College of Engineering

Office of the Dean of the College
4183 Bell Engineering Center
479-575-7455

Dean
Ashok Saxena

Associate Deans
William D. Brown
Jim L. Gattis
Terry W. Martin

Assistant Deans
Colleen Briney
Thomas Carter III

Student Information
3189 Bell Engineering Center
479-575-3052

Recruitment
Carol Gattis, Director
Engineering Welcome Center
Bell Engineering Center
479-575-7780

Diversity, Retention and Scholarship
Carol Gattis, Director
3189 Bell Engineering Center
479-575-3051

Cooperative Education
Andy Matthews, Director
3158 Bell Engineering Center
479-575-6265

Engineering Research Center
Jim Gattis, Director
479-575-6407

World Wide Web:
http://www.engr.uark.edu/

E-mail: info@engr.uark.edu

MISSION AND OBJECTIVES

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 mathematics, 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 College of Engineering adds personal, social and economic value to the region, the state, the nation, and to the world through engineering education and cutting-edge research in emerging technologies. 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 the following areas of emphasis:

- Biological, Chemical and Food Processing
- Biomedical Engineering
- Database and Telecommunications
- Electronics Manufacturing
- Environmental and Ecosystems Analysis
- Nanotechnologies
- Transportation, Logistics and Infrastructure
- Homeland Security

Extensive information about the College of Engineering is available from the Web site http://www.engr.uark.edu. The site includes overviews of each programmatic activity and area of emphasis as well as 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 and fully accredited 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 that 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 related functions.

COLLEGE OF ENGINEERING STRATEGIC PLAN

"Engineering the Future – Today"

For more than 100 years, the College of Engineering has successfully fulfilled its primary mission: to provide an excellent engineering education to undergraduate and graduate students at the University of Arkansas.

The College of Engineering faculty, staff, alumni and students decided to accept the challenge to become one of the best. Specifically, our collective goal is:

To become and be perceived as one of the top tier graduate and undergraduate engineering programs in the U.S.

The College's strategic plan encompasses six main goals. By successfully accomplishing these objectives, the College of Engineering will contribute to the University of Arkansas becoming a nationally-competitive, student-centered research institution serving Arkansas and the world, effectively fulfilling its purpose.

Six Strategic Goals

1. **Implementing the Student-Centered Educational Experience**
   Provide a student-centered educational experience that attracts diverse, high-quality students, enables them to realize their potential, inspires them to pursue excellence at all degree levels and grooms them to become leaders in their profession.
2. **Implementing an Enabling Research Environment**
   Create a research environment that enables, enhances and recognizes scholarship, while stimulating entrepreneurship and economic development within our state, nation and world.
3. **Implementing the Vision as it Relates to Faculty**
   Recruit, mentor and retain high-quality and diverse faculty members who value and promote world-class scholarship.
4. **Implementing the Vision as it Relates to Staff**
   Attract, develop and retain well-qualified, diverse and skilled staff members who are equipped to support the growth and potential of the College of Engineering.
5. **Implementing the Service and Outreach Plan**
   Enhance the impact of the College of Engineering both within and outside the university through service and outreach.
6. **Implementing the Economic Development Plan**
   Become a catalyst for economic development to achieve the long-term economic goals of Arkansas through entrepreneurship, research and collaboration with industry and government.

FACILITIES AND RESOURCES

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 used only to purchase and maintain equipment and staff the engineering laboratories to assist students.

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. It 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 Center for Training Transportation Professionals, and the Chemical Hazards Research Center.

Distance Learning

A Master of Science in Engineering (M.S.E.) degree is available for students who wish to take a broad range of engineering courses. See the Graduate School Catalog for details.

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

The Master of Science in Operations Management (MSOM) degree program at the University of Arkansas offers students the philosophy,

concepts, and techniques needed to manage available resources to achieve maximum efficiency and effectiveness in meeting operational goals. It provides the tools needed for successful management in industrial and/or military settings. Geared toward the working student, classes meet in the evenings in five 8-week terms per year. The program is offered at military installations at Little Rock Air Force Base (Jacksonville, Ark.), Naval Support Activity Mid-South (Millington, Tenn.), Hurlburt Field, Fla., and at in-state sites at Fayetteville, Camden, and Blytheville. Students in remote locations may also earn the MSOM degree by taking video courses. This is a non-engineering degree that is open to students from all undergraduate backgrounds. See the Graduate School catalog for details.

DEGREES OFFERED

The College of Engineering offers programs leading to the following eight undergraduate 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.)
- Bachelor of Science in Computer Science (B.S.)

OTHER PROGRAMS

Off-Campus Programs

The College of Engineering at the University of Arkansas, Fayetteville (UAF) is offering the Bachelor of Science degrees in Electrical Engineering and Mechanical Engineering at the University of Arkansas at Fort Smith (UAFS). Upper-division courses are taught in person or through distance-learning technology by UAF faculty, and lower-division courses are taught by UAFS faculty. The degree is awarded by UAF but all classes are offered at the UAFS campus.

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.

Three-Two Transfer Plan

The College of Engineering recognizes that a graduate engineer, to be of full service to 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 elevates 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. The student is awarded the Bachelor of Arts/Bachelor of Science degree by the partner university. The student is awarded the Bachelor of Science in an engineering discipline by the University of Arkansas.

COLLEGE ADMISSION REQUIREMENTS

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

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.

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 spreadsheets. 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 all electrical engineering and computer engineering applicants must submit a Test of Spoken English (TSE) score of at least 5.0, or a 7.0 on the spoken section of the IELTS, and an ACT score of 25 (or SAT score of 1140(R)) or above, to be eligible for admission.

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. Unless exceptions are granted at the time of admission to the University of Arkansas, 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. See the Admission chapter in this catalog for more information.

COLLEGE SCHOLARSHIPS

The College of Engineering awards numerous scholarships and fellowships to entering freshmen, continuing students, transfer students, and graduate students. Most scholarships are based primarily on academic performance. However, scholarships also may be awarded on the basis of financial need and diversity. Scholarships are available from both the college and its individual departments. College scholarships are available to any engineering student, and departmental scholarships are meant for students enrolled in a particular discipline of engineering. Students must be admitted to the University of Arkansas and accepted into the College of Engineering to qualify and receive either a college or departmental scholarship. The college has a one-step application process that allows a student to be considered for all college-level and departmental scholarships.

For more information concerning scholarship and diversity opportunities, contact the Engineering Student Affairs Office at 575-3051 or e-mail tic@engr.uark.edu.

