

# College of Engineering

## Dean

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## Director, Center for Computer-Aided Design

- Karim Abdel-Malek

## Director, Iowa Institute for Biomedical Imaging

- Milan Sonka

## Director, IIHR—Hydroscience and Engineering

- Larry Weber

**Undergraduate degree:** B.S.E.

**Undergraduate certificates:** naval hydrodynamics; technological entrepreneurship; wind energy

**Graduate degrees:** M.S.; Ph.D.

**Website:** <https://www.engineering.uiowa.edu/>

Engineering is defined by ABET (formerly known as Accreditation Board for Engineering and Technology) as that profession in which knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgment to develop ways to use, economically, the materials and forces of nature for the benefit of mankind.

In short, engineering is the application of science and mathematics to solve problems for society.

The major aim of engineering is the creation of a new process, product, material, or system. This activity demands a high degree of creativity and problem solving ability coupled with a full understanding of engineering fundamentals, good judgment, and a practical sense of economics.

The College of Engineering prepares students for one or more of the many career opportunities in the engineering profession. Such opportunities include positions in design, production, development, research, management, and consulting. Engineers are employed in industrial organizations, governmental agencies, and private practice.

The College of Engineering's mission is to develop, disseminate, transfer, and preserve technical knowledge that improves people's lives. The college endeavors to:

- provide a well-rounded and superior engineering education that draws upon resources of a comprehensive research university to attract outstanding undergraduate and graduate students in selected engineering fields;
- conduct high-quality research in selected areas, enabling faculty members and students to keep pace with new developments and ensuring that the newest concepts are taught in its courses; and
- serve the needs of the University, industry, government, and the general populace by making its facilities and faculty expertise accessible.

## College Organization

The College of Engineering has five departments and four research units. The Department of Biomedical Engineering, Department of Chemical and Biochemical Engineering, Department of Civil and Environmental Engineering, Department of Electrical and Computer Engineering, and Department of Mechanical and Industrial Engineering offer a total of seven undergraduate programs of study with Bachelor of Science in Engineering degrees offered in:

biomedical engineering,  
chemical engineering,  
computer science and engineering,  
civil engineering,  
electrical engineering,  
environmental engineering,  
industrial engineering, and  
mechanical engineering.

The college also offers joint undergraduate degrees with the College of Liberal Arts and Sciences and the Tippie College of Business; a dual degree with the University of Northern Iowa; a joint bachelor's/master's degree program in each engineering discipline; and a joint bachelor's/master's degree with the School of Urban and Regional Planning (also see graduate Certificate in Transportation Studies). See "Joint and Dual Degrees" under Requirements in the Bachelor of Science in Engineering section of the Catalog.

In addition, the College of Engineering partners with the Tippie College of Business to offer the Certificate in Technological Entrepreneurship for undergraduate engineering students. The College of Engineering also teams with the College of Liberal Arts and Sciences to offer the Certificate in Wind Energy, which is open to all University of Iowa undergraduates. The college also offers the undergraduate Certificate in Naval Hydrodynamics.

The College of Engineering offers Master of Science and Doctor of Philosophy degrees in:

biomedical engineering,  
chemical and biochemical engineering,  
civil and environmental engineering,  
electrical and computer engineering,  
industrial engineering, and  
mechanical engineering.

The research units are the Center for Bioinformatics and Computational Biology, the Center for Computer-Aided Design, the Iowa Institute for Biomedical Imaging, and IIHR—Hydroscience and Engineering.

## Diversity and Inclusion in the College of Engineering

The College of Engineering is committed to developing an inclusive community of learning and scholarship with the sustainable support systems that enable participants of all ages (pre-K-12, college, graduate students, staff, and faculty) to succeed. This welcoming extends beyond the college to the wider University of Iowa community and to national venues. Inclusion efforts are led by the Outreach, Admissions, Scholarship and Inclusion Services (OASIS) team. Diversity programs offered by the Ethnic Inclusion Effort for Iowa Engineering (ei2) and by Women in Science and Engineering (WiSE) help to nourish the college community. Project Lead the Way (PLTW) and FIRST Tech Challenge (FTC), as well as general pre-engineering summer camps, engage K-12 students and teachers in the Midwest expanding inclusion practices to broaden participation of underrepresented groups in science and engineering disciplines. These programs enjoy the support from several international engineering and manufacturing firms, federal agencies, and private foundations. The associate dean for diversity and outreach manages these efforts and further serves to increase recruitment and retention of diverse undergraduate and graduate students, faculty, and staff within the college.

### Diversity and Inclusion in Graduate Programs

Diversity programs have served to build and nourish the graduate community within the College of Engineering. The college is active in recruiting graduate students of diverse backgrounds and provides mentoring, networking, professional development, and financial support for many graduate students. The success in mentoring underrepresented students in engineering has been built on strong collaboration with other campus units and has been supported through private, state, and federal funding.

Signature programs within the College of Engineering which support graduate students include the Ethnic Inclusion Effort for Iowa Engineering (ei2) and Women in Science and Engineering (WiSE) which provide opportunities for graduate professional development. In addition, the college is a diversity leader as a part of the University Center for Exemplary Mentoring, supported by the Alfred P. Sloan foundation, and as a member of The National GEM Consortium.

## Professional Licensure

Licensure as a professional engineer is governed by the laws of each state. Most states' minimum requirements include graduation from an accredited engineering curriculum of at least four years, followed by at least four years of practical experience and successful completion of two major examinations.

The agency that controls and monitors the licensing procedure in Iowa is the Engineering and Land Surveying Examining Board. The first step in the procedure for students enrolled in an accredited program is to pass an examination on engineering fundamentals given near the time of graduation. Following graduation and the successful completion of the engineering fundamentals exam, graduates receive an Engineer-in-Training (EIT) certificate. The final step in the procedure is to pass the principles and practice exam in a specialty area following a minimum of four years of approved

professional experience. At this point, the graduate engineer becomes a licensed Professional Engineer.

## Student Organizations

The College of Engineering is invested in creating inclusive opportunities for students to further develop their leadership skills and to become more engaged and committed student leaders. In turn, student organizations are empowered to maximize their impact around the college, the university, and the community. The College of Engineering is home to more than 30 student groups comprised of honors organizations, departmental and multidisciplinary organizations, diversity and professional organizations, and industry specific organizations. The Student Development Center (SDS) and Outreach, Admissions, Scholarships, and Inclusion Services (OASIS), as well as the dean's office, in conjunction with the Engineering Student Council, work together to support recognized student organizations. Engineering Student Council plans and carries out activities involving the entire college and acts on college-wide matters of general student interest.

Several engineering professional societies have University of Iowa student chapters: American Institute of Chemical Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers, Biomedical Engineering Society, Institute of Electrical and Electronics Engineers, and Institute of Industrial and Systems Engineers.

The following student organizations are multidisciplinary and are open to all engineering students:

American Institute of Aeronautics and Astronautics is a professional organization affiliated with the field of aerospace engineering;

American Wind Energy Association focuses on career development, research, and advocacy for wind energy;

Artneers is an organization that fosters collaborations between engineering and the arts;

Engineering Sales Club helps engineering students develop the professional skills required for careers in technical sales and consulting;

Engineering World Health, Continental Crossings, and Engineers Without Borders work to reduce poverty and improve global sustainability;

FIRST Alumni Organization brings together students who participated in the FIRST program while in high school and are willing to give back to the community through mentoring and volunteering at FIRST events;

Human Factors and Ergonomics Society promotes the discovery and exchange of knowledge concerning the characteristics of human beings that are applicable to the design of systems and devices;

Iowa Marine Autonomous Racing Club is a design team that focuses on competing in the annual RoboBoat competition sponsored by the Office of Naval Research and the Association for Unmanned Vehicle Systems International;

UI Robotics Club is an all-encompassing robotics club where members may compete, volunteer, mentor, and learn;

Society of American Military Engineers promotes and facilitates engineering support for national security;

Society of Automotive Engineers is a technical organization that designs and fabricates a mini-Baja car to compete at regional and national competitions; and

Theta Tau, a national professional engineering fraternity, focuses on developing engineering leaders for service, profession, and brotherhood.

The University chapter of Tau Beta Pi, a national honorary society for students in all engineering fields, gives special recognition to superior students in their junior and senior years. The work of students who are outstanding in specific engineering disciplines is recognized by Alpha Eta Mu Beta (biomedical engineering), Omega Chi Epsilon (chemical engineering), Chi Epsilon (civil engineering), Eta Kappa Nu (electrical engineering), Alpha Pi Mu (industrial engineering), and Pi Tau Sigma (mechanical engineering).

Student organizations that support the enrollment of women and members of minority populations in the college include the Multi-Ethnic Engineering Student Association; the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers; the National Society of Black Engineers; Out in Science, Technology Engineering, and Mathematics; the Society of Asian Scientists and Engineers; the Society of Hispanic Professional Engineers; the Society of Women Engineers; and Women in Science and Engineering.

For more information, visit Engineering Student Organizations on the college's website.

## Programs

### Undergraduate Programs of Study

The College of Engineering offers the Bachelor of Science in Engineering; see that section of the Catalog for detailed information about the B.S.E., including requirements, admission, and academic rules and procedures. B.S.E. degrees are offered in Biomedical Engineering, Chemical and Biochemical Engineering, Civil and Environmental Engineering, Electrical and Computer Engineering, and Mechanical and Industrial Engineering. For information about each B.S.E. major, see the Catalog's College of Engineering department sections. The College of Engineering also offers two undergraduate certificates in Naval Hydrodynamics and Wind Energy.

### Graduate Programs of Study

The College of Engineering offers the Master of Science and Doctor of Philosophy; see Biomedical Engineering, Chemical and Biochemical Engineering, Civil and Environmental Engineering, Electrical and Computer Engineering, and Mechanical and Industrial Engineering departmental sections in the Catalog for information about principal research and study areas, degree requirements, admission, and financial support for individual graduate programs.

### High School Programs

#### FIRST: FTC

For Inspiration and Recognition of Science and Technology (FIRST) gives students the opportunity for real-world application of science, technology, engineering, and math (STEM) concepts. Students participate in an atmosphere that encourages team building, entrepreneurship, and sportsmanship. FIRST Tech Challenge (FTC) allows teams

of students to be responsible for designing, building, and programming robots to compete in an alliance format against other teams. Teams are required to develop strategy and build robots based on sound engineering principles. Students learn about working in a team environment, effective communication skills, the ability to fail and succeed at the same time, and competing fairly while being supportive of their competition.

### Project Lead The Way

Project Lead The Way (PLTW) is a four-year high school sequence taught in conjunction with traditional math and science courses. The program's curriculum emphasizes critical thinking, creativity, innovation, and real-world problem solving. PLTW courses provide students with in-depth, hands-on knowledge of engineering and technology-based careers.

## Facilities

### Facilities and Resources

#### Seamans Center for the Engineering Arts and Sciences

The Seamans Center for the Engineering Arts and Sciences is home to the College of Engineering. The Seamans Center provides space for learning, teaching, research, and collaboration that meet the needs of 21st-century engineering. Additional work rooms and conference areas join the Seamans Center's expanded classrooms and flexible research space in an environment designed to serve the needs of the college's students, faculty, and staff.

Construction began in 2016 on an addition that will provide state-of-the-art collaborative classrooms and learning spaces that further enhance the creative learning opportunities for students. The Seamans Center provides the welcoming and collaborative facilities that support the active and engaging educational and research programs in the College of Engineering.

#### Engineering Student Services

The professional staff of Engineering Student Services administers student services for the College of Engineering, including advising, tutoring, student records, and global engineering. It also is the administrative home of Engineering Professional Development and the Hanson Center for Technical Communication.

#### Engineering Professional Development

Engineering Professional Development (EPD) develops and promotes experiential education and professional opportunities for students in the College of Engineering. Professional staff coordinates the college's co-op and internship program, engage in employer outreach, and provide opportunities for students to network with employers, including an engineering career fair each semester and other programming related to career development. EPD offers individual advising and class presentations on résumé and cover letter preparation, job and internship search strategies, interviewing skills, and job offer evaluation. EPD partners with the Pomerantz Career Center to facilitate on-campus interviewing and administration of the University's online recruiting system, HireaHawk.

## Global Engineering

In the world's global society, engineering graduates in all disciplines are expected to have a level of global competence in order to successfully interact with colleagues and customers around the world. Successful engineers are able to communicate across cultures, work in ethnically and culturally diverse teams, and can effectively deal with ethical issues and conflicts arising from such differences.

University of Iowa engineering students have numerous opportunities to study abroad. Students can immerse themselves in another culture while taking required engineering courses in English for a winter, summer, semester or full academic year. Students can also explore opportunities abroad to fulfill their minor or elective focus area requirements.

In addition to studying abroad, engineering students can pursue additional opportunities abroad, such as volunteering abroad, conducting research in other countries, and global internships.

## Lichtenberger Engineering Library

The Lichtenberger Engineering Library is a branch of the University of Iowa Main Library and is a center of engineering college activity. Its collections include more than 140,000 volumes and electronic full-text access to over 5,000 engineering and scientific journals. It offers electronic access to primary engineering and scientific indexes and abstracts, and full-text access to standards and U.S. patents. The library also maintains a substantial collection of publications from major engineering societies and a collection of national and international standards. Tools also are available for check out to students and faculty in order to allow for more hands-on projects and use in class assignments. Example tools include screwdrivers, scales, and light meters. The library provides 35 computer workstations with specialized software packages and a significant amount of study space for students. The study spaces allow for individual as well as group study. The library features individual study carrels, group tables, lounge chairs, a collaborative work station, and movable whiteboards. Library personnel are available to assist with specialized engineering-related reference and informational questions. Personnel also provide course- and topic-specific instructional programs to further critical thinking and life-long learning skills.

## Hanson Center for Technical Communication

The Hanson Center for Technical Communication (HCTC) assists undergraduate engineering students develop and polish their communication skills. The center's director and assistant director supervise a staff of professional writing consultants and peer tutors.

HCTC writing consultants are professional instructors who work in teams to help engineering faculty members present and evaluate writing-intensive assignments. They also provide individual feedback and assessment of students' work throughout the writing process.

HCTC peer consultants are engineering students who have strong communication skills. Peer tutors conduct one-on-one tutoring sessions at the center, helping their fellow students develop skills for organization and audience analysis and for creating precise technical descriptions and persuasive, logical narratives.

## Engineering Computer Services

Engineering Computer Services (ECS) provides information technology administration for curricular, administrative, and research computing at the College of Engineering. The college has three drop-in computer labs with 180 high-end Linux and Windows computer workstations, 24-seat and a 45-seat computer classrooms and labs, and a 250-seat virtual computer lab with graphics support that students can access on the Internet. Numerous public domain applications and commercial engineering applications support the full range of engineering classes. Software is upgraded annually, and hardware is upgraded every four years. The college's computer labs are open 24 hours a day, every day of the year.

## Engineering Electronics Shop

The Engineering Electronics Shop (EES) is a full-service electronics facility that supports sales and service for the College of Engineering and the University. EES provides design, construction, repair, calibration, and preventive maintenance services for teaching and research laboratories. EES maintains more than 100,000 parts in stock, including electronic components, computer and office supplies. The shop has laser cutting and etching equipment, a printed circuit board mill, and 3-D printers. EES also maintains a large set of rental lockers for students.

## Engineering Machine Shop

The Engineering Machine Shop (EMS) is a full-service, light manufacturing facility that supports curricular, research, and operational needs of the College of Engineering and the University. EMS provides professional design and fabrication services and gives students, staff, and faculty controlled access to a variety of manufacturing equipment. The shop has a high resolution 3-D scanner and several high resolution 3-D printers. EMS also supports College of Engineering clubs with its projects support facility.

## Research Centers

The College of Engineering has four major research centers. College of Engineering researchers also collaborate with researchers from outside the college in several interdisciplinary research units.

## College of Engineering Research Centers

### Center for Bioinformatics and Computational Biology

The Center for Bioinformatics and Computational Biology (CBCB) is a multidisciplinary research center dedicated to applying high performance networking and computing to basic life science and applied biomedical research. With faculty and students representing more than 20 traditional disciplines, the CBCB has contributed to the understanding of inherited human diseases, including blinding eye disease, cancer, deafness, diabetes, autism, schizophrenia, hypertension, obesity, and heart disease. For almost 20 years, the CBCB has been at the cutting edge of high throughput molecular discovery and interpretation in transcriptomics, genomics, and proteomics. At the confluence of these efforts lies the current wavefront of personalized genomic medicine, to which the CBCB plays a central role in partnership with labs, centers, and institutes across the University's Carver College of Medicine and basic science programs across campus. The CBCB also has been a nexus for industry start-ups and

partnerships with numerous commercial enterprises. The center is jointly sponsored by the College of Engineering and the Carver College of Medicine.

### **Center for Computer-Aided Design**

The Center for Computer-Aided Design (CCAD) focuses on modeling and simulation, and conducts basic and applied research in six units: the Operator Performance Laboratory (research in human performance); the Virtual Soldier Research Program (research in human modeling and simulation); the National Advanced Driving Simulator (research in driving and transportation); the Reliability and Sensory Prognostic Systems Program; the Musculoskeletal Imaging, Modeling, and Experimentation Program (computational modeling of anatomic structures); Advanced Manufacturing Technology (virtual testing of manufacturability, design effectiveness, and performance); and the Biomechanics of Soft Tissues focusing on understanding, diagnosis, and treatment of diseases of the soft tissues in the human body.

### **Iowa Institute for Biomedical Imaging**

The Iowa Institute for Biomedical Imaging (IIBI) conducts research in the following areas: medical imaging (CT, MR, OCT, PET, SPECT, ultrasound), medical image analysis and computer-aided diagnosis; cardiovascular image analysis (angiography-intravascular ultrasound data fusion, MR image analysis of congenital heart disease, coronary CT image analysis, early detection of cardiovascular disease); pulmonary image analysis (CT and MR image analysis of the lung); cell image analysis (cell tracking, shape analysis); and virtual surgery planning (augmented reality for liver resection surgery). The institute is sponsored jointly by the College of Engineering and the University's Carver College of Medicine.

### **IIHR—Hydroscience & Engineering**

IIHR—Hydroscience & Engineering is a world-renowned center for education, research, and public service focusing on hydraulic engineering and fluid mechanics. Based in the C. Maxwell Stanley Hydraulics Laboratory, a five-story red brick building on the banks of the Iowa River, IIHR is a unit of the University of Iowa's College of Engineering. IIHR students, faculty members, and research engineers work together to understand and manage one of the world's greatest resources—water. Students from around the world benefit from IIHR's comprehensive multidisciplinary approach, which includes basic fluid mechanics, laboratory experimentation, and computational approaches.

IIHR activities include fluid dynamics (turbulent flows, vortex dynamics, ship hydrodynamics, biological fluid flow, atmospheric boundary layer, experimental and computational fluid dynamics); environmental hydraulics (hydraulics structures, river mechanics, hydraulic structures, fish passage, sediment management, heat disposal in water bodies and power productions, bioremediation of groundwater, computational hydraulics, water-quality monitoring); water and air resources (air pollution, hydroclimatology, hydrogeology, hydrology, hydrometeorology, remote sensing, water resources and basin-scale processes); environmental engineering and science (PCBs in the air and water, innovative ways of removing contaminants from the soil and water, ultra-fine particles of pollutants in the atmosphere, bioremediation strategies for persistent groundwater contaminants); and water sustainability (development of sound strategies and technological solutions to meet the challenges facing society's growing need for water resources). The University of Iowa's Water Sustainability Initiative (WSI) brought new interdisciplinary expertise to the institute in 2013 when the

WSI faculty members (based in the Colleges of Liberal Arts and Sciences, Engineering, and Public Health) affiliated with IIHR. The Iowa Geological Survey joined IIHR in 2014, bringing new expertise in Iowa's subsurface resources, groundwater modeling, innovative geophysical skills, and more.

Students gain hands-on experience through close cooperation with faculty and staff on research projects funded by industry, government, and other organizations.

### **Interdisciplinary Research Units**

#### **Center for Biocatalysis and Bioprocessing**

The Center for Biocatalysis and Bioprocessing (CBB) concentrates on biocatalysis and bioprocessing education, research, and technology transfer. Its research includes fermentation; bioprocessing of small molecules, peptides, proteins and biocatalysis; pilot-scale technology transfer; structural biology of biocatalysts; biocatalyst screening and discovery; bioremediation; cloning of genes and optimization of protein expression in microorganisms; and GMP operations for producing clinical-grade biotherapeutics.

#### **Center for Global and Regional Environmental Research**

The Center for Global and Regional Environmental Research (CGRER) is devoted to studying and bettering the environment. Its focus includes multiple aspects of global environmental change, including regional effects on nature ecosystems, environments, and resources on human health, culture, and social systems. The center helps Iowa's agencies, industries, and people prepare for accelerated environmental change.

#### **Center for Health Effects of Environmental Contamination**

The Center for Health Effects of Environmental Contamination (CHEEC) is a multidisciplinary environmental health research center dedicated to supporting and conducting research to identify, measure, and prevent adverse health outcomes related to exposure to environmental toxins, particularly water contaminants. The center also conducts educational programs on environmental health and works with environmental database design, development, and systems support for environmental health research.

#### **Center for International Rural and Environmental Health**

The Center for International Rural and Environmental Health (CIREH) promotes understanding and awareness of the causes, consequences, and prevention of communicable, chronic, environmental, and occupational diseases in all regions of the world. The center focuses its education, training, and research on nations with substantial agrarian economies.

#### **Environmental Health Sciences Research Center**

The Environmental Health Sciences Research Center (EHSRC) researches the adverse health effects of environmental contaminants among rural and agricultural populations. The center is at the forefront of research on rural environmental health problems such as pesticide-induced cancers and birth defects, community and occupational exposures to airborne hazards from concentrated livestock operations, asthma among rural children, and remediation of rural hazardous waste sites. It also trains scientists to characterize

mechanisms that underlie environmental disease and approaches to their prevention.

### Injury Prevention Research Center

The Injury Prevention Research Center (IPRC) is a multidisciplinary unit whose focus includes injury prevention, acute care, biomechanics, and surveillance activities. The center's current work involves examining different types of residential smoke detectors, using simulation technology to study driving safety among persons with sleep apnea and persons on antiseizure medication, using bicycling simulation to study risk taking in children, and studying the effect of interpersonal violence on women's health.

### Optical Science and Technology Center

The Optical Science and Technology Center (OSTC) involves researchers from the College of Engineering and the College of Liberal Arts and Sciences. The center's objective is to catalyze research in the optical sciences by establishing an environment that promotes collaborative science and the development of innovative technology. Broad areas of interest include development of novel semiconductor materials with unique electronic and optical properties; design, fabrication, and characterization of nanostructures and nanomaterials; photopolymerization processes; exploration of environmental science; and application of novel optical devices in the biosciences.

### Orthopedic Biomechanics Laboratory

The Orthopedic Biomechanics Laboratory researches the application of advanced innovative computational formulations and novel experimental approaches to clinically-oriented problems across the spectrum of musculoskeletal biomechanical research, including total joint replacement (hip, spine, knee, ankle) posttraumatic arthritis, osteonecrosis of the hip, high-energy limb trauma, carpal tunnel syndrome, and articular contact stresses as they relate to joint degeneration.

### Photopolymerization Center

The Photopolymerizations Center (IUCRC) works to advance the fundamental understanding of the kinetics and mechanisms of photopolymerizations; to establish a venue for active discussions and collaborations among industrial and academic researchers; to explore high-risk, cutting-edge research on photopolymerization processes that could lead to technological innovations; and to promote and/or develop novel applications that exploit the unique set of advantages offered by photopolymerizations.

### Public Policy Center

The Public Policy Center (PPC) facilitates interdisciplinary academic research on policy related to health, transportation and vehicle safety, social and education related issues, environment, and politics. It works to provide policy makers and the public with information they can use to help communities and individuals thrive in sustainable ways.

## Courses

The college's individual undergraduate programs and course requirements for each engineering major also are described in the Catalog's College of Engineering department sections. Each undergraduate program builds upon a core program (see Bachelor of Science in Engineering in the Catalog). Not all core courses are required for each engineering major. Core program courses are intended for College of Engineering

students. Undergraduates in other disciplines who wish to register for core program courses should contact Engineering Student Services.

## Core Engineering Courses

### ENGR:0000 Engineering Internship/Co-op 0 s.h.

For engineering majors participating in the Cooperative Education and Internship Program and averaging 35-40 hours per week on assignment.

### ENGR:0002 Engineering Half-Time Internship 0 s.h.

For engineering majors participating in the Cooperative Education and Internship Program and averaging 15-20 hours per week on assignment.

### ENGR:0004 Engineering Academic Internship arr.

Academic credit for engineering majors participating in the Cooperative Education and Internship Program. Requirements: for international students—F-1 or J-1 visa, engineering undergraduate standing, full-time internship offer letter in hand (at least 40 hours/week and one semester in length), internship approved by International Student and Scholar Services for F-1 Curricular Practical Training (CPT) or J-1 Academic Training (AT), concurrent registration in approved 3 s.h. distance education or evening course, and preapproval of internship by Engineering Professional Development; non-international students may be eligible on case-by-case basis.

### ENGR:0006 Engineering Global Internship/Co-op 0 s.h.

For engineering majors participating in the Cooperative Education and Internship Program working on a global assignment.

### ENGR:1000 Engineering Success for First-Year Students 1 s.h.

Introduction to engineering student life; electronic resources; keys to and skills for success; coping with adversity; selecting a major; advising; curriculum choices and career objectives; ethics; communication; internships and co-ops; job search skills.

### ENGR:1029 First-Year Seminar arr.

Introduction to engineering fields of study; work closely with a faculty member or senior administrator; participation that eases the transition to college-level learning; cutting-edge research taking place in the College of Engineering.

### ENGR:1100 Introduction to Engineering Problem Solving 3 s.h.

Development and demonstration of specific problem solving skills; directed project or case study involving actual engineering problems and their solutions.

### ENGR:1300 Introduction to Engineering Computing 3 s.h.

Engineering problem solving using computers; introduction to digital computations, problem formulation using a procedural high-level language; structured, top-down program design methodology; debugging and testing; introduction to use of software libraries; examples from numerical analysis and contemporary applications in engineering. Corequisites: MATH:1550.

### ENGR:1430 Introduction to Engineering Design 3 s.h.

Problem-solving skills taught through a design-development process; use of solid-modeling computer design software to create, analyze, and communicate models of product solutions. Requirements: enrollment in Project Lead The Way program and consent of UI Project Lead The Way director.

- ENGR:1431 Principles of Engineering** 3 s.h.  
Introduction to engineering and engineering technology; exploration of varied technology systems and manufacturing processes to show how engineers and technicians use math, science, and technology to solve engineering problems and help people; concerns about social and political consequences of technological change. Requirements: enrollment in Project Lead The Way program and consent of UI Project Lead The Way director.
- ENGR:1432 Digital Electronics** 3 s.h.  
Applied logic, with focus on application of electronic circuits and devices; use of computer simulation software to design and test digital circuitry before circuits and devices are built. Requirements: enrollment in Project Lead The Way program and consent of UI Project Lead The Way director.
- ENGR:1433 Computer Integrated Manufacturing** 3 s.h.  
Builds on computer solid modeling skills developed in ENGR:1430 on of robotics and automation principles; robotics in automated manufacturing, design analysis; students use CNC equipment to produce models of their 3-D designs. Requirements: enrollment in Project Lead The Way program and consent of UI Project Lead The Way director.
- ENGR:1434 Civil Engineering and Architecture** 3 s.h.  
Overview of civil engineering and architecture; interrelationship and dependence of each field on the other; roles of civil engineers and architects, project planning, site planning, building design, project documentation and presentation; students use state-of-the-art software to solve real-world problems and provide solutions for projects and activities. Requirements: enrollment in Project Lead The Way program and consent of UI Project Lead The Way director.
- ENGR:1435 Aerospace Engineering** 3 s.h.  
Experience applying scientific and engineering concepts to design materials and processes for aeronautics and flight; aerospace information systems, star sailing or astronautics rocketry, propulsion, physics of space science, space life sciences; habitat and crew systems with life support, biology of space science, principles of aeronautics, structures and materials, systems engineering. Requirements: enrollment in Project Lead The Way program and consent of UI Project Lead The Way director.
- ENGR:1436 Biotechnical Engineering** 3 s.h.  
Experiences from the fields of biotechnology, bioengineering, biomedical engineering, and biomolecular engineering; biomechanics, cardiovascular engineering, genetic engineering, agricultural biotechnology, tissue engineering, biomedical devices, human interface, bioprocess engineering, forensics, bioethics. Requirements: enrollment in Project Lead The Way program and consent of UI Project Lead The Way director.
- ENGR:1437 Computer Science Principles** 3 s.h.  
Implementation of the College Board's 2013 Computer Science Principles framework; development of computational thinking, career paths that utilize computing, professional tools to foster creativity and collaboration; use of Python as a primary tool; incorporation of multiple platforms and languages for computation; development of programming expertise, exploration of Internet workings; projects and problems including app development, visualization of data, cybersecurity, robotics, simulation. Requirements: enrollment in Project Lead The Way program and consent of UI Project Lead The Way director.
- ENGR:1438 Computer Science A** 3 s.h.  
Development of computational thinking skills through Android app development for mobile platforms; utilization of industry-standard tools such as Android Studio, Java programming language, XML, and device emulators; students collaborate to create original solutions to problems of their own choosing by designing and implementing user interfaces and Web-based databases; curriculum is a College Board-approved implementation of AP Computer Science A. Requirements: enrollment in Project Lead The Way program and consent of UI Project Lead the Way director.
- ENGR:1440 Environmental Sustainability** 3 s.h.  
Investigation and design of solutions in response to real-world challenges related to clean and abundant drinking water, food supply issues, and renewable energy; application of knowledge through hands-on activities and simulations. Requirements: enrollment in Project Lead The Way program and consent of UI Project Lead The Way director.
- ENGR:1450 STEM Innovator: Solving Problems Through Innovation and Entrepreneurship** 3 s.h.  
Work with STEM (science, technology, engineering, mathematics) industry mentors to engage in innovation and entrepreneurship by employing conceptual understandings and practices of engineering and science within an entrepreneurship framework; students solve real-world STEM problems that are of interest to them and their community, and acquire and demonstrate 21st-century skills working on authentic, meaningful, and cross-curricular projects; exposure to potential STEM careers and preparation to be successful in postsecondary STEM majors and careers of the future. Requirements: enrollment in Project Lead the Way program and consent of UI Project Lead the Way director.
- ENGR:1550 FIRST Tech Challenge - Introduction to Engineering Problem Solving** 3 s.h.  
Introduction to engineering problem solving and design; projects introduce students to common elements of engineering problem solving and design (e.g., application of organizing principles to describe engineered systems, economic analysis upon which to base decisions, technical presentation and analysis of data), and provides an opportunity for students to apply common elements of problem solving in the solution of engineering problems in context of a structured problem solving and design process. Taught in high schools by state certified teachers.
- ENGR:2110 Engineering Fundamentals I: Statics 2-3** s.h.  
Vector algebra, forces, couples, moments, resultants of force couple systems; friction, equilibrium analysis of particles and finite bodies, centroids; applications. Prerequisites: MATH:1550. Corequisites: MATH:1560 and PHYS:1611.
- ENGR:2120 Engineering Fundamentals II: Electrical Circuits** 3 s.h.  
Kirchhoff's laws and network theorems; analysis of DC circuits; first order transient response; sinusoidal steady-state analysis; elementary principles of circuit design; SPICE analysis of DC, AC, and transient circuits. Corequisites: MATH:2560.
- ENGR:2130 Engineering Fundamentals III: Thermodynamics** 3 s.h.  
Basic elements of classical thermodynamics, including first and second laws, properties of pure materials, ideal gas law, reversibility and irreversibility, and Carnot cycle; control volume analysis of closed simple systems and open systems at steady state; engineering applications, including cycles; psychrometrics. Prerequisites: PHYS:1611 and CHEM:1110. Corequisites: MATH:1560.

- ENGR:2510 Fluid Mechanics** 4 s.h.  
Fluid properties; hydrostatics; transfer of mass, momentum, and energy in control-volume and differential forms; dimensional analysis and similitude; laminar and turbulent flow in conduits; flow past bluff bodies and airfoils; engineering applications; experimental laboratories, computer simulation projects. Prerequisites: MATH:2560 and ENGR:2710. Corequisites: ENGR:2130.
- ENGR:2710 Dynamics** 3 s.h.  
Vector calculus, Newton's laws, 3-D motion of particles and multiparticle systems, 2-D motion of rigid bodies applications. Prerequisites: ENGR:2110 and MATH:1550.
- ENGR:2720 Materials Science** 3 s.h.  
Concepts and examples of selection and applications of materials used by engineers; mechanical, electrical, and thermal properties that govern a material's suitability for particular applications; lectures supplemented by laboratory experiments. Prerequisites: CHEM:1110. Corequisites: MATH:1550.
- ENGR:2730 Computers in Engineering** 2-3 s.h.  
Advanced programming; good software engineering techniques including pseudocode and documentation, dynamic data structures, recursive programming, procedural and object-oriented computing, inheritance, and standard template library; contemporary and global impact of software and computers on society; robot programming lab arranged (using C/C++ language). Prerequisites: ENGR:1300.
- ENGR:2750 Mechanics of Deformable Bodies** 3 s.h.  
Elementary theory of deformable bodies, stress, strain; axial, transverse, bending, torsion, combined and buckling loads; deflection of beam. Prerequisites: ENGR:2110. Corequisites: MATH:2560.
- ENGR:2760 Design for Manufacturing** 3 s.h.  
Fundamentals of design, engineering graphics, and manufacturing processing; computer graphics using Pro/ENGINEER for CAD and CAM; typical industrial processes, including casting, welding, machining, forming; laboratory exercises and projects. Corequisites: ENGR:2720.
- ENGR:4000 Engineering Honors Seminar** 1 s.h.  
Completion of an approved project under the supervision of a faculty member. Requirements: engineering honors and junior or higher standing.
- ENGR:4001 Leadership Seminar: Mediocrity is Not an Option** 1 s.h.  
Skills needed to gain competitive edge in professional world with understanding that mediocrity is not an option; importance of developing a career plan, power of networking, significance of soft skills, value of mentoring; participation in series of discussions and activities; deeper insight of strengths and weaknesses, how to enhance skills that employers desire, and become effective leaders in workplace; presentation by retired chief operating officer of a leading aerospace company.
- ENGR:4010 Engineering Grand Challenges Program Fellow** 0 s.h.  
The Engineering Grand Challenges Program is designed to prepare tomorrow's engineering leaders to solve the grand challenges facing society during the next century; through completion of components of the program, students have the opportunity to engage in research relating to their selected grand challenge, explore interdisciplinary course work, gain an international perspective, engage in entrepreneurship, and give back to the community through service learning; for students who have been accepted as a fellow into the Engineering Grand Challenges Program and are working on completion of the program requirements. Requirements: acceptance to the Engineering Grand Challenges Program.
- ENGR:4011 Engineering Grand Challenges Program Scholar** 0 s.h.  
The Engineering Grand Challenges Program is designed to prepare tomorrow's engineering leaders to solve the grand challenges facing society during the next century; through completion of components of the program, students have the opportunity to engage in research relating to their selected grand challenge, explore interdisciplinary course work, gain an international perspective, engage in entrepreneurship, and give back to the community through service learning; for students who have been accepted as a scholar to the Engineering Grand Challenges Program and are working on completion of the program requirements. Requirements: acceptance to the Engineering Grand Challenges Program.
- ENGR:4012 Engineering Grand Challenges Program Final** 0 s.h.  
The Engineering Grand Challenges Program is designed to prepare tomorrow's engineering leaders to solve the grand challenges facing society during the next century; through completion of components of the program, students have the opportunity to engage in research relating to their selected grand challenge, explore interdisciplinary course work, gain an international perspective, engage in entrepreneurship, and give back to the community through service learning; for students who have been accepted to the Engineering Grand Challenges Program and are in the final semester of completing the program requirements. Requirements: acceptance to the Engineering Grand Challenges Program.
- ENGR:5200 COE Fellows Seminar** 1 s.h.  
Aspects of professional development for academic research, including applications for graduate fellowships, types of student aid, stewardship of discretionary accounts, identifying and meeting milestones in the Ph.D. process, integrating into the research team, teaching in a variety of academic settings, writing research articles, developing a curriculum vitae, networking in professional organizations, preparing research presentations, critical thinking, creating inclusive laboratory and classroom environments, and the impact of engineering on sustainability.
- ENGR:6431 Concepts of Physical Science and Principles of Engineering** 5 s.h.  
Understanding the field of engineering and engineering technology; technology systems and manufacturing processes explored to learn how engineers and technicians use math, science, and technology to solve engineering problems and benefit people; concerns about social and political consequences of technological change. Requirements: Project Lead The Way high school teacher.



**ENGR:6433 Concepts in Physical Science with Computer Integrated Manufacturing Applications 5 s.h.**

Introduction to high-tech, innovative nature of modern manufacturing; opportunities related to understanding manufacturing; manufacturing processes, product design, robotics, automation; students may earn a virtual manufacturing badge recognized by the National Manufacturing Badge system; proper paradigm for relating these concepts to secondary level students. Requirements: Project Lead The Way teacher.

**ENGR:6434 Concepts of Physical Science with Civil Engineering Applications 5 s.h.**

Civil engineering and architecture field experience; proper paradigm for relating concepts to secondary-level students, history of civil engineering, architectural design, surveying, cost and efficiency analysis, sustainable design, soil testing, site evaluation and layout. Requirements: Project Lead The Way high school teacher.

**ENGR:6437 Concepts of Physical Science with Computer Engineering 5 s.h.**

Field of computer science and software engineering; exploration of pedagogy to learn how engineers and technicians use math, science, and technology to solve engineering problems and benefit people; concerns about social and political consequences of technological change. Requirements: Project Lead The Way high school teacher.

**ENGR:6438 Concepts of Physical Science with Medical Detectives Training 2 s.h.**

Field of medical testing and forensics, exploration of pedagogy; how medical personnel use math, science, and technology to solve problems and benefit people; solving medical mysteries through hands-on projects and labs; how to measure and interpret vital signs; how systems of human body work together to maintain health. Requirements: Project Lead The Way high school or middle school teacher.

**ENGR:6439 Concepts of Physical Science with Engineering Design and Development 5 s.h.**

Experiences from engineering design and development fields; proper paradigm for relating concepts to secondary-level students; team work to design and develop an original solution to a technical problem by applying engineering design process; research to choose, validate, and justify a technical problem; teams design, build, and test solutions, then present and defend original solution to an outside panel; developed by Project Lead The Way.

**ENGR:6440 Concepts in Physical Science with Environmental Sustainability Applications 1,5 s.h.**

Investigation and design of solutions in response to real-world challenges related to clean and abundant drinking water, food supply issues, and renewable energy; proper paradigm for relating these concepts to secondary level students; application of knowledge through hands-on activities and simulations. Requirements: Project Lead The Way teacher.

**ENGR:6450 Concepts in Physical Science with K-5 STEM Launch Applications 1-2 s.h.**

Introduction to Project Lead the Way (PLTW) launch curriculum; 24 modules (K-5 grade level) that align to Common Core State Standards for math and English language arts, Next Generation Science Standards, and other national and state standards; 10-hour modules presented in pairs that combine to create a thematic unit; flexibility of teachers and schools to introduce modules that they want, when they want, and at the grade level they want; proper paradigm for relating these concepts to elementary (K-5) students, training other elementary teachers. Requirements: Project Lead The Way teacher.

**ENGR:6451 Concepts in Physical Science with Introduction to Computer Science 2-3 s.h.**

Preparation for teaching beginning computer science course; creation of simple applications for mobile devices using MIT App Inventor; impact of computing on society, application of computing across career paths, skill building and awareness of digital citizenship and cybersecurity; transfer of programming skills gained in MIT App Inventor to text-based programming in Python to create strategy games; proper paradigm for relating these concepts to secondary students.

**ENGR:6462 Concepts in Computer Science A Applications 5 s.h.**

Developing computational thinking skills through the medium of Android App development for mobile platforms; utilize industry-standard tools such as Android Studio, Java programming language, XML, and device emulators; students collaborate to create original solutions to problems of their own choosing by designing and implementing user interfaces and Web-based databases; course curriculum is a college board-approved implementation of AP CS A; focus on the proper paradigm for relating these concepts to secondary level students. Requirements: consent of UI Project Lead The Way director.

**ENGR:6470 Concepts in Principles of Biomedical Science Applications 5 s.h.**

Introductory course of the Project Lead The Way Biomedical Science program; students explore concepts of biology and medicine to determine factors that led to the death of a fictional person; students examine autopsy reports, investigate medical history, and explore medical treatments that might have prolonged the person's life; activities and projects introduce students to human physiology, basic biology, medicine, and research processes while allowing them to design their own experiments to solve problems; course also stresses the proper paradigm for relating these concepts to secondary level students. Requirements: consent of UI Project Lead The Way director.

**ENGR:7270 Engineering Ethics 1 s.h.**

Introduction to practical issues associated with being a responsible scientist; topics in responsible conduct of research in engineering and the sciences using case studies, presentations, and discussions with visiting speakers; conforms to mandates set by the Office of the Vice President for Research and the Graduate College to train graduate students and postdoctoral scholars/fellows in responsible conduct of research. Requirements: first-year graduate standing in College of Engineering.

**ENGR:7604 Engineering Ethics for Post Docs 0 s.h.**

Introduction to practical issues associated with being a responsible scientist; topics in responsible conduct of research in engineering and the sciences using case studies, presentations, and discussions with visiting speakers; conforms to mandates set by the Office of the Vice President for Research and the Graduate College to train graduate students and postdoctoral scholars/fellows in responsible conduct of research. Requirements: new postdoctoral research scholar/fellow in College of Engineering.