies elective
3 Technical elective
14 semester hours

128 Total hours required

SEE PAGE 268 FOR BIOLOGICAL ENGINEERING (BENG) COURSES

CHEMICAL ENGINEERING (CHEG)

Thomas O. Spicer, III
Interim Head of the Department
3202 Bell Engineering Center
575-4951

- Distinguished Professor Havens
- Distinguished Professors Emeriti Gaddy, Thatcher
- University Professor Turpin
- Professors Babcock, Clausen, Penney, Spicer, Ulrich, Welker
- Professors Emeriti Couper, Oxford, Springer
- Research Professors Cross, Silano
- Associate Professors Ackerson, Beitle, Thoma
- Instructor Myers
- Visiting Instructors Beasley, Bushkuhl
- Adjunct Professor Siebenmorgen
- Adjunct Research Assistant Professor Howell

Chemical engineering deals with the creation, design, operation, and optimization of processes that derive practical benefits from chemical or physical changes. The profession is quite broad and has traditionally provided the technology for: supplying energy and fuel; synthesizing materials such as plastics, chemicals, fertilizers, and pharmaceuticals; and managing environmental and safety concerns of physical and chemical processes.

Chemical engineers have a variety of traditional job opportunities in industries such as petroleum production and refining, chemical and petrochemical manufacturing, mining, pharmaceutical production, and equipment manufacturing. Job opportunities may involve research, development, design, manufacturing, sales, or teaching as professional activities. The chemical engineer can also move easily into environmental engineering, nuclear engineering, oceanography, biomedical engineering, pharmacology, medicine, or other multidisciplinary fields.

In chemical engineering, the student obtains a broad foundation in chemistry, mathematics, physics, communication skills, economics, and the humanities. Courses in material and energy balances, thermodynamics, reaction kinetics, fluid mechanics, heat and mass transfer, process control, computer methods, safety, and design provide students with the background and learning skills required of the practicing chemical engineer. The curriculum includes elective courses that enable a student to prepare for immediate employment or further study at the graduate level. The chemical engineering program also serves as an excellent preparation for medical, dental, pharmacy, or law school.

The educational objective of the Chemical Engineering undergraduate program is to provide students with an adequate foundation in science, the humanities and social sciences, engineering sciences, engineering design methods, and specific chemical engineering skills, and to thereby prepare them, in a global context, to face the challenges of today's complex and difficult problems.

The educational outcomes of our four-year curriculum are to assure that each student has had the opportunity to:

- apply a knowledge of mathematics, science, and engineering;
- identify, formulate, and solve engineering problems including, for example, development of the critical thinking process and the solution of mass and energy balances;
- design a system, component, or process to meet desired needs including, for example, determining the capital and operating costs for chemical process equipment and performing technical economic projections;
- locate, interpret, and use physical property data; when data are unavailable, design and conduct experiments, and interpret the resulting data;
- understand professional and ethical responsibility;
- use the techniques, skills, and modern engineering tools necessary for engineering practice including, for example, writing structured computer programs and using commercially available technical computer software;
- develop and use effective written and oral communication skills;
- function in multi-disciplinary teams;
- recognize the need to engage in lifelong learning;
- understand the impact of engineering solutions in a global or societal context including, for example, being conscious of social, environmental, and safety concerns; and
- be familiar with contemporary issues.

These outcomes are reinforced and demonstrated in a senior capstone safety and design sequence.

The following section contains the list of courses required for the Bachelor of Science in Chemical Engineering degree and a suggested sequence. All courses are not offered every semester so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites. Technical electives are to be selected from a list approved by the Department.

CHEMICAL ENGINEERING PROGRAM

Freshman Year - First Semester
4 MATH 2554, Calculus I
3 CHEM 1123, University Chemistry II
1 CHEM 1121L, University Chemistry II Lab
3 ENGL 1013, Composition I
3 CHEG 1113, Intro to Chem Engr I
3 HIST 2003, Hist./American People to 1877 (HIST 2013 or PLSC 2003 may be substituted.)
17 semester hours

Second Semester
4 MATH 2564, Calculus II
3 CHEG 1123, Intro to Chem Engr II
3 ENGL 1023, Technical Composition II
2 CHEG 1212L, Chemical Engr Lab I
3 Humanities/Social science elective
15 semester hours

Sophomore Year - First Semester
4 MATH 2574, Calculus III
3 CHEM 3603, Organic Chemistry I
1 CHEM 3601L, Organic Chemistry I Lab
3 PHYS 2054, Univ Physics I
1 PHYS 2050L, Univ Physics Lab I
3 CHEG 2313 Thermodynamics of Single Component Systems
1 CHEG 3221, Professional Practice Seminar
16 semester hours

Second Semester
4 MATH 3404, Differential Equations
3 CHEM 3613, Organic Chemistry II
1 CHEM 3611L, Organic Chemistry II Lab
3 PHYS 2074, Univ Physics II
1 PHYS 2070L, Univ Physics II Lab
3 CHEG 2133, Fluid Mechanics
3 CHEG 3323, Thermodynamics of Multicomponent Systems
18 semester hours

Junior Year - First Semester
4 CHEM Elective
3 MEEG 2003, Statics
3 CHEG 3143, Heat Transport
2 CHEG 3232L, Chemical Engr Lab II
3 CHEG 3253,Chem Engr Computer Methods
3 Humanities/SocialScience Elective
18 semester hours

Second Semester
4 CHEM Elective
3 MEEG 3013, Mechanics of Materials
3 CHEG 3333, Chem Engr Reactor Design
3 CHEG 3153, Non-Equil Mass Transfer
3 ECON 2143, Basic Economics (ECON 2013, Principles of Macro-economics, may be substituted.
16 semester hours

Senior Year - First Semester
3 CHEG 4163, Equil Stage Mass Transfer
3 CHEG 4413, Chem Engr Design I
3 CHEG 4813 Chemical Process Safety
3 Technical elective
3 Humanities/social science elective
15 semester hours

Second Semester
2 CHEG 4332L, Chem Engr Lab III
3 CHEG 4443, Chem Engr Design II
3 ELEG 3903, Electric Circuits & Machines
3 CHEG 4423, Auto Process Control
3 Technical elective
3 Humanities/social science elective
17 semester hours

132 Total hours required

Technical Elective Options in Chemical Engineering

Each student in chemical engineering is required to complete six semester hours of technical electives. A minimum of three semester hours of these courses must be 4000- or 5000-level chemical engineering elective courses. Students may select the remaining semester hours from upper division (3000 and above) technical electives in mathematics, engineering, and the sciences with the approval of their adviser. At least three semester hours must be selected from courses outside the chemical engineering department. An undergraduate education in chemical engineering provides a firm foundation for many areas of specialization. The following groups of courses can strengthen the background of a student in a particular area of expertise; note that other technical electives are included on the list approved by the Department and that not all of the following courses will meet the requirements of a technical elective.