STUDENT ORGANIZATIONS

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

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

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

- American Chemical Society
- American Nuclear Society
- Amateur Radio Club of the University of Arkansas
- American Society of Agricultural and Biological Engineers
- American Society of Civil Engineers
- American Society of Heating, Refrigeration, and Air-Conditioning
- American Society of Mechanical Engineers
- Institute of Biological Engineers
- Institute of Chemical Engineers
- Institute of Electrical and Electronics Engineers
- Institute of Electrical and Electronics Engineers, Components, Packaging, and Manufacturing Technology
- Institute of Industrial Engineers
- Institute of Transportation Engineers
- International Microelectronics and Packaging Society
- National Society of Black Engineers
- Society of American Military Engineers
- Society of Automotive Engineers Assoc. for Computing Machinery
- Society of Hispanic Professional Engineers
- Society of Manufacturing Engineers
- Society of Women in Engineering
- Transportation and Logistics Association

COLLEGE 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.

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:

- Submission, as one's own, of any work prepared totally or in part by someone else.
- Plagiarism, i.e., the unacknowledged incorporation of another person's work, either verbatim or in substance, in work submitted for credit.
- Unauthorized collaboration with another person in preparing work submitted for credit.
- Unauthorized submission, for credit, of work previously credited in another course.
- Unauthorized alteration of work submitted for re-grading.
- The use of unauthorized materials or aids during examinations.
- Copying from the examination paper of another student or giving aid to, or seeking aid from, another student during an examination.
- Using, obtaining, or attempting to obtain by any means the whole or any part of an examination not yet administered, or of information pertaining thereto.
- Taking, or attempting to take, an examination for another student, or allowing another student to take or attempt to take an examination for oneself.
- Any conduct expressly stated to be unethical by the instructor in a particular course.
- 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 reduce the grade on a particular test or assignment or 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 Dean 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.

HONORS PROGRAM

The College of Engineering has established an honors program to challenge superior students with a more in-depth academic program and research experience 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. Admission requirements for the college's Honors Program are as follows: entering freshmen must have at least a 3.5 high school GPA and at least 28 composite score on the ACT; entering transfer students must have a 3.25 GPA on their transfer work. Students not qualifying for the Engineering Honors Program initially are eligible after one year if they earn at least a 3.25 GPA.

Students must formally apply for admission to the Engineering Honors Program. Once accepted into the program, Honors students take a minimum of 12 hours of Honors courses (a minimum of 6 of these 12 hours must be in engineering), participate in undergraduate research and write an undergraduate thesis, and must fulfill any additional departmental requirements. To retain status in the Honors Program, a student must maintain a minimum cumulative GPA (for all course work, computed at the end of the spring semester) of 3.25. To receive honors distinction at graduation, a student must hold a cumulative GPA of 3.50 or better (for all course work, computed at graduation). Students with a GPA between 3.25 and 3.50 do not receive honors distinction at graduation.

DEGREE REQUIREMENTS

The basic requirement for a Bachelor of Science degree in engineering is 124-136 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 (five 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 specific departmental requirements for degree plans, students should refer to the Academic Regulations chapter of this catalog for general university requirements, beginning on page 39. A portion of that information is listed here for convenience.

1. Arkansas Assessment of General Education (AAGE) or Rising Junior Exam
   All undergraduates in Arkansas public institutions who have earned at least 45 hours of credit toward a degree are required to take the Arkansas Assessment of General Education Exam (AAGE), also known as the Rising Junior Exam.
2. Residency Requirement
   The full senior year must be completed in residence except that a senior who has already met the minimum residency requirement will be permitted to earn not more than 12 of the last 30 hours in extension or correspondence courses or in residence at another accredited institution granting the baccalaureate degree. No more than six of these 12 hours may be correspondence courses. The minimum residence requirement is 36 weeks and 30 semester hours. Residency for the senior year is defined as a period during which the student must be enrolled in courses offered on the campus in Fayetteville. This is intended to provide adequate contact with the University and its faculty for each student who is awarded a degree. Colleges and departments have the authority to prescribe residence requirements that exceed those described here.
3. Grade-Point Average
   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.
4. Courses That Do Not Count Toward a Degree
   The following courses do not count toward degree credit: ANTH 0003, PHSC 0003, ENGL 0003, MATH 0003, CIED 0003, MATH 1203, MATH 1213, MATH 1285, and ENGL 2003.
5. "D" Rule
   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.
6. 68 Hour Rule
   Students who transfer into the University may present for degree credit no more than 68 hours of lower division course work (1000 and 2000 level).
7. Advanced Composition
   Every undergraduate student is required to take and pass ENGL 2003 Advanced Composition unless exemption can be gained. ENGL 2003 will not count as part of the total number of hours required for a degree in the College of Engineering.
8. University Core (State Minimum Core)
   The University of Arkansas has adopted a University Core of 35 semester-credit-hours of general education courses that are required of all baccalaureate degree candidates. This is in compliance with Arkansas Act 98 of 1989 and the subsequent action of the Arkansas State Board of Higher Education. Beginning in the fall semester of 1991, all state institutions of higher education in Arkansas have a 35-hour minimum core requirement with specified hours in each of six academic areas. The University and the College of Engineering have identified those courses that meet the minimum requirement, and they are listed in the chart below.

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

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

   No more than nine semester hours from any single discipline may be presented for degree credit. To meet the University Core requirements, the total number of hours (both upper level and lower level) in the fine arts/humanities courses must be at least six, and the social science hours must total at least nine (in addition to the U.S. history or government requirement). The six hours of courses at the 3000 and 4000 level may be in the fine arts and humanities area, the social science area, or divided between the two areas. Since some of the humanities and social science courses are specified in some of the curricula, e.g., ECON 2143 in chemical and mechanical engineering, the student should consult the curriculum of the department in which he/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 Composition II	
(ENGL 1023 Composition II may be taken in lieu of Technical Composition II)	
Mathematics	4
MATH 2554 Calculus I	
Science	8
PHYS 2054 University Physics I	
PHYS 2074 University Physics II	
U.S. History or Government	3
HIST 2003 History of Amer. People or Government to 1877	
HIST 2013 History of Amer. People 1877 to Present	
PLSC 2003 American National Government	
Fine Arts, Humanities and Social Sciences	
Fine Arts and Humanities	6
Social Sciences	9
Six hours of Fine Arts, Humanities and Social Sciences must be upper level courses (3000-4000 level). A list of approved courses is available in departmental office.	

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.

Requirements to Graduate with 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 designation, the student must meet the following criteria:

1. Must have completed at least one-half of his or her degree work at the University of Arkansas;
2. Must have at least a 3.50 GPA on University of Arkansas course work, computed at graduation (students with grade-point averages

lower than 3.50 do not receive honors designation at graduation);
3. Must successfully complete the Engineering Honors Program, which includes a minimum of 12 hours of honors courses (at least 6 of these hours in engineering), an undergraduate research experience and thesis, and any additional departmental requirements;
4. Research and thesis material shall be evaluated by each department;
5. For cum laude, the student must achieve a GPA of 3.50 or higher and have good or better performance on the undergraduate research and thesis;
6. For magna cum laude, the student must achieve a GPA of 3.75 or higher and have good or better performance on the undergraduate research and thesis;
7. For summa cum laude, the student must achieve a GPA of 3.90 or higher and have outstanding performance on the undergraduate research and thesis.

The criteria may be evaluated and changed periodically by the College of Engineering.

Requirements to Graduate with Distinction

Students who have not completed the Engineering Honors Program but have demonstrated excellent academic performance in baccalaureate degree programs will be recognized at graduation by the designation of "with distinction," "with high distinction," or "with highest distinction." To earn these designations, the student must meet the following criteria on his or her University of Arkansas course work:

1. Must have completed at least one-half of his or her degree work at the University of Arkansas;
2. For "with distinction," the student must achieve a GPA of 3.60 or higher;
3. For "with high distinction," the student must achieve a GPA of 3.75 or higher;
4. For "with highest distinction," the student must achieve a GPA of 3.90 or higher.

The criteria may be evaluated and changed periodically by the College of Engineering.

GRADUATE STUDIES

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

Master of Science in Biological Engineering (M.S.B.E.)
Master of Science in Biomedical Engineering (M.S.B.M.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 Computer Science (M.S.)
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 Management (M.S.)
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 Computer Science (Ph.D.)
Doctor of Philosophy in Engineering (Ph.D.)

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

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

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

ACCREDITATIONS

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 of Engineering offers the following programs accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone (410) 347-7700.

- 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.)
- Master of Science in Environmental Engineering (M.S.En.E)
- Master of Science in Transportation Engineering (M.S.T.E)

Departmental Majors

BIOLOGICAL AND AGRICULTURAL ENGINEERING (BAEG)

Lalit Verma
Head of the Department
203 Engineering Hall
479-575-2351

- Professors Gardisser, Griffis, Li, Loewer, VanDevender, Verma
- Associate Professors Carrier, Chaubey, Costello, Huitink, Matlock, Tacker
- Assistant Professors Bajwa, Kavdia, Kim, Osborn, Ye
- Adjunct Professor Ang, Clausen, Deaton, Ingels
- Adjunct Associate Professors Beitle, Yang
- Adjunct Assistant Professors Haggard, Howell, Shafirstein, Wimberly

Biological Engineers improve people's lives today and help assure a sustainable quality of life for tomorrow. They create solutions to problems by coupling living systems (human, plant, animal, environmental, food, and microbial) with the tools of engineering and biotechnology. Biological engineers improve human health through biomedical engineering; ensure a safe, nutritious food supply and create critical, new medicines through biotechnology engineering; secure a healthy and safe environment through ecological engineering. A bachelor of science degree in biological engineering is also excellent preparation for medical school.

Biological Engineering is an ABET accredited program leading to the B.S. degree. M.S. and Ph.D. degrees are also offered. The curriculum is under the joint supervision of the dean of the College of Engineering and the dean of the Dale Bumpers College of Agricultural, Food and Life Sciences. The Bachelor of Science in Biological Engineering degree is conferred by the College of Engineering and is granted after the successful completion of 129 hours of approved course work.

The educational objectives of the Biological Engineering program are to produce graduates who 1) effectively apply engineering to biological systems and processes (plant, animal, human, microbial, and ecosystem) with demonstrated proficiency in basic professional and personal skills, and 2) are well prepared for future challenges in biological engineering, life-long learning, and professional and ethical contributions to society through sustained accomplishments.

Areas of Concentration

The three areas of concentration in biological engineering are as follows:

Biomedical Engineering – nanomedicine, tissue engineering, organ regeneration and its clinical application, bioinstrumentation, biosensing/medical imaging, medical electronics, physiological modeling, biomechanics, and rehabilitation engineering. This area is excellent preparation for medical, veterinary or dental school as well as for graduate programs in biomedical engineering.

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

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

Each student is required to complete 15 semester hours of approved electives in his or her area of concentration. Six hours must be from the biological engineering design elective courses (listed below) from a single area of concentration. The remaining nine hours are classified as technical electives and consist mainly of upper-division courses in engineering, mathematics, and the sciences as approved by the student's adviser. The selected technical electives must included at least three hours of upper-level engineering courses, either within BENG or from other engineering departments. The department maintains a list of approved electives.

The areas of technical concentration and the recommended elective courses for each are listed here.

Biomedical Engineering

Design Electives:

BENG 3213 Biomedical Engineering: Emerging Methods and Applications
BENG 4203 Biomedical Engineering Principles

Technical Electives:

BIOL 2533/2531L Cell Biology
CHEM 3613 Organic Chemistry II
CHEM 3611L Organic Chemistry II Lab
BIOL 2404 Comparative Vertebrate Morphology, or BIOL 2443/2441L Human Anatomy
BIOL 4234 Comparative Physiology, or BIOL 2213/2211L Human Physiology
BENG 4113 Risk Analysis for Biological Systems
BENG 4123 Biosensors and Bioinstrumentation
BENG 4623 Biological Reactor Systems Design
BENG 451VH, Honors Thesis
BIOL 4233 Microbial Genetics
KINS 3353 Mechanics of Human Movement
ELEG 2903 Digital Systems
HESC 3204 Nutrition

Biotechnology Engineering

Design Electives:

BENG 4703 Biotechnology Engineering
BENG 4623 Biological Reactor Systems Design

Technical Electives:

BENG 4113 Risk Analysis for Biological Systems
BENG 4123 Biosensors and Bioinstrumentation
BENG 451VH Honors Thesis
FDSC 4304 Food Chemistry
FDSC 4124 Food Microbiology
FDSC 3103 Principles of Food Proc.
BIOL 4233 Microbial Genetics
BIOL 4313 Physiology of Microorganisms
CHEM 3453/3451L Elements of Physical Chemistry
MEEG 4413 Heat Transfer
CHEG 3153 Non-equilibrium Mass Transfer
CHEG 4423 Auto. Process Control
HESC 3204 Nutrition

Ecological Engineering

Design Electives:

BENG 4903 Ecological Engineering Principles
BENG 4923 Ecological Engineering Design

Technical Electives:

BENG 4113 Risk Analysis for Biological Systems
BENG 4403 Enclosed Ecosystems Design
BENG 4623 Biological Reactor Systems Design
BENG 4803 Precision Agriculture
BENG 4123 Digital Remote Sensing and GIS
BENG 451VH, Honors Thesis
BIOL 3863/3861L General Ecology
CVEG 3243 Environmental Engineering
CVEG 4243 Environmental Engineering Design
CSES 2203 Soil Science
CSES 4043 Environmental Impact and Fate of Pesticides
GEOG 4543 Geographic Information Systems
ENSC 4034 Analysis of Environmental Contaminants

Biological Engineering Eight-Semester Degree Program

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

Students wishing to follow the eight-semester degree plan should see page 42 in the Academic Regulations chapter for university requirements of the program.

Students who have earned 45 hours must take the Rising Junior Exam.

Students must also take ENGL 2023 during the third year or gain exemption.

Fall Semester 1

3 GNEG 1103 Introduction to Engineering
3 ENGL 1013 Composition I
3 CHEM 1103 University Chemistry I

4 MATH 2554 Calculus I
3 U.S. History Requirement
16 semester hours

Spring Semester 1
2 BENG 1022 Biological Engr Design Studio I
3 ENGL 1023 Technical Composition II
3 CHEM 1123 University Chemistry II
1 CHEM 1121L University Chemistry II Lab
4 MATH 2564 Calculus II
3 BIOL 1543 Principles of Biology
1 BIOL 1541L Principles of Biology Lab
17 semester hours

Fall Semester 2
2 BENG 2612 Biological Engr Design Studio II
3 MEEG 2003, Statics
4 PHYS 2054 University Physics I
4 MATH 2574 Calculus III
3 BIOL 2013 General Microbiology*
1 BIOL 2011L General Microbiology Lab
17 semester hours

Spring Semester 2
2 BENG 2622 Biological Engr Design Studio III
4 PHYS 2074 University Physics II
3 MEEG 2403 Thermodynamics, or
CHEG 2313 Thermodynamics of Single Component Systems
3 ELEG 2103 Electronic Circuits
1 ELEG 2101L Electronic Circuits Lab
3 CHEM 2613 Organic Physiological Chemistry*
1 CHEM 2611L Organic Physiological Chemistry Lab
17 semester hours

Fall Semester 3
2 BENG 3712 Engr Properties of Biol Materials
3 MEEG 3013 Mechanics of Materials
3 CVEG 3213 Hydraulics, or
MEEG 3503 Mechanics of Fluids, or
CHEG 2133 Fluid Mechanics
3 CHEM 3813 Intro. to Biochemistry
4 MATH 3404 Differential Equations
3 Technical Elective
18 semester hours

Spring Semester 3
3 BENG 3723 Unit Operations in Biological Engr
3 BENG 3803 Mechanical Design in Biological Engr
3 BENG 4103 Instrumentation in Biological Engr
3 BENG Design elective
3 Humanities/Social Science Elective
0 ENGL 2003 Advanced Composition or Exemption
15 semester hours

Fall Semester 4
3 BENG 4813 Senior Biological Engr Design I
3 BENG 3733 Transport Phenomena in Biological Systems
3 BENG Design Elective
6 Humanities/Social Studies Elective
15 semester hours

Spring Semester 4
2 BENG 4822 Senior Biological Engr Design II
6 Humanities/Social Science Elective
3 Technical (Engineering) elective
3 Technical elective
14 semester hours

129 Total hours

SEE PAGE 321 FOR BIOLOGICAL ENGINEERING (BENG) COURSES

CHEMICAL ENGINEERING (CHEG), RALPH E. MARTIN DEPARTMENT OF

Thomas O. Spicer, III
Head of the Department
3202 Bell Engineering Center
479-575-4951

- Distinguished Professor Havens
- Distinguished Professors Emeriti Gaddy, Thatcher
- University Professor Turpin
- Professors Babcock, Clausen, King, Penney, Spicer, Thoma, Ulrich
- Professors Emeriti Couper, Springer, Welker
- Research Professors Cross, Silano
- Associate Professors Ackerson, Beitle,
- Instructor Myers
- Visiting Assistant Professor Teo
- Adjunct Professors Muralidhara, Siebenmorgen
- Adjunct Associate Professor Eason

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 perform the following:

- 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 life-long 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.

Chemical Engineering Eight-Semester Degree Program

The following section contains the list of courses required for the Bachelor of Science in Chemical Engineering degree and a suggested sequence. Not all courses are offered every semester, so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites. Students wishing to follow the eight-semester degree plan should see page 42 in the Academic Regulations chapter for university requirements of the program.

Students who have earned 45 hours must take the Rising Junior Exam.

Students must also take ENGL 2023 during the third year or gain exemption.

Fall Semester 1
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

Spring Semester 1
4 MATH 2564 Calculus II
3 CHEG 1123 Intro. to Chem Engr II
3 ENGL 1023 Composition II
2 CHEG 1212L Chemical Engr Lab I
3 Humanities/social science elective
15 semester hours

Fall Semester 2
4 MATH 2574 Calculus III
3 CHEM 3603 Organic Chemistry I
1 CHEM 3601L Organic Chemistry I Lab
4 PHYS 2054 University Physics I
0 PHYS 2050L University Physics Lab I
1 CHEG 2221 Professional Practice Seminar
3 CHEG 2313 Thermodynamics of Single Component Systems
16 semester hours

Spring Semester 2
4 MATH 3404 Differential Equations
3 CHEM 3613 Organic Chemistry II
1 CHEM 3611L Organic Chemistry II Lab
4 PHYS 2074 University Physics II
0 PHYS 2070L University Physics II Lab
3 CHEG 2133 Fluid Mechanics
3 CHEG 3323 Thermodynamics of Multicomponent Systems
18 semester hours

Fall Semester 3
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/social science Elective
18 semester hours

Spring Semester 3
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.)
0 ENGL 2003 Advanced Composition or Exemption
16 semester hours

Fall Semester 4
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

Spring Semester 4
2 CHEG 4332L Chem Engr Lab III
3 CHEG 4443 Chem Engr Design II
3 ELEG 3903 Electric Circuits and 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. Students may select these courses from upper division (3000 and above) courses in mathematics, engineering, and the sciences with the approval of their adviser. 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, or
CHEM 5843 Biochemistry II
BIOL 2323/2321L 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 available from the department.

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
BIOL 2013/2011L General Microbiology
BIOL 2213/2211L Human Physiology
BIOL 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 328 FOR CHEMICAL ENGINEERING (CHEG) COURSES

CIVIL ENGINEERING (CVEG)

Kevin D. Hall
Head of the Department
4190 Bell Engineering Center
479-575-4954

- University Professor Emeritus LeFevre
- Professors Buffington, Dennis, Elliott, Gattis, Gross, Hall, Selvam, Wang, Young
- Associate Professors Edwards, Soerens
- Associate Professors Emeritus Pleimann
- Assistant Professors Hale, Heymsfield, Tooley, Williams (R.), Williams (S.)

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 supervision. Employment is possible anywhere in the world.

The objectives of the civil engineering program are to produce graduates who are:

1. employable in any of the following fields: foundation, earthwork, and embankment design and analysis; water, wastewater, and waste handling and treatment; highway facility design and operation; and structural design and analysis.
2. academically prepared to pursue licensure as a Professional Engineer.
3. prepared to pursue an advanced education.

To fulfill these objectives, 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 two major design projects.

Civil Engineering Eight-Semester Degree Program

The following section contains the list of courses required for the Bachelor of Science in Civil Engineering degree and a suggested sequence. Not all courses are offered every semester, so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites. Students wishing to follow the eight-semester degree plan should see page 42 in the Academic Regulations chapter for university requirements of the program.

Students who have earned 45 hours must take the Rising Junior Exam.

Students must also take ENGL 2023 during the third year or gain exemption.

Fall Semester 1
3 ENGL 1013 Composition I

4 MATH 2554 Calculus I
2 CVEG 1012 Civil Engr Fund
3 CHEM 1103 University Chemistry I
1 CHEM 1101L University Chemistry I Lab
3 Humanities/social science elective
16 semester hours

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

Fall Semester 2
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

Spring Semester 2
3 CVEG 2113 Structural Materials
3 INEG 3313 Engineering Statistics
4 MATH 3404 Differential Equations
3 MEEG 3013 Mechanics of Materials
3 Humanities/social science elective
16 semester hours

Fall Semester 3
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

Spring Semester 3
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
0 ENGL 2003 Advanced Composition or Exemption
18 semester hours

Fall Semester 4
3 CVEG 4143 Foundation Engineering
3 CVEG 4303 Reinforced Concrete Design I
3 CVEG 4433 Transportation Pavements & Materials
2 CVEG 4852 Professional Practice Issues
6 Engineering electives
1 Civil Engineering design elective
18 semester hours

Spring Semester 4
3 CVEG 4243 Environmental Engr Design
3 CVEG 4513 Construction Mgmt
6 Engineering electives
1 Civil Engineering design elective
3 Humanities/social science elective
16 semester hours

136 Total hours

Elective Courses

Students must select four 3-hour engineering elective courses in conference with their adviser. The selection must include at least three civil engineering courses. The fourth course can be a civil engineering course or one of the following: MEEG 2013 Dynamics, MEEG 2403 Thermodynamics, ELEG 3903 Electric Circuits and Machines, MEEG 3703 Numerical Methods. Normally, the civil engineering courses are selected from among the 4000-level elective CVEG courses. Exceptional students may be allowed to choose from the 5000 (graduate-level) course 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 CHEM 3601L, Organic Chemistry, GEOL 3513 and GEOL 3511L, Structural Geology, BIOL 2013 and BIOL 2011L, General Microbiology, or PHYS 2074 and PHYS 2070L, University Physics II. Lists of approved electives are on file in the department office.

Civil Engineering Design Electives

Students must complete two of the following four CVEG design project electives: CVEG 4811 Environmental Design Project, CVEG 4821 Geotechnical Design Project, CVEG 4831 Structural Design Project, and CVEG 4841 Transportation Design Project. Each design project elective is associated with a specific design-oriented course. The associated course must be taken at the same time as the design project elective. The associated courses may be taken alone but the design electives cannot.

Honors Program Requirements

Students enrolled in the Honors College who are to receive the Bachelor of Science in Civil Engineering must complete a minimum of 12 hours of honors credit. At least 6 hours must be completed within the Civil Engineering program including at least 3 hours resulting in an Honors Thesis. The CVEG honors courses are acceptable as engineering electives and in some cases may be substituted for required courses. The following Civil Engineering courses are offered for honors credit: CVEG 491V H Honors Studies in Geotechnical Engineering, CVEG 492V H Honors Studies in Environmental Engineering, CVEG 493V H Honors Studies in Structural Engineering, CVEG 494V H Honors Studies in Transportation Engineering, and CVEG 4983 H Undergraduate Honors Thesis

SEE PAGE 339 FOR CIVIL ENGINEERING (CVEG) COURSES

COMPUTER SCIENCE AND COMPUTER ENGINEERING (CSCE)

Jerry Yeargan
Head of the Department
311 Engineering Hall
479-575-6197

- Distinguished Professor Yeargan
- Professors Crisp, Deaton, Skeith, Thompson (C.)
- Associate Professors Apon, Beavers, Li, Lusth, Panda, Parkerson,

Thompson (D.)
- Assistant Professors Di, Hexmoor
- Instructor Baker
- Emeritus Professor Starling
- Emeritus Instructor Johnson

The faculty of the Computer Science and Computer Engineering department is engaged in multidisciplinary academic research, course offerings, and student projects in areas such as: high performance and scientific computing, grid computing, agents, middleware, networking, data security, nanotechnology, graph theory, and subsystem design.

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; pursue life-long learning and continued professional development; and undertake leadership roles in their profession, in their communities, and in the global society.

Since almost all of today's complex systems encompass hardware and software elements, the computer engineering degree (CENG) has required sequences of courses in both hardware and software aspects of computer applications and design. Computer engineering graduates must acquire the skills required 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.

A degree in computer science (CSCE) provides unique diversity in career choices. Computer science graduates can design, implement, or manage computer systems, as well as adapt computers to new applications. Computer science core courses include the fundamentals of programming concepts, data structures, operating systems, algorithms, formal languages, database management systems, and programming languages.

Humanities and social science electives are selected from courses approved by the College of Engineering. The 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 (B.S.Cmp.E.) and the Bachelor of Science in Computer Science (B.S.C.S.) degrees and suggested sequences for each.

Computer Engineering Eight-Semester Program

The following section contains the list of courses required for the Bachelor of Science in Computer Engineering (B.S.Cmp.E.) degree and a suggested sequence. Not all courses are offered every semester, so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites. Students wishing to follow the eight-semester degree plan should see page 42 in the Academic Regulations chapter for university requirements of the program.

Students who have earned 45 hours must take the Rising Junior Exam.

Students must also take ENGL 2023 during the third year or gain exemption.

Fall Semester 1
4 MATH 2554 Calculus I
3 CHEM 1103 University Chemistry
1 CHEM 1101L University Chemistry Lab
3 CSCE 1113 Programming Foundations I
1 CSCE 1111L Programming Foundations I Lab
3 ENGL 1013 English Composition
15 semester hours

Spring Semester 1
4 MATH 2564 Calculus II
4 PHYS 2054 University Physics I
0 PHYS 2050L University Physics I Lab
3 CSCE 1123 Programming Foundations II
1 CSCE 1121L Programming Foundations II Lab
3 ENGL 1023 Composition II
3 MATH 2103 Discrete Math
18 semester hours

Fall Semester 2
4 MATH 2574 Calculus III
4 PHYS 2074 University Physics II
0 PHYS 2070L University Physics II Lab
3 CENG 2113 Digital Techniques I
0 CENG 2110L Digital Techniques I Lab
3 CSCE 2143 Data Structures
3 Humanities/social sciences elective
17 semester hours

Spring Semester 2
4 MATH 3404 Differential Equations
3 ELEG 3933 Circuits and Electronics
3 CENG 2213 Computer Organization
3 CENG 2123 Digital Techniques II
0 CENG 2120L Digital Techniques II Lab
3 Basic science elective
16 semester hours

Fall Semester 3
3 CENG 3953 Logic Synthesis-VHDL
3 CSCE 3313 Algorithms
3 Technical Elective
3 History/Government requirement
3 Humanities/social sciences elective
15 semester hours

Spring Semester 3
3 CSCE 3613 Operating Systems
3 CSCE 3513 Software Engineering
3 PHIL 3103 Ethics and the Professions
3 Technical Elective
3 STAT 3013 Introduction to Probability and Statistics (INEG 3313 may be substituted)
0-3 ENGL 2003 Advanced Composition or Exemption
15 semester hours

Fall Semester 4
1 CENG 4571 Senior Design Project I
3 Technical electives/hardware
3 Technical electives/software
3 Humanities/social sciences elective
3 Free Elective
3 Free Elective
16 semester hours

Spring Semester 4
3 CENG 4973 Senior Design Project II
3 CENG 4213 Intro. to Computer Architecture
3 Technical electives/hardware
3 Technical electives/software

3 Humanities/social sciences elective (3000+)
15 semester hours

127 Total hours

Computer Science Eight-Semester Program

The following section contains the list of courses required for the Bachelor of Science in Computer Science (B.S.C.S.) degree and a suggested sequence. Not all courses are offered every semester, so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites. Students wishing to follow the eight-semester degree plan should see page 42 in the Academic Regulations chapter for university requirements of the program.

Students who have earned 45 hours must take the Rising Junior Exam.

Students must also take ENGL 2023 during the third year or gain exemption.

Computer Science majors are required to take 12 hours of natural science consisting of either PHYS 2054/2050L, PHYS 2074/2070L and CHEM 1103/1101L; **or** CHEM 1103/1101L, CHEM 1123/1121L and PHYS 2054/2050L.

Fall Semester 1
4 MATH 2554 Calculus I
4 PHYS 2054 University Physics I
0 PHYS 2050L University Physics I Lab
3 CSCE 1113 Programming Foundations I
1 CSCE 1111L Programming Foundations I Lab
3 ENGL 1013 English Composition
15 semester hours

Spring Semester 1
4 MATH 2564 Calculus II
4 PHYS 2074 University Physics II
0 PHYS 2070L University Physics II Lab
3 CSCE 1123 Programming Foundations II
1 CSCE 1121L Programming Foundations II Lab
3 ENGL 1023 Composition II
3 MATH 2103 Discrete Mathematics
18 semester hours

Fall Semester 2
3 MATH 3083 Linear Algebra
3 CHEM 1103 University Chemistry I
1 CHEM 1101L University Chemistry I Lab
3 CENG 2113 Digital Techniques I
0 CENG 2110L Digital Techniques I Lab
3 CSCE 2143 Data Structures
3 Humanities/Social sciences elective
16 semester hours

Spring Semester 2
3 MATH 3103, Combinatorics
3 Free elective
3 CENG 2213, Computer Organization
3 Humanities/social sciences elective
3 History/government requirement
15 semester hours

Fall Semester 3
3 STAT 3013 Intro to Probability and Statistics
(INEG) 3313 can be substituted)
3 CS Elective
3 CSCE 3313 Algorithms
3 Humanities/social sciences elective
3 Humanities/social sciences elective
15 semester hours

Spring Semester 3
3 CSCE 3613 Operating Systems
3 CSCE 3513 Software Engineering
3 Free elective
3 Free elective
3 PHIL 3103 Ethics & the Profession
0 ENGL 2003 Advanced Composition or Exemption
15 semester hours

Fall Semester 4
1 CSCE 4561 CS Capstone I
3 CSCE 4313 Programming Languages
3 CSCE 4523 Database Management
3 CS elective
3 Free elective
3 Humanities/social sciences elective
16 semester hours

Spring Semester 4
3 CSCE 4963 CS Capstone II
3 CS elective
3 CSCE 4323 Formal Languages
3 Free elective
3 Humanities/social sciences elective (3000+)
15 semester hours

125 Total hours

Degree Program Changes

Students must meet all requirements of their degree programs and are expected to keep 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 might 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 required of that student. Students should consult their departmental adviser for additional information.

Requirements for Departmental Honors Computer Science and Computer Engineering

The Honors Program in Computer Science and Computer Engineering is designed for the superior student and is intended to help the student develop a more comprehensive view of Computer Science and Computer Engineering. The program provides a vehicle for the recognition of achievements of work beyond the usual course of study. Higher degree distinctions are recommended only in truly exceptional cases and are based upon the candidate's whole program of honors studies.

The department considers the following requirements necessary for graduation with honors:

1. The candidate must satisfy the requirements set forth by the College of Engineering.
2. A student must obtain at least a 3.50 grade-point average in required Computer Engineering and/or Computer Science courses.
3. The student must complete 7 hours of Honors credit in the major, which includes 4 hours of Honors Thesis taken as two

successive semesters of CSCE 4912H or CENG 4912H and 3 hours of non-thesis.

Requirements for the Bachelor of Arts degree with a Major in Computer Science (B.A.C.S):

At least 30 hours in computer science including CSCE 1113/1111L, CSCE 1123/1121L, CSCE 2143, CSCE 3313, and CSCE 4313 plus 13 hours of electives to be selected from a list of CSCE courses numbered 3000 or higher offered by the department.

The mathematics requirements of the degree are MATH 2043 or MATH 2554, MATH 2103, and MATH 3103. The remaining courses should meet the requirements for a B.A. degree listed in the Fulbright College section.

Requirements for a Minor in Computer Science:

CSCE 1113/1111L, CSCE 1123/1121L, CSCE 2143, CSCE 3313, and either CENG 2213 or CSCE 4313.

SEE PAGE 326 FOR COMPUTER ENGINEERING (CENG) COURSES AND PAGE 337 FOR COMPUTER SCIENCE (CSCE) COURSES

ELECTRICAL ENGINEERING (ELEG)

Aicha Elshabini
Head of the Department
3217 Bell Engineering Center
479-575-3009

- Distinguished Professor Brown (W.D.), Elshabini, Yeargan, Vasundara Varadan, Vijay Varadan
- University Professor Schmitt
- Professors Ang, Balda, Manasreh, Mantooth, Martin, Naseem, Schaper, Sohraby, Waite
- Associate Professors Barlow, Brown (R.L.), Burkett, El-Shenawee, Caldwell, Gattis, McCann
- Assistant Professor Lee
- Professors Emeritus Jones, Mix, Stephenson, Webb

Electrical engineering is a profession in charge of designing electrical devices, components, integrated chips, computer chips, integrated circuits, and electronic assemblies to benefit mankind. This may encompass systems such as radar and satellite antennas, microelectronics, optical, portable or wireless electronics and communications, and embedded computers in everyday consumer, homeland security, detection and identification of biological threats, or military 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 real time embedded control systems with smart highways and smart vehicles, the dominating influence of the computer on modern society, the wireless chemical and biological nanosensors for network solution, the miniaturization of electronics, and a host of other developments. The increased use of electronic equipment for measurement, network, communication, and control has spread into such diverse areas as improved health care, transportation, recreation, agricultural production, marketing, manufacturing, underwater, space, information technology, networking, renewable energy, computer hardware, automotives, and countless others. This widespread 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 department also participates in the Honors Program to challenge superior students with a more in-depth academic program and research experience and to provide a structure for working more closely with faculty members and other students in a team environment.

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 who:

1. are recruited in a competitive market and valued as reliable and competent employees by a wide variety of industries, in particular electrical and computer 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, a Master of Science degree in Telecommunications Engineering, a Master of Science degree in 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 gifted undergraduate 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. 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, manufacturing and processing, measurement and characterization, or management. Students progressively build their design experience throughout the curriculum and demonstrate this ability in the senior design lab, the Honors electri-

cal engineering design I and II, and the senior honors thesis. Honors Colloquium provides information on special topics and issues in the electrical engineering discipline. Equally important, the curriculum introduces students to subjects in the humanities, social sciences, success, 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 concentrates on development of a sound understanding of basic science and mathematics. 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, such as power, electronics, mixed-signal, microelectronics, circuits, digital or computer hardware, communications, controls, electromagnetics, sensors, and nanotechnology. 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.

Electrical Engineering Eight-Year Degree Program

The following section contains the list of courses required for the Bachelor of Science degree in Electrical Engineering and a suggested eight-semester sequence. Not all courses are offered every semester, so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites. Students wishing to follow the eight-semester degree plan should see page 42 in the Academic Regulations chapter for university requirements of the program.

Students who have earned 45 hours must take the Rising Junior Exam.

Students must also take ENGL 2023 during the third year or gain exemption.

In addition to the graduation requirements for the College of Engineering and the University of Arkansas, candidates for an electrical engineering degree must have earned a grade-point average of no less than 2.00 on all ELEG courses, excluding ELEG laboratories.

Fall Semester 1
3 GNEG 1003 Intro. to Engineering
3 ENGL 1013 Composition I
4 MATH 2554 Calculus I
3 ELEG 1903 Digital Design I
0 ELEG 1900L Digital Design I Lab
3 History/Government Requirement
16 semester hours

Spring Semester 1
3 ENGL 1023 Technical Composition II
4 MATH 2564 Calculus II
3 ELEG 1913 Digital Design II
0 ELEG 1910L Digital Design II Lab
4 PHYS 2054 University Physics I
0 PHYS 2050L University Physics I Lab
3 Humanities/social Science elective
17 semester hours

Fall Semester 2
3 CSCE 1113 Programming Foundations I
1 CSCE 1111L Programming Foundations I Lab
3 ELEG 2103 Electric Circuits I
1 ELEG 2101L Electric Circuits I Lab
4 MATH 2574 Calculus III
4 PHYS 2074 University Physics II
0 PHYS 2070L University Physics II Lab
16 semester hours

Spring Semester 2
3 CENG 1123 Programming Foundations II
1 CENG 1121L Programming Foundations II Lab
4 Math/Science Elective
3 ELEG 2113 Electric Circuits II
1 ELEG 2111L Electric Circuits II Lab
4 MATH 3404 Differential Equations
16 semester hours

Fall Semester 3
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 3923 Microprocessor System Design
0 ELEG 3920L Microprocessor Sys Design Lab
3 Humanities/social Science elective
3 Math/Science Elective
0 ENGL 2023 Advanced Composition
17 semester hours

Spring Semester 3
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 Conv Lab
3 ELEG 3703 Electromagnetics
15 semester hours

Fall Semester 4
1 ELEG 4061 Electrical Engineering Design I
3 ELEG 3143 Stochastic Signal Processing
3 Electrical Eng Technical Elective
3 Engineering Science Elective
3 Technical Elective
3 Upper-level humanities/social Science elective
16 semester hours

Spring Semester 4
1 ELEG 4071 Electrical Engineering Design II
6 Electrical Eng Technical Elective
3 Technical Elective
3 Upper-level humanities/social Science elective
3 Humanities/social Science elective
16 semester hours

129 Total hours

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.

Electrical Engineering Honors Program

To graduate with Honors in electrical engineering, students must be a member of the Honors College and complete a minimum of 12 hours of honors credit of which 6 hours must be Electrical Engineering courses and includes the following courses: ELEG 4061H – Honors Electrical Engineering Design I, ELEG 4071H – Honors Electrical Engineering Design II, and ELEG 4081H – Senior Thesis. Students must also have a minimum cumulative GPA of 3.50 to graduate with Honors in Electrical Engineering.

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. 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 5603 Wireless Data Communications
ELEG 5613 Introduction to Telecommunications
ELEG 5623 Information Theory
ELEG 5633 Detection and Estimation
ELEG 5643 Computer Communication Networks
ELEG 5653 Artificial Neural Networks
ELEG 5673 Pattern Recognition
ELEG 5683 Image Processing
ELEG 5693 Wireless Communications
ELEG 5713 Antennas and Radiation
ELEG 587V Communication Theory
ELEG 587V Probability Theory and Stochastic Processes
ELEG 587V Spread Spectrum Systems

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
CSCE 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 5403 Systems Theory
ELEG 5413 Stochastic Control Systems
ELEG 5423 Optimal Control Systems
ELEG 5433 Digital Control Systems
ELEG 5443 Nonlinear Systems Analysis
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

Electromagnetics

ELEG 4713 Electromagnetic Transmission
ELEG 4723 Introduction to RF and Microwave
ELEG 487V Introduction to Antennas
ELEG 5633 Detection and Estimation
ELEG 5723 Advanced Microwave Design
ELEG 5743 Radar Systems
ELEG 5763 Advanced Topics in Electromagnetics

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 Electric 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 Introduction 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 487V Advances in Integrated Circuit Processing
ELEG 487V Microelectronic Fabrication
ELEG 487V Microsensors, MEMS, and Smart Devices

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
ELEG 5323 Semiconductor Nanostructures I
ELEG 5333 Semiconductor Nanostructures II
ELEG 587V Microelectronics Fabrication
ELEG 587V Neurolectronics and Neurosurgery

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 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:

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 2094 University Physics III
PHYS 3113 Analytical Mechanics
PHYS 3544 Optics
PHYS 3614 Modern Physics
MEEG 2703 Computer Methods in Mechanical Engineering

SEE PAGE 345 FOR ELECTRICAL ENGINEERING (ELEG) COURSES

INDUSTRIAL ENGINEERING (INEG)

John English
Head of the Department
4207 Bell Engineering Center
479-575-3156

- Distinguished Professor White
- Professors English, Johnson, Meller
- Associate Professors Cassady, Fant, Mason, Nachtmann, Pohl, Rossetti
- Assistant Professors Buyurgan, Chimka, Nam
- Adjunct Associate Professor Gattis

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, teamwork 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, life-long 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 total graduation requirement in industrial engineering is 128 hours. For further information please visit us on the World Wide Web at http://www.ineg.uark.edu/.

Industrial Engineering Eight-Semester Degree Program

The following section contains the list of courses required for the Bachelor of Science in Industrial Engineering degree and a suggested sequence. Not all courses are offered every semester, so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites. Students wishing to follow the eight-semester degree plan should see page 42 in the Academic Regulations chapter for university requirements of the program.

Students who have earned 45 hours must take the Rising Junior Exam.

Students must also take ENGL 2023 during the third year or gain exemption.

Fall Semester 1
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

Spring Semester 1
4 MATH 2564 Calculus II
3 INEG 1403 Industrial Cost Analysis
3 ENGL 1023 Technical Composition II
3 Science elective
13 semester hours

Fall Semester 2
4 MATH 2574 Calculus III
3 Computer Elective I
3 INEG 3313 Engineering Statistics
4 PHYS 2054 University Physics I
3 ECON 2143 Basic Economics
17 semester hours

Spring Semester 2
4 MATH 3404 Differential Equations
3 Computer Elective II
4 PHYS 2074 University Physics II
3 INEG 3413 Eng Economic Analysis
3 INEG 3333 Industrial Statistics
17 semester hours

Fall Semester 3
3 INEG 3713 Methods and Standards
3 INEG 4623 Intro. to Simulation
3 Engineering Science Elective I
3 ELEG 3903 Electric Circuits and Machines
3 INEG 3513 Manuf Design and Processes
3 (History or government requirement:
HIST 2003, HIST 2013, or PLSC 2003)
18 semester hours

Spring Semester 3
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
0 ENGL 2003 Advanced Composition or Exemption
15 semester hours

Fall Semester 4
3 INEG 4433 Sys Engineering and Management
(An upper-level ROTC course may be substituted.)
3 INEG 4543 Materials Handling
3 Technical elective
3 INEG 4723 Ergonomics
6 Humanities/social science electives
18 semester hours

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

128 Total hours

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, PSYC 2003 General Psychology 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 367 FOR INDUSTRIAL ENGINEERING (INEG) COURSES

MECHANICAL ENGINEERING (MEEG)

Joseph J. Rencis
Head of the Department
204 Mechanical Engineering Bldg.
479-575-3153
Fax: 479-575-6982
E-mail: meeg-undergrad@engr.uark.edu

- Distinguished Professor Saxena
- Giffels Professor Bhat
- Professors Jong, Malshe, Rencis, Schmidt, West
- Associate Professors Couvillion, Gordon, Nutter, Roe, Springer, Tung
- Assistant Professor Zou
- Instructor Davis
- Adjuncts Batzer, Cole, Hamilton

The mechanical engineering program is designed to offer a high-

quality course of instruction involving classroom, laboratory, and extracurricular activities that results in graduates who are qualified and prepared to meet the demands of a professional career in the present and future work place and be 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 elective courses, a total of 12 hours of technical and science electives. A student must select these electives with the approval of his or her adviser. It is expected that electives will be chosen to provide a coherent program within one or more areas of specialization or options available to mechanical engineers. Areas of specialization are available in the nuclear, mechanical systems design, materials, thermal systems design, and engineering mechanics fields. Current options include pre-medical, management, business, and astronautics.

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.

Mechanical Engineering Eight-Semester Degree Program

The following section contains the list of courses required for the Bachelor of Science in Mechanical Engineering degree and a suggested sequence. Not all courses are 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.

Students wishing to follow the eight-semester degree plan should see page 42 in the Academic Regulations chapter for university requirements of the program.

Students who have earned 45 hours must take the Rising Junior Exam.

Students must also take ENGL 2023 during the third year or gain exemption.

Fall Semester 1
3 ENGL 1013 Composition I
3 CHEM 1103 University Chemistry I
1 CHEM 1101L University Chemistry I Lab
4 MATH 2554 Calculus I
2 GNEG 1122 Introduction CAD
3 MEEG 1103 Intro. to Mechanical Engineering
16 semester hours

Spring Semester 1
3 CHEM 1123 University Chemistry II
1 CHEM 1121L University Chemistry II Lab
4 MATH 2564 Calculus II
4 PHYS 2054 University Physics I
0 PHYS 2050L University Physics I Lab
3 ENGL 1023 Technical Composition II
15 semester hours

Fall Semester 2
4 PHYS 2074 University Physics II
0 PHYS 2070L University Physics II Lab
4 MATH 2574 Calculus III
3 MEEG 2303 Intro. to Materials
3 MEEG 2003 Statics
14 semester hours

Spring Semester 2
4 MATH 3404 Differential Equations
3 MEEG 2013 Dynamics
3 MEEG 2403 Thermodynamics
3 MEEG 2703 Computer Methods in Mechanical Engineering
3 ELEG 3903 Electric Circuits and Machines
16 semester hours

Fall Semester 3
3 MEEG 3013 Mechanics of Materials
3 MEEG 3113 Machine Dynamics & Control
2 MEEG 3202 Mechanical Engr Lab I
3 MEEG 3503 Mechanics of Fluids
3 ELEG 3913 Engineering Electronics
3 Humanities/social science elective
(History or Gov. Requirement)
17 semester hours

Spring Semester 3
2 MEEG 3212 Mechanical Engr Lab II
3 MEEG 4413 Heat Transfer
3 MEEG 4103 Machine Element Design
3 ECON 2143 or ECON 2013
3 Humanities/social science elective (lower-level)
0 ENGL 2003 Advanced Composition or Exemption
14 semester hours

Fall Semester 4
3 MEEG 4033 Creative Project Design I
2 MEEG 4202 Mechanical Engr Lab III
3 MEEG 4483 Thermal Systems Analysis & Design
3 Technical/science elective
3 Technical/science elective
3 Humanities/social science elective (3000 - 4000 level)
17 semester hours

Spring Semester 4
3 MEEG 4133 Creative Project Design II
3 Technical/science elective
3 Technical/science elective
3 Humanities/social science elective (lower level)
3 Humanities/social science elective (3000- 4000-level)
15 semester hours

124 Total hours

Technical/Science Electives

The purpose of technical/science electives is to provide students with the opportunity to expand their education along lines of particular interest to them. The approved list of technical/science electives and selected courses for various options is available in the Mechanical Engineering department office.

Humanities/Social Science Electives

Any elective included on the humanities/social science list may be selected. This list is available in the department office.

SEE PAGE 381 FOR MECHANICAL ENGINEERING (MEEG) COURSES