Biotechnology/Biomedical Engineering

CHEG 5513, Biochemical Engineering Fundamentals
CHEG 5523, Bioprocess Engineering
CHEM 3813, Introduction to Biochemistry, or
CHEM 5813, Biochemistry I,
CHEM 5843, Biochemistry II
BIOL 3323/3321L, General Genetics
CEMB 5911, Seminar in Cellular/ Molecular Biology

Chemical Process Safety

CHEG 5273, Corrosion Control
INEG 3213, Safety Engineering
INEG 4223, Occupational Safety and Health Standards
FDSC 4223, Risk Analysis for Biological Systems
OMGT 4303, Industrial Safety Administration

Environmental Engineering

CHEG 5753, Air Pollution
CHEG 4263, Environmental Experimental Methodology
CHEG 4913, Environmental Engineering Chemodynamics
CHEG 5273, Corrosion Control
MEEG 4813, Air Pollution Abatement
MEEG 4843, Environmentally Conscious Design and Manufacturing
CVEG courses on an approved list

Food Process Engineering

BENG 4703/4700L, Food and Bioprocess Engineering
BENG 3712, Engineering Properties of Biological Materials
FDSC 4713/4710L, Food Product and Process Development
FDSC 4124, Food Microbiology
FDSC 4223, Risk Analysis for Biological Systems
FDSC 4304/4300L, Food Chemistry

Materials Science and Engineering

CHEG 5273, Corrosion Control
CHEG 5733, Polymer Theory and Practice
MEEG 4303, Materials Laboratory

Microelectronics

CHEG 5613, Microelectronics Fabrication and Materials
ELEG 4203, Semiconductor Devices
PHYS 3614, Modern Physics
MATH 3423, Advanced Applied Mathematics

Nuclear Power Engineering

CHEG 5273, Corrosion Control
MEEG 4603, Basic Nuclear Engineering
MEEG 4623, Radiation Protection and Shielding
MEEG 4633, Nuclear Power Generation
CHEM 5263, Nuclear Chemistry

Pre-medicine

BIOL 1543/1541L, Principles of Biology
CHEM 3813, Introduction to Biochemistry
MBIO 2013/2011L, General Microbiology
ZOOL 2213/2211L, Human Physiology
ZOOL 2443/2441L, Human Anatomy

Simulation and Optimization

CHEG 5033, Technical Administration
CHEG 5213, Advanced Chemical Engineering Calculations
INEG 3313, Engineering Statistics
INEG 3613, Introduction to Operations Research
INEG 4623, Introduction to Simulations
MATH 3083, Linear Algebra

SEE PAGE 273 FOR CHEMICAL ENGINEERING (CHEG) COURSES

CIVIL ENGINEERING (CVEG)

Robert P. Elliott
Head of the Department
4190 Bell Engineering Center
575-4954

- University Professor Emeritus LeFevre
- Professors Buffington, Dennis, Elliott, Gross, Schemmel, Selvam, Young
- Professor Emeriti Ford, Heiple, Jeffus, Knowles, Moore, Parker
- Associate Professors Gattis, Hall, Wang
- Associate Professor Emeriti Alguire, Pleimann, Thornton
- Assistant Professors, Burian, Edwards, Heymsfield, Soerens, Tooley, R. Williams, S.Williams

Civil engineering is the oldest of all the engineering fields, yet it is as contemporary as the need to provide solutions to today's environmental problems and to develop advanced transportation systems. The civil engineer plans, designs, builds, and operates projects for the advancement and well being of society while coordinating and conserving human resources. Civil engineering projects range from small to monumental and include public water systems, buildings, bridges, rail and highway networks, wastewater treatment plants, solid and hazardous waste disposal facilities, airports, and soil conservation and flood diversion controls.

The civil engineering profession offers a vast array of opportunities. Civil engineers may work in private employment or with public agencies. They may work indoors in activities such as planning and design, or outdoors in areas such as construction supervi-

sion. Employment is possible anywhere in the world.

The objectives of the civil engineering program are as follows:

1. To produce graduates who are prepared for entry-level positions in foundation and earthwork design and analysis; environmental engineering; transportation planning, design, materials, and operation; and concrete and steel structural design and analysis.
2. To prepare graduates for advanced civil engineering studies.

To this end, all students must take courses in geotechnical , environmental, transportation, and structural engineering. Courses are designed to present "real world" applications without sacrificing conceptual and theoretical basics. Students complete design problems in each of these areas; and, as part of the senior year, they participate in a major design project (CVEG 4994, Civil Engineering Design).

The following section contains the list of courses required for the Bachelor of Science in Civil Engineering degree and a suggested sequence. All courses are not offered every semester so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites.

CIVIL ENGINEERING PROGRAM

Freshman Year - First Semester
3 ENGL 1013, Composition I
4 MATH 2554, Calculus I
2 CVEG 1012, Civil Engr Fund
3 CHEM 1103,Univ Chemistry I
1 CHEM 1101L, Univ Chemistry I Lab
3 Humanities/social science elective
16 semester hours

Second Semester
3 ENGL 1023, Technical Composition II
3 PHYS 2054, University Physics I
1 PHYS 2050L, Univ Physics I Lab
3 CHEM 1123, University Chemistry II
1 CHEM 1121L, Univ Chemistry II Lab
4 MATH 2564, Calculus II
2 GNEG 1122, Introduction CAD
17 semester hours

Sophomore Year - First Semester
4 MATH 2574, Calculus III
3 MEEG 2003, Statics
3 CVEG 1113, CE Computer Applications
3 Humanities/social science elective
3 CVEG 2053, Surveying Systems
1 CVEG 2051L, Surveying Systems Lab
17 semester hours

Second Semester
3 CVEG 2113, Structural Materials
3 INEG 3313, Engineering Statistics
4 MATH 3404, Differential Equations
3 MEEG 2013, Dynamics
3 MEEG 3013, Mechanics of Materials
16 semester hours

Junior Year - First Semester
4 CVEG 3304, Structural Analysis
3 CVEG 3133, Soil Mechanics
3 CVEG 3213, Hydraulics
3 CVEG 3413, Transportation Engineering
2 GEOL 3002, Geology for Engineers
3 Humanities/social science elective
18 semester hours

Second Semester
2 CVEG 3022, Public Works Economics
3 CVEG 3223, Hydrology
3 CVEG 3243, Environmental Engineering
3 CVEG 4313, Structural Steel Design I
4 Science Elective
3 Humanities/social science elective
18 semester hours

Senior Year - First Semester
3 CVEG 4143, Foundation Engineering
3 CVEG 4243, Environmental Engr Design
3 CVEG 4303, Reinforced Concrete Design I
3 CVEG 4433, Transportation Pavements & Materials
3 Civil Engineering elective
3 Humanities/social science elective
18 semester hours

Second Semester
3 CVEG 4513, Construction Mgmt
4 CVEG 4994, Civil Engineering Design
6 Civil Engineering electives
3 Humanities/social science elective
16 semester hours

136 Total hours required

Civil Engineering Electives

Students must select a nine-hour technical elective program in conference with their adviser. Selection should be made from 4000-level civil engineering courses. Only in unusual circumstances will a senior student choose from the 5000 (graduate-level) courses series. Humanities and social science electives are selected from courses approved by the college. The science elective requirement is satisfied by completing one of the following course sequences: CHEM 3603 and 3601L, Organic Chemistry, GEOL 3513 and 3511L, Structural Geology, MBIO 2013 and 2011L, General Microbiology, or PHYS 2074 and 2070L, University Physics II,. Lists of approved electives are on file in the department office.

SEE PAGE 284 FOR CIVIL ENGINEERING (CVEG) COURSES

COMPUTER SCIENCE AND COMPUTER ENGINEERING (CSCE)

Aicha Elshabini
Interim Head of the Department
311 Engineering Hall
575-6197

- Professors Brewer, Crisp, Elshabini, Lala, Skeith, Starling
- Associate Professors Apon, Deaton, Li, Panda
- Adjunct Associate Professor Beavers
- Assistant Professors Hexmoor, Parkerson, Simonson, Thompson
- Instructors Baker, Holmes, Johnson, McPherson, Wiggins

The department offers the bachelor of science degree in computer engineering, bachelor of science and bachelor of arts degrees in computer science, and master of science and doctor of philosophy degrees in both computer engineering and computer science. The undergraduate computer science degrees are described in the listing for this department in the Fulbright College of Arts and Sciences section of this catalog. The graduate degrees are described in the Graduate School Catalog.

The educational objectives of the department are to produce graduates who are recruited in a competitive market and make valuable contributions to a wide variety of industries, particularly in computer and information technology, succeed in graduate or professional studies in such areas as engineering, science, law, medicine, or business, if pursued; pursue life-long learning and continued professional development; undertake leadership roles in their profession, in their communities, and in the global society.

To meet these objectives, the computer engineering curriculum has required sequences of courses in both hardware and software aspects of computer applications. The computer engineer must understand both hardware and software techniques to design, build, and test complex digital systems. At the advanced level, students are exposed to hands-on experience with open-ended problems with opportunities for research and design.

The computer engineering program is divided into three phases. In the first year, all computer engineering undergraduate students must successfully complete a pre-professional curriculum that covers the essential foundations in mathematics, science and introductory computer engineering and programming. Due to the critical importance of this foundation material, satisfactory completion of the pre-professional curriculum is required prior to admission to sophomore level and above computer engineering courses. In the second

and third years, students perform course and laboratory work in the core subjects of data structures, algorithms, digital systems, and computer organization. The final phase is a combination of technical electives and advanced courses which can be chosen from the areas of computer architecture, software engineering, networking, telecommunications, artificial intelligence, robotics, object-oriented programming, client-server programming, VLSI design, and programmable logic.

Humanities and social science electives are selected from courses approved by the College. A list of these electives is available on the Engineering College web page or in the Dean's office.Undergraduate Handbook has a list of approved basic science, mathematics, and technical electives. Any course not included in these lists requires faculty approval.

The following section contains the list of courses required for the Bachelor of Science in Computer Engineering degree and a suggested sequence. All courses are not offered every semester, so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites.

COMPUTER ENGINEERING PROGRAM

Freshman Year - First Semester
4 MATH 2554, Calculus I
3 CHEM 1103, Gen. Chemistry
1 CHEM 1101L, Gen. Chem. Lab
3 CENG 1113, Intro to Computers
1 CENG 1111L, Intro to Computers Lab
3 ENGL 1013, English Composition
15 semester hours

Second Semester
4 MATH 2564, Calculus II
3 PHYS 2054, U Physics I
1 PHYS 2050L, U Physics I Lab
3 CENG 1123, Intro Programming
1 CENG 1121L, Intro Programming Lab
3 ENGL 1023, Technical Comp
3 MATH 2103, Discrete Math
18 semester hours

Sophomore Year - First Semester
4 MATH 2574, Calculus III
3 PHYS 2074, U Physics II
1 PHYS 2070L, U Physics II Lab
3 CENG 2113, Digital Tech I
3 CENG 2143, Data Structures
3 Humanities/social science elective
17 semester hours

Second Semester
4 MATH 3404, Differential Equations
3 ELEG 3903, Circuits and Machines
3 CENG 2133, Assembly Language
3 CENG 2123, Digital Tech II
3 Basic science elective
16 semester hours

Junior Year - First Semester
3 ELEG 3913, Engineering Electronics
3 Technical Elective
3 CENG 3313, Algorithms
3 History/Government Requirement
3 Humanities/social science elective
15 semester hours

Second Semester
3 Free Elective
3 PHIL 3103, Ethics and the Professions
3 Technical Elective
3 CENG 3213, Computer Organization
3 STAT 3013, Intro to Probability and Statistics (INEG 3313 may be substituted)
15 semester hours

Senior Year - First Semester
3 CENG 4513, Software Engineering
1 CENG 457V, Senior Design Project
3 CENG 4213, Computer Architecture
6 Technical electives
3 Humanities/social science elective
16 semester hours

Second Semester
3 CENG 457V, Senior Design Project
3 CENG 4413, Operating Systems
6 Technical electives
3 Humanities/social sci. elective (3000+)
15 semester hours

127 Total hours required

Degree Program Changes

Students must meet all requirements of their degree programs and are expected to keep themselves informed concerning current regulations, policies, and program requirements in their fields of study. Changes made in curriculum at a level beyond that at which a student is enrolled may become graduation requirements for that student. Changes made in the curriculum at a level lower than the one at which a student is enrolled are not normally required by that student. Students should consult their departmental adviser for additional information.

SEE PAGE 281 FOR COMPUTER SCIENCE AND COMPUTER ENGINEERING (CSCE) CSCE

ELECTRICAL ENGINEERING (ELEG)

Aicha Elshabini
Head of the Department
3217 Bell Engineering Center
575-3009

- Distinguished Professor Yeargan
- University Professors Brown (W.D.), Schmitt, Yaz
- Professors Ang, Balda, Elshabini, Jones, Mantooth, Martin, Naseem, Olejniczak, Schaper, Waite
- Associate Professors Brown (R.L.), Caldwell, Charlton, Gattis,
- Assistant Professors Barlow, El-Shenawee, Lee

Electrical engineering is a profession in charge of designing electrical devices and assemblies to benefit mankind. This may encompass systems such as satellite antennas, microelectronics, portable or wireless electronics, or embedded computers in everyday consumer electronics.

The electrical engineering graduate is at the forefront of the technology leading to the dramatic increase in global communications, the accelerated use of electric power, the dominating influence of the computer on modern society, and a host of other developments. The increased use of electronic equipment for measurement and control has spread into such diverse areas as improved health care, transportation, recreation, agricultural production, marketing, manufacturing, and countless others. This wide-spread and expanding use of electronic equipment in virtually all fields has made electrical engineering the largest of all scientific disciplines and assures a continuing demand for electrical engineering graduates throughout business and government.

The University of Arkansas is the state land-grant university and is a nationally competitive, student-centered, research university serving Arkansas and the world. As such, our mission is education, research, and service. The electrical engineering program is designed to offer a high-quality course of instruction involving classroom, laboratory, and extracurricular activities that results in graduates qualified and prepared to meet the demands of a professional career in the present and future work place and able to assume a responsible place of leadership in a complex technological society.

The educational mission of the department is conducted through both the undergraduate and graduate programs. The educational objectives for the undergraduate program, which leads to a Bachelor of Science degree in electrical engineering, are to produce graduates

that exhibit the following attributes:

1. are recruited in a competitive market and valued as reliable and competent employees by a wide variety of industries, in particular electrical engineering industries,
2. succeed in graduate studies, such as engineering, science, law, medicine, business, and other professions, if pursued,
3. understand the need for life-long learning and continued professional development for a successful and rewarding career, and
4. accept responsibility for leadership roles, in their profession, in their communities, and in the global society.

The graduate program offers a Master of Science degree in Electrical Engineering and a Doctor of Philosophy degree in Engineering. Having received additional instruction and hands-on experience beyond the undergraduate level, an additional educational objective for the graduate program is to produce graduates that are prepared to promptly address critical issues and assume advanced positions in the profession, such as management, design, and development.

The research mission of the department is conducted mainly through the graduate program. Internal and external funded research projects serve to

1. discover new knowledge, address technical problems, and develop new electrical/electronic technologies,
2. provide the tools and resources which keep our faculty at the cutting edge of electrical engineering,
3. provide financial support for graduate students, and
4. improve the quality of life for citizens of Arkansas and the world.

The graduate program also supports the undergraduate program by giving top undergraduate students access to research laboratories with state-of-the-art equipment and software. Topics covered in graduate courses migrate into senior undergraduate elective courses and eventually into required undergraduate courses.

Faculty, students, administrators, and staff conduct the service mission of the department. The electrical engineering program, including faculty, students, staff, and facilities, is a major resource of the state, region and nation. Faculty members are encouraged to provide services to both the community and the profession. Our faculty members are active in local, state, national, and international professional and service organizations, as well as public and private schools involving grades K-12.

The electrical engineering curriculum is designed to provide students with a knowledge of scientific principles and methods of engineering analysis to form a solid foundation for a career in design, research and development, or management. Students progressively build their design experience throughout the curriculum and demonstrate this ability in the senior design lab. Equally important, the curriculum introduces students to subjects in the humanities, social sciences, and ethics so they may better understand the interaction of technology and society.

The electrical engineering curriculum is divided into three phases. The first year is the pre-professional curriculum, which concentrates on development of a sound understanding of basic science and mathematics. Due to the crucial importance of this foundation material to the study of electrical engineering, satisfactory completion of the pre-professional curriculum is required prior to admission to entry-level electrical engineering courses. The second- and third-year course work further develops scientific principles and covers the basic core of the professional curriculum in electrical engineering. The fourth year is composed primarily of senior-level elective courses. At this time, the student in conjunction with his or her adviser may plan a program to concentrate in one or more of the technical specializations within electrical engineering. This final year permits the student to tailor a program suited to his or her individual career objectives.

The graduation requirement in electrical engineering is 128 semester hours.

The following section contains the list of courses required for the Bachelor of Science in Electrical Engineering degree and a suggested sequence. All courses are not offered every semester so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites.

ELECTRICAL ENGINEERING PROGRAM

Freshman Year - First Semester
(Pre-Professional Curriculum)
1 ELEG 1001, Intro to Elec Engineering
3 ENGL 1013, Composition I
4 MATH 2554, Calculus I
3 PHYS 2054, University Physics I
1 PHYS 2050L, University Physics Lab
3 History/Government Requirement
15 semester hours

Second Semester
1 ELEG 1011, Eng Success and Ethics
3 ENGL 1023, Technical Composition II
4 MATH 2564, Calculus II
3 CHEM 1123, University Chemistry II
1 CHEM 1121L, Univ Chemistry II Lab
3 PHYS 2074, University Physics II
1 PHYS 2070L, Univ Physics Lab II
16 semester hours

Sophomore Year - First Semester
(Professional Curriculum)
3 CENG 1113, Intro to Computers
1 CENG 1111L, Intro to Computers Lab
3 ELEG 2103, Electric Circuits I
1 ELEG 2101L, Electric Circuits I Lab
3 ELEG 2903, Digital Systems
4 MATH 2574, Calculus III
3 Humanities-Social Science Elective
18 semester hours

Second Semester
3 CENG 1123, Intro to Programming
1 CENG 1121L, Intro to Progr Lab
3 ELEG 2113, Electric Circuits II
1 ELEG 2111L, Electric Circuits II Lab
3 ELEG 2913, Digital Design II
4 MATH 3404, Differential Equations
15 semester hours

Junior Year - First Semester
3 ELEG 3123, Analog Signal Processing
1 ELEG 3121L, Analog Signal Proc Lab
3 ELEG 3213, Electronics I
1 ELEG 3211L, Electronics I Lab
3 ELEG 3703, Electromagnetics I
3 ELEG 3923, Microprocessor System Design
3 MEEG 2023, Introductory Mechanics
0 ENGL 2003, Advanced Composition
17 semester hours

Second Semester
3 ELEG 3133, Digital Signal Processing
1 ELEG 3131L, Digital Signal Proc Lab
3 ELEG 3223, Electronics II
1 ELEG 3221L, Electronics II Lab
3 ELEG 3303, Electromechanical Energy Conversion
1 ELEG 3301L, Electromechanical Energy Conversion Lab
3 ELEG 3143, Stochastic Signal Processing
3 Humanities Social Science Elective
18 semester hours

Senior Year - First Semester
3 Electrical Eng Technical Elective
3 Technical Elective8
3 Math/Science Elective
3 Humanities-Social Science Elective
3 Upper-level Humanities/Social Science Elective
15 semester hours

Second Semester
2 ELEG 4062L Elect. Engr. Design Lab
6 Electrical Eng Technical Elective
3 Technical Elective
3 Upper-level Humanities-Social Science Elective
14 semester hours

128 Total hours required

Degree Program Changes

A student must meet all requirements of the degree programs and is expected to keep informed concerning current regulations, policies, and program requirements in a chosen field of study. Changes made in curriculum at a level beyond that at which a student is enrolled may become graduation requirements for that student. Changes made in the curriculum at a level lower than the one at which a student is enrolled are not normally required for that student. Students should consult their adviser for additional information.

Recommended Technical Studies

Students in electrical engineering are required to complete 15 semester hours of technical electives. A minimum of nine semester hours of these courses must be 4000- or 5000-level electrical engineering elective courses. A student may select the remaining six semester hours from upper-division technical courses in electrical engineering, mathematics, engineering, and the sciences with the approval of an adviser. Not more than six semester hours total in ELEG 488V and ELEG 489V may be credited toward technical electives.

Communications

ELEG 4603, Deterministic DSP System Design
ELEG 4623, Communication Systems
ELEG 4683, Intro to Image Processing
ELEG 4713, Electromagnetic Transmission
ELEG 5173L, Digital Signal Proc Lab
ELEG 5183L, DSP Digital Communications Lab
ELEG 5193L, Advanced DSP Proc Lab
ELEG 5403, Systems Theory
ELEG 5613, Introduction to Telecommunications
ELEG 5623, Information Theory
ELEG 5633, Detection and Estimation
ELEG 5643, Computer Comm Networks
ELEG 5653, Artificial Neural Networks
ELEG 5673, Pattern Recognition
ELEG 5683, Image Processing
ELEG 5713, Antennas and Radiation

Computers

ELEG 4683, Intro to Image Processing
ELEG 4933, Minicomputer Applications
ELEG 4943, Digital Systems Design
ELEG 4983, Intro to Computer Architecture
ELEG 5153, Real Time Data Acquisition Systems
ELEG 5163, Advance Microcontroller Design Project
ELEG 5173L, Digital Signal Proc Lab
ELEG 5643, Computer Comm Networks
ELEG 5653, Artificial Neural Networks
ELEG 5683, Image Processing
ELEG 5913, Parallel Programming
ELEG 5963, Computer Systems Optimization
CENG 2143, Data Structures Applications
CENG 4813, Computer Graphics
CENG 3943, Engineering Applications of Unix
CENG 4423, Computer Systems Analysis

Controls

ELEG 4403, Control Systems
ELEG 4463L, Control Systems Lab
ELEG 4603, Deterministic DSP System Design
ELEG 5173L, Digital Signal Proc Lab
ELEG 5413, Stochastic Control Systems
ELEG 5423, Optimal Control Systems
ELEG 5453, Adaptive Filtering and Control
ELEG 5653, Artificial Neural Networks

Digital Systems

ELEG 4603, Deterministic DSP System Design
ELEG 4943, Digital Systems Design
ELEG 4963, Field Programmable Gate Array Lab
ELEG 5113, Stochastic DSP Systems Design
ELEG 5163, Advanced Microcontroller Design
ELEG 5173L, Digital Signal Proc Lab
ELEG 5183L, Digital Comm Lab
ELEG 5193L, Advanced DSP Proc Lab
ELEG 5653, Artificial Neural Networks
ELEG 5673, Pattern Recognition
ELEG 5683, Image Processing

Energy Systems

(Power Distribution, Electric Machines, Power Electronics, Electric Propulsion)

ELEG 4323, Switch Mode Power Conversion
ELEG 4403, Control Systems
ELEG 4463L, Control Systems Lab
ELEG 4503, Elec Power Dist Systems
ELEG 4513, Power System Analysis
ELEG 4523, Intro to Power Electronics
ELEG 4533, EMC in Power Electronics
ELEG 5313, Power Semiconductor Devices
ELEG 5513, Electric Power Quality
ELEG 5533, Power Electronics and Motor Drives
ELEG 5543, Communication Networks for Motion Control
MEEG 4603, Basic Nuclear Engineering

Microelectronics

(Devices, Modeling, Fabrication, Design, Test)

ELEG 4203, Semiconductor Devices
ELEG 4223, Design and Fabrication of Solar Cells
ELEG 4233, Intro to Integrated Circuit Design
ELEG 4243, Analog Integrated Circuits
ELEG 4273, Electronics Manufacturing Processes
ELEG 4283, Mixed Signal Test Eng I
ELEG 4293, Mixed-Signal Modeling and Simulation
ELEG 4323, Switch Mode Power Conversion
ELEG 5213, Integrated Circuit Fabrication Technology
ELEG 5233, Solid State Electronics I
ELEG 5253L, Integrated Circuit Design Lab I
ELEG 5263L, Integrated Circuit Design Lab II
ELEG 5273, Electronic Packaging
ELEG 5283, Mixed Signal Test Eng II
ELEG 5293L, Integrated Circuits Fabrication Lab
ELEG 5313, Power Semiconductor Devices

The following courses are applicable to all of the technical specialization areas listed above.

INEG 3113, Law and Ethics
INEG 3213, Safety Engineering
INEG 3413, Eng Economic Analysis
INEG 4223, Occupational Safety and Health Standards
INEG 4433, Administrative Analysis
INEG 4443, Engineering Management

Mathematics/Science Elective

Each student in electrical engineering is required to complete three semester hours of mathematics or science elective to be chosen from the following courses with the approval of the student's advisor.

MATH 3083, Linear Algebra
MATH 3353, Numerical Methods in Analysis
MATH 3423, Advanced Applied Mathematics
MATH 3443, Complex Variables for Application
STAT 3013 Intro to Probability and Statistics
CHEM 3504, Physical Chemistry I
CHEM 3603, Organic Chemistry I
PHYS 3113, Analytical Mechanics
PHYS 3544, Optics
PHYS 2094, University Physics III
ZOOL 2213, Human Physiology
MEEG 3703, Numerical Methods I

SEE PAGE 289 FOR ELECTRICAL ENGINEERING (ELEG) COURSES

INDUSTRIAL ENGINEERING (INEG)

John English
Head of the Department
4207 Bell Engineering Center
575-3156

- Distinguished Professor White
- University Professor Taha
- Professors Asfahl, English, Johnson
- Associate Professor Fant
- Assistant Professors Cole, Cassady, Collins, Kutanoglu, Mason, Nachtmann, Rossetti
- Adjunct Associate Professor Gattis
- Instructor Harrelson, Watson

The mission of the industrial engineering department at the University of Arkansas is to be a nationally competitive, student-centered, industrial engineering program serving Arkansas and the world through undergraduate and graduate studies, and leading-edge research programs.

Industrial engineers are concerned with improving organized activity. The physical arrangement of people, equipment, and material significantly influences the effectiveness of any organization - whether the organization is industrial, governmental, or commercial.

Today's industrial engineers develop applications of new processing automation and control technology; install data processing systems, performance measures and standards, job evaluation and wage and salary programs; research new products and product applications; devise ways to improve productivity through application of technology and human factors; select operating processes and methods to accomplish a given task using proper tools and equipment; design facilities, management systems, operations procedures, storage systems; improve allocation of resources, planning and control systems for distribution of goods and services, production, inventory, quality and plant maintenance; enhance plant environment and the quality of working life; evaluate reliability and quality performance; implement office systems, procedures, and policies; analyze complex business problems through operations research; conduct long-range organization studies, plant location surveys, system effectiveness studies; and study potential markets for goods and services, raw material sources, labor supply, energy resources, financing and taxes.

Industrial engineers integrate engineering skills with mathematics and computer science tools, providing systematic ways to maximize productivity and quality while minimizing time and cost.

The goal of the Industrial Engineering Undergraduate Program at the University of Arkansas is to prepare men and women for professional careers and graduate studies in Industrial Engineering. We provide a foundation in mathematics, science, humanities and social sciences, engineering science, and engineering design to produce Industrial Engineers with the intellectual, technical, and professional competence to develop, implement, and manage industrial engineering solutions to complex problems in industry, government, and society.

The IE Program Objectives represent and describe the expected accomplishments of our graduates resulting from participation within our program within the first few years after graduation. Our objectives have been developed to address the needs of our constituencies and to be consistent with and supportive of our mission and programmatic goals. The IE Program Objectives are as follows:

1. To train and educate students in the mathematics, science, methodologies, computational skills, and analysis techniques of Industrial Engineering practice including such core Industrial Engineering topics as probability, statistics, engineering economics, human factors, engineering management, computing, and operations research applied to manufacturing, logistics, and service systems.

2. To develop students with written and oral communication skills, team work skills, professionalism, and ethics so that they can contribute to Industrial Engineering practice and leadership within the profession.

3. To develop students who possess the ability to design, improve, and manage integrated systems of people, technologies, material, information, and equipment within the context of societal and contemporary issues in engineering practice such as safety and health.

4. To develop students who possess the ability to solve unstructured problems by collecting, modeling, analyzing, and interpreting data within Industrial Engineering practice.

5. To make students aware of the need for and to provide the ability to accomplish lifelong learning, continuing education, and professional growth within the field of Industrial Engineering.

These specific objectives are reinforced by a senior capstone design course in which the student must apply the skills to a comprehensive design problem for an industry setting. This course integrates preceding courses through development of physical systems and organizational characteristics, financial aspects, product analysis, equipment selection, production layout, distribution systems, and overall economic analysis.

The following section contains the list of courses required for the Bachelor of Science in Industrial Engineering degree and a suggested sequence. All courses are not offered every semester so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites.

The total graduation requirement in industrial engineering is 130 hours. For further information please visit us on the World Wide Web at <http://web.ineg.uark.edu>.

INDUSTRIAL ENGINEERING PROGRAM

Freshman Year - First Semester
3 INEG 1103, Principles of Indust Engr
4 MATH 2554, Calculus I
3 ENGL 1013, Composition I
3 CHEM 1103, University Chemistry I
1 CHEM 1101L, Univ Chemistry I Lab
14 semester hours

Second Semester
4 MATH 2564, Calculus II
3 INEG 1403, Industrial Cost Analysis
3 ENGL 1023, Technical Composition II
3 Science Elective
2 GNEG 1122, Introduction CAD
15 semester hours

Sophomore Year - First Semester
4 MATH 2574, Calculus III
3 Computer Elective I
3 INEG 3413, Eng Economic Analysis
4 PHYS 2054, University Physics I
3 ECON 2143, Basic Economics
(humanities/social science elective)
17 semester hours

Second Semester
4 MATH 3404, Differential Equations
3 Computer Elective II
3 INEG 3513, Manuf System Design
3 INEG 3313, Engineering Statistics
4 PHYS 2074, University Physics II
17 semester hours

Junior Year - First Semester
3 INEG 3713, Methods and Standards
3 Engineering Science Elective I
3 INEG 4333, Industrial Statistics
3 ELEG 3903, Electric Circuits and Machines
6 Humanities/social science elective (History or government requirement: HIST 2003, HIST 2013, or PLSC 2003)
18 semester hours

Second Semester
3 INEG 3613, Intro to Operations Research
3 Engineering Science Elective II
3 INEG 4523, Automated Production
3 Engineering Science Elective III
3 Humanities/social science electives
15 semester hours

Senior Year - First Semester
3 INEG 4433, Administrative Analysis
(An upper-level ROTC course may be substituted.)
3 INEG 4543, Materials Handling
3 INEG 4623, Intro to Simulation
3 Technical elective
3 INEG 4723, Ergonomics
3 Humanities/social science electives
18 semester hours

Second Semester
3 INEG 4553, Production Planning/ Control
4 INEG 4904, I.E. Design
3 Humanities/social science elective
6 Technical electives
16 semester hours

130 Total hours required

Technical Electives

The purpose of technical electives is to provide students with the opportunity to expand their education along lines of particular interest to them. The approved list of technical electives is available in the industrial engineering department. At least three hours must be selected from INEG courses.

Humanities/Social Science Electives

Although any elective included on the humanities/social science list may be selected, General Psychology PSYC 2003 is recommended for industrial engineers.

Science Elective

The approved list of science electives is available in the industrial engineering departmental office.

Computer Elective

The approved list of computer electives is available in the industrial engineering departmental office.

Engineering Science Electives

The approved list of engineering science electives is available in the industrial engineering departmental office.

SEE PAGE 308 FOR INDUSTRIAL ENGINEERING (INEG) COURSES

MECHANICAL ENGINEERING (MEEG)

William F. Schmidt
Head of the Department
204 Mechanical Engineering Bldg.
575-3153

- Professors Bhat, Cole, Jong, Schmidt, West
- Associate Professors Couvillion, Gordon, Malshe, Nutter, Roe, Springer
- Assistant Professors Batzer, Reynolds, Tung
- Instructor Davis

The mechanical engineering program is designed to offer a high-quality course of instruction involving classroom, laboratory, and extracurricular activities that results in graduates qualified and prepared to meet the demands of a professional career in the present and future work place, and able to assume a responsible place of leadership in a complex technological society.

The courses offered in mechanical engineering provide the student with a broad understanding of fundamental scientific principles that serve as a background for many fields of specialization. The undergraduate curriculum is designed to stress basic engineering principles and to assist in developing creative thinking. Emphasis is placed on the science and art of designing machines and systems, of converting energy into useful forms, and developing a basic understanding of engineering mechanics. The undergraduate program leads to a Bachelor of Science degree in Mechanical Engineering; its educational objectives are to produce graduates who

1. effectively analyze and design mechanical systems and energy systems
2. contribute to the success of companies in Arkansas and the rest of the world through the practice of mechanical engineering
3. meet or exceed the needs and expectations of mechanical engineering employers in industry, government, and private practice
4. engage in professional activities that promote the mechanical engineering profession and provide continuing self-development
5. succeed in graduate study and research if pursued

The Bachelor of Science in Mechanical Engineering curriculum includes, in addition to the humanities/social science courses, a total of 12 hours of technical and mechanical engineering electives. A student must select these electives with the approval of his or her advisor. It is expected that electives will be chosen to provide a coherent program within one or more areas of specialization available to mechanical engineers. Areas of specialization are available in the nuclear, mechanical systems design, materials, thermal systems design, and engineering mechanics fields.

The first-year curriculum is essentially the same as prescribed for all engineering freshmen. The full curriculum follows, with the number of credit hours at the left, preceding course numbers and titles. In addition to the curriculum below, all students must meet the exemption requirements or take ENGL 2003 Advanced Composition.

The following section contains the list of courses required for the Bachelor of Science in Mechanical Engineering degree and a suggested sequence. During the senior year, at least one, either MEEG 4103 or MEEG 4483, must be taken. All 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 interested in obtaining a sequencing schedule of courses may contact the Mechanical Engineering office.

MECHANICAL ENGINEERING PROGRAM

Freshman Year - First Semester
3 ENGL 1013, Composition I
3 CHEM 1103, University Chemistry I
1 CHEM 1101L, Univ Chemistry I Lab
4 MATH 2554, Calculus I
2 GNEG 1122, Introduction CAD
3 MEEG 1103, Intro to Mech. Engr
16 semester hours

Second Semester
3 CHEM 1123, University Chemistry II
1 CHEM 1121L, Univ Chemistry II Lab
4 MATH 2564, Calculus II
4 PHYS 2054, University Physics I
0 PHYS 2050L, Univ Physics I Lab
3 ENGL 1023, Technical Composition II
3 MEEG 1113, Mechanical Engineering Fundamentals
18 semester hours

Sophomore Year - First Semester
4 PHYS 2074, Univ Physics II
0 PHYS 2070L, Univ Physics II Lab
4 MATH 2574, Calculus III
3 MEEG 2303, Introduction to Materials
3 ECON 2143 or ECON 2013
3 MEEG 2003, Statics
17 semester hours

Second Semester
4 MATH 3404, Differential Equations
3 MEEG 2013, Dynamics
3 MEEG 2403, Thermodynamics
3 ELEG 3903, Electric Circuits and Machines
3 Humanities/social science elective (History or gov requirement)
16 semester hours

Junior Year - First Semester
3 MEEG 3013, Mechanics of Materials
3 MEEG 3403,Thermodynamics II
2 MEEG 3202, Mechanical Engr Lab I
3 ELEG 3913, Engineering Electronics
3 MEEG 3103, Mechanisms
3 MEEG 3703, Numerical Methods I
17 semester hours

Second Semester
3 MEEG 3113, Vibration & Machine Dynamics
3 MEEG 3123, Design Stress Analysis
2 MEEG 3212, Mechanical Engr Lab II
3 MEEG 3503, Mechanics of Fluids
3 Mechanical Engr elective
3 Humanities/social science elective (lower-level)
17 semester hours

Senior Year - First Semester
3 MEEG 4413, Heat Transfer
3 MEEG 4103, Machine Element Design
2 MEEG 4132, Creative Project Design I
2 MEEG 4202, Mechanical Engr Lab III
3 Mechanical Engr elective (Design)
3 Humanities/social science elective (lower level)
13 - 16 semester hours

Second Semester
3 Mechanical Engr elective
3 MEEG 4483, Thermal Systems Analysis and Design
3 MEEG 4133, Creative Project Design II
3 Technical elective
3 Humanities/social science elective (3000-4000 level)
3 Humanities/social science elective (3000- 4000-level)
15 - 18 semester hours

132 Total hours required

SEE PAGE 317 FOR MECHANICAL ENGINEERING (MEEG) COURSES

OPERATIONS MANAGEMENT (OMGT)

Offered through Graduate Resident Centers

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- Professors Asfahl, English
- Associate Professors Fant, Gattis
- Assistant Professors Collins, Nachtmann
- Visiting Assistant Professors Benamon, Berthelot, Bonanno, Carmichael, Collier, Cote, Dansby, Davis, Day, Doddridge, Dyer, Esrael, Ellixson, Findley, Garner, George, Hipple, Jones, Lamphear, Maksi, Martin, MacKinnon, McCaa, Miller, Moores, Moorhead, Nethercutt, Noland, Roy, Ton, Ward, Whitehouse, Wilke, Yeager

Degree Conferred: M.S. (OMGT)

The Master of Science program in operations management is directed toward the acquisition of practical knowledge in the areas of project planning, quality assurance, safety management, inventory techniques, and human factors analysis.

The operations management program is offered at Graduate Resident Centers in Arkansas, Tennessee, and Florida. Courses are offered in eight-week terms, five terms an academic year.

The operations management curriculum is aimed at the needs of both military and civilian working managers of technical and logistics operations, regardless of the major they selected as an undergraduate student. The subject matter is patterned after the industrial engineering curriculum, but is less technical and does not require a calculus mathematics background.

Before students complete more than 12 hours of course work toward the operations management degree, they must successfully complete the following courses (or equivalent courses or demonstrate knowledge of subject areas):

OMGT 4313, Law and Ethics
OMGT 4323, Industrial Cost Analysis
OMGT 4333, Applied Statistics
OMGT 4853, Data Processing Systems

These courses are offered at the undergraduate level and may not be applied toward the requirements for a Master of Science degree. To fulfill requirements for the M.S. degree, a student must earn a total of 30 semester hours credit in the program.

SEE PAGE 325 FOR OPERATIONS MANAGEMENT (OMGT) COURSES

OPERATIONS RESEARCH (ORES)

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- Distinguished Professor White
- University Professor Taha
- Professors Asfahl, English, Johnson
- Associate Professors Fant
- Assistant Professors Cassady, Cole, Collins, Kutanoglu, Mason, Nachtmann, Rossetti
- Adjunct Associate Professor Gattis

Degree Conferred: M.S.O.R. (ORES)

The Department of Industrial Engineering offers a graduate program leading to the Master of Science in Operations Research (M.S.O.R.) for engineering, science, and other non-engineering graduates. Candidates for the degree must possess or obtain mathematical training through multivariate calculus, knowledge of probability theory and statistics, and either linear algebra or undergraduate operations research. Minors in the areas of mathematics, computer science, and statistics are also available under the program.

In addition to the requirements of the Graduate School and the College of Engineering, the following program requirements must be satisfied. A number of undergraduate prerequisites exist that are specified in the Department's Handbook for Advanced Degrees.

1. All candidates for the Master of Science in Operations Research degree (M.S.O.R.) must successfully complete three core courses: INEG 5313 Probability Theory and Stochastic Processes, INEG 5613 Optimization Theory I, and INEG 5823 Systems Simulation.
2. Candidates for a Master of Science in Operations Research degree (M.S.O.R.) who present a thesis are required to complete a minimum of 24 semester hours of course work and six semester hours of thesis.
3. Candidates for the degree who present a project are required to complete 30 semester hours of course work and three hours credit for INEG 513V, Master's Research Project and Report.
4. Candidates for the degree who do not present either a thesis or project are required to complete 36 semester hours of course work.
5. All candidates must successfully complete a master's oral examination that is conducted by the candidate's faculty committee.
6. Attendance at INEG graduate seminar is required of all graduate students in industrial engineering.

Course listings and descriptions may be found under Industrial Engineering